AQA Trilogy-Biology key terms – Cell Biology

Cells – The basics	
Animal cells (eukaryote) contain a **nucleus** (store genetic information), a **cell membrane** (controls what enters and leaves the cell), **cytoplasm** (chemical reactions take place), **ribosomes** (make proteins from amino acids) and **mitochondria** (release energy in respiration).	**Plant cells (eukaryote)** also have a nucleus, cell membrane, cytoplasm, ribosome and mitochondria. However, they also have a **vacuole** (filled with cell sap), **chloroplasts** (contain chlorophyll-where photosynthesis happens) and a **cell wall** (made of cellulose-strengthens cell). **Algal cells** also have a cell wall made of cellulose.
Bacteria (prokaryotic) cells are smaller than plant/animal cells.. Have a **cytoplasm**, **cell wall** and **cell membrane**. **No nucleus**- DNA is found in a single **DNA loop** or in small rings called **plasmids**.	*Comparing bacteria and plant/animals cells*- give **like for like** comparisons (i.e. compare on the **same** feature) -Bacteria don't have a nucleus (have loop DNA or plasmids) - Animal/Plant cells do -Bacteria don't have a etc
Specialised cells have a structure which is **adapted** for their function e.g. sperm cell has a tail for movement etc. Some cells have **different cell parts** to help them do their job (e.g. sperm have more mitochondria for energy to help them swim)	Cells are really small, so we need to use smaller units. **1mm = 1000 µm. 1µm = 1000nm**
Magnification = **Image/Object** (remember to convert to correct units)	**Orders of magnitude** - to make approximate comparisons between numbers or objects. If one cell is 10 times bigger than another, it is an order of magnitude bigger or $\mathbf{10^1}$. If it is 100 times bigger, it is two orders of magnitude bigger or 10^2.
- **Magnification -** Being able to enlarge something in appearance **-Resolution** - Ability to distinguish points close together	**Light microscopes** (sometimes called optical microscopes) are the ones we use at school. They can only see **view larger cell parts** (e.g. nucleus). With the discovery of the **electron microscope** we could view **smaller parts** (e.g. ribosomes), so our understanding of sub-cellular structures got much better.
Benefits of electron microscopes (vs light) - Have a **higher resolution** (& magnification) because the electrons have a shorter wavelength (than light) - Thus can see smaller objects	Required practical- observe plant or animal cells under the microscope -Start with the objective lens with the lowest magnification first, as it is the easiest to focus. -O**verall magnification=** magnification of the eyepiece lens **X** magnification of objective lens.
Objects must be very **thin** to be viewed under a light microscope- a **single layer of cells** so that **light can pass through**	
Cell Differentiation and Stem Cells	
In **animals**, cells become specialised early. **Stem cells from human embryos** can be cloned and can differentiate into **most** types of human cells. **Adult stem cells** (in bone marrow) are less versatile and can only form **some** types of cells (e.g. blood cells).	Cells **differentiate** into different types of cells as an organism develops (and become specialised for a certain job). **Stem cells =** undifferentiated cells.
Stem cells can be used to treat conditions like **paralysis** and **diabetes**.	In many **plants** they can differentiate throughout life. Meristem tissue (in roots and tips) can differentiate into **any** type of cell throughout the plants life.
Pros of using embryo stem cells- can become any type of cell. Painless to get them. Can create many embryos in a lab **Cons of using embryo stem cells**- embryo cannot give consent. Death to embryo. Less reliable	**Pros of using adult stem cells-** patient can give consent. Patients quickly recover. Reliable technique. **Cons of using adult stem cells**- Can only treat some diseases. Procedure can be painful and there is risk of infection.

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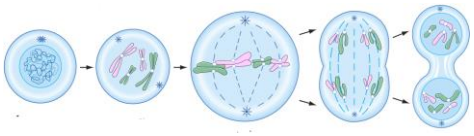
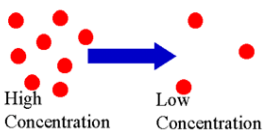
Stem cells from plant meristem tissue → used to make quick and economical **clones** (e.g. used to protect rare species from becoming extinct)	**Therapeutic cloning**- embryo made with same genes as patient. Stem cells from embryo are **not rejected** by patient so can be used for treatment. But, risks of viral infection and ethical/religious concerns.
	The **digestive system** (an organ system) is made up of a number of organs; **Mouth, oesophagus, stomach, liver, pancreas, small** and **large intestines, rectum and anus**
Mitosis (Cell Division)	
Nucleus- the part of a cell where **all** of the genetic information is found (i.e. DNA, genes, chromosomes etc)	**Mitosis** forms 2 genetically **identical body** cells. It is used for **growth/repair**. Cell parts (e.g. ribosomes) are grown, then the DNA replicates and then the cell divides.
DNA- a polymer made of 2 strands forming **a double helix**. Found in the nucleus and makes up chromosomes.	**Mitosis** questions often look at root tips (i.e. meristem tissue on plants)- because the cells are dividing quickly here.
Chromosomes- Long molecules of DNA that contain a large number of genes. These are in pairs, one from each parent. We have **46** chromosomes in each body cell & **23** in each gamete (sex cell).	May show diagrams like the one below for mitosis  Diagram 1-DNA is replicating 2/3- cell is preparing to divide 4-one set of chromosomes is being pulled to each end of the cell 5- one set of chromosomes at each end of cell and cytoplasm starts to divide to form 2 identical daughter cells **The quicker each stage is (or the less cells in this stage)- the quicker mitosis is**
Genome- The entire genetic material of an organism	**Cancer** = **uncontrolled** growth and division of a cell (by mitosis).
Genes are short sections of **DNA** on a chromosome that contain a code for a particular sequence of amino acids, to make a specific protein.	
Transport in Cells	
Substances may move into and out of cells across the cell membranes via **diffusion**. **Diffusion** is the spreading out of the particles resulting in a **net** movement from an area of higher concentration to an area of lower concentration. It is the process by which gases (O_2/CO_2) are exchanged in cells and waste (urea) removed from cells into the blood plasma.  	Rate of diffusion can be increased by: -increased **temperature** (particles have more kinetic energy, so move more) -**larger surface area to volume ratio** (more space for particles to travel to) - a larger difference in concentration (**concentration gradient**),

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Calculating surface area to volume ratio-

1. Calculate surface area (length x height x no. of sides)
2. Calculate volume (length x height x width)
3. Divide result for surface area by the volume

Smaller organisms have a larger surface area to volume ratio. Big animals have a small one.

-Consequently single celled organisms (i.e. v small) can rely on diffusion alone to transport materials in and out of the cell

-Bigger organisms must have a specialised transport system instead (as diffusion would be too slow)

Lungs, small intestine, roots and leaves are all adapted to maximise diffusion. Have **large surface area**s, **thin membranes** (short diffusion path) and in animals have a **good blood supply** (to keep concentration gradient)

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**

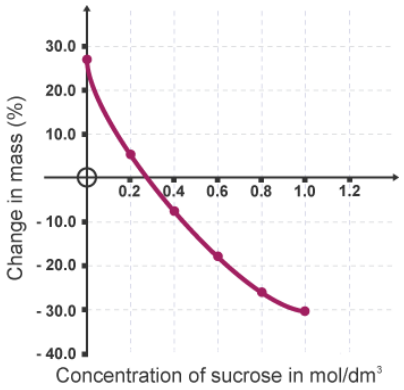
Concentrated solutions have more sugar/salt (and thus less water). Water will move into these areas. The water moves from where there is lots of it, to less of it.

Required practical- Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.

1. Use a potato borer to cut out several strips of potato
2. Measure their length and mass
3. Place each one in a different test tube. Each test tube should have a different concentration of salt/sugar in it
4. Leave overnight (or at least half an hour)
5. Remove potato chips and measure and re-weigh

Work out percentage change in mass/length (change in mass/starting mass)

You may see a graph like this (based on the results of the required practical)



Where the line of best fit crosses the X axis is what the water potential of the potato cell is- no net movement of water by osmosis. Positive numbers show mass has increased (there is less sugar in solution, as there will be more water in the solution than the potato, so it will move into the potato **BY OSMOSIS**!.). Negative numbers show mass has decreased (when the sugar solution is high, there is less water in the solution (more in the potato), so it moves out of the potato **BY OSMOSIS)**. You must say by osmosis each time you mention water movement.

Other potential required practical questions: (higher tier)

-if you are asked to find the change in mass from a concentration of sugar/salt you haven't got results from, draw a **line of best fit** on a graph and read off it

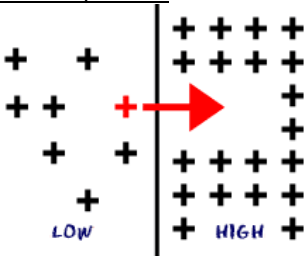
-**Rate** means how quickly something happens (i.e. over time)

-Doesn't really matter if all the potato chips are exactly the same length if you have calculated % change, as **%s allow you to compare when you have different starting values.**

-Ideally you should **blot** the potato chips with paper towel before weighing them, to make sure the mass is only taking into account the water in the potato (and not the water that hasn't actually moved into the potato)

-Ideally you should use **bungs** on the tubes so water doesn't' evaporate. (both not using bungs or not blotting could be sources of error in an experiment)

Active transport moves substances from a more dilute solution to a more concentrated solution -**against a concentration gradient** (i.e. low to high concentration). This requires **energy** from respiration .



Cells that carry out active transport often have lots of **mitochondria** (to release energy for the process)

Used to absorb mineral ions into plant root hairs and sugar to be absorbed in the gut into the blood (so it can be used for respiration)

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-Osmosis & diffusion don't need energy (passive process)- active transport does (active process) -Osmosis and diffusion go down a concentration gradient. Active transport goes against it -Osmosis is the movement of water. Active transport and diffusion can be any other particles (e.g. ions) -osmosis and active transport, substances move from a dilute to a more concentrated solution You must give **like for like points** (i.e. compare on the same feature)	