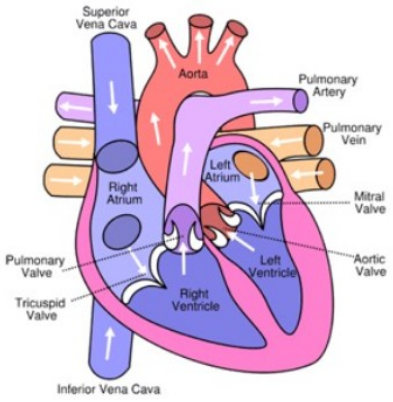
ST JOHN BOSCO COLLEGE
BATTERSEA

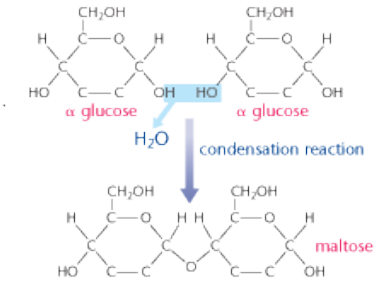
The Spirit of St John Bosco College
RUAH - the breath of God

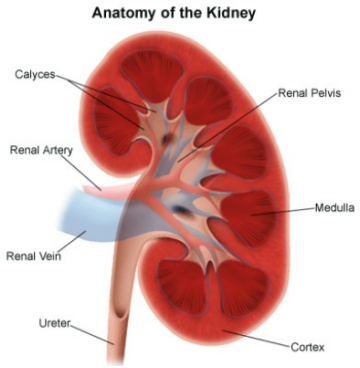
AS Level Biology

This booklet will provide you with a brief account of the content covered at GCSE and how it crosses over into AS and A2 level. Content will include mostly GCSE content with extension text relating to the A level.
You will be expected to sit an entrance examination within the first 2 weeks of the Biology course to assess your initial understanding in both Biology and Mathematics, therefore you must read through this booklet answering all questions. Bring the booklet to every lesson as the questions will be marked in class.
Please use the booklet effectively to revise for the examination, use it as a basis on which to start your revision.

Best of luck!





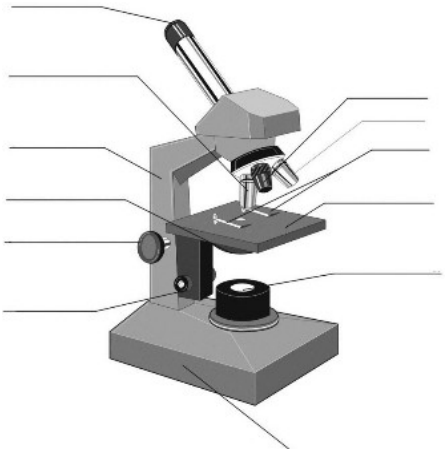


We are happy that you have chosen to study A-Level Biology. You have chosen a very desirable subject for Universities and employers. The subject is, however, very demanding and requires dedication. Please use this booklet to ease your transition into A-Level Biology.

Microscopes

The Light microscope allows you to view animal cells. It can magnify up to 1500 times. Some organelles such as mitochondria, chloroplasts, vacuoles, cell walls, cell membranes and nuclei are visible. Staining makes these organelles visible.

Label and annotate the diagram.

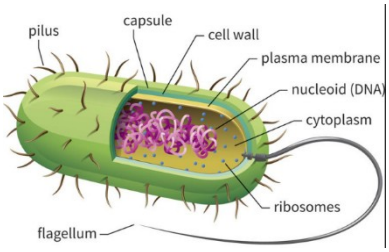


The electron microscope; invented in 1950s it allows a much higher magnification (500 000x) and better resolution, allowing greater detail to be seen. Electron microscopes allowed detailed ultrastructure of the cell to be seen, such as ribosomes and the inside of mitochondria and chloroplasts. The image is called an **ELECTRON MICROGRAPH.**

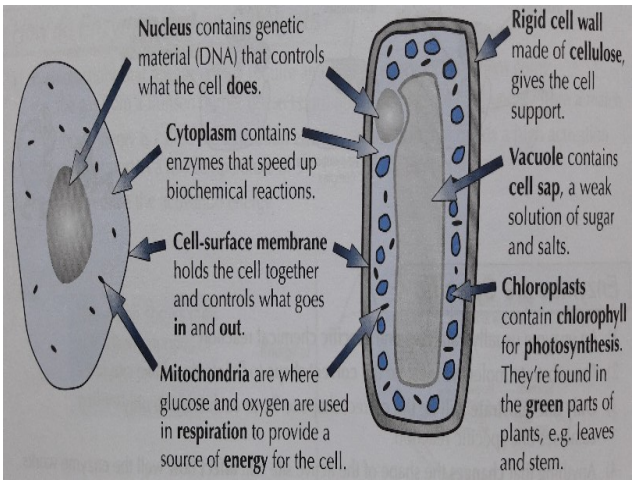
Eukaryotes and prokaryotes

Prokaryotes are singled celled organisms such as bacteria.

Usually much smaller than eukaryotic cells (1/10th the size), do not contain a nucleus, chloroplasts or mitochondria, DNA can be found floating free in the cytoplasm or in loops called Plasmids, some have flagellum for movement.



Eukaryotic cells are more complex and can be single cellular or multi-cellular organisms.



Questions

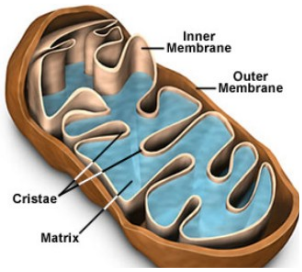
Name 3 things visible with a light microscope in both animal and plant cells.	

Name 4 organelles that both plant and an animal cell have.	
What is the calculation used to calculate the magnification of an object?	
What is the function of the mitochondria?	

Cell structure

Nuclei: controls the cell function, containing the DNA which is the coded information for the production of proteins.
During cell division the chromosomes become shorter and thicker and can be seen with a light microscope. The chromosomes will then make a copy of themselves, one copy for each cell produced during cytokinesis. Nuclei have a double membrane called the nuclear envelope.

Mitochondria

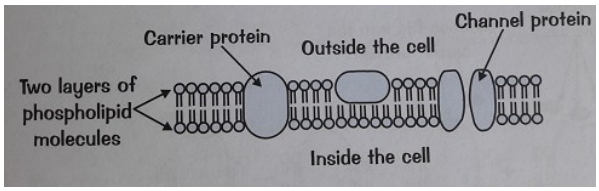


Can be seen with a light microscope, however, greater internal detail can be seen using an electron microscope. The mitochondria's function is to carry out aerobic respiration. The energy released is used to form molecules of ATP. ATP is used in the cells to provide energy for muscular contractions, active transport as well as anabolic and catabolic reactions.

Cell wall: the plant cell wall is made up of cellulose Molecules laid side by side to form microfibrils. These provides rigidity and support for the cell.

Cell structure

Cell surface membrane: Found around every cell, it allows the movement of substances into and out of the cell. It is a partially permeable membrane and will prevent certain substances from entering.



It is made up of a double layer called the PHOSPHOLIPID BILAYER. These are molecules closely packed together in a mosaic pattern. Within the bilayer are large proteins which are also responsible for transport and for cell recognition.

Transport into and out of cells

There are 4 modes of transport you need to be aware of;
Diffusion; can be gas or liquid particles. They move from an area of high concentration to an area of low concentration down a concentration gradient. Small molecules such as oxygen, water and carbon dioxide can pass through the phospholipid bilayer.
Osmosis; occurs only with water. The water particles move from an area of high water concentration to an area of low water concentration, down a concentration gradient, across a partially permeable membrane. NO ENERGY IS REQUIRED. You will be required to refer to water potential in AS level not water concentration.
Facilitated diffusion; Some particles are too large to fit through the phospholipid bilayer and therefore require a carrier protein to assist. The protein carriers are within the bilayer and they change shape when they come into contact with a specific molecule (i.e. Glucose). NO ENERGY IS REQUIRED.
Active transport; This moves substances for an area of low concentration to an area of high concentration against a concentration gradient. ENERGY IS NEEDED for this to occur. Specific carrier proteins are also required these can be called 'pumps'.

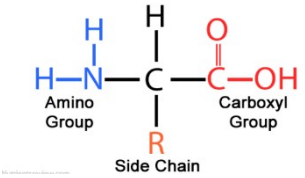
Questions	
Name 2 molecules that make up the cell membrane.	
Describe the membranes of the mitochondria.	
What is the name of the molecule that provide energy to the cell?	
What term is used to describe water concentration?	

Proteins

Proteins are made of long chains of amino acids, up to several hundred long. There are only 20 different amino acids and the combination of these 20 produce a wide range of complex proteins. Protein structures are held together with strong bonds called PEPTIDE bonds. The order of the amino acids determines the structure and how it works.

All amino acids have the same structure with one variation on the R group.

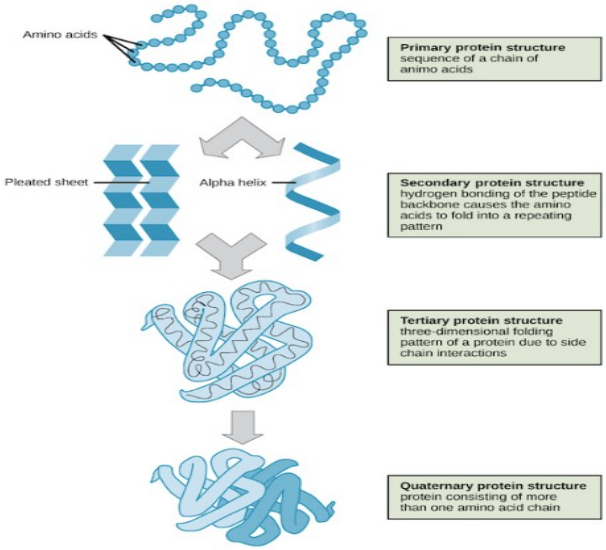
Contains; Hydrogen, oxygen, Nitrogen and carbon.



Proteins structure;

The order of the amino acids forms the PRIMARY STRUCTURE. The protein chain can then **coil** or **fold** into **pleats** which are held together by weak hydrogen bonds to for the SECONDARY STRUCTURE.

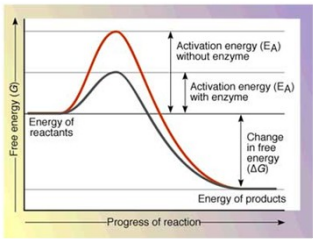
Enzymes have a further folding held together with stronger disulphide bonds. This is the TERTIARY STRUCTURE. If the structure is almost spherical it is called a **globular protein**.



Enzymes; Help to speed up biochemical reactions.

Metabolism is the sum of all the biochemical reactions that occur per second and a single chain of these reactions is called a metabolic pathway.

Enzymes are biological catalysts and increase the rate of reactions.

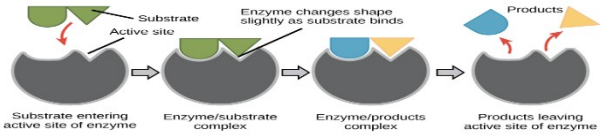


Reactions that release energy need an input energy to start.

The input energy is called the ACTIVATION ENERGY. Enzymes reduce the activation energy.

Enzymes are proteins; enzymes are globular proteins with a specific order of amino acids that determines what the enzyme does.

Enzymes can be catabolic (break substrates down) or anabolic (build substrates up). Enzymes have a specific site into which the substrates can attach itself, this attachment site is called the **active site.** The active site is **complementary** to the shape of the substrate. Once they attach together they form the **enzyme substrate complex**. The substrate then breaks bonds or makes bonds (depending on the type of enzyme) and the product leaves the active site. The active site is now able to accept another substrate.



Denaturing enzymes; Enzymes have a specific tertiary shape held in place by weak hydrogen bonds and stronger disulphide bonds. These bonds can be broken by an increase in temperature (kinetic energy) or a change in pH (H^+ in acid or OH^- in alkali disrupt the bonds).

Useful enzymes; Digestive enzymes are catabolic, breaking down food into smaller molecules. Enzymes are also needed in DNA replication, building up molecules (DNA polymerase).

Questions

What types of bond hold together the secondary structure?	

What types of bond hold together the tertiary structure?	
How many amino acids are there and what elements are found in them?	
Explain why denatured enzymes will not function.	
What is activation energy?	

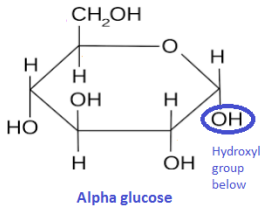
Carbohydrates

Three elements make up the carbohydrate molecule – carbon, hydrogen and oxygen.

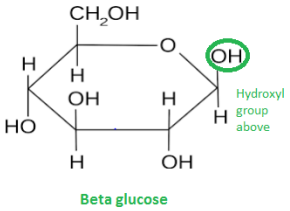
There are several types of carbohydrates;

Sugars; Small, sweet, water soluble molecules. Can be **monosaccharides** or **disaccharides**. Monosaccharides are single units from which disaccharides are built. **Glucose** and **Fructose** are monosaccharides and join together to form the disaccharide sucrose. The joining together of 2 monosaccharides occurs to release a molecule of **water** this is called a **condensation reaction.**

Glucose occurs in 2 forms alpha (**α)** glucose and beta (**β)** glucose.



Alpha glucose

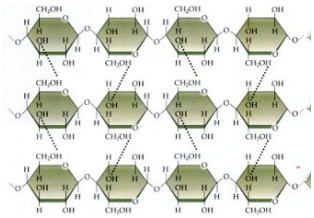


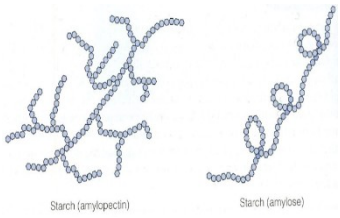
Beta glucose

Starch; A **POLYSACCHARIDE** (a large molecule – polymer, made up of monomers). Two different polysaccharides of glucose are used to make starch- **amylose** and **amylopectin**. Starch is insoluble so it is a good storage molecule in plants.

Cellulose; a polymer of glucose. Bonding is different in cellulose, molecules are bonded in a long straight line with **hydrogen** bonds between the strands. It forms **microfibrils** to provide strength to plant cell walls.

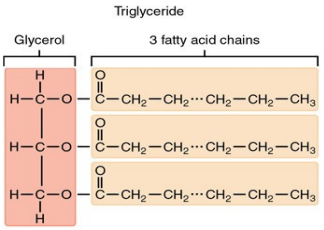
Cellulose Amylopectin Amylose





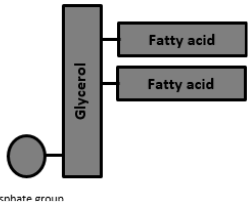
Lipids

Three elements make up the lipid molecule – carbon, hydrogen and oxygen. Lipids are fats and oils, predominantly made up of a group of lipids called **triglycerides**. These contain a molecule of **GLYCEROL** with 3 **fatty acids**.



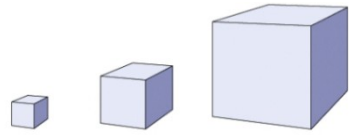
The fatty acid is a long chain of carbon atoms with an acid (-COOH) group. Hydrogen atoms are attached to the carbons by single bond. A single bond forms a **saturated** lipid. If there is a double bond then the lipid is **unsaturated**, many double bonds forms a **polyunsaturated** lipid.

Cell membranes are formed from phospholipid. They do not have 3 fatty acid chains but 2 fatty acid chains and a phosphate group.



Exchange surfaces

All good exchange surfaces require adaptations to make the exchange efficient. The smaller the object the quicker exchange is able to occur due to it having a large surface area to volume ration, however larger, more complex organisms have a much smaller surface area to volume ratio. The larger the object the lower the surface area to volume ratio.



Surface area	6 sides × 1^2 = 6 mm^2	6 sides × 2^2 = 24 mm^2	6 sides × 4^2 = 96 mm^2
Volume	1^3 = 1 mm^3	2^3 = 8 mm^3	4^3 = 64 mm^3
Surface area-to-volume ratio	6/1	3/1	1.5/1

To overcome this, multicellular organisms have highly adapted exchange organs. Adaptations include;

- Folded to increase the surface area to volume ratio for a faster exchange.
- A good blood supply to maintain the concentration gradient.
- One cell thick (thin) to reduce diffusion distance.

Materials that need to be exchanged between the cell and he environment include; heat, oxygen, water,

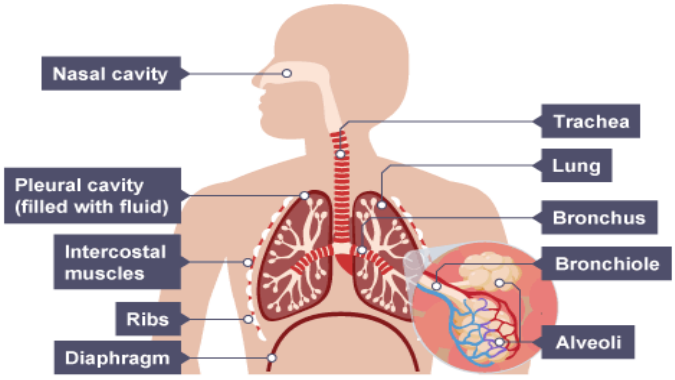
	carbon dioxide, nutrients and other waste products such as urea. The adaptations allow MORE substances to be exchanged at a faster rate.

Questions

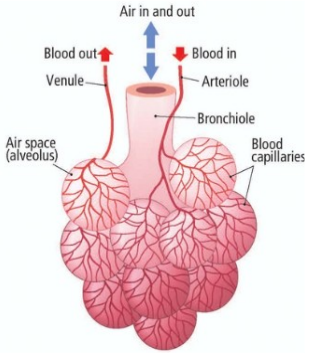
Describe the difference between a triglyceride and a phospholipid	
Describe the difference between Starch and cellulose.	
What bonds hold Cellulose microfibrils together?	

Gas exchange in animals

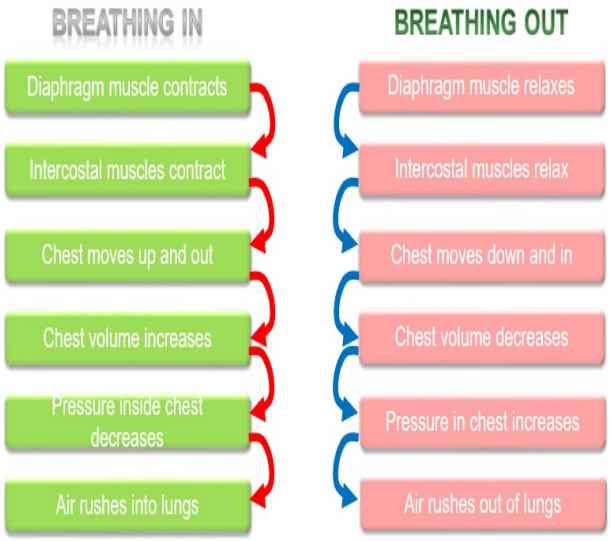
Lungs; Multi cellular organisms have evolved a **complex blood supply system** and a large gas exchange system (**lungs**). The lungs contain millions of tiny air sacs called ALVEOLI which are then folded to further increase the surface area of the lung.



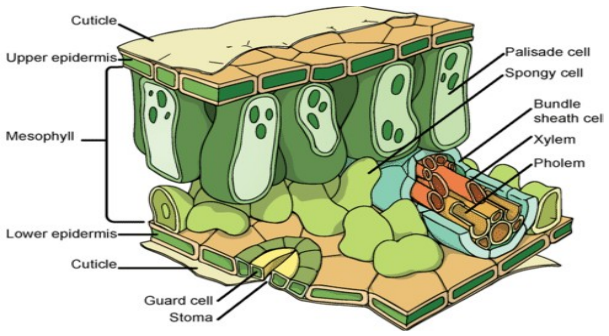
The alveoli are further adapted by having a single flattened layer of **epithelial squamous cells** which reduces the diffusion distance increasing the speed of diffusion. Alveoli have a dense network of capillaries to move the blood away quickly, maintaining a steep diffusion gradient. The walls of the alveoli are fully permeable to dissolved oxygen and carbon dioxide.



Breathing/ventilation; The process of maintaining a high concentration of oxygen inside the lungs and getting rid of the waste product carbon dioxide. Ventilation increases the rate of diffusion.
Lungs are suspended in the airtight Thorax and any change in volume will affect the pressure in the thorax.



Gas exchange in plants



Plants also have adaptations to allow gas exchange. The leaf is an organ that is adapted to allow the movement of water from the leaf and the diffusion of carbon dioxide into the leaf. The upper mesophyll layer contains Palisade cells which are packed with chloroplasts to absorb as much energy from the sun as possible for photosynthesis. The lower part of the mesophyll layer is the spongy mesophyll which contains air spaces to facilitated the diffusion of gases into the cells and out of the cells.
The upper epidermis is covered by a waxy cuticle to prevent water loss. The lower epidermis has a specialised pair of cells called the **GUARD CELLS**. The guard cells have an uneven thickening in the cell wall which causes the cell to bend and open up a hole in the lower epidermis called the **STOMA**. The stoma allows the water vapour to move out of the leaf into the environment (**transpiration**) and carbon dioxide to move into the leaf.
Transpiration; The movement of water from the root and out of the leaf is called the transpiration stream. Water passes into the root by osmosis and then moves through the root by 3 different processes;

- The symplast pathway; water moves from root cell to root cell through the cytoplasm.
- The apoplast pathway; water moves through the cell wall, not passing over the cell membrane, carrying minerals with it through a process called **MASS FLOW**.
- The vacuolar pathway; water moves from root cell to root cell via the cytoplasm and the vacuole.

Water moves out of the leaf by diffusion into the environment. The water moves from root to leaf through a specialised tube called the **xylem**. Water is pulled up the xylem due to an attraction force between the water particles causing a tension in the xylem (**Cohesion tension**) and the attraction between the water particles and the sides of the xylem vessel (**adhesion**).
The second vessel in the plant is the **phloem** and this is responsible for **translocation**, the mass flow of substances from the leaf to the rest of the plant.

Questions	
What are the features that makes a surface better adapted for exchange?	
What is transpiration?	
What is translocation?	