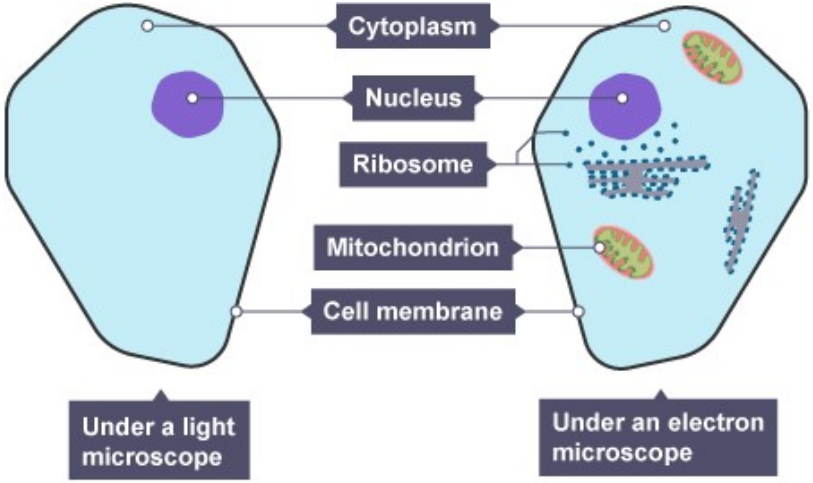
Synergy Science Knowledge Organiser
3 Cells

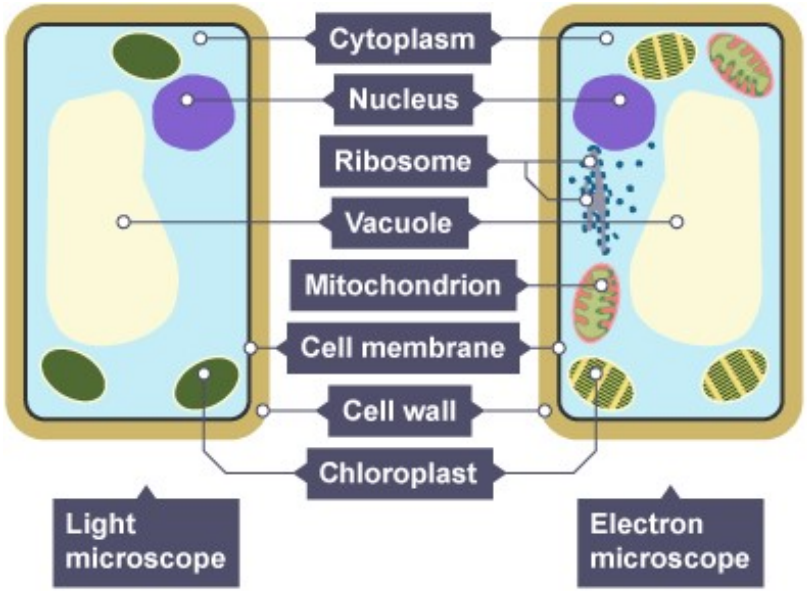
Cell Structure – Animal cells



	Function
Cytoplasm	A jelly-like material that contains the organelles. It is where many of the chemical reactions happen.
Nucleus	Contains genetic material, including DNA, which controls the cell's activities.
Cell membrane	Its structure is permeable to some substances but not to others. It therefore controls the movement of substances in and out of the cell.
Mitochondria	Organelles that contain the enzymes for respiration, and where most energy is released in respiration.
Ribosomes	Tiny organelles where protein synthesis occurs.

Cell Structure – Plant cells

- Plant cells also have additional structures:



	Function
Chloroplasts	Organelles that contains the green pigment, chlorophyll, which absorbs light energy for photosynthesis. Contains the enzymes needed for photosynthesis.
Cell wall	Made from cellulose fibres it strengthens the cell and supports the plant.
Permanent vacuole	Filled with cell sap to help keep the cell turgid.

Synergy Science Knowledge Organiser
3 Cells

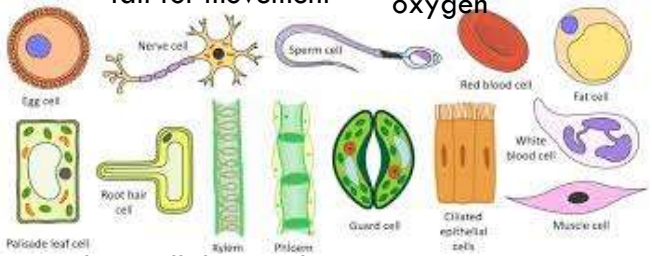
Specialised cells

- Specialised cells carry out a particular function.
- Differentiation is essential to produce a variety of cells with different functions in multicellular organisms (animals and plants).

Sperm cells have a tail for movement

Red blood cells have a larger surface area to transport more oxygen

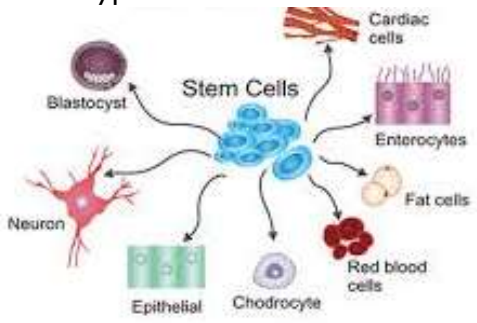
Palisade cells have many chloroplasts for more photosynthesis

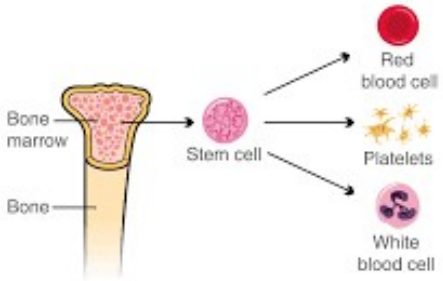


Root hair cells have a larger surface area to absorb more water

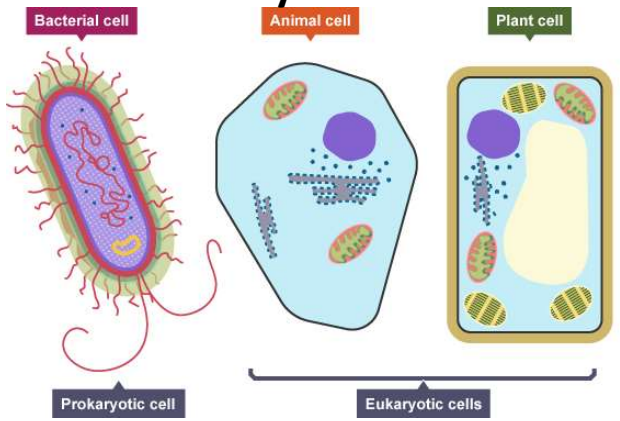
Stem cells

- An embryo develops from a fertilised egg. The embryo cells are embryonic stem cells that can differentiate into any type of cell
- Adult stem cells can differentiate into related cell types, for example, bone marrow cells can differentiate into blood cells but no other type of cell





Prokaryotes and Eukaryotes



- Cells of bacteria do not have a nucleus. Their DNA is present in the cytoplasm of their cells. It is found in a loop. Bacteria can also have much smaller circles of DNA called plasmids

	Eukaryotic cell	Prokaryotic cell
Size	Most are 5 µm – 100 µm	Most are 0.2 µm – 2.0 µm
Outer layers of cell	Cell membrane - surrounded by cell wall in plants and fungi	Cell membrane - surrounded by cell wall
Cell contents	Cytoplasm, cell organelles include mitochondria, chloroplasts in plants, and ribosomes	Cytoplasm, ribosomes - no mitochondria or chloroplasts
Genetic material	DNA in a nucleus - plasmids are found in a few simple eukaryotic organisms	DNA is a single molecule, found free in the cytoplasm - additional DNA is found on one or more rings called plasmids
Type of cell division	Mitosis	Binary fission

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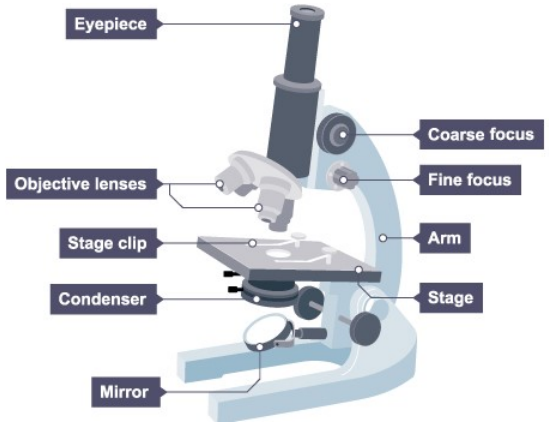
3 Cells

Microscopes

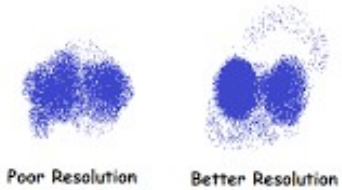


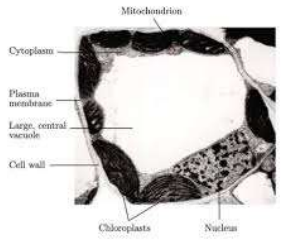
- Focus – produces a clear, non-blurry image
- Magnification – the number of times bigger it is than the object being viewed
- Microscopes do not zoom

- Light microscopes use two lenses to magnify the specimen – the eyepiece lens and the objective lens
- Magnification = eyepiece lens x objective lens

Electron Microscopes

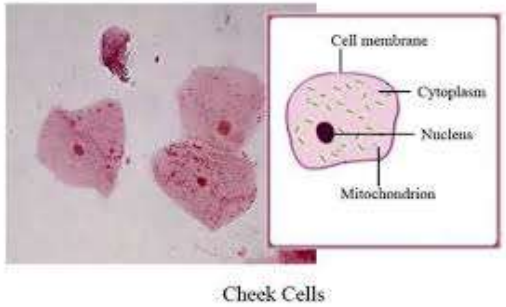
- An electron microscope has a much higher resolution than a light microscope. This means that it can be used to study cells in much finer detail.
- An electron microscope can magnify up to a million times (× 1000 000) or more, which is much more than a light microscope which has a useful magnification of only about a thousand times (× 1000).





Required Practical: Microscopes

- Use a light microscope to observe, draw and label a selection of plant and animal cells. A magnification scale must be included.



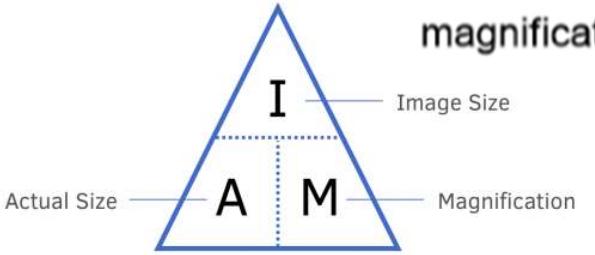
Cheek Cells

Eyepiece lens = x 10

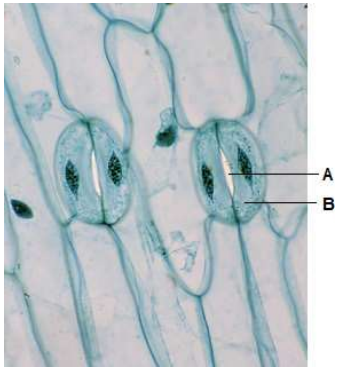
Objective lens = x 40

E: Magnification = eyepiece x objective
lens lens
S: Magnification = 10 x 40
A: Magnification = 400
U: Magnification = 400 x

Magnification of Images



$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$



- This is a photograph taken through a microscope. The image is magnified 800 times. One of the cells in the image has a width of 12 mm.
- Calculate the real width of this cell in micrometres.

E: size of real object = $\frac{\text{size of image}}{\text{magnification}}$

S: size of real object = $\frac{12}{800}$

A: size of real object = 0.015 mm 0.015 x 1000 = 15 µm

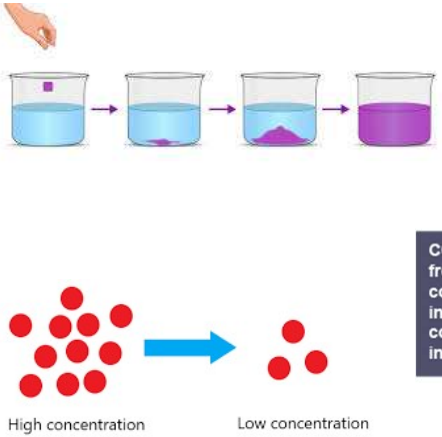
U: size of real object = 15 µm

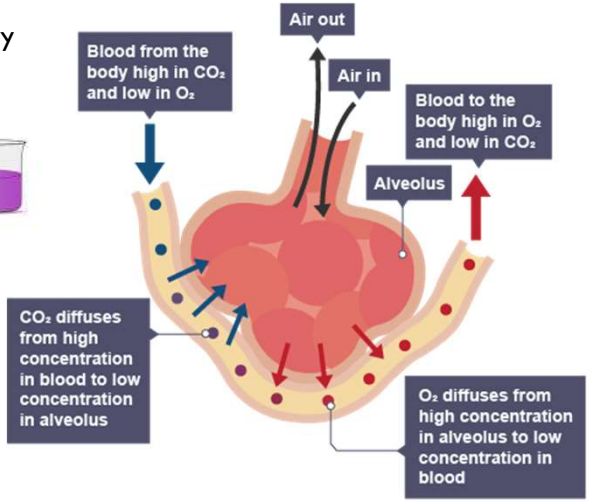
Synergy Science Knowledge Organiser
3 Cells

Diffusion

- Diffusion is the movement of substances from an area where they are at a higher concentration to an area where they are at a lower concentration, down a concentration gradient.

- Diffusion does not need energy



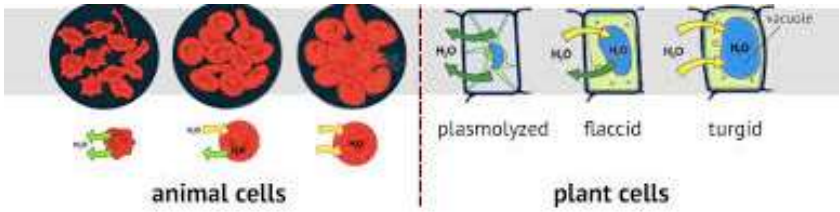


Factors that affect the rate of diffusion across a membrane are:

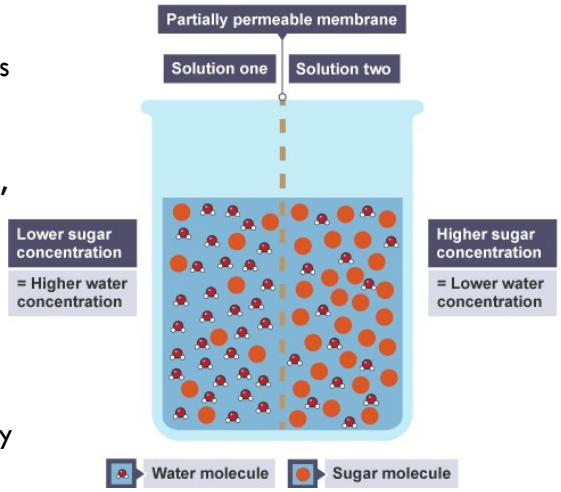
Factor	Reason
The concentration gradient	The greater the difference in concentration, the quicker the rate of diffusion.
The temperature	The higher the temperature, the more kinetic energy the particles will have, so they will move and mix more quickly.
The surface area of the cell membrane separating the different regions	The greater the surface area, the faster the rate of diffusion.

Osmosis

- Osmosis is the movement of water from an area where they are at a higher concentration to an area where they are at a lower concentration, across a partially permeable membrane, down a concentration gradient.



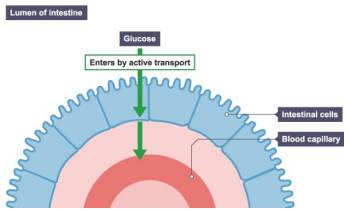
- During osmosis water diffuses from where it is more concentrated (because the solute concentration is lower), to where water is less concentrated (because the solute concentration is higher).

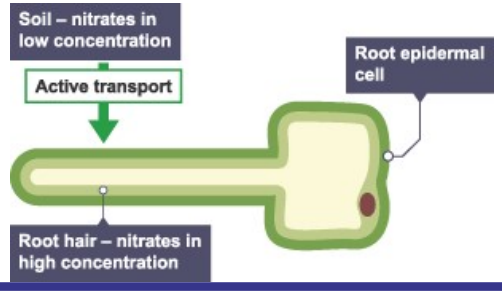


- Osmosis does not need energy

Active Transport

- Active transport is the movement of a dissolved substance from an area where they are at a lower concentration to an area where they are at a higher concentration, against a concentration gradient.





- Active transport needs energy

Synergy Science Knowledge Organiser
3 Cells

Required Practical: Osmosis

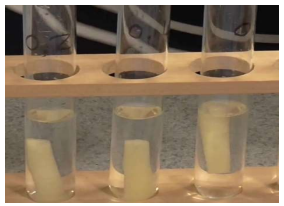
- To investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue

- Independent Variable: The concentration of the sucrose solutions, with a range of 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0 mol/dm^{-3}.
- Dependent variable: The change in mass of the potato cylinders.
- Control variables: The time that each cylinder is left in the sucrose solution, the size of each cylinder, the volume of sucrose solutions

Method

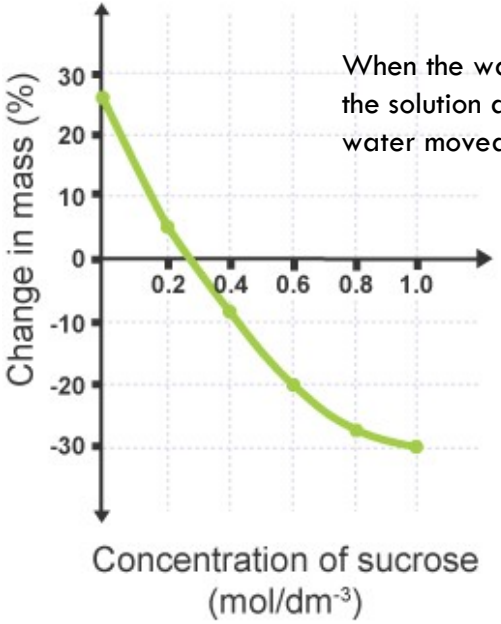
1. Set up 6 boiling tubes, each containing the same volume of one of the sucrose solutions. The 0.0 mol/dm^{-3} sucrose solution is distilled water. Label the boiling tubes.
2. Prepare 6 potato cylinders using a borer and cut the cylinders to the same length. Gently dry each potato cylinder using a paper towel to remove excess liquid and record its mass before placing it into one of the boiling tubes.

3. Leave the potato cylinders in the boiling tubes for 40 minutes.



4. Remove each potato cylinder from its boiling tube, gently remove excess liquid from the surface of the cylinder with a paper towel and record its mass.
5. If possible, repeat the experiment to obtain multiple values of mass change for each solution. Making a series of repeat measurements will enable you to identify and ignore any anomalous results and calculate a mean.

Concentration of sucrose	Average change in mass
0.0 mol dm^{-3}	+26.8%
0.2 mol dm^{-3}	+5.0%
0.4 mol dm^{-3}	-7.7%
0.6 mol dm^{-3}	-17.9%
0.8 mol dm^{-3}	-26.0%
1.0 mol dm^{-3}	-31.4%



When the water was at a higher concentration in the solution and a lower concentration in the potato, water moved into the potato and it gained mass

Where the line crosses the horizontal axis at 0 % change in mass, the sucrose concentration is equal to the concentration of the contents of the potato cells. Therefore, the concentration of the water in the outer solution is equal to the concentration of the water inside the cells.

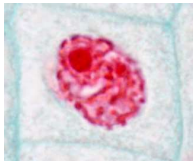
When the water was at a lower concentration in the solution and a higher concentration in the potato, water moved out of the potato and it lost mass

Synergy Science Knowledge Organiser
3 Cells

Mitosis

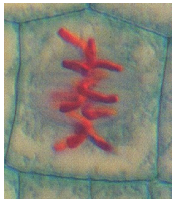
- Mitosis is cell division for growth and repair of damaged tissue
- The nucleus of body cells contain 46 chromosomes or 23 pairs.
- Chromosomes are made of genes, which are made of DNA
- Before a cell can divide it must grow, and make copies of all the organelles such as mitochondria and ribosomes.

Chromosomes make a copy of themselves and become shorter and thicker



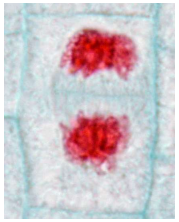
Spindle fibres attach to the chromosomes

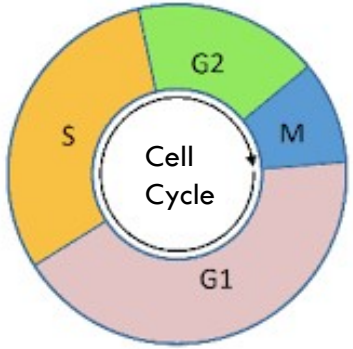
The nucleus breaks down and the chromosomes line up in the centre of the cell



Spindle fibres shorten and chromosomes copies are pulled to the opposite ends of the cell

Nucleus reforms and cell division takes place to produce 2 genetically identical daughter cells





G1 - Growth

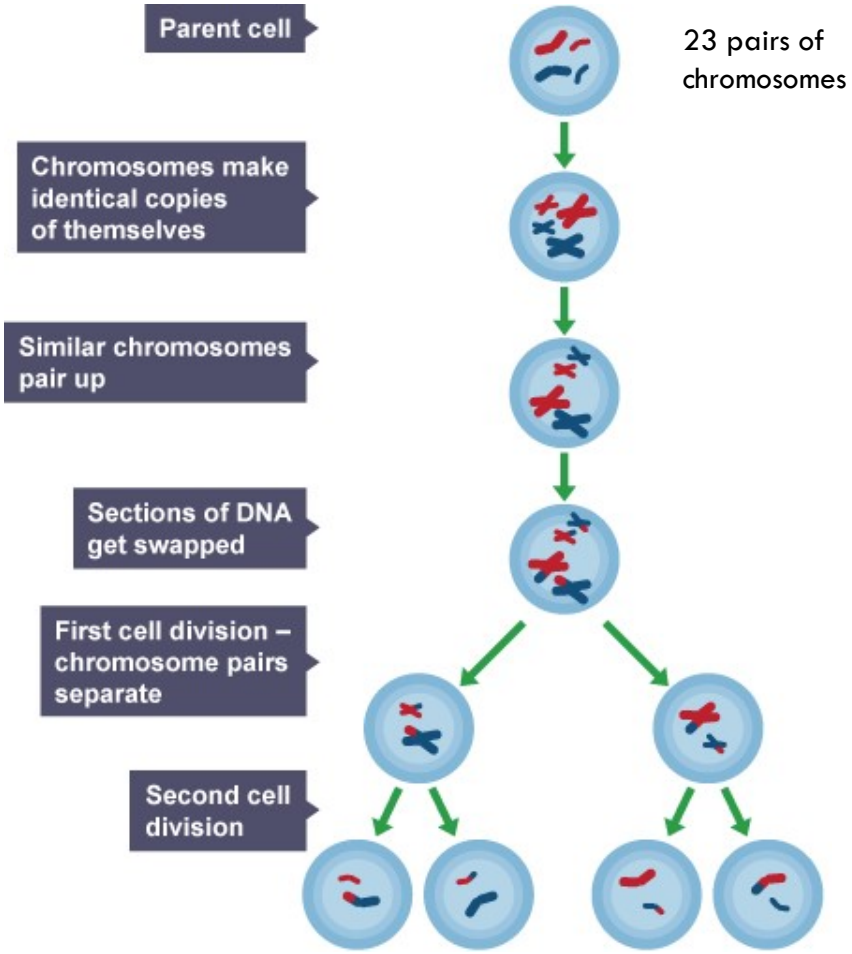
S - DNA synthesis

G2 - Growth and preparation for mitosis

M - Mitosis (cell division)

Meiosis

- Meiosis is cell division which takes place when sex cells, gametes, are produced in the ovaries and testes of animals
- The gametes, eggs and sperm contain 23 chromosomes only, half the number of a body cell.
- The gametes divides twice to form four genetically different gametes
- Gametes join at fertilisation to make a fertilised egg cell with the normal number of chromosomes, 23 pairs
- The fertilised egg cell will divide by mitosis to grow



4 genetically unique gametes with 23 chromosomes only

Synergy Science Knowledge Organiser
1 States of Matter

Cell Structure

Task: Match the structure to its function

Structure	Function
Mitochondria	A jelly-like material that contains the organelles. It is where many of the chemical reactions happen.
Cytoplasm	Contains genetic material, including DNA, which controls the cell's activities.
Cell membrane	Its structure is permeable to some substances but not to others. It therefore controls the movement of substances in and out of the cell.
Ribosomes	Organelles that contain the enzymes for respiration, and where most energy is released in respiration.
Nucleus	Tiny organelles where protein synthesis occurs.

Cell Division

Task: Complete the sentences

Mitosis produces _____ genetically identical daughter cells

The 4 gametes produced in meiosis are genetically _____

The egg cell and the sperm cell fuse together during _____

Stem cells are produced when the newly formed cell divides by _____

Stem cells become specialised cells during the process of _____

Cell Transport

Task: Use the word bank to complete the table

	Diffusion	Osmosis	Active transport
Concentration gradient			
Energy			
Protein carriers			
Membrane			
Examples			

Higher to lower concentration, Higher to lower concentration, Lower to higher concentration, Yes, Yes, Yes, Yes, No, No, No, No, No, Gas exchange in lungs, Absorption of glucose in the small intestine, Absorption of water by root hair cells

Highlight the keywords: nucleus, cytoplasm. cell membrane, ribosome, mitochondria, chloroplast, cell wall, permanent vacuole, specialised, differentiate, bacteria, plasmid, focus, magnification, resolution, higher concentration, lower concentration, concentration gradient, 46 chromosomes, 23 pairs, , growth, repair, genetically identical, genetically unique, 23 chromosomes only