Morecambe Bay Academy

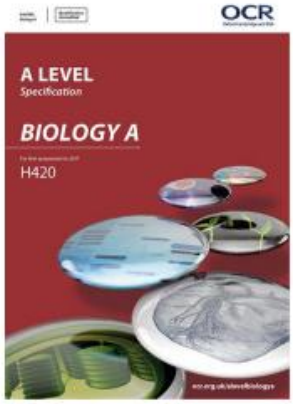
# A level Biology Transition Work

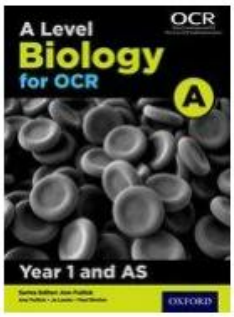
Welcome

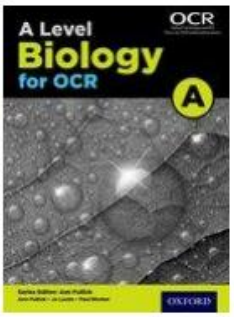
We are happy that you have chosen to study A-Level Biology. You have chosen a very desirable subject for Universities and employers. The subject is, however, very demanding and requires dedication. Please use this booklet to ease your transition into A-Level Biology. The recommended books and movie/video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

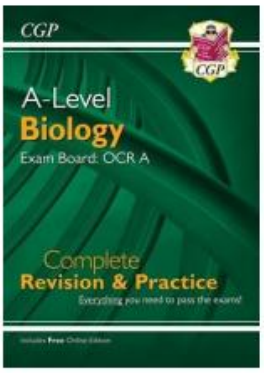
The course you will be following is OCR A level Biology A (H420). The home page is:-

https://ocr.org.uk/qualifications/as-and-a-level/biology-a-h020-h420-from-2015/










This is the text book we will be using. We will provide you with the Year 1 and AS book for Year 12, then the full book for Year 13. The revision guide is recommended by past students which you can purchase online or from school in September.

## What you should do.

The entry requirements for A level Biology is Grade 6 in Biology or Combined Science GCSE.

First, check how good you are at the GCSE work. Here are links to the 2018 Biology exam papers and markschemes.

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Paper 1 Higher https: //www.ocr.org.uk/Images/234579-unit-j247-03-biology-higher-tier-paper-3-sample-assessment-material.pdf

Paper 2 Higher https://www.ocr.org.uk/Images/234580-unit-j247-04-biology-higher-tier-paper-4-sample-assessment-material.pdf

**Contents for transition work in A Level Biology**

The material contained within the rest of the Biology pack is extended GCSE level to help prepare for the A Level Biology course. It is recommended that you aim to complete as much as possible to help you in Yr 12.

- Get Inspired- Read some books and watch some films!

- Recap and Extend- Complete the activities and the questions. Use the suggested websites and the basic recap material to help you on the following topics:

1. Cells and cell division

2. Biological molecules

3. Exchange and Transport

4. Energy

5. DNA and the genetic code

6. Scientific Skills

7. Maths skills and answers

8. Challenge- Taking it further

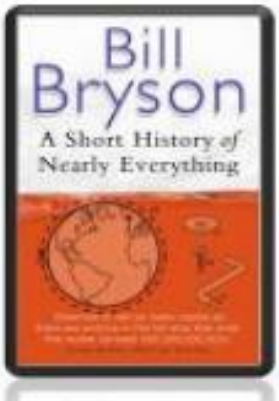
**Get Inspired! Find out about Biology**

## Book Recommendations

Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Biology

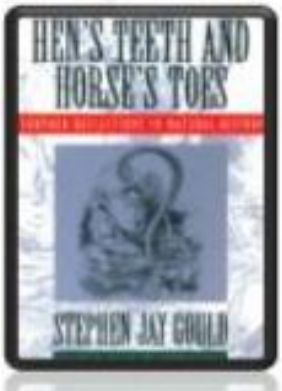

**Junk DNA**
Our DNA is so much more complex than you probably realize, this book will really deepen your understanding of all the work you will do on Genetics. Available at amazon.co.uk

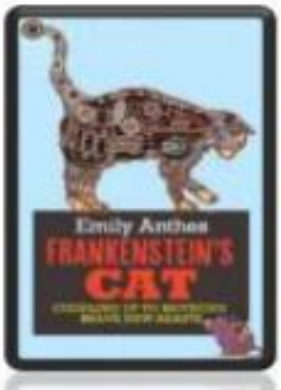
**The Red Queen**
Its all about sex. Or sexual selection at least. This book will really help your understanding of evolution and particularly the fascinating role of sex in evolution. Available at amazon.co.uk


**A Short History of Nearly Everything**
A whistle-stop tour through many aspects of history from the Big Bang to now. This is a really accessible read that will re-familiarise you with common concepts and introduce you to some of the more colourful characters from the history of science! Available at amazon.co.uk

Studying Geography as well? **Hen's teeth and horses toes** Stephen Jay Gould is a great Evolution writer and this book discusses lots of fascinating stories about Geology and evolution. Available at amazon.co.uk



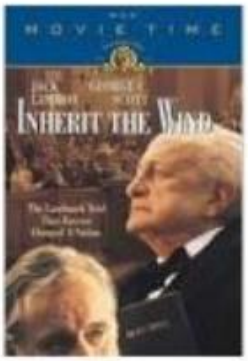

An easy read..
**Frankenstein's cat**
Discover how glow in the dark fish are made and more great Biotechnology breakthroughs. Available at amazon.co.uk

# Movie Recommendations

Everyone loves a good story and everyone loves some great science. Here are some of the picks of the best films based on real life scientists and discoveries. You wont find Jurassic Park on this list, we've looked back over the last 50 years to give you our top 5 films you might not have seen before. Great watching for a rainy day.


**Gorillas in the Mist (1988)**
An absolute classic that retells the true story of the life and work of Dian Fossey and her work studying and protecting mountain gorillas from poachers and habitat loss. A tear jerker.

**Inherit The Wind (1960)**
Great if you can find it. Based on a real life trial of a teacher accused of the crime of teaching Darwinian evolution in school in America. Does the debate rumble on today?




**Andromeda Strain (1971)**
Science fiction by the great thriller writer Michael Cricthon (he of Jurassic Park fame). Humans begin dying when an alien microbe arrives on Earth.


**Lorenzo's Oil (1992)**
Based on a true story. A young child suffers from an autoimmune disease. The parents research and challenge doctors to develop a new cure for his disease.


**Something the Lord Made (2004)**
Professor Snape (the late great Alan Rickman) in a very different role. The film tells the story of the scientists at the cutting edge of early heart surgery as well as issues surrounding racism at the time.

There are some great TV series and box sets available too, you might want to check out: Blue Planet, Planet Earth, The Ascent of Man, Catastrophe, Frozen Planet, Life Story, The Hunt and Monsoon.

**Cells and Cell division**

The cell is a unifying concept in biology, you will come across it many times during your two years of A level study. Prokaryotic and eukaryotic cells can be distinguished on the basis of their structure and ultrastructure. In complex multicellular organisms' cells are organised into tissues, tissues into organs and organs into systems. During the cell cycle genetic information is copied and passed to daughter cells. Daughter cells formed during mitosis have identical copies of genes while cells formed during meiosis are not genetically identical

http://www.s-cool.co.uk/a-level/biology/cells-and-organelles

And take a look at these videos:

https://www.youtube.com/watch?v=gcTuQpuJyD8

https://www.youtube.com/watch?v=L0k-enzoeQM

https://www.youtube.com/watch?v=qCLmR9-YY7o

**Task- Produce a powerpoint/revision cards/diagram slide on the main structures of Plant cells, animal cells and Prokarvote cells.**

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.

Quick Questions;

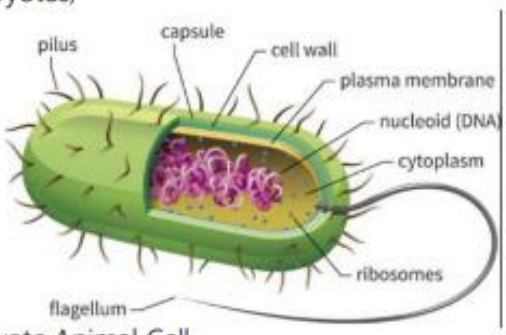
Name 3 things visible with a light microscope in both animal and plant cells

Name 4 organelles that both plant and an animal cell have.

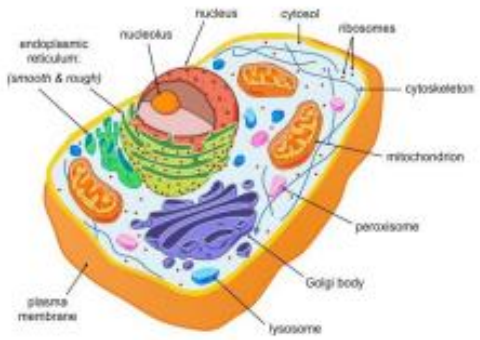
What is the calculation used to calculate the magnification of an object?

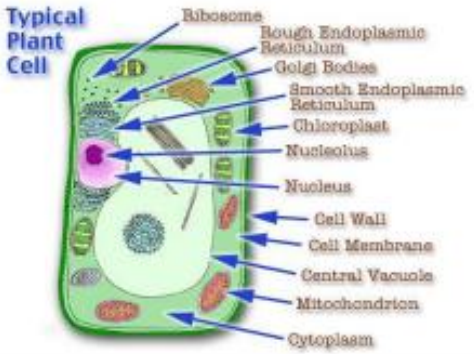
What is the function of the mitochondria?

Prokaryotes;




Eukaryote Animal Cell



## 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.

Challenge-

Can you find out about the other structure and their function of the other organelles labelled on the diagram?

Questions;

Name 2 molecules that make up the cell membrane.

_____

Describe the membranes of the mitochondria.

_____

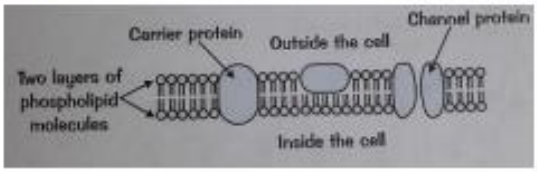
What is the name of the molecule that provide energy to the cell? _____

What term is used to describe water concentration?

_____

## 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.

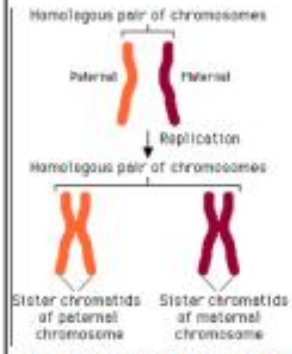
*Osmosis;* occurs only with water. The water particles move from an area of high water concentration to an area of low water concentration, down a concentration gradient, across a partially permeable membrane. NO ENERGY IS REQUIRED. You will be required to refer to water potential in AS level not water 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'.

# Genetics and cell division;

The DNA molecule contains thousands of genes along its length. The DNA molecule is wound up into a chromosome. Each body cell in a human contains **23 pairs of chromosomes (diploid number)**, one from mother and one from father. These pair up forming a **homologous pair**, both the **same size** and containing the **same genes** (these genes can be different **alleles**). A chromosome is often seen as an X shaped molecule. The X shape is actually one chromosome attached to an exact copy of itself (2 **CHROMATIDS**). They are joined together by an attachment called a **centromere.** In preparation for **cell division** the chromosome will make a copy of itself. All damaged tissue and cells are replaced by a process of cell division called **MITOSIS**. Mitosis is also seen in **asexual reproduction,** the offspring are **genetically identical** to the parent.




***Mitosis cell division;***

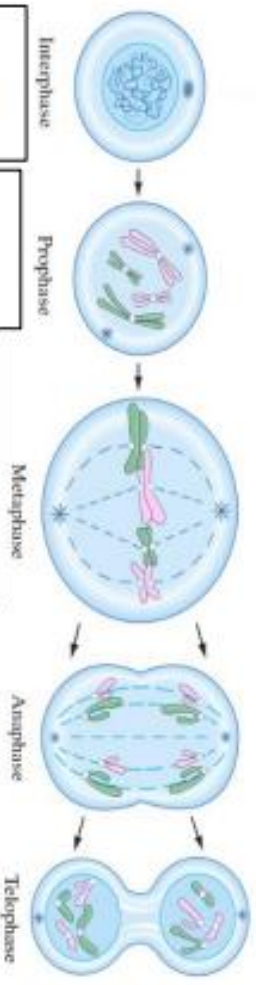
**Interphase**; DNA molecules are indistinct in the nucleus. They replicate their DNA, attaching at the centromeres.

**Prophase**; The DNA becomes **supercoiled** and **compact** and can now be seen under a light microscope. It has the X shape.

**Metaphase**; the nuclear membrane breaks down, the chromosomes line up along the **equator** of the cell and **spindle fibres**, produced by the **centrioles**, attach to the chromosomes.

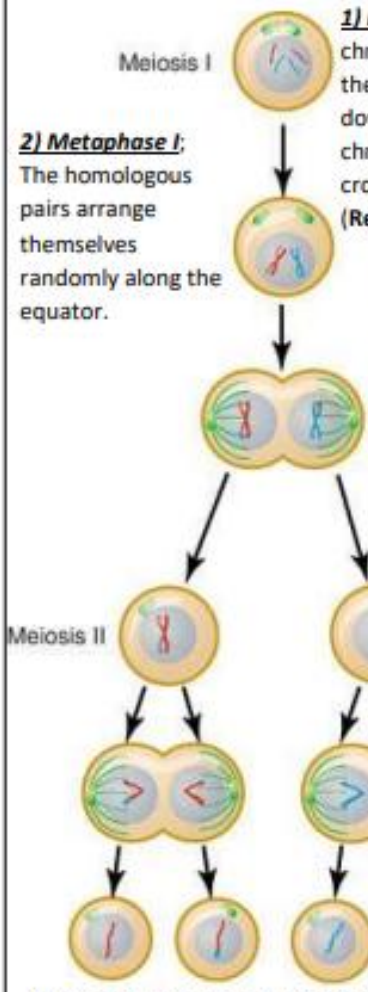
**Anaphase**; The **spindle fibres** pull the **centromere** apart and the **chromatids** separate and are dragged to the poles of the cell.

**Telophase**; A **nuclear envelope** forms around each set of **chromatids** and the **cytoplasm divides** forming 2 genetically identical cells.




***Meiosis***; This cell division is responsible for the production of sex cells and introduces **genetic variation**. It results in the formation of gametes containing half the original genetic information (**Haploid number**). This ensures, that during **fertilisation**, the **embryo** obtains two complete sets of genetic information.

In meiosis the cell undergoes 2 cellular divisions.




***1) Prophase I***; The chromosomes condense and the nuclear envelope breaks down. Homologous chromosomes pair up and can cross over DNA (**Recombination**).

***2) Metaphase I***; The homologous pairs arrange themselves randomly along the equator.

***3) Anaphase I***; Spindle fibres attach to the centromere and pull the chromosomes to opposites poles.

***4)Telophase I***; Two nuclear envelopes surround the divided genetic information. Each contains half the number of chromosomes.

***5)Prophase 2;*** New nucleus breaks down and chromosomes coil and condense.

***6) Metaphase 2;*** Spindle fibres attach to the centromeres.

***7) Anaphase 2;*** The spindle fibres start to drag the chromatids to opposite sides of the cell.

***8) Telophase 2***; The nuclei's start to reform and the cytoplasm spits to form 4 haploid cells that are genetically different to the parent cells.

Questions;

Which cell division forms haploid cells? _____

What happens during prophase? _____

_____

What do centrioles do? _____

_____

Which organs produce haploid cells? _____

_____

What happens in Telophase? _____

**Biological Molecules**

Biological molecules are often polymers and are based on a small number of chemical elements. In living organisms carbohydrates, proteins, lipids, inorganic ions and water all have important roles and functions related to their properties. DNA determines the structure of proteins, including enzymes. Enzymes catalyse the reactions that determine structures and functions from cellular to whole-organism level. Enzymes are proteins with a mechanism of action and other properties determined by their tertiary structure. ATP provides the immediate source of energy for biological processes.

Read the information on these websites (you could make more Cornell notes if you wish):

http://www.s-cool.co.uk/a-level/biology/biological-molecules-and-enzymes

http://www.bbc.co.uk/education/guides/zb739j6/revision

And take a look at these videos:

https://www.youtube.com/watch?v=H8WJ2KENlK0

http://ed.ted.com/lessons/activation-energy-kickstarting-chemical-reactions-vance-kite

**Task:**

**Krabbe disease occurs when a person doesn't have a certain enzyme in their body. The disease effects the nervous system. Write a letter to a GP or a sufferer to explain what an enzyme is.**

Your poster should:

Describe the structure of an enzyme

Explain what enzymes do inside the body

**Exchange and Transport**

Organisms need to exchange substances selectively with their environment and this takes place at exchange surfaces. Factors such as size or metabolic rate affect the requirements of organisms and this gives rise to adaptations such as specialised exchange surfaces and mass transport systems. Substances are exchanged by passive or active transport across exchange surfaces. The structure of the plasma membrane enables control of the passage of substances into and out of cells

Read the information on these websites (you could make more Cornell notes if you wish):

http://www.s-cool.co.uk/a-level/biology/gas-exchange

http://www.s-cool.co.uk/a-level/biology/nutrition-and-digestion/revise-it/human-digestive-system

And take a look at these videos:

http://ed.ted.com/lessons/insights-into-cell-membranes-via-dish-detergent-ethan-perlstein

http://ed.ted.com/lessons/what-do-the-lungs-do-emma-bryce

**Task:**

**Create a poster or display to go in your classroom in September. Your poster should either: compare exchange surfaces in mammals and fish or compare exchange surfaces in the lungs and the intestines. You could use a Venn diagram to do this**. Your poster should:

Describe diffusion, osmosis and active transport

Explain why oxygen and glucose need to be absorbed and waste products removed

Compare and contrast your chosen focus.

**Biological Molecules**

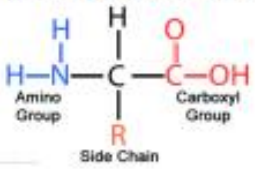
## Proteins;

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,

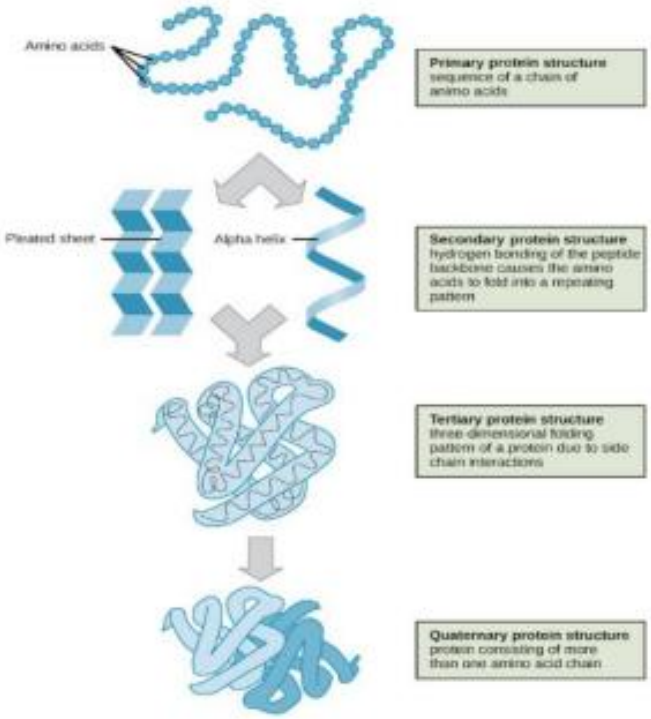
Nitrogen and carbon.




## 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.

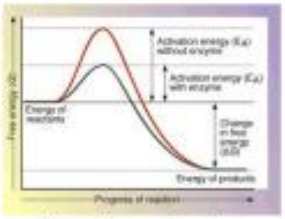
Enzymes have a further folding held together with stronger disulphide bonds. This is the TERTIARY STRUCTURE. If the structure is almost spherical it is called a **globular protein**




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.

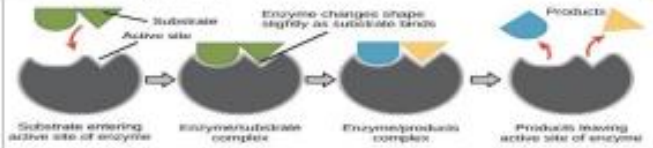
Enzymes are biological catalysts and increase the rate of reactions.



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? _____ 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? _____

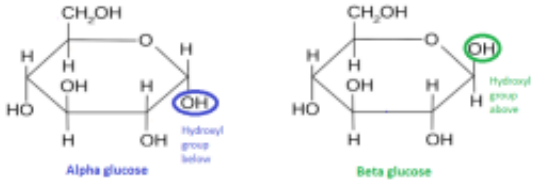
# Carbohydrates;

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.**

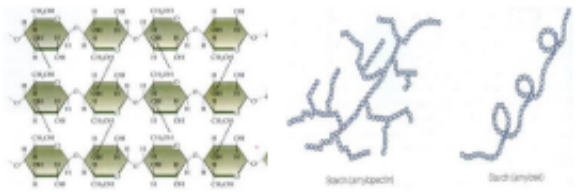
Glucose occurs in 2 forms alpha (**α**) glucose and beta (**β**) glucose.




**St**[illegible] e 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



Questions;

Describe the difference between a triglyceride and a phospholipid. _____

_____

Describe the difference between Starch and cellulose.

_____

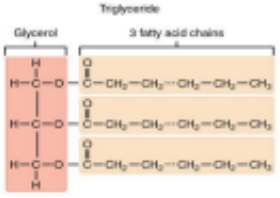
_____

What bonds hold Cellulose microfibrils together? _____

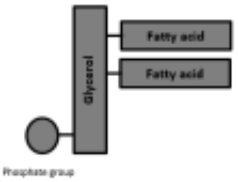
# Lipids;

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** bond then the lipid is **unsaturated**, many double bonds forms a **polyunsaturated** lipid.



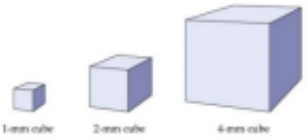

Cell membranes are formed from phospholipid. They do not have 3 fatty acid chains but 2 fatty acid chains and a phosphate group.




# 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 × 1² = 6 mm² | 6 sides × 2² = 24 mm² | 6 sides × 4² = 96 mm² |
| Volume | 1³ = 1 mm³ | 2³ = 8 mm³ | 4³ = 64 mm³ |
| Surface area-to-volume ratio | 6/1 | 3/1 | 1.5/1 |

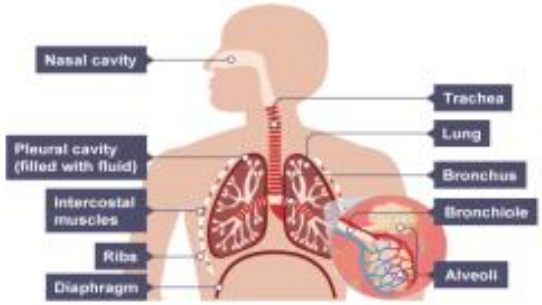
To overcome this, multicellular organisms have highly adapted exchange organs. Adaptations include;

- 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.

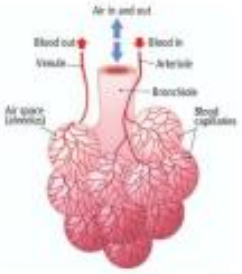
Materials that need to be exchanged between the cell and he environment include; heat, oxygen, water, carbon dioxide, nutrients and other waste products such as urea. The adaptations allow MORE substances to be exchanged at a faster rate.

## 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 he 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.

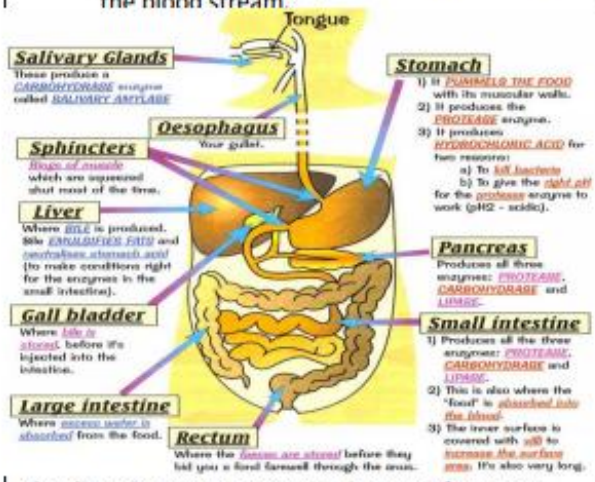
Water moves out of the leaf by diffusion into the environment. The water moves from root to leaf through a specialised tube called the **xylem**. Water is pulled up the xylem due to an attraction force between the water particles causing a tension in the xylem (**Cohesion tension**) and the attraction 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.

## Other exchange surfaces;

***Digestion;*** The human digestive system has 3 main functions;

- Mechanical breakdown of food
- Chemical breakdown of food
- Absorption of digested food particles into the blood stream.




The digestive system contains 3 types of enzyme;

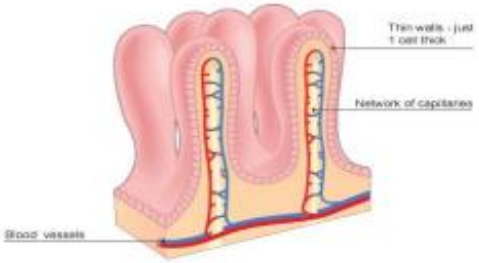
- **Carbohydrase** enzymes for breaking down complex carbohydrates into simple sugars. These are found in the mouth (amylase enzyme), the pancreas and the small intestine.
- **Protease** enzymes break down proteins into amino acids. These are found in the stomach (protease enzyme requires a pH 2 which is provided by the **hydrochloric acid**), the pancreas and the small intestine.
- **Lipase** enzymes breaks down lipids into fatty acids and glycerol. These are found in the pancreas and the small intestine.

Bile is made in the liver and stored in the gall bladder.

1. Makes the digested food, leaving the stomach, slightly alkali for enzymes to work in.
2. It emulsifies the lipids, breaking them up into small droplets to increase the surface area for lipase to digest.

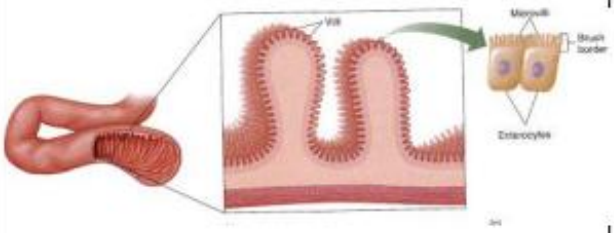
## Other exchange surfaces:

All of the digested food is now small enough to pass through the wall of the small intestine into the blood stream.




As an exchange surface it displays the same characteristic adaptations as the lung; Large surface area to volume ratio, good blood supply and one cell thick.

***Microvilli;*** the walls of the small intestine are highly folded into villi, to increase the SA:Vol. ratio. However, this can be increase further by each individual cell having further folds called microvilli.




Questions;

What are the 3 ways water moved through the root? _____

_____

_____

What are the 3 digestive enzymes, what do they break down and where are they found?

| Enzyme | Breaks down (chemical) | Into (chemicals) | Where found |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

How is the small intestine adapted to increase the rate of diffusion of digested food products? _____

_____

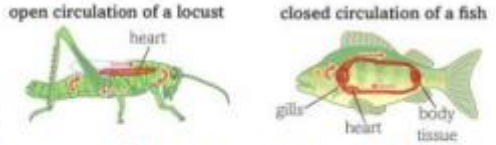
_____

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

# The circulatory system and blood vessels;

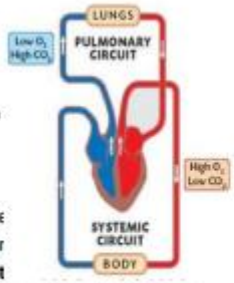
Large multicellular organisms have a small surface area to volume ratio and have evolved a complex circulatory system to transport chemicals around the body, this is called the **CIRCULATORY SYSTEM**.

Some organisms such as flat worms can diffuse oxygen and glucose across their surface. Less active organisms such as insects may have a much more simplified circulatory system.

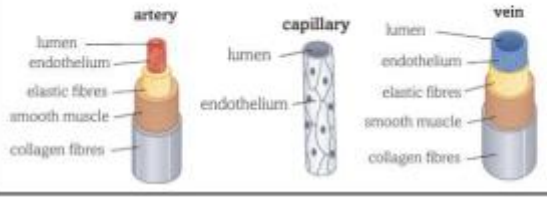



Fis
the heart once before being transported to the **systemic** system this is called a **single circulatory system**. Mammals have evolved a **double circulatory** system with a **pulmonary** and a **systemic** circuit.

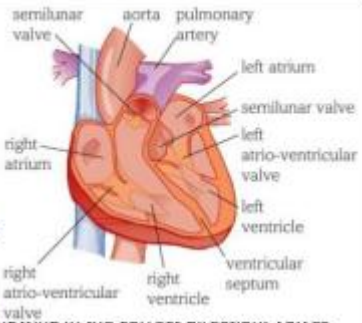
The heart pumps the deoxygenated blood to the lungs **(pulmonary system**) to pick up oxygen and removes carbon dioxide. The oxygenated blood is then returned to the heart to be pumped out to the organs (**systemic system**).




The blood travels through 3 main type
1) **The Arteries**; carry blood **away** fror
thick layer of **elastic tissue** and **smoot**
walls **stretch** when the heart contracts and the elastic tissue **recoils** to maintain the pressure.
2) **Capillaries;** These consist of a single layer of **endothelial cells**. The arteries subdivide **arterioles** which further divide into thousands of capillaries. The capillaries come into close contact with body cells providing a huge surface area to volume ratio and a short diffusion distance for the exchange of oxygen, glucose, carbon dioxide, urea and other substances.
3) **Veins**; The capillaries start to come back together forming **venules** and then veins. Veins carry blood back towards the heart. Blood is at a lower pressure and therefore do not need such a thick layer of elastic tissue or smooth muscle. The veins contain **valves** to prevent the blood flowing backwards.




# The heart;



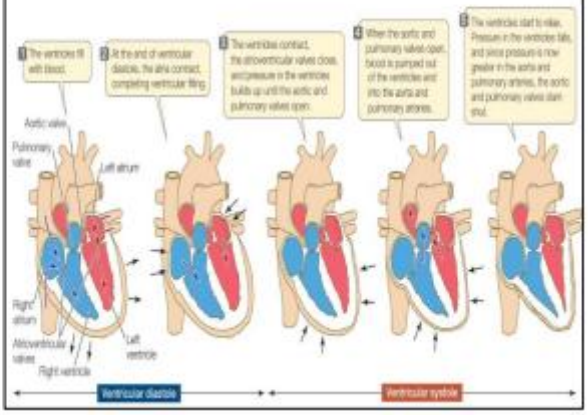

The heart has two separate pumps. The right side of the heart pumps blood to the lungs and the left side pumps blood to the body.
Valves within the heart keep the blood f
open and close in response to the changes of pressure inside the chambers.

The heart is made up of 4 chambers; the right **atria**, the right **ventricle**, the left **atria** and the left **ventricle**. The left side of the heart has a **thicker muscular wall** to create enough pressure to force the blood around the whole body.

The hearts contractions are initiated by a cluster of specialised cells called the **SINO-ATRIAL NODE** or the **PACEMAKER**. These cells send out electrical impulses at regular intervals.

The coronary arteries supply the muscle in the heart with blood.

## The cardiac cycle; This is the sequence of events that occur in a single heartbeat.




Questions;

What is the name of the system that sends blood to body organs?
_____
Which blood vessels contain valves? _____
Which blood vessel has the thickest smooth muscle and what is its function? _____
Which Valves close when the ventricles contract? _____
Which side of the heart is the thickest and why? _____

**Energy for Biological Processes**

In cellular respiration, glycolysis takes place in the cytoplasm and the remaining steps in the mitochondria. ATP synthesis is associated with the electron transfer chain in the membranes of mitochondria and chloroplasts in photosynthesis energy is transferred to ATP in the light-dependent stage and the ATP is utilised during synthesis in the light-independent stage.

Read the information on these websites:

http://www.bbc.co.uk/education/guides/zcxrd2p/revision

http://www.s-cool.co.uk/a-level/biology/respiration

And take a look at these videos:

https://www.youtube.com/watch?v=00jbG_cfGuQ

https://www.youtube.com/watch?v=2f7YwCtHcgk

**Task:**

**Produce an A3 annotated information poster that illustrates the process of cellular respiration and summarises the key points.**

Your poster should include:

Both text and images

Be visually stimulating

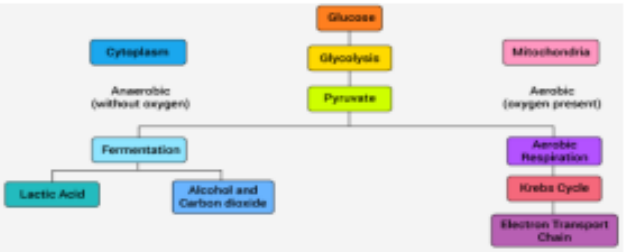
Key words and definitions

Clearly labelled diagrams

Short explanations of key ideas or processes.

## Respiration;

**Aerobic respiration**; This occurs in the mitochondria of cells. It requires a number of small stages to break down **glucose** ($C_6H_{12}O_6$) to release a large amount of energy; **adenosine triphosphate** (ATP). The first stage is a stage called **GLYCOLYSIS**, this occurs in the cytoplasm and converts glucose into two 3 carbon molecules called **PYRUVATE**. Pyruvate is formed in both aerobic and anaerobic respiration, however in aerobic respiration the pyruvate passes into the matrix of the Mitochondria. Pyruvate then goes into the **link reaction** to form **acetyl CoA** which then passes into to the **Kreb cycle** with the oxidise products passing into **oxidative phosphorylation** to form **ATP** and waste products **carbon dioxide** and **water**.




converted into pyruvate, through the process of **GLYCOLYSIS**, in the cytoplasm and is unable to pass into the mitochondria. The process of glycolysis releases small amounts of energy and over a short period of time it can keep the muscles working.

Anaerobic respiration in plants and yeast forms **carbon dioxide** and **alcohol**. Anaerobic respiration in animals forms **lactic acid**. The build-up of lactic acid in muscles must be broken down as the formation of the acid alters the pH and affects enzymes in the cells, slowing down reactions. As the lactate ions build up in the muscles this causes pain called **fatigue**. The oxygen required to convert the lactate ions back to pyruvate is called the **oxygen debt**.

1. What is the name of the stage of respiration that is common to aerobic and anaerobic respiration?

   _____

2. What are the products of the first stage of respiration?

   _____

3. Name the remaining 3 stages of aerobic respiration.

   _____

4. Name the molecule that is produced and will supply energy to other parts of the body.

   _____

5. Define the term anaerobic respiration-

   _____

6. Write a word equation for;
   a) anaerobic respiration in plants and yeast-

   _____

   b) anaerobic respiration in mammals _____

7. What is the oxygen debt? _____
8. Why can a person not anaerobically respire for a long time? _____

**DNA and the Genetic Code**

In living organisms nucleic acids (DNA and RNA have important roles and functions related to their properties. The sequence of bases in the DNA molecule determines the structure of proteins, including enzymes.

The double helix and its four bases store the information that is passed from generation to generation. The sequence of the base pairs adenine, thymine, cytosine and guanine tell ribosomes in the cytoplasm how to construct amino acids into polypeptides and produce every characteristic we see. DNA can mutate leading to diseases including cancer and sometimes anomalies in the genetic code are passed from parents to babies in disease such as cystic fibrosis, or can be developed in unborn foetuses such as Downs Syndrome.

Read the information on these websites:

http://www.s-cool.co.uk/a-level/biology/dna-and-genetic-code

https://www.wisc-online.com/learn/general-education/anatomy-and-physiology1/ap1302/protein-synthesis

And take a look at these videos:

http://ed.ted.com/lessons/the-twisting-tale-of-dna-judith-hauck

http://ed.ted.com/lessons/where-do-genes-come-from-carl-zimmer

**Task:**

**Produce a wall display to put up in your classroom in September. You might make a poster or do this using PowerPoint or similar Your display should use images, keywords and simple explanations to:**

Define gene, chromosome, DNA and base pair

Describe the structure and function of DNA and RNA

Explain how DNA is copied in the body- Protein Synthesis done at TRIPLE HIGHER not covered in Combined

Outline some of the problems that occur with DNA replication and what the consequences of this might be.

**Scientific and Investigative Skills**

As part of your A level you will complete a practical assessment. This will require you to carry out a series of practical activities as well as planning how to do them, analysing the results and evaluating the methods. This will require you to: use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH), use appropriate instrumentation to record quantitative measurements, such as a colorimeter or photometer, use laboratory glassware apparatus for a variety of experimental techniques to include serial dilutions, use of light microscope at high power and low power, including use of a graticule, produce scientific drawing from observation with annotations, use qualitative reagents to identify biological molecules, separate biological compounds using thin layer/paper chromatography or electrophoresis, safely and ethically use organisms, use microbiological aseptic techniques, including the use of agar plates and broth, safely use instruments for dissection of an animal organ, or plant organ, use sampling techniques in fieldwork.

**Task:**

**Produce a glossary for the following key words:**

accuracy, anomaly, calibration, causal link, chance, confounding variable, control experiment, control group, control variable, correlation, dependent variable, errors, evidence, fair test, hypothesis, independent, null hypothesis, precision, probability, protocol, random distribution, random error, raw data, reliability, systematic error, true value, validity, zero error,

# DNA and protein synthesis;

DNA is a complex chemical, found in the nucleus of eukaryotes and in the cytoplasm of prokaryotes. DNA is made up of; **pentose sugar**, **phosphate** and **nitrogenous bases** forming a **NUCLEOTIDE**.

There are 4 different nitrogenous bases;

**A= Adenine**
**T= Thymine**
**C= Cytosine**
**G= Guanine**

*Complementary pair;*

**A pairs with T**
**C pairs with G**

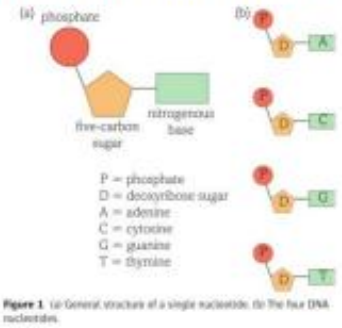
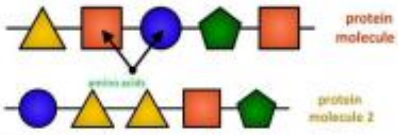


Figure 1 (a) General structure of a single nucleotide. (b) The four DNA nucleotides.

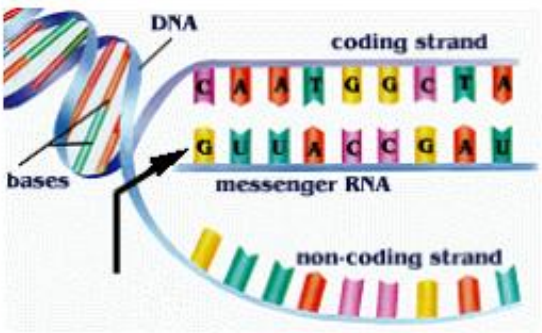
The bases pair up in the formation stated above. They are held together by **hydrogen bonds**. The two strands run in opposite directions causing the molecule to spiral forming a **DOUBLE HELIX**.

DNA controls the production of proteins. A section of DNA that codes for a protein is called a **gene**. Proteins are made up of a string of **amino acids**, each protein has a different number and order of amino acids. The proteins also have different bonds which holds the molecule in a unique shape which means all proteins have a different function.

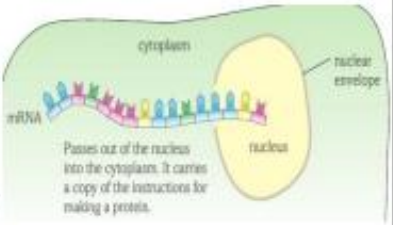


Different combinations of amino acids make different proteins.

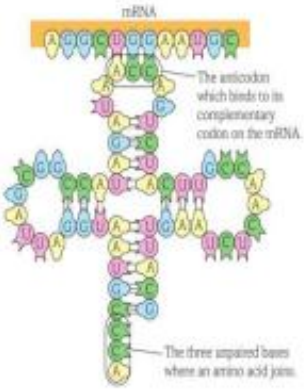
***Protein synthesis***; Protein synthesis occurs in the cytoplasm, carried out by **RIBOSOMES**. When a protein is required then the gene has to be copied producing a molecule called **messengerRNA (mRNA)**. mRNA is small enough to pass out of the nucleus into the cytoplasm. mRNA is a template, containing nucleotides and bases. The nucleotide on the mRNA will line up with the **complementary base**. However, on RNA there is no Thymine, RNA will have the base **URACIL (U)**.

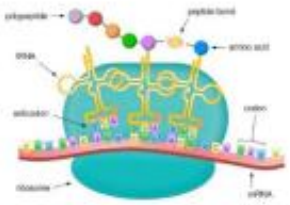



The mRNA passes out of the nucleus carrying the code for a protein. Once in the cytoplasm the mRNA binds to a ribosome.




Within the cytoplasm there is another molecule called transferRNA (tRNA). At one end, the **anticodon** is complementary to the mRNA. At the opposite end there are three **unpaired bases** which code for an **amino acid**. The amino acid is brought in to form a **peptide bond** with the amino acids brought in by the previous tRNA. This forms a **polypeptide** chain which will form hydrogen and **disulfide bonds** to form the unique protein.



***Mutations:*** Mutations change the order of bases in the DNA. Some bases may change to a different base (**substitution**), some bases may be deleted and some bases may be added. Mutations can cause the following;

- Incorrect protein to be produces
- No change in protein being made
- Causes a harmful proteins/ no protein to be made

Questions;

What are the components of a nucleotide. _____

_____

What are the names of the 4 nitrogenous bases?

_____

What type of bonds hold the 2 strands together? _____

What is the name of a section of DNA that codes for a protein? _____

What are proteins made from? _____

DNA is too big to leave the nucleus, what is the copy of the gene called that enters the cytoplasm? _____

What organelle will this molecule attach to? _____

Which molecule has a complementary anticodon and brings in the correct amino acid? _____

# Maths skills

## 1 Numbers and units

### 1.1 Units and prefixes

A key criterion for success in biological maths lies in the use of correct units and the management of numbers. The units scientists use are from the *Système Internationale* – the SI units. In biology, the most commonly used SI base units are metre (m), kilogram (kg), second (s), and mole (mol). Biologists also use SI derived units, such as square metre ($m^2$), cubic metre ($m^3$), degree Celsius (°C), and litre (l).

To accommodate the huge range of dimensions in our measurements they may be further modified using appropriate prefixes. For example, one thousandth of a second is a millisecond (ms). Some of these prefixes are illustrated in the table below.

| Multiplication factor | Prefix | Symbol |
|---|---|---|
| $10^9$ | giga | G |
| $10^6$ | mega | M |
| $10^3$ | kilo | k |
| $10^{-2}$ | centi | c |
| $10^{-3}$ | milli | m |
| $10^{-6}$ | micro | μ |
| $10^{-9}$ | nano | n |

#### *Practice questions*

**1** A burger contains 4 500 000 J of energy. Write this in:
**a** kilojoules **b** megajoules.

**2** HIV is a virus with a diameter of between $9.0\times10^{-8}$ m and $1.20\times10^{-7}$ m.
Write this range in nanometres.

### 1.2 Powers and indices

Ten squared = 10 × 10 = 100 and can be written as $10^2$. This is also called 'ten to the power of 2'.

Ten cubed is 'ten to the power of three' and can be written as $10^3 = 1000$.

The power is also called the index.

Fractions have negative indices:

one tenth = $10^{-1} = 1/10 = 0.1$

one hundredth = $10^{-2} = 1/100 = 0.01$

Any number to the power of 0 is equal to 1, for example, $29^0 = 1$.

If the index is 1, the value is unchanged, for example, $17^1 = 17$.

When multiplying powers of ten, you must *add* the indices.

So 100 × 1000 = 100 000 is the same as $10^2 \times 10^3 = 10^{2+3} = 10^5$

When dividing powers of ten, you must *subtract* the indices.

So 100/1000 = 1/10 = $10^{-1}$ is the same as $10^2/10^3 = 10^{2-3} = 10^{-1}$

But you can only do this when the numbers with the indices are the same.

So $10^2 \times 2^3 = 100 \times 8 = 800$

And you can't do this when adding or subtracting.

$10^2 + 10^3 = 100 + 1000 = 1100$

$10^2 - 10^3 = 100 - 1000 = -900$

**Remember:** You can only add and subtract the indices when you are multiplying or dividing the numbers, not adding or subtracting them.

### *Practice questions*

**3** Calculate the following values. Give your answers using indices.

**a** $10^8 \times 10^3$ **b** $10^7 \times 10^2 \times 10^3$

**c** $10^3 + 10^3$ **d** $10^2 - 10^{-2}$

**4** Calculate the following values. Give your answers with and without using indices.

**a** $10^5 \div 10^4$ **b** $10^3 \div 10^6$

**c** $10^2 \div 10^{-4}$ **d** $100^2 \div 10^2$

## 1.3 Converting units

When doing calculations, it is important to express your answer using sensible numbers. For example, an answer of 6230 µm would have been more meaningful expressed as 6.2 mm.

If you convert between units and round numbers properly, it allows quoted measurements to be understood within the scale of the observations.

To convert 488 889 m into km:

A kilo is $10^3$ so you need to divide by this number, or move the decimal point three places to the left.

488 889 ÷ $10^3$ = 488.889 km

However, suppose you are converting from mm to km: you need to go from $10^3$ to $10^{-3}$, or move the decimal point six places to the left.

333 mm is 0.000 333 km

Alternatively, if you want to convert from 333 mm to nm, you would have to go from $10^{-9}$ to $10^{-3}$, or move the decimal point six places to the right.

333 mm is 333 000 000 nm

### *Practice questions*

**5** Calculate the following conversions:

**a** 0.004 m into mm **b** 130 000 ms into s

**c** 31.3 ml into µl **d** 104 ng into mg

**6** Give the following values in a different unit so they make more sense to the reader.

Choose the final units yourself. (Hint: make the final number as close in magnitude to zero as you can. For example, you would convert 1000 m into 1 km.)

**a** 0.000 057 m **b** 8 600 000 µl **c** 68 000 ms **d** 0.009 cm

# 2 Decimals, standard form, and significant figures

## 2.1 Decimal numbers

A decimal number has a decimal point. Each figure *before* the point is a whole number, and the figures *after* the point represent fractions.

The number of decimal places is the number of figures *after* the decimal point. For example, the number 47.38 has 2 decimal places, and 47.380 is the same number to 3 decimal places.

In science, you must write your answer to a sensible number of decimal places.

### *Practice questions*

**1** New antibiotics are being tested. A student calculates the area of clear zones in Petri dishes in which the antibiotics have been used. List these in order from smallest to largest.

0.0214 $cm^2$ 0.03 $cm^2$ 0.0218 $cm^2$ 0.034 $cm^2$

**2** A student measures the heights of a number of different plants. List these in order from smallest to largest.

22.003 cm 22.25 cm 12.901 cm 12.03 cm 22 cm

## 2.2 Standard form

Sometimes biologists need to work with numbers that are very small, such as dimensions of organelles, or very large, such as populations of bacteria. In such cases, the use of scientific notation or standard form is very useful, because it allows the numbers to be written easily.

Standard form is expressing numbers in powers of ten, for example, $1.5\times10^7$ microorganisms.

Look at this worked example. The number of cells in the human body is approximately 37 200 000 000 000. To write this in standard form, follow these steps:

**Step 1:** Write down the smallest number between 1 and 10 that can be derived from the number to be converted. In this case it would be 3.72

**Step 2:** Write the number of times the decimal place will have to shift to expand this to the original number as powers of ten. On paper this can be done by hopping the decimal over each number like this:


until the end of the number is reached.

In this example that requires 13 shifts, so the standard form should be written as $3.72\times10^{13}$.

For very small numbers the same rules apply, except that the decimal point has to hop backwards. For example, 0.000 000 45 would be written as $4.5\times10^{-7}$.

### *Practice questions*

**3** Change the following values to standard form.

**a** 3060 kJ **b** 140 000 kg **c** 0.000 18 m **d** 0.000 004 m

**4** Give the following numbers in standard form.

**a** 100 **b** 10 000 **c** 0.01 **d** 21 000 000

**5** Give the following as decimals.

**a** $10^6$ **b** $4.7\times10^9$ **c** $1.2\times10^{12}$ **d** $7.96\times10^{-4}$

## 2.3 Significant figures

When you use a calculator to work out a numerical answer, you know that this often results in a large number of decimal places and, in most cases, the final few digits are 'not significant'. It is important to record your data and your answers to calculations to a reasonable number of significant figures. Too many and your answer is claiming an accuracy that it does not have, too few and you are not showing the precision and care required in scientific analysis.

Numbers to 3 significant figures (3 s.f.):

7.88 25.4 741

Bigger and smaller numbers with 3 significant figures:

0.000 147 0.0147 0.245 39 400 96 200 000 (notice that the zeros before the figures and after the figures are *not* significant – they just show you how large the number is by the position of the decimal point).

Numbers to 3 significant figures where the zeros *are* significant:

207 4050 1.01 (any zeros between the other significant figures *are* significant).

Standard form numbers with 3 significant figures:

$9.42\times10^{-5}$ $1.56\times10^{8}$

If the value you wanted to write to 3.s.f. was 590, then to show the zero was significant you would have to write:

590 (to 3.s.f.) or $5.90 \times 10^2$

**Remember:** For calculations, use the same number of figures as the data in the question with the lowest number of significant figures. It is not possible for the answer to be more accurate than the data in the question.

### *Practice questions*

**6** Write the following numbers to **i** 2 s.f. and **ii** 3 s.f.

**a** 7644 g

**b** 27.54 m

**c** 4.3333 g

**d** $5.995\times10^2$ cm$^3$

**7** The average mass of oxygen produced by an oak tree is 11800 g per year.

Give this mass in standard form and quote your answer to 2 significant figures.

# 4 Magnification

To look at small biological specimens you use a microscope to magnify the image that is observed. The microscope was developed in the 17th century. Anton van Leeuwenhoek used a single lens and Robert Hooke used two lenses. The lenses focus light from the specimen onto your retina to produce a magnified virtual image. The magnification at which observations are made depends on the lenses used.

## 4.1 Calculating the magnifying power of lenses

Lenses each have a magnifying power, defined as the number of times the image is larger than the real object. The magnifying power is written on the lens.

To find the magnification of the virtual image that you are observing, multiply the magnification powers of each lens used. For example, if the eyepiece lens is ×10 and the objective lens is ×40 the total magnification of the virtual image is 10 × 40 = 400.

### *Practice questions*

**1** Calculate the magnification of the virtual image produced by the following combinations of lenses:

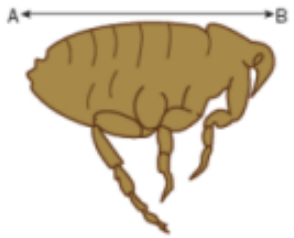
**a** objective ×10 and eyepiece ×12 **b** objective ×40 and eyepiece ×15

## 4.2 Calculating the magnification of images

Drawings and photographs of biological specimens should always have a magnification factor stated. This indicates how much larger or smaller the image is compared with the real specimen.

The magnification is calculated by comparing the sizes of the image and the real specimen. Look at this worked example.

The image shows a flea which is 1.3 mm long. To calculate the magnification of the image, measure the image (or the scale bar if given) on the paper (in this example, the body length as indicated by the line A–B).




For this image, the length of the image is 42 mm and the length of the real specimen is 1.3 mm.

$$\text{magnification} = \frac{\text{length of image}}{\text{length of real specimen}} = 42/1.3 = 32.31$$

The magnification factor should therefore be written as ×32.31

**Remember:** Use the same units. A common error is to mix units when performing these calculations. Begin each time by converting measurements to the same units for both the real specimen and the image.

### *Practice questions*

**2** Calculate the magnification factor of a mitochondrion that is 1.5 µm long.

## 4.3 Calculating real dimensions

Magnification factors on images can be used to calculate the actual size of features shown on drawings and photographs of biological specimens. For example, in a photomicrograph of a cell, individual features can be measured if the magnification is stated. Look at this worked example.

The magnification factor for the image of the open stoma is ×5000.

This can be used to find out the actual size of any part of the cell, for example, the length of one guard cell, measured from A to B.

**Step 1:** Measure the length of the guard cell as precisely as possible. In this example the image of the guard cell is 52 mm long.

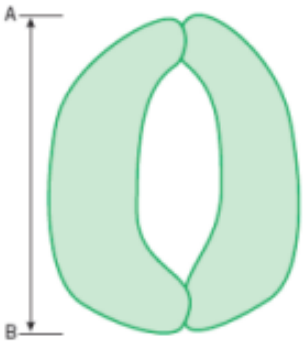
**Step 2:** Convert this measurement to units appropriate to the image. In this case you should use µm because it is a cell.

So the magnified image is 52 × 1000 = 52 000 µm

**Step 3:** Rearrange the magnification equation (see Topic 3.2) to get:

real size = size of image/magnification = 52 000/5000 = 10.4

So the real length of the guard cell is 10.4 µm.



### *Practice questions*

**3** Use the magnification factor to determine the actual size of a bacterial cell.


## 5 Percentages and uncertainty

A percentage is simply a fraction expressed as a decimal. It is important to be able to calculate routinely, but is often incorrectly calculated in exams. These pages should allow you to practise this skill.

### 5.1 Calculating percentages as proportions

To work out a percentage, you must identify or calculate the total number using the equation:

$$\text{percentage} = \frac{\text{number you want as a percentage of total number}}{\text{total number}} \times 100\%$$

For example, in a population, the number of people who have brown hair was counted.

The results showed that in the total population of 4600 people, 1800 people had brown hair.

The percentage of people with brown hair is found by calculating:

$$\frac{\text{number of people with brown hair}}{\text{total number of people}} \times 100$$

$$= \frac{1800}{4600} \times 100 = 39.1\%$$

### *Practice questions*

**1** The table below shows some data about energy absorbed by a tree in a year and how some of it is transferred.

| | |
|---|---|
| Energy absorbed by the tree in a year | 3 600 000 kJ/m$^2$ |
| Energy transferred to primary consumers | 2240 kJ/m$^2$ |
| Energy transferred to secondary consumers | 480 kJ/m$^2$ |

Calculate the percentage of energy absorbed by the tree that is transferred to

**a** primary consumers **b** secondary consumers.

**2** One in 17 people in the UK has diabetes.

Calculate the percentage of the UK population that have diabetes.

### 5.2 Calculating the percentage change

When you work out an increase or a decrease as a percentage change, you must identify, or calculate, the total original amount:

$$\%\ \text{increase} = \frac{\text{increase}}{\text{original amount}} \times 100$$

$$\%\ \text{decrease} = \frac{\text{decrease}}{\text{original amount}} \times 100$$

**Remember:** When you calculate a percentage change, use the total *before* the increase or decrease, not the final total.

#### *Practice questions*

**3** Convert the following mass changes as percentage changes.

| Sucrose conc. / mol $dm^{-3}$ | Initial mass / g | Final mass / g | Mass change / g | Percentage change in mass |
|---|---|---|---|---|
| 0.9 | 1.79 | 1.06 | | |
| 0.7 | 1.86 | 1.30 | | |
| 0.5 | 1.95 | 1.70 | | |
| 0.3 | 1.63 | 1.76 | | |
| 0.1 | 1.82 | 2.55 | | |

# Answers to maths skills practice questions

## 1 Numbers and units

**1** **a** 1 kJ = 1000 J, so 4 500 000 J = 4 500 000/1000 kJ = 4500 kJ **b** 1 MJ = 1000 kJ, so 4500 kJ = 4.5 MJ

**2** 1 m = $10^9$ nm (there are a billion nanometre in a metre)

$9.0 \times 10^{-8}$ m = $9.0 \times 10^{-8} \times 10^9$ nm = $9.0 \times 10^{-8+9}$ nm = $9.0 \times 10$ nm = 90 nm

$1.20 \times 10^{-7}$ m = $1.20 \times 10^{-7} \times 10^9$ nm = $1.20 \times 10^{-7+9}$ nm = $1.20 \times 100$ nm = 120 nm

Range = 90 nm to 120 nm

**3** **a** $10^{11}$ **b** $10^{12}$

**c** 1000 + 1000 = 2000 **d** 100 − 0.01 = 99.99

**4** **a** $10^1$ or 10 **b** $10^{-3}$ or 0.001

**c** $10^6$ or 1 000 00 **d** $100^2 \div 100 = 100$ or $10^2$

**5** **a** 4 mm **b** 130 s

**c** 31 300 µl **d** 0.000 104 mg

**6** **a** 57 µm **b** 8.6 L or 8.6 $dm^3$

**c** 68 s **d** 0.09 mm

## 2 Decimals, standard form, and significant figures

**1** 10.0214 $cm^2$ 0.0218 $cm^2$ 0.03 $cm^2$ 0.034 $cm^2$

**2** 12.03 cm 12.901 cm 22 cm 22.003 cm 22.25 cm

**3** **a** $3.06 \times 10^3$ kJ **b** $1.4 \times 10^5$ kg

**c** $1.8 \times 10^{-4}$ m **d** $4 \times 10^{-6}$ m

**4** **a** $1 \times 10^2$ **b** $1 \times 10^4$

**c** $1 \times 10^{-2}$ **d** $2.1 \times 10^7$

**5** Give the following as decimals.

**a** 1 000 000 **b** 4 700 000 000

**c** 1 200 000 000 000 **d** 0.000 796

**6** **a** 7600 g / 7640 g **b** 28 m / 27.5 m

**c** 4.3 g / 4.33 g **d** $6.0 \times 10^2$ m / $5.00 \times 10^2$ m

**7** $1.2 \times 10^4$ g

## 4 Magnification

1 **a** ×120 **b** ×600

2 ×26 000

3 0.88 µm

## 5 Percentages and uncertainty

1 **a** $\frac{2240}{3600000} \times 100 = 0.06\%$ **b** $\frac{480}{3600000} \times 100 = 0.013\%$

2 5.88%

---

3

| Sucrose conc. / mol $dm^{-3}$ | Initial mass / g | Final mass / g | Mass change / g | Percentage change in mass |
|---|---|---|---|---|
| 0.9 | 1.79 | 1.06 | −0.73 | −40.8% |
| 0.7 | 1.86 | 1.30 | −0.56 | −30.1% |
| 0.5 | 1.95 | 1.70 | −0.25 | −12.8% |
| 0.3 | 1.63 | 1.76 | +0.13 | +8.0% |
| 0.1 | 1.82 | 2.55 | +0.73 | +40.1% |

4 **a** 1 $cm^3$ **b** 0.005 s **c** 0.05 °C

**Challenge**-

If you are aiming for the heights! You could have a look at some of the following-

| | |
|---|---|
| **Virology & Global Health** | • Explained: The Next Global Pandemic (20 mins) https://www.netflix.com/watch/81062202?trackId=13752289&tctx=0%2C3%2C0d03e68c-6321-41f2-9dfa-11f336ddc8ca-52560540%2C%2C<br>• FutureLearn course on Coronavirus: https://www.futurelearn.com/courses/covid19-novel-coronavirus<br>• The Life Scientific - viruses: https://www.bbc.co.uk/programmes/m0009b2t |
| **Natural Selection & Genetic Modification** | • Can Science Make Me Perfect? https://www.bbc.co.uk/iplayer/episode/b0b6q3qy/can-science-make-me-perfect-with-alice-roberts<br>• Explained: Designer DNA (20 mins) https://www.netflix.com/search?q=science&jbv=80216752&jbp=2&jbr=1<br>• Unnatural Selection (short series) https://www.netflix.com/watch/80208833?trackId=13752289&tctx=0%2C0%2C8bd41505-055d-4d08-a8c9-e71150318bb2-44683054%2C%2C<br>• In Our Time: Neanderthals https://www.bbc.co.uk/programmes/b00sq1nv<br>• The Life Scientific: evolution of cancer https://www.bbc.co.uk/programmes/m0003ks6 |
| **Homeostasis & Hormones** | • Interviews with researchers working on hormones: https://endocrinepod.com/episodes/<br>• Open University course on diabetes: https://www.open.edu/openlearn/science-maths-technology/biology/living-diabetes/content-section-3.1 |

Looking forward to seeing you all in September-

Mrs Bradley & Miss Miller