Cells

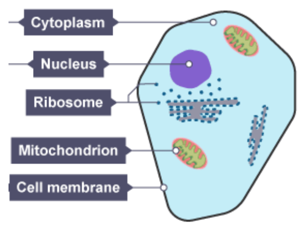
TPS

Keyword	Definition
Eukaryotic	A cell which contains genetic material enclosed in a nucleus.
Prokaryotic	A cell which does not have its genetic material enclosed in a nucleus.
Nucleus	An organelle found in eukaryotic cells which contains genetic material. This controls the cell.
Cytoplasm	Found in all cells. It is where most chemical reactions occur.
Cell membrane	This organelle controls what enters and exits the cell.
Mitochondria	An organelle found in eukaryotic cells. Aerobic respiration occurs here to release energy.
Ribosome	An organelle found in all cells. This is where proteins are created.
Chloroplast	An organelle found in plant cells. Contains chlorophyll which absorbs sunlight. Site of photosynthesis.
Vacuole	A large organelle in plant cells which contains cell sap. When full, it makes the cell turgid to give it shape and support.
Cell wall	Plant and algal cells have this extra layer to strengthen the cell.
Plasmid	Found in prokaryotic cells. This is a ring of DNA.
Magnification	The action of making a specimen, viewed under a microscope, larger.
Resolution	The ability to distinguish between two close objects. The ability to see the finer detail in the specimen.
Stem cell	An unspecialised (undifferentiated) cell.
Meristem cell	An unspecialised (undifferentiated) cell in a plant.
Differentiation	The process by which a stem cell turns into a specialised cell.
Mitosis	A part of the cell cycle in which one set of chromosomes is pulled to each end of the cell and the nucleus divides.

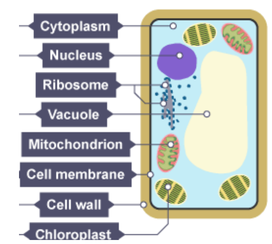
Ce02 & 04 Cell Structure

A

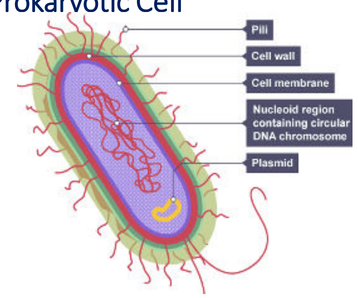
Animal cell



Plant Cell



Prokaryotic Cell



Ce14 Cell Differentiation

D

- Animal cells differentiate most of their cells in the embryonic stage of development.
- Plant cells can differentiate throughout their whole lives.

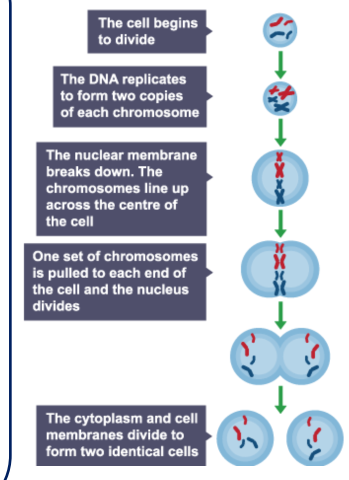
Ce13 Stem Cells

D

- Embryonic stem cells are the cells that make up the early embryo (2-3 days old).
- Embryonic stem cells have the ability to differentiate into any type of specialised cell.
- Adult stem cells are stem cells found in the bodies of animals which are born, including children.
- An examples of where adult stem cells can be found is within bone marrow.
- Adult stem cells are limited as to which types of cells they can differentiate into depending on where they are found in the body.

Ce12 Cell Cycle

D

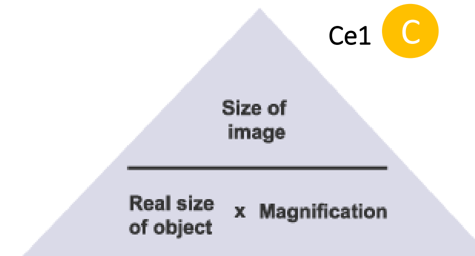


Required Practical: *Microscopy*

Mathematical Skills:

- *Be prepared to use the magnification equation to calculate real size of a cell or image size.*
- *Make sure you understand standard form.*
- *Be prepared to convert units from mm to µm and vice versa.*
- *Understand what is meant by orders of magnitude.*

Ce1 C

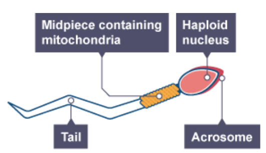


Number	Multiples	Standard form
1000	= 10 x 10 x 10	= 1 x 10^3
100	= 10x 10	= 1 x 10^2
10	= 10	= 1 x 10^1
1	= 1	= 1 x10^0
0.1	= 1÷10	= 1 x 10^{-1}
0.01	= 1÷100	= 1 x 10^{-2}
0.001	= 1÷1000	= 1 x 10^{-3}

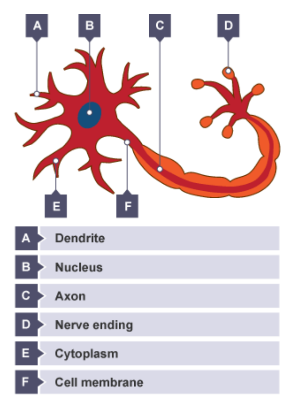
Ce05 Specialised Animal Cells

B

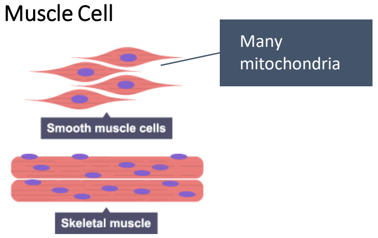
Sperm Cell



Nerve Cell



Muscle Cell



Ce13 Uses of Stem Cells - Pros and Cons

D

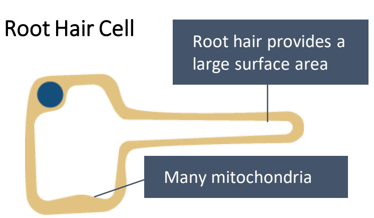
- Embryonic stem cells are the most useful for stem cell treatment as they can be used to differentiate into any type of cell.
- Embryonic stem cells can be created with a cloning technique to make sure the cells have the patients own DNA so the cells are rejected by their body.
- Some people believe that the use of embryonic stem cells for treatment is murder of the potential life.

Key Point

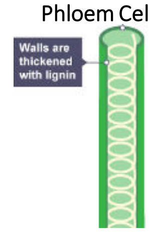
Ce06 Specialised Plant Cells

B

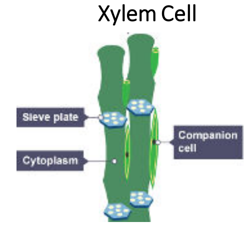
Root Hair Cell



Phloem Cell



Xylem Cell



Ce04 Orders of Magnitude

C

- Differences in size are often described as differences in order of magnitude. That's the difference calculated in factors of 10.
- If you increase a number by one order of magnitude, you are multiplying the number by 10.

Example:

A person's height = 2 m = 2 × 10^0
The oak tree's height = 20 m = 2 × 10^1

Meaning there is one order of magnitude between the height of a human being (2m) and the height of an oak tree (20 m).

Relevant Modules:

AQA

- Organisation
- Infection and Response
- Homeostasis

Useful YouTube links:

Cells | Stem Cells | Cell Cycle

Ce01 Types of Microscopes

C

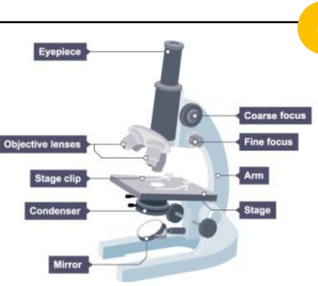
Light – smaller, portable microscopes which are used to see 2D images of specimens. Lower magnification and resolution compared to electron microscopes.

Electron – larger, more expensive microscopes which are used to see 3D images of specimens. Higher magnification and resolution compared to light microscopes.

Ce01 Light Microscope

C

Always begin viewing the specimen with the lowest power objective lens to see the biggest field of view. Focus the image and then you can increase the magnification.



Ce05 & 06

B

A common specialised cell feature is having many mitochondria in order to do more aerobic respiration to release energy. This energy is then used to help the cell perform its function.

Key Point

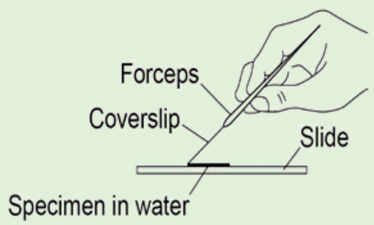
Required Practical – Microscopy

Ce03 C

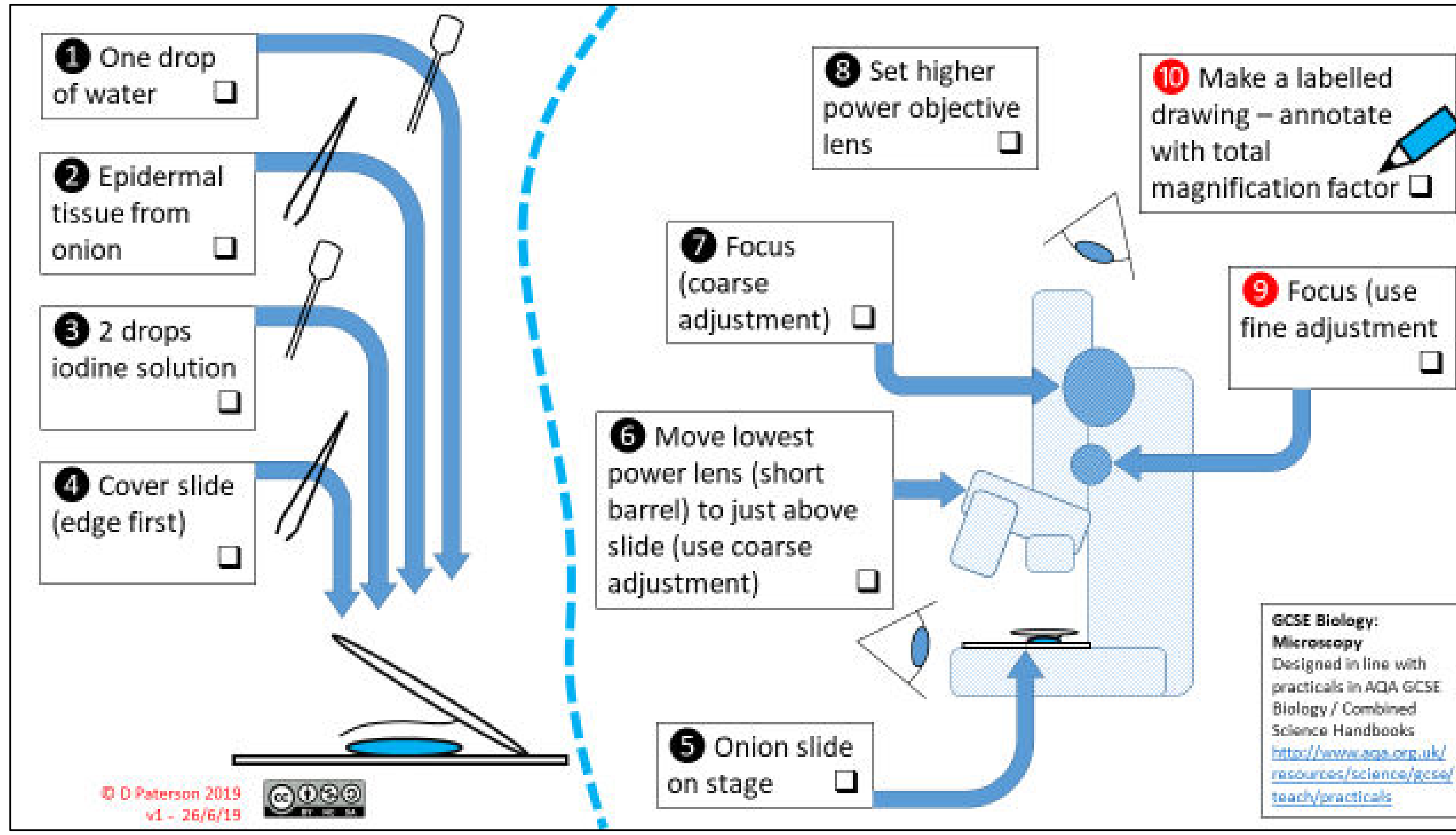
TPS

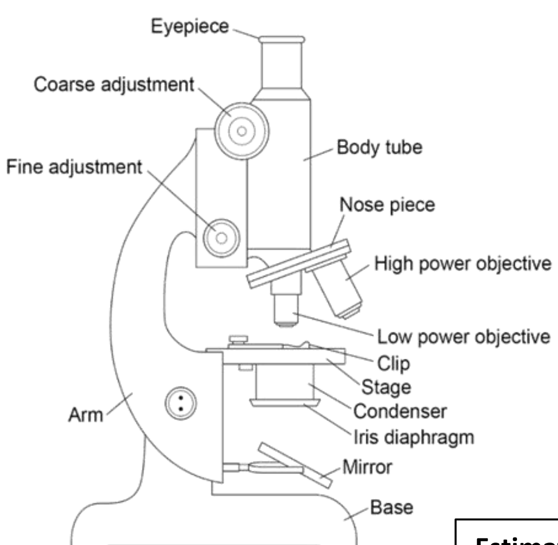
Method:

- Use a pipette to put one drop of water onto a microscope slide.
- Separate one of the thin layers of the onion.
- Peel off a thin layer of epidermal tissue from the inner surface.
- Use forceps to place this thin layer on to the drop of water that you have placed on the microscope slide, ensuring the layer is flat.
- Place two drops of iodine solution onto the onion tissue.
- Carefully lower a coverslip onto the slide. Do this by:
  - placing one edge of the coverslip on the slide
  - use the forceps to lower the other edge onto the slide.
- Carefully use a piece of tissue paper to soak up the excess liquid from around the edge of the cover slip.

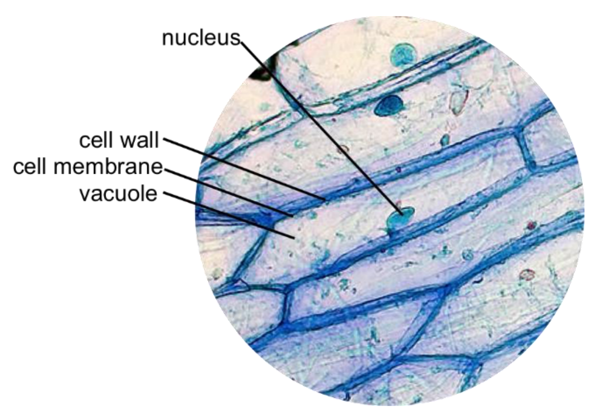


- Put the slide on the microscope stage.
- Use the lowest power objective lens. Turn the nosepiece to do this.
- The end of the objective lens needs to almost touch the slide. Do this by turning the coarse adjustment knob. Look from the side (**not** through the eyepiece) when doing this.
- Now looking through the eyepiece, turn the coarse adjustment knob in the direction to increase the distance between the objective lens and the slide. Do this until the cells come into focus.
- Now rotate the nosepiece to use a higher power objective lens.
- Slightly rotate the fine adjustment knob to bring the cells into a clear focus and use the high-power objective to look at the cells.





Typical Results



Ruler under microscope

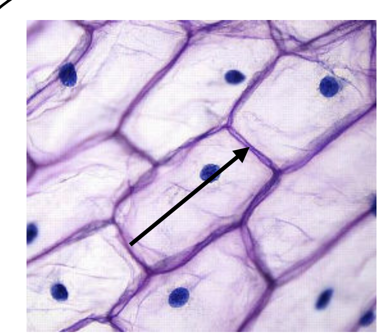
Estimating the size of the cell

- Count the number of cells across your field of view. In the above image, that is 1.
- Remove your specimen and place a ruler underneath your objective lens. Identify how many mm your field of view is.
- Knowing that every 1mm = 1000µm. If the field of view measures 2mm as depicted above, this means the view is 2000µm.
- This therefore means that one cell in this field of view also measures 2000µm.

Useful YouTube links:

Practical Demo

Calculations



Exam-Style Question

A student looked at onion cells under a light microscope with a magnification of 400x.

Calculate the real size of the cell.

Step 1

Measure the cells diameter in mm with a ruler. This is your **image size**. Here it is labelled with an arrow, so measure the length of the arrow.

....

Step 2

Enter the values in the equation

Real size = image size ÷ magnification

....

Step 3

Record the answer in µm. To convert from mm to µm, multiply your answer from step 2 by 1000.

....

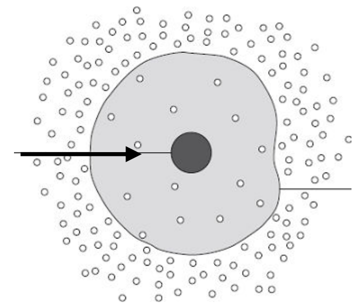
Cell Transport

Keyword	Definition
Diffusion	The spreading out of the particles of any substance in solution, or particles of a gas, resulting in a net movement from an area of higher concentration to an area of lower concentration.
Osmosis	The diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.
Active transport	The movement of substances from a low concentration to a higher concentration through a partially permeable membrane. This process requires energy from respiration.
Hypertonic	A solution which is more concentrated than the cell.
Hypotonic	A solution which is less concentrated than the cell.
Isotonic	A solution which is at the same concentration than the cell.
Turgid	A plant cell is turgid when it is full of water and the cytoplasm and vacuole push against the cell wall.
Flaccid	A plant cell is flaccid when it is lacking water so the cytoplasm and vacuole are not pushing against the cell wall.
Plasmolysed	The cell contents shrivels away from the cell wall when there is a serious lack of water.

Ce07 Diffusion

E

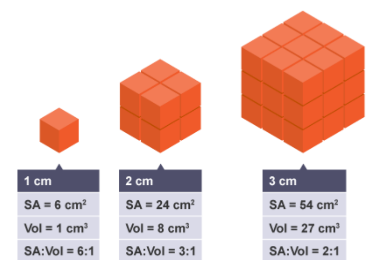
High concentration of oxygen outside the cell.
Low concentration of oxygen inside the cell.
Oxygen will diffuse **into** the cell.



Ce07 Factors affecting the rate of diffusion

E

- Temperature – hotter = faster as particles have more kinetic energy.
- Surface area – larger = faster as there is more room for substances to diffuse across.
- Concentration gradient (the difference in concentration between the two areas) – larger = faster

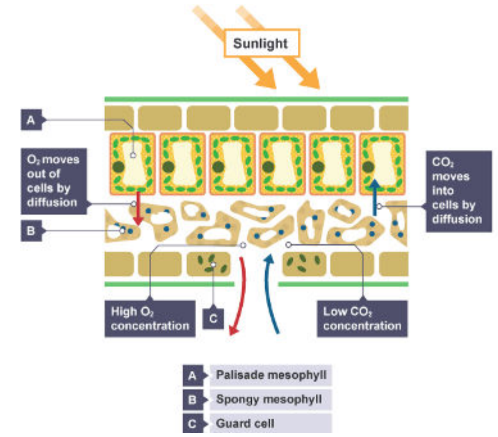


Key Point

E

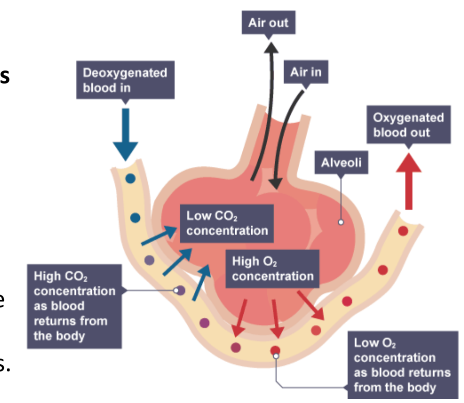
Ce07 Examples of diffusion in Biology

E



Plant Leaf
Gas exchange between oxygen and carbon dioxide through the stomata.

Alveoli (air sac) in lungs
Gas exchange between oxygen and carbon dioxide through the cell membranes.



Required Practical:
Osmosis

Mathematical Skills:

- *Be prepared to calculate surface area.*
- *Be prepared to calculate percentages to calculate the percentage gain or loss of mass in the osmosis required practical.*

Key Point

E

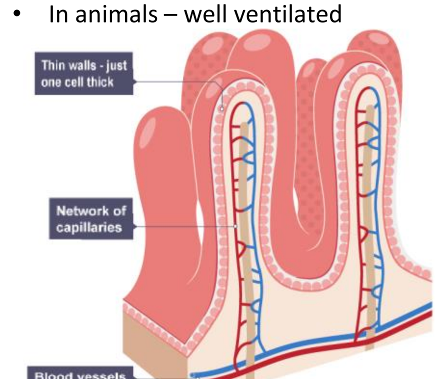
Ce11 Exchange Surfaces

Multicellular organisms require special organ systems to obtain the substances they need to survive such as food, water and oxygen.

Examples of exchanges surfaces are alveoli in lungs, gills in fish, plant leaves, plant root hair cells and villi in small intestine as pictured below.

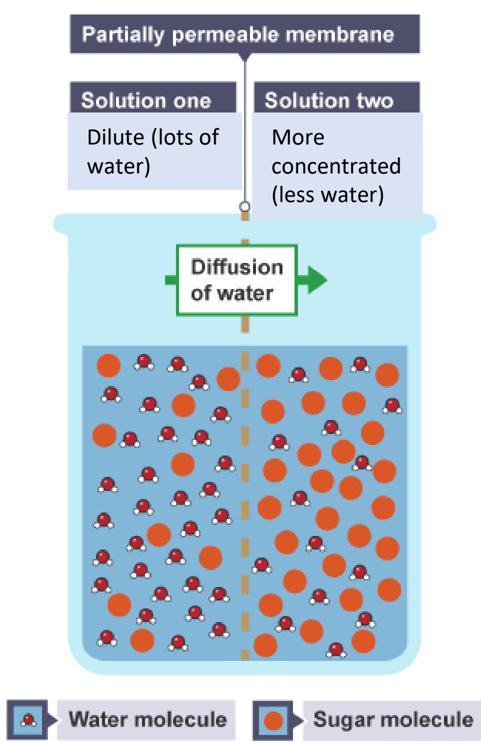
All exchange surfaces have the following common features which allow the movement of substances into and out of them to happen quickly:

- Large surface area
- Thin diffusion pathway
- High concentration gradient
- In animals – good blood supply
- In animals – well ventilated



The axolotl has external gills which allow it to do gas exchange. This little guy is seen regularly in exams!

Ce09 Osmosis



Relevant Modules: AQA
- Organisation
- Bioenergetics

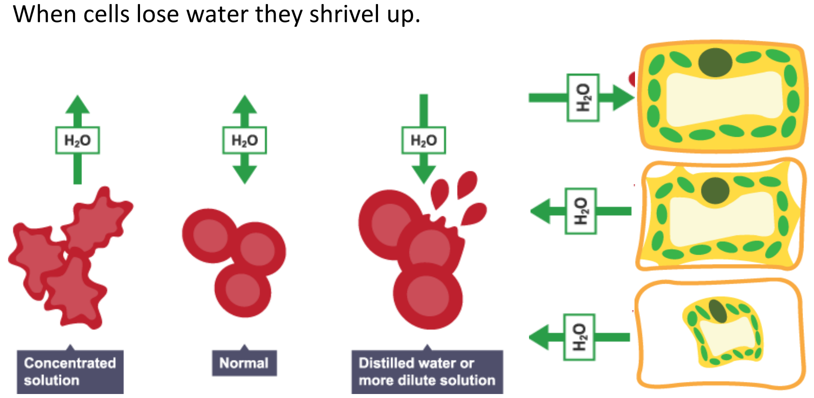
Useful YouTube links:
Diffusion and Osmosis
Active Transport
Exchange Surfaces

Ce09 Osmosis in Cells

E

When cells gain water they swell. Animal cells burst under the pressure as they do not have cell walls like plant cells.

When cells lose water they shrivel up.

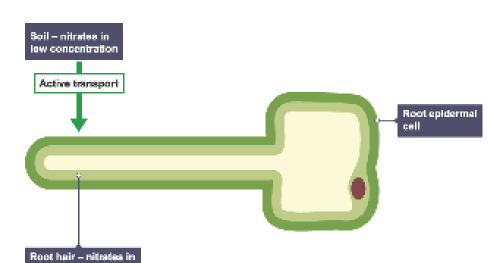


Ce10 Active Transport

E

Uses energy from respiration to move the substances against the concentration gradient.

Cells which do lots of active transport, such as root hair cells, have lots of mitochondria in order to carry out lots of respiration.



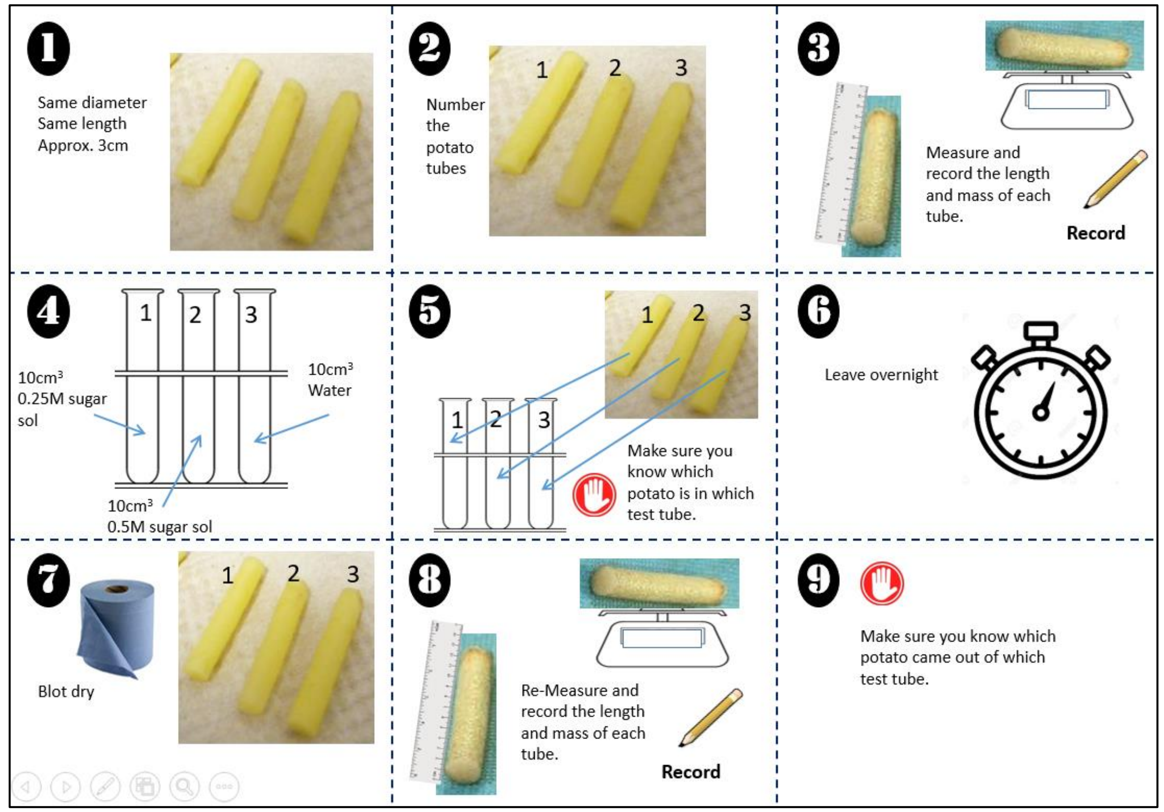
Required Practical - Osmosis

Ce08 E

TPS

Method

- Using a cork borer, cut three potato cylinders of the same diameter.
- Cut each cylinder to the same length using a ruler and knife (avoid leaving skin on either end).
- Accurately measure and record the length **and** mass of each potato cylinder.
- Measure 10 cm³ of the distilled water and transfer into the third boiling tube. Label this boiling tube as ***water***.
- Measure 10 cm³ of the 0.5 M sugar solution and transfer into the first boiling tube. Label this boiling tube as: ***0.5 M sugar***.
- Measure 10 cm³ of 0.25 M sugar solution and transfer into the second boiling tube. Label this boiling tube as: ***0.25 M sugar***.
- Add one potato cylinder to each boiling tube – it is essential that you know which cylinder is being placed in each tube.
- Leave the tubes for a minimum of 24 hours.
- Remove the potato cores from their tubes and blot dry.
- Re-measure the mass and length of each core and record the results.



Hypotonic – the concentration outside of the cell is **lower** than that inside the cell.

Isotonic - the concentration outside of the cell is **the same** as that inside the cell.

Hypertonic - the concentration outside of the cell is **higher** than that inside the cell.

Useful YouTube links:

Practical Demo

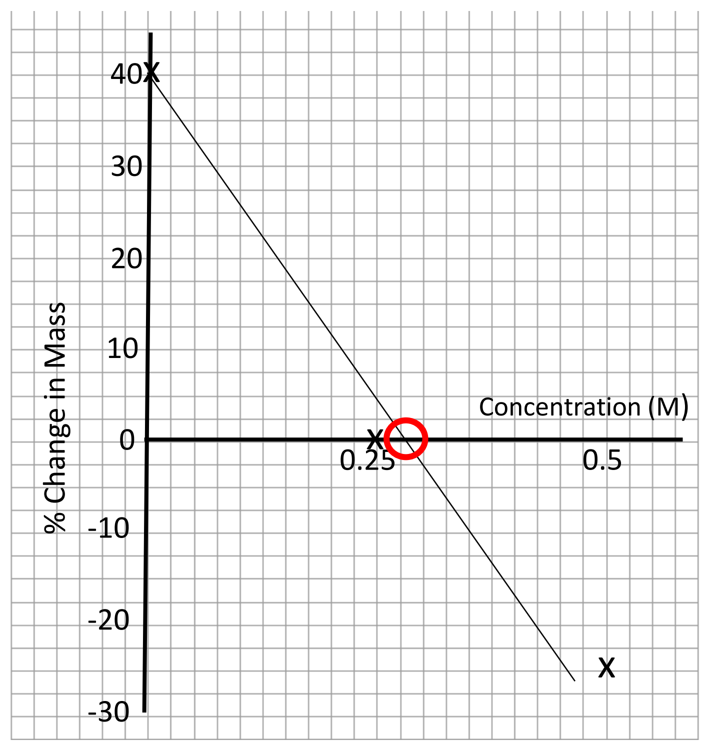
Osmosis Theory

Typical Results

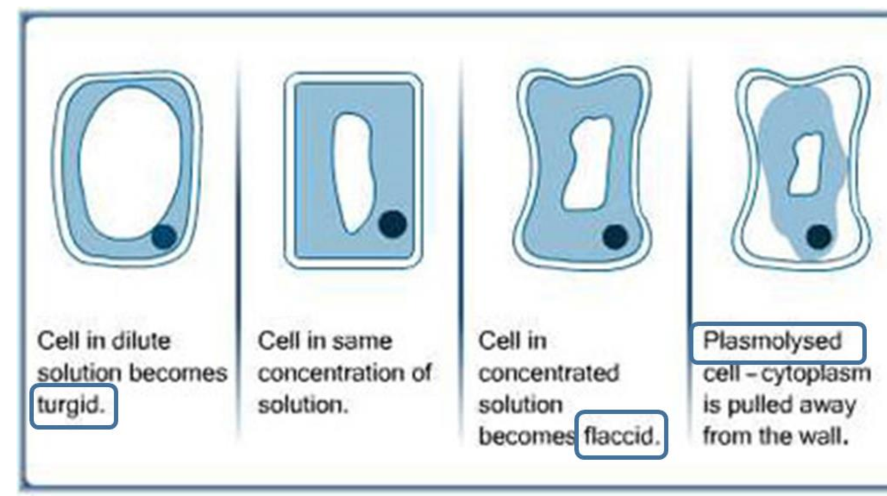
	Distilled Water (0 M sugar solution)	0.25 M sugar solution	0.5 M sugar solution
Initial length (mm)	30	30	30
Final length (mm)	35	31	27
Change in length (mm)	+5	+1	-3
Initial mass (g)	2	2	2
Final mass (g)	2.8	2	1.5
Change in mass (g)	+0.8	0	-0.5
Change in mass (%)	+40	0	-25

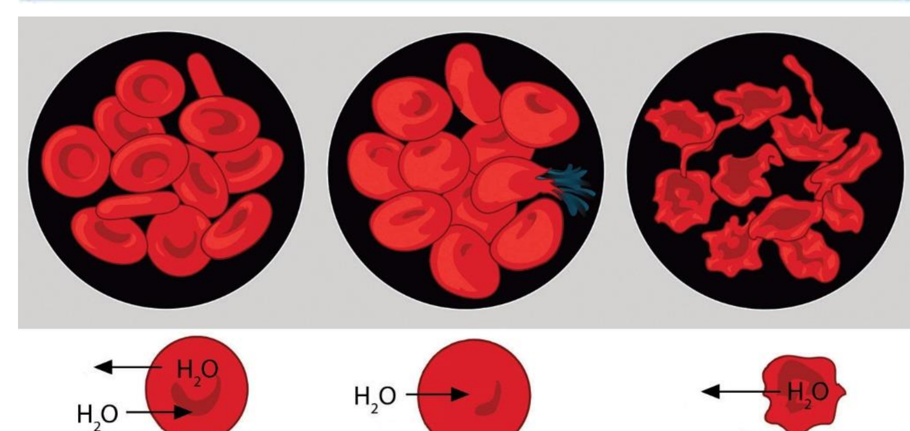
$$\%\text{ change in mass} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

Typical Graph



To find the concentration of the potato cells, you must plot your results on a graph like the one above. The point at which your line of best fit intercepts the x axis is the concentration of your cells. This is because this is where there is 0% change in mass meaning the solution would be isotonic in comparison to the cells at this concentration.





(a) Isotonic (b) Hypotonic (c) Hypertonic