



A level Biology
Edexcel Biology A (SNAB)

Summer Transition Booklet

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Summer Bridging Work: Biology Y11 into Y12

Welcome to A-Level Biology at Slough and Eton

This is a guide to help you get ready for A-Level Biology. It is aimed to be used after you complete your GCSE throughout the remainder of the summer term and over the Summer Holidays to ensure you are ready to start your course in September.

Assessment

Please bring this completed booklet, textbook and equipment to your FIRST Biology lesson (this could be the first day of school). There will also be a transition test in the second week on all GCSE Biology content, Transition Booklet content and test will determine your suitability for the course.

Introduction

A-level Biology is a big step up from GCSE. In order to prepare for Biology A-level, it is vital that you have an excellent understanding of the following concepts, all of which you covered at GCSE and will study in greater depth over the first year of A-level Biology:

1. Biological Molecules
2. Cell Structure
3. Organisms and Exchange
4. The Circulatory System
5. Genetics and Cell Division
6. Variation, Evolution and Classification

To ensure you have an excellent grounding in each of these topics, please continue to review all GCSE Biology content so that you have a solid foundation to starting A-level Biology.

Task -ALL students must complete this

1. Complete the **GCSE prior knowledge quiz** for each of the sections outlined in this booklet. If there is anything you struggle with, write Cornell notes on it using this video for guidance [How to make Cornell Notes](#) (ignore AO1/2/3) and put them in your folder.
2. Read through the information provided on **building knowledge** for A-level Biology and complete the questions that follow on for each of the **sections** in this booklet. Revise the content, **answer ALL the questions**. You must **print the booklet** and bring it to your first Biology lesson.

Preparing for A-level Biology Lessons

1. Purchase **A4 lined paper** and a **A4 folder with dividers** and plastic wallets for use in Biology Only. You also should have pens, pencil, highlighters, green pen, calculator, ruler etc. Prepare to be fully equipped every lesson.
2. Purchase the following **textbook**: Salters-Nuffield AS/A level Biology Student Book 1 + ActiveBook (Salters-Nuffield Advanced Biology(2015)) ISBN **1447991001** – **try and buy a second-hand book**

Pre-read and make notes on the first few pages from your Edexcel Biology A Book 1 Topic 1 and 2.

GCSE to A-Level Biology Transition Booklet and Quiz

Content:

1) Biological Molecules

- a) Carbohydrates: Starch, Cellulose and Glycogen
- b) Lipids
- c) Proteins and Enzymes
- d) DNA, Energy and Water

2) Cells

- a) Animal Cell Structure and Function
- b) Plant Cell Structure and Function
- c) Diffusion, Osmosis and Active Transport
- d) Immunology

3) Organisms Exchange Surface

- a) Diffusion and Gas Exchange Surfaces
- b) Circulatory System
- c) Transport in a plant

4) Genetics

- a) Genetics and Cell Division Key Definitions
- b) Variation and Evolution
- c) Classification

5) Maths Skills and Investigation Skills

- a) References and Variables

This booklet is to help highlight some basic key GCSE knowledge needed to have a good start to the Edexcel A Biology A-level course.

Although other knowledge is required these questions will help determine your basic understanding of biology.

BIOLOGICAL MOLECULES GCSE PRIOR KNOWLEDGE

1) Biological Molecules

- a) Carbohydrates: Starch, Cellulose and Glycogen
- b) Lipids
- c) Proteins and Enzymes
- d) DNA, Energy and Water

Carbohydrates: Starch, Cellulose and Glycogen Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. How may glucose be stored/used by plants? (4)			
2. What is starch made of? (1)			
3. What is the chemical formula for glucose? (1)			
4. Name two reasons starch is important in plants. (2)			
5. Which test is used to see if starch is present? (1)			
6. Which test is used to see if glucose is present? (1)			
7. Describe the method to test for glucose? (3)			

8. Where is cellulose found in a plant cell? (1)			
9. What is the function of cellulose? (1)			
10. Where is glycogen found? (1)			
11. What is the function of glycogen? (1)			
12. How is glycogen made? (2)			
13. What are carbohydrates made of? (1)			
14. What enzyme breaks down carbohydrates? (1)			
TOTAL			/ 20

Carbohydrates Building Knowledge

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

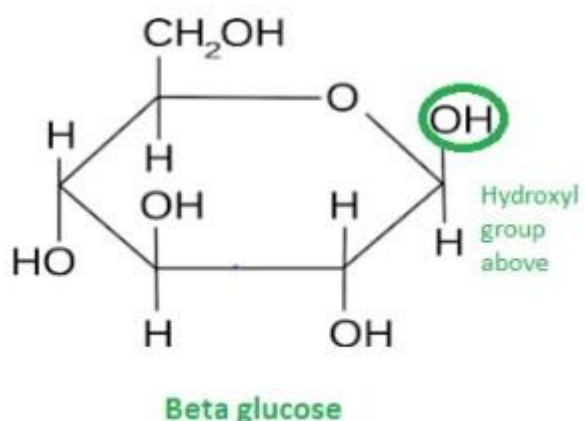
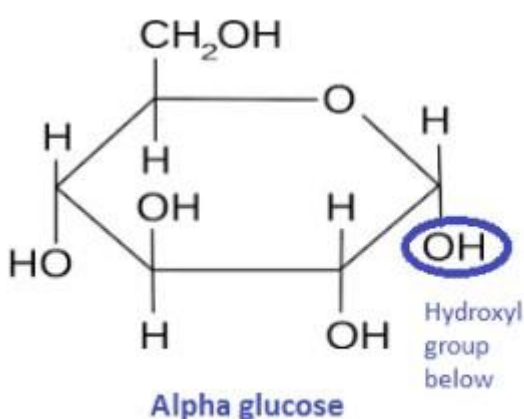
There are several types of carbohydrates;

Sugars

Small, sweet, water soluble molecules. Can be **monosaccharides** (one) or **disaccharides** (two).

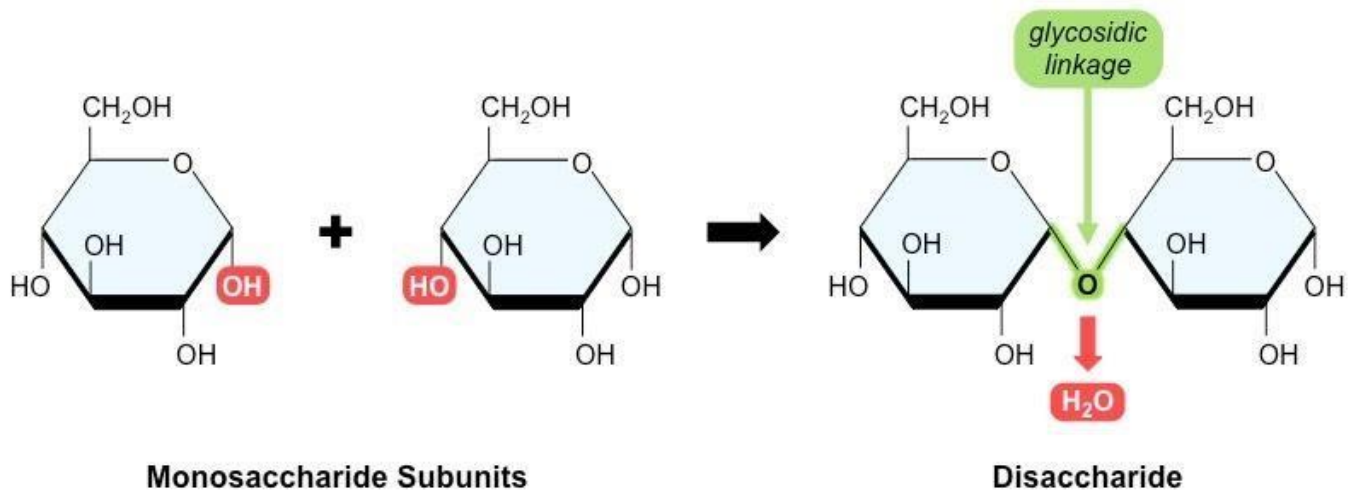
Monosaccharides are single units from which disaccharides are built.

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



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**.

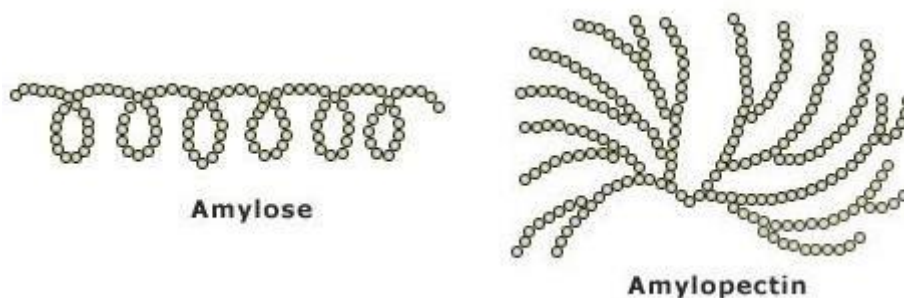


Disaccharides are made from the following monomers:

Glucose + Fructose ⑦ Sucrose + Water
Glucose + Galactose ⑦ Lactose + Water
Glucose + Glucose ⑦ Maltose + Water

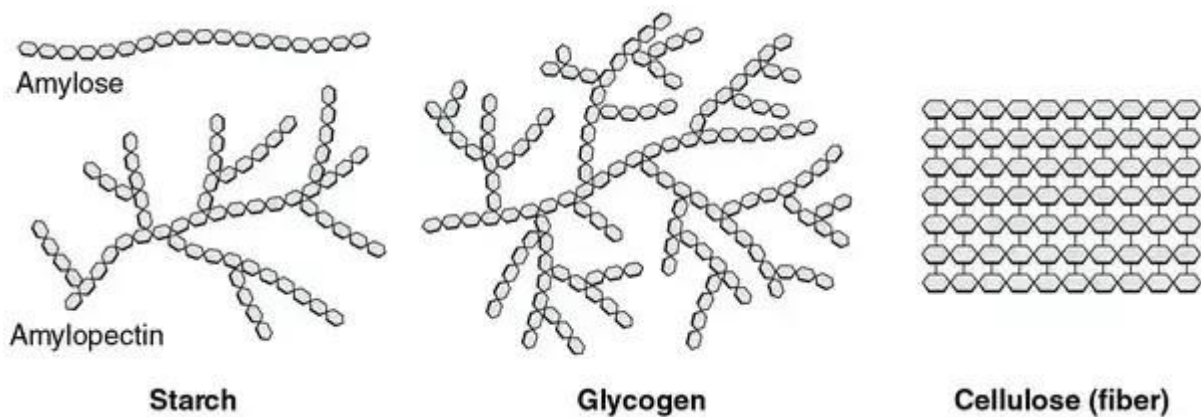
Starch;

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 and compact, so it is a good **storage molecule** in plants. Starch is only found in plant cells.



Cellulose;

Polysaccharide; a polymer of glucose. Bonding is different in cellulose; molecules are bonded in a long straight line with weak **hydrogen bonds** between the strands. Several cellulose molecules form microfibrils to provide strength to plant cell walls.



	Cellulose	Starch		Glycogen
		Amylose	Amylopectin	
Source	Plant	Plant	Plant	Animal
Subunit	β -glucose	α -glucose	α -glucose	α -glucose
Bonds	1-4	1-4	1-4 and 1-6	1-4 and 1-6
Branches	No	No	Yes (~per 20 subunits)	Yes (~per 10 subunits)
Diagram				
Shape				

Questions:

1 Name two monosaccharides.

_____ & _____

2 Which disaccharide is composed of two molecules of glucose?

3 Name two polysaccharides.

_____ & _____

Lipids Prior Knowledge

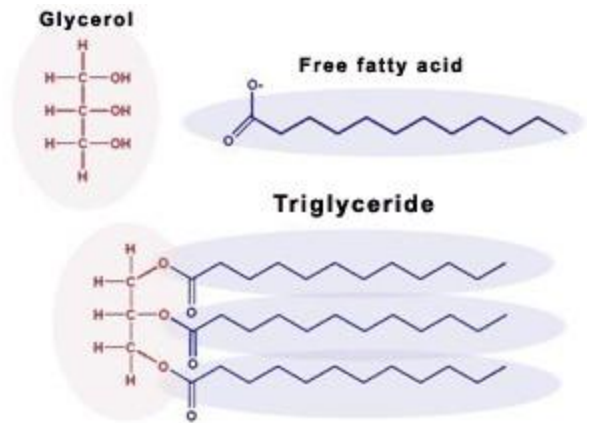
QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. What are Lipids made up of? (1)			
2. What test is used to see if lipids are present? (1)			
3. Describe the method used to test for lipids? (3)			
4. What enzymes are used to break down lipids? (1)			
5. State 3 functions of lipids in the body (3)			
6. Name 2 foods high in lipids? (1)			
7. What disease is caused when large amounts of lipids are store (1)			
TOTAL		/ 11	

Lipids Building Knowledge

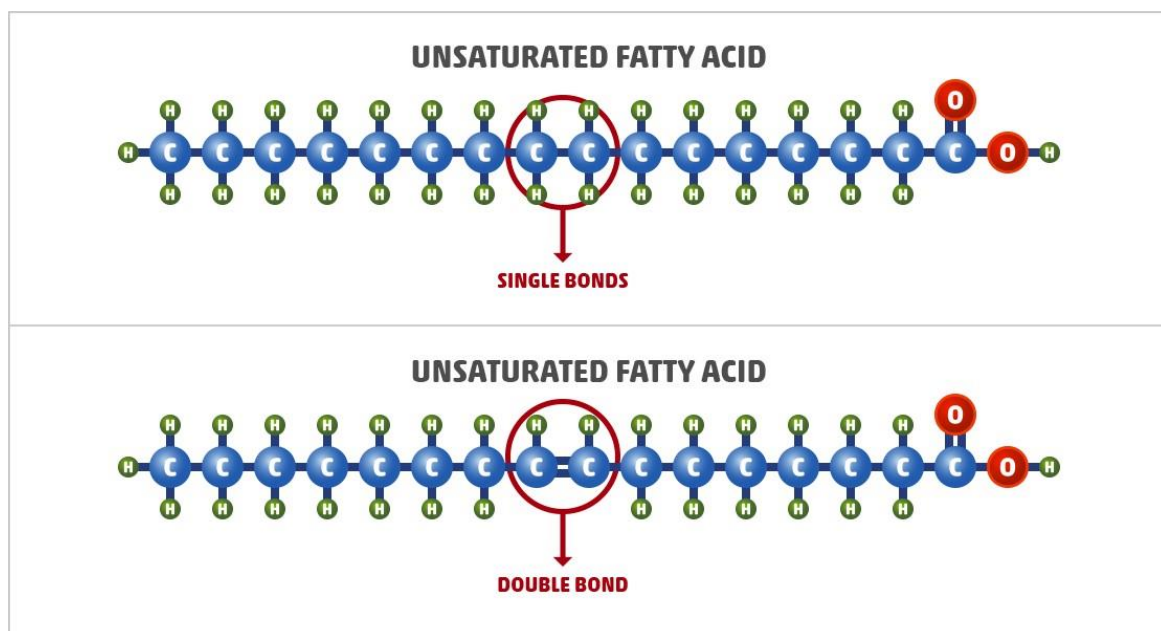
Lipids;

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**.



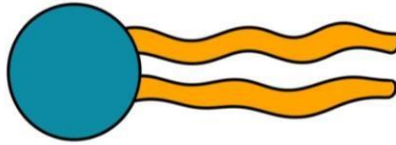
The **fatty acid** is a long chain of **Carbon** atoms with a carboxylic acid (**-COOH**) group on one end. **Hydrogen** atoms are attached to the Carbons by single bond. A single bond forms a **saturated** lipid. If there is a double bond then the lipid is **unsaturated**, many double bonds form a polyunsaturated lipid.



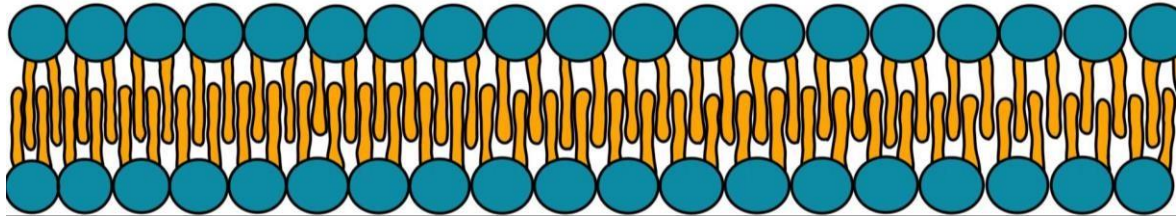
Phospholipids

Cell membranes are formed from two layers of **phospholipids**. They do not have 3 fatty acid chains but **2 fatty acid** chains and a **phosphate group**.

Phospholipids make up the cell membrane.
Each phospholipid consists of a phosphate head linked to 2 fatty acid chains.



The head is hydrophilic and interacts with water. The tails are hydrophobic and hate water.
Phospholipids create two layers to make the cell's double membrane.



Questions:

1 Which elements are fatty acids composed of?

2 What is the difference between saturated and unsaturated fatty acids?

3 How are triglycerides different to phospholipids?

Proteins and Enzymes Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. What are proteins made up of? (1)			
2. What test is used to see if protein is present? (1)			
3. Describe the method used to test for proteins? (3)			
4. What are proteins needed for? (4)			
5. Define enzyme (2)			
6. What are enzymes made of? (1)			
7. Name 3 factors that affect the rate an enzyme works? (3)			
8. What happens to an enzyme is the temperature is too low? (1)			
9. What happens to an enzyme if the temperature is too high? (1)			
10. Define the answer to question 7 (1)			
11. State 3 processes in the human body enzymes where are needed (3)			
TOTAL			/ 21

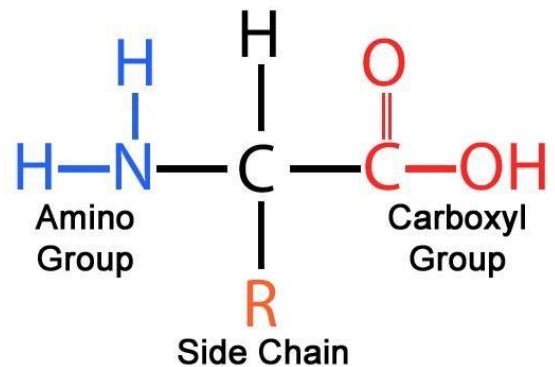
Proteins and Enzymes Building Knowledge

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 general structure however with a different **R group**. They contain; **Hydrogen, Oxygen, Nitrogen** and **Carbon**.



Protein structure

PRIMARY STRUCTURE

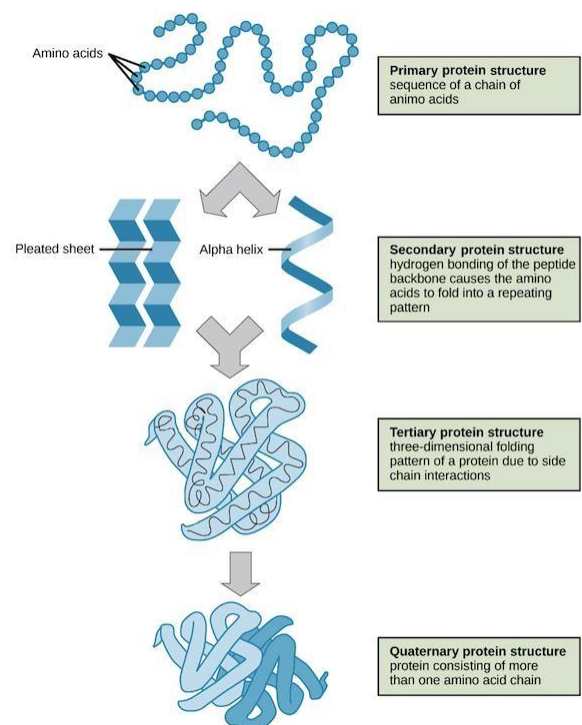
The order of the amino acids that are held together by **peptide bonds** into a **polypeptide chain**.

SECONDARY STRUCTURE

The polypeptide (protein) chain can then **coil** or **fold into pleats** which are held together by weak **hydrogen bonds**.

TERTIARY STRUCTURE

Enzymes have a further folding held together with hydrogen bonds as well as stronger **ionic bonds and disulphide bonds**. If the structure is almost spherical it is called a **globular protein**.

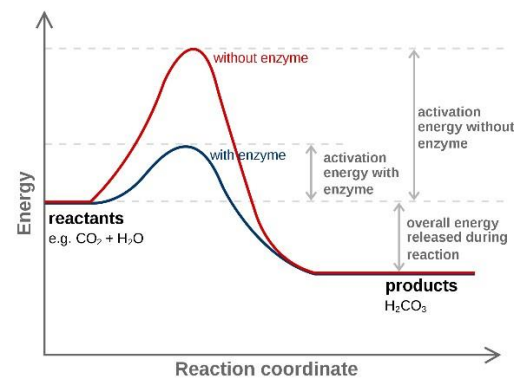
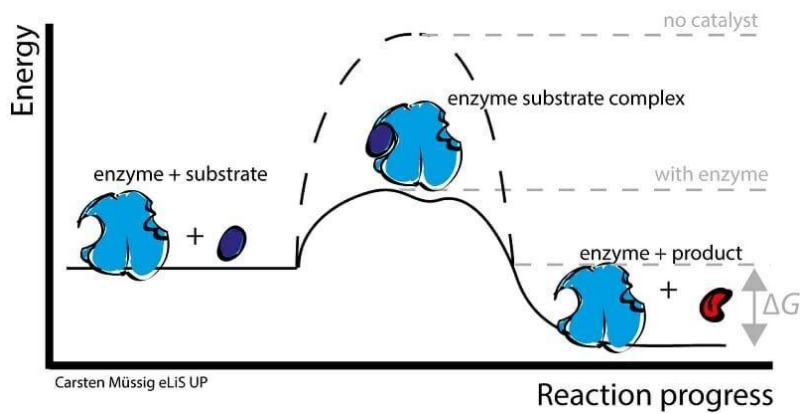


Enzymes

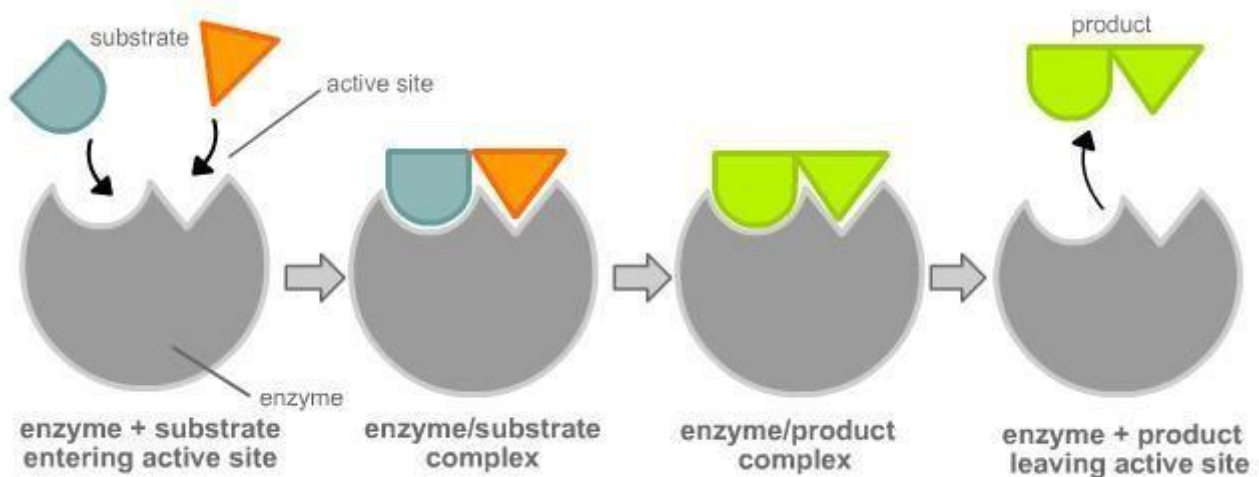
Speed up biochemical reactions.

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 lower 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 called the **active site** into which the **substrates** can attach itself. The active site is **complementary** to the shape of the substrate. Once attached, 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. Enzymes are not used up in the reaction.



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:

1 What is the primary structure of a protein? Draw a labelled diagram of the monomer.

Labelled Diagram:

2 What type of bonding is present in the secondary and tertiary structure of a protein?

Secondary Structure: _____

Tertiary Structure: _____

3 What is the role of enzymes?

4 What is activation energy?

5 What is the role of digestive enzymes?

DNA, Energy and Water Prior Knowledge

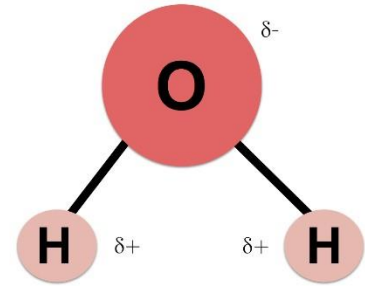
QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. What does DNA stand for? (1)			
2. Describe the structure of DNA (2)			
3. Where is DNA found in a prokaryotic cell? (1)			
4. Where is DNA found in a eukaryotic cell? (1)			
5. What is the function of DNA? (1)			
6. What process is used to provide cells with energy? (1)			
7. Write the balanced symbol equation for aerobic respiration (2)			
8. Where does aerobic respiration take place? (1)			
9. Where does anaerobic respiration take place? (1)			
10. Name 4 way energy can be transferred in a cell (4)			
11. How many elements and atoms are present in a water molecule? (2)			
12. Draw the structure of water (2)			
13. State 3 ways your body losses water (3)			
TOTAL			/ 22

DNA, Energy and Water Building Knowledge

Water

Water is a **polar molecule** with partially positive charges on the Hydrogens and a partially negative charge on the Oxygen.

Water is an excellent **solvent** which means it can dissolve many polar and ionic substances.



Questions:

1 What charge do each of the elements on a water molecule have?

DNA and protein synthesis

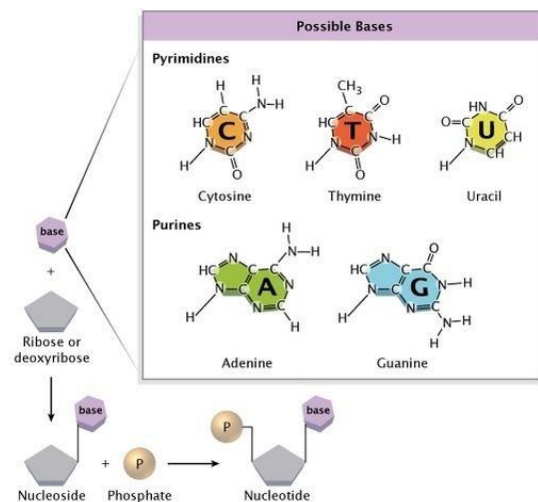
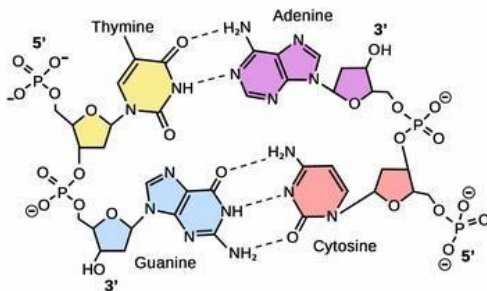
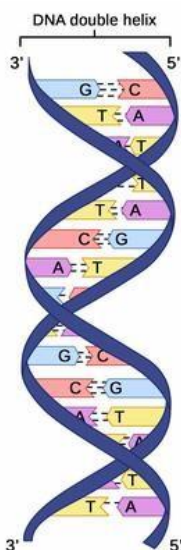
DNA is a complex chemical, found in the nucleus of eukaryotes and in the cytoplasm of prokaryotes. DNA is made up of; **pentose sugar, phosphate and nitrogenous bases** forming a **NUCLEOTIDE**.

There are 4 different nitrogenous bases;

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

Complementary pair;

A pairs with T C pairs with G

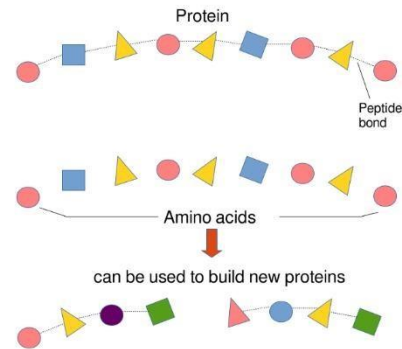


The bases pair up in the formation stated above. They are held together by **hydrogen bonds**. The two strands run in opposite directions causing the molecule to spiral forming a **DOUBLE HELIX**.

DNA controls the production of proteins. A section of DNA that codes for a protein is called a **gene**.

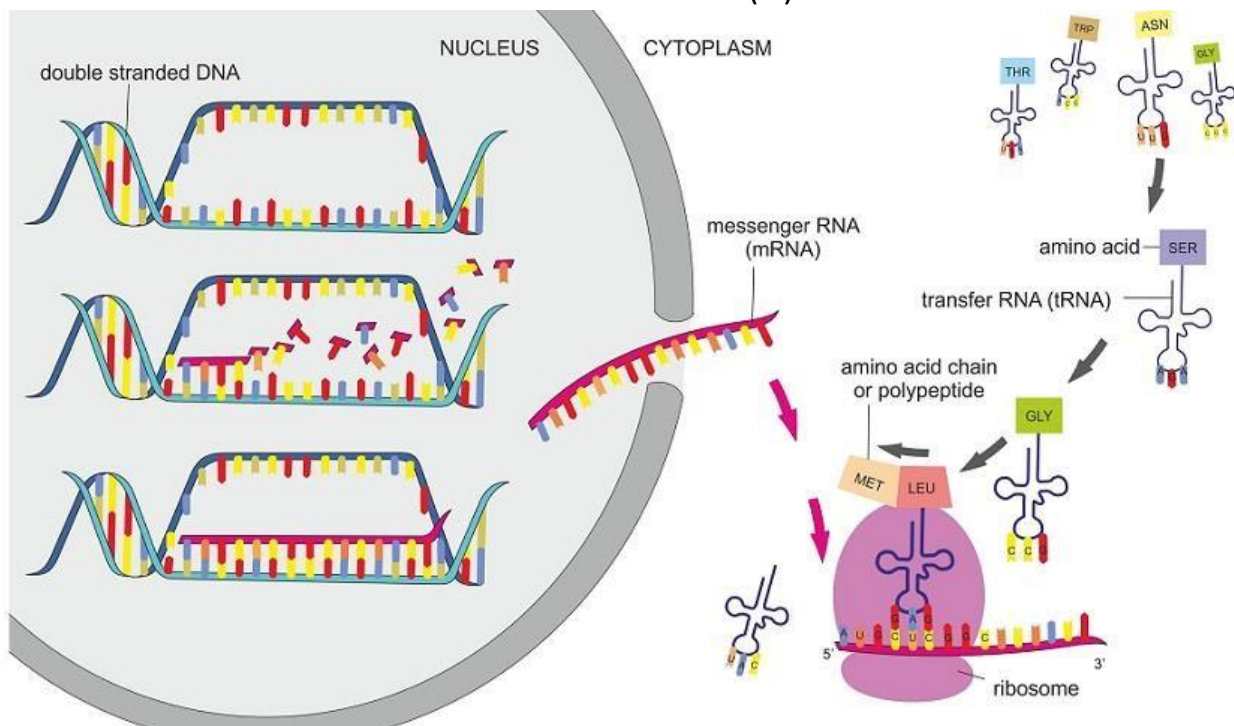
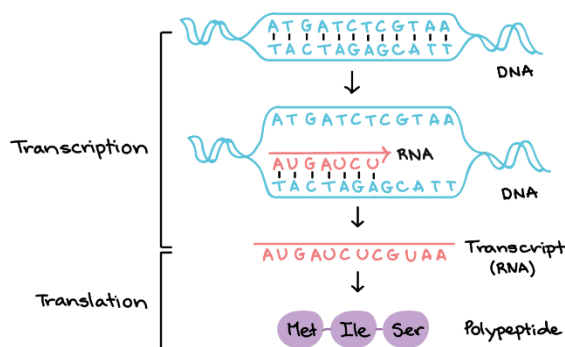
Proteins are made up of a string of **amino acids**, each protein has a different number and order of amino acids. The proteins also have different bonds which holds the molecule in a unique shape which means all proteins have a different function.

Chain formation of amino acids in 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.

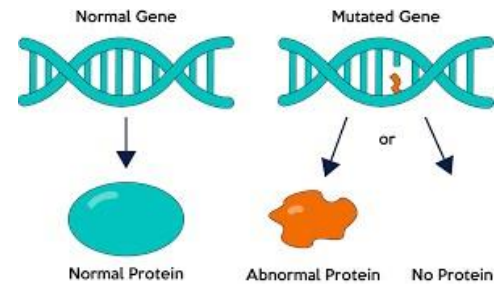
At the opposite end there are three **unpaired bases** which code for an **amino acid**. The amino acid is brought in to form a **peptide bond** with the amino acids brought in by the previous tRNA. This forms a **polypeptide** chain which will form hydrogen and **ionic** and disulphide **bonds** to 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 produced
- No change in protein being made
- Causes a harmful protein/ no protein to be made



Questions:

1 What are the components of a nucleotide?

2 What are the four nitrogenous bases?

3 What is the name given to the double-stranded structure of DNA?

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

5 What are proteins made from?

6 What molecule contains the information from the DNA and is able to leave the nucleus?

7 What organelle will this molecule attach to in the cytoplasm?

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

2) Cells

- a) Animal Cell Structure and Function
- b) Plant Cell Structure and Function
- c) Diffusion, Osmosis and Active Transport
- d) Immunology

Animal Cell Structure and Function Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. What are the 5 most common structures in an animal cell? (5)			
2. Describe the function of each of those 5 structures? (5)			
3. List 3 specialised animal cells (3)			
4. How many mm in a cm? (1)			
5. How many μm in a mm? (1)			
6. What equation links magnification, size of real object and size of image? (1)			

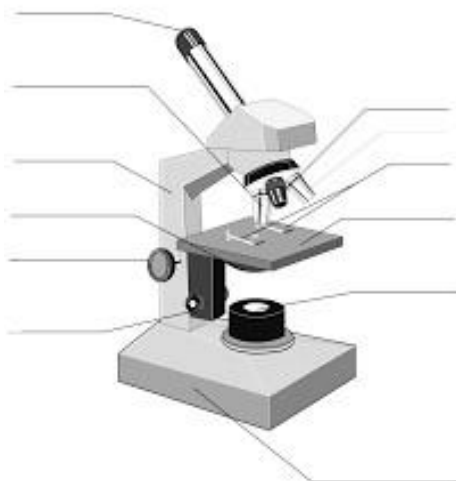
7. State 2 differences between electron microscope and a light microscope? (2)			
TOTAL			/ 18

Animal Cell Structure and Function Building Knowledge

Microscopes;

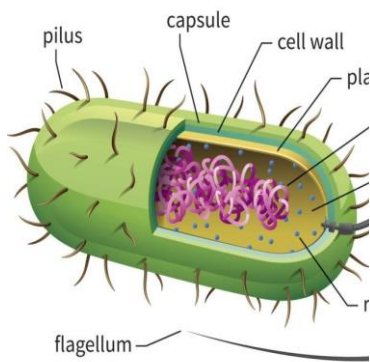
The Light microscope allows you to view animal cells. It can magnify up to 1500 times. Some organelles such as mitochondria, chloroplasts, vacuoles, cell walls, cell membranes and nuclei are visible. Staining makes these organelles visible.

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.

Prokaryotes; A bacterial cell is a prokaryotic cell. It is a single celled organism.



Prokaryotes like bacteria are roughly a **tenth the size** of eukaryotic cells.

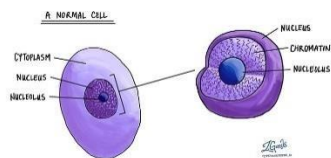
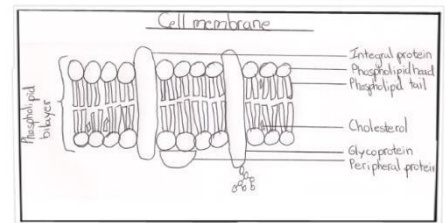
Prokaryotic cells **don't** contain a nucleus, mitochondria or chloroplasts.

Some prokaryotes have a **rings of DNA** called **plasmids**.

Eukaryote Animal Cell

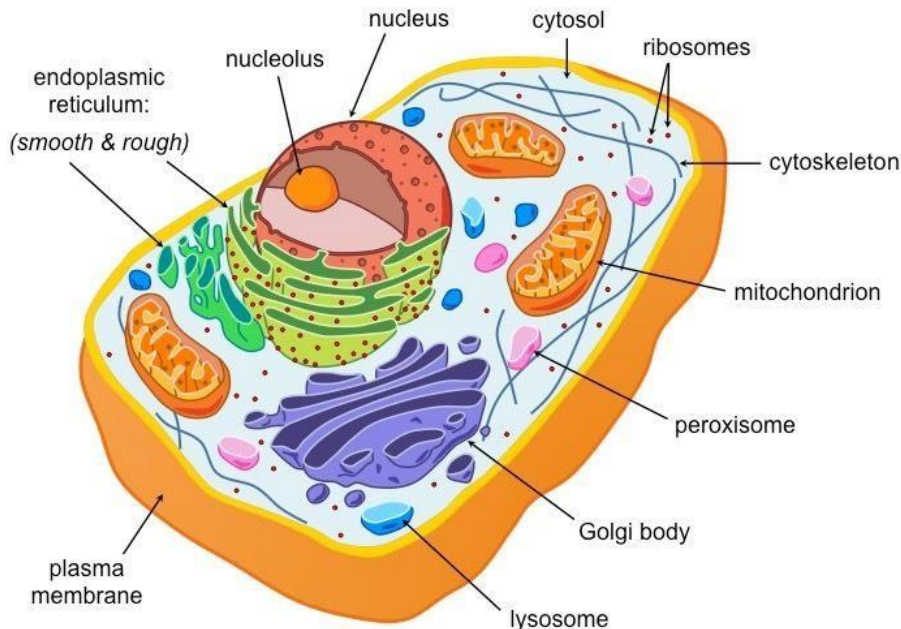
Cell structures

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.



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.



Challenge:

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

Plant Cell Structure and Function Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. State the 3 structures found in plant cells but not animal cells? (3)			
2. State the function of these 3 structures (3)			
3. What are cell walls made of? (1)			
4. What is the permanent vacuole filled with? (1)			
5. State 3 specialised plant cells (3)			

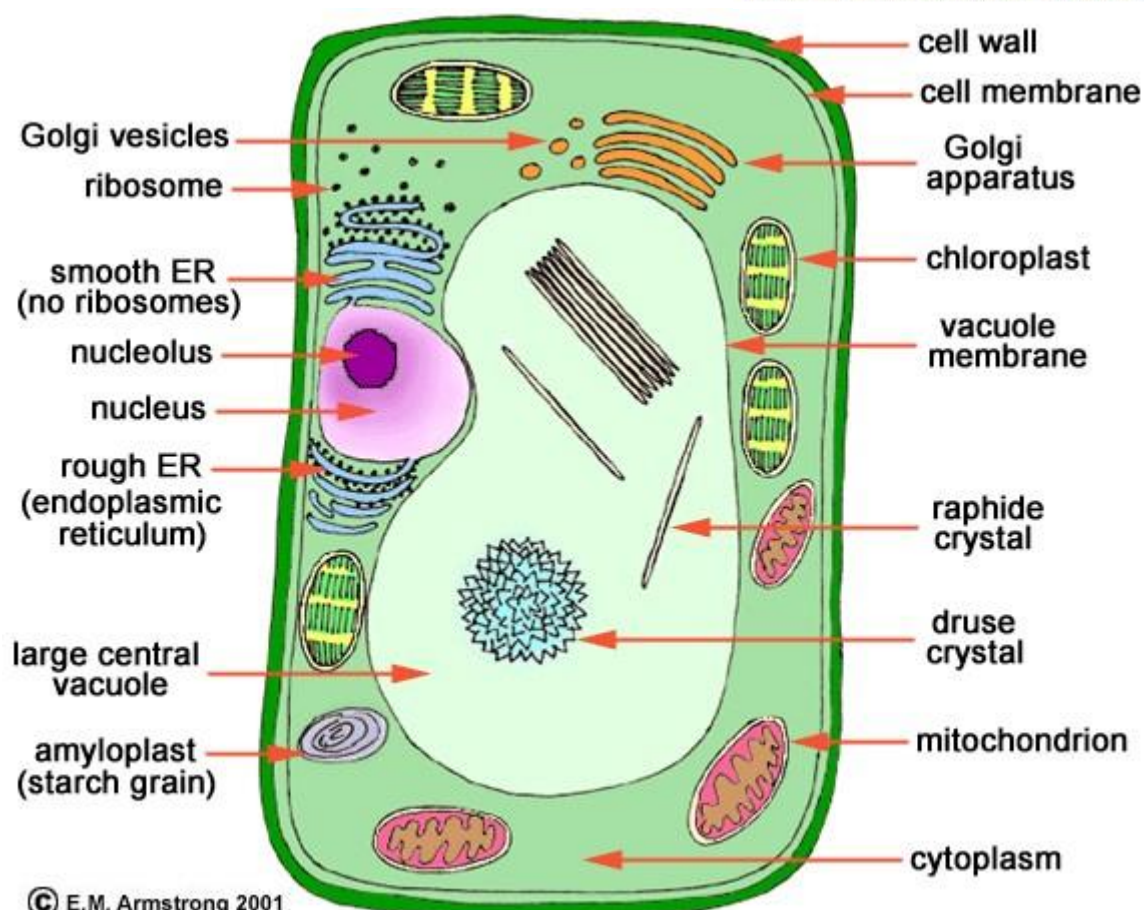
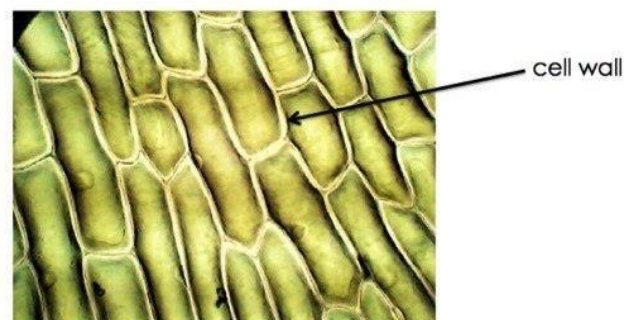
6. Name 4 tissues found in a leaf (4)			
7. Explain the roles of the 4 tissues found in a leaf (4)			
TOTAL			/ 19

Plant Cell Structure and Function Building Knowledge

Eukaryote Plant Cell

Cell structures;

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 structure and function of the other organelles labelled on the diagram?

Questions:

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

2 Name four organelles that both plant and animal cells have.

3 What is the equation used to calculate the magnification of an object?

4 What is the function of a mitochondrion?

Diffusion, Osmosis and Active Transport Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. Define diffusion (1)			
2. Define osmosis (1)			
3. Define active transport (1)			

4. What is the main difference between diffusion and osmosis? (1)			
5. What are the 2 main differences between active transport and the other 2? (2)			
6. State and describe where in a plant Active Transport occurs (2)			
7. State and describe where in an animal Diffusion will occur? (2)			
8. State and describe where in an animal osmosis will occur? (2)			
9. State and explain 3 factor that can change the rate of diffusion (6)			
10. Put these 500 ml sucrose concentrations in order of water concentration from highest to lowest. 20%, 0%, 45%, 10% and 15%(1)			
TOTAL			/ 19

Diffusion, Osmosis and Active Transport Building Knowledge

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. **NO ENERGY IS REQUIRED.**

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:

1 What do you call the diffusion of water molecules through the cell membrane?

2 Give another term for the concentration of water molecules.

3 Name the two types of protein involved in facilitated diffusion.

4 Why does active transport require energy?

ORGANISMS EXCHANGE GCSE PRIOR KNOWLEDGE

3) Organisms Exchange Surface

- a) Diffusion and Gas Exchange Surfaces
- b) Circulatory System
- c) Transport in a plant

Diffusion and Gas Exchange Surfaces Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. Define diffusion (1)			
2. State 4 ways how the rate of diffusion is increased in the alveoli (4)			
3. Explain how the 3 ways stated in question 2 speed up the rate of diffusion. (3)			
4. Explain how capillaries are efficient for diffusion (2)			
5. What is facilitated diffusion? (1)			
6. Give 2 example in animals where diffusion is needed (2)			

7. Give 2 examples in plants where diffusion is needed (2)			
8. State 3 ways the small intestine is sufficient for diffusion (3)			
9. Explain the 3 ways the small intestine is sufficient for diffusion (3)			
TOTAL / 21			

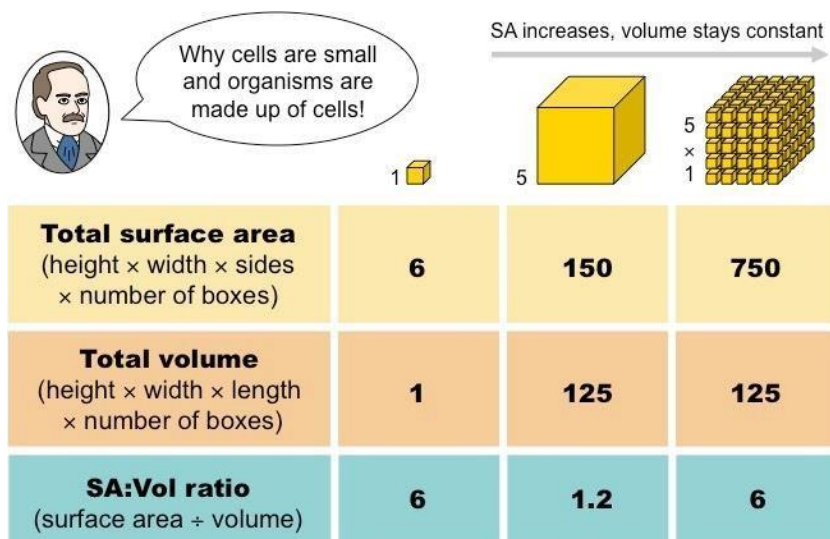
Diffusion and Gas Exchange Surfaces Building Knowledge

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 ratio**, 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.



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.

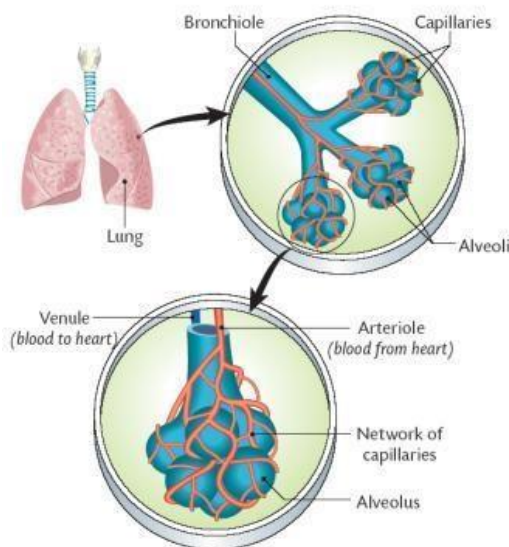
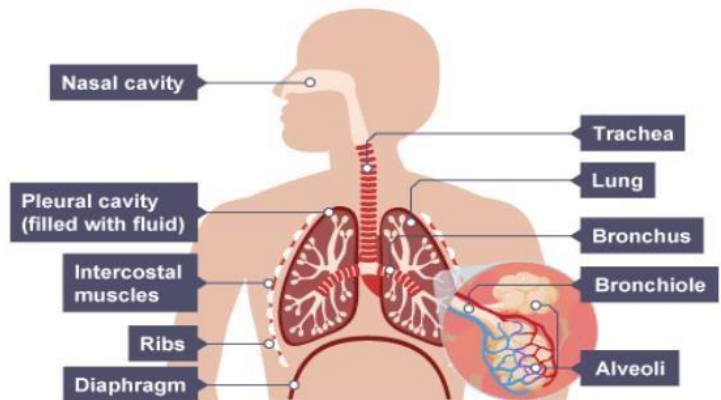
- One cell thick (thin) to reduce diffusion distance.

Materials that need to be exchanged between the cell and the 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;

Multicellular 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 **shortens 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**.

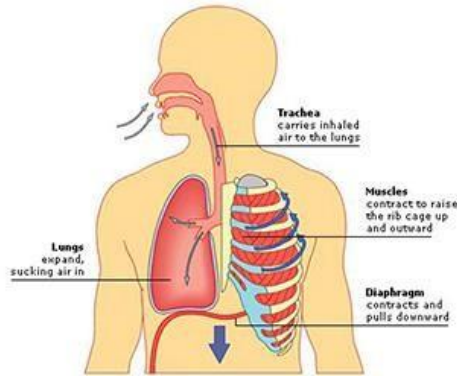
The walls of the alveoli are **fully permeable** to dissolved oxygen and carbon dioxide.

Breathing - Ventilation

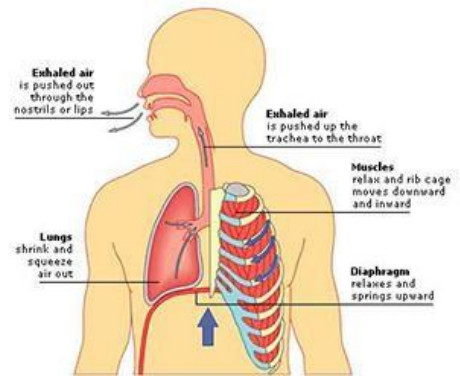
The process of maintaining a high concentration of oxygen inside the lungs and getting rid of the waste product carbon dioxide. Ventilation increases the rate of diffusion. Lungs are suspended in the airtight Thorax and any change in volume will affect the pressure in the thorax.

Inhalation and Exhalation

- Intercostal muscles contract, lifting rib cage up and out
- Diaphragm contracts and pulls downward
- The lungs expand, air is sucked in



- Intercostal muscles relax
- Diaphragm relaxes
- The ribs fall downward and inward
- Diaphragm back into dome shape, squeezing lungs and pushing air out

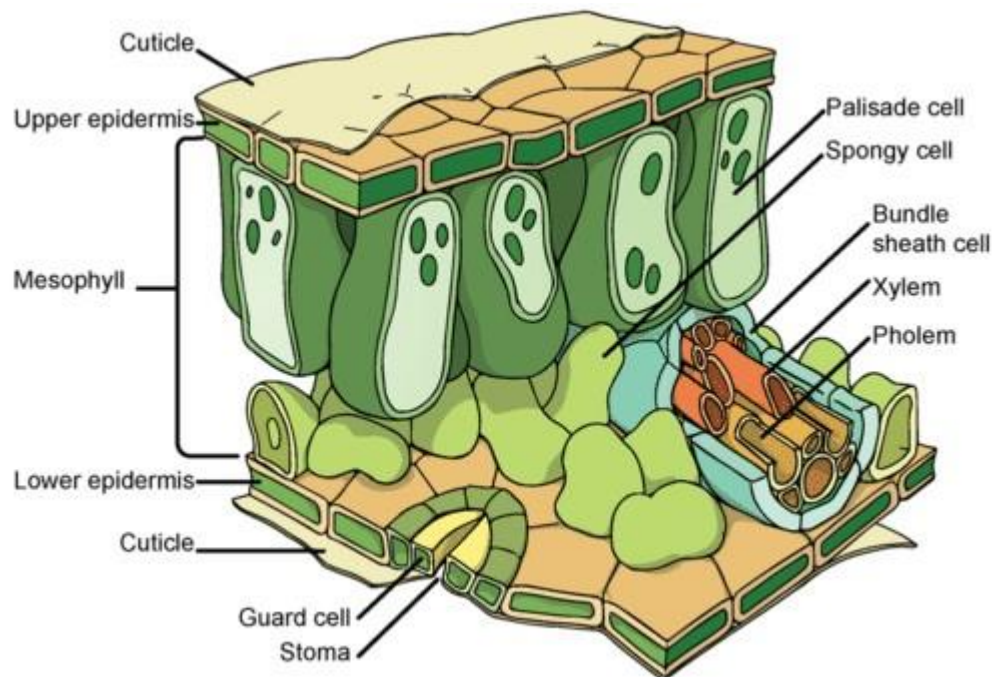


Gas exchange in Plants

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 **spongy mesophyll layer** which contains air spaces to facilitate 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.

Questions:

1 An animal has a surface area of 7.5cm^2 and a volume of 1cm^3 . What is the SA:V ratio?.

2 Which has a bigger SA:V ratio, a small organism or a large organism?

3 Why have large mammals developed complex blood systems and lungs?

4 What type of cells are the alveoli walls made of?

5 Does the volume of the thorax increase or decrease when you breathe out?

6 Which two sets of muscles contract when we breathe in?

7 Describe the movement of gases in a plant.

Circulatory System Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. Describe the function of the circulatory system? (2)			
2. State the 4 chambers of the heart (4)			
3. Name the vessel carrying oxygenated blood to the heart (1)			
4. Name the vessel carrying deoxygenated blood away from the heart (1)			
5. Name the vessel carrying oxygenated blood away from the heart (1)			
6. Name the vessel carrying deoxygenated blood to the heart (1)			
7. Describe 2 differences in structure between arteries and veins (2)			
8. What is the name given to the structures that separate the top chambers from the bottom chambers (1)			
9. Name the order of chambers the blood flows through the heart (4)			

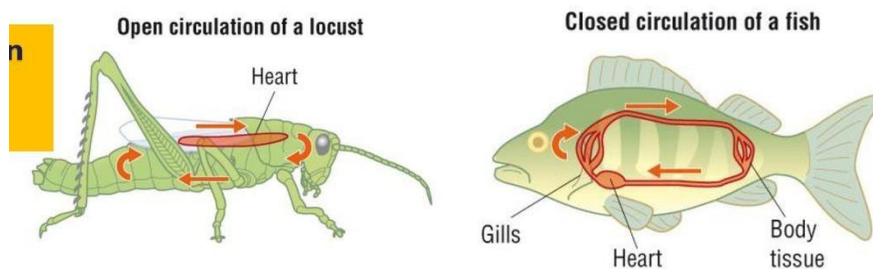
10. Name the order of vessels the blood flows through the heart (4)			
11. What is the difference between oxygenated and deoxygenated blood (1)			
12. What is the pigment inside red blood cells that carries oxygen? (1)			
TOTAL / 23			

Circulatory System Building Knowledge

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**.

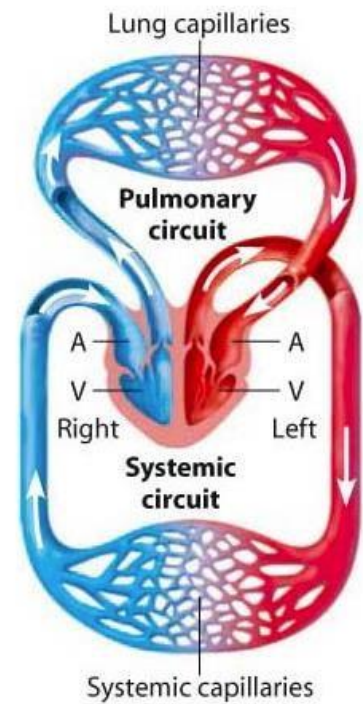
Some organisms such as flat worms can diffuse oxygen and glucose across their surface. Less active organisms such as **insects** may have a much more simplified circulatory system.



Fish have a more complex system where the blood enters 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.

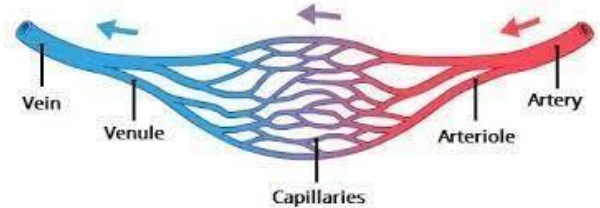
The **heart** pumps the **deoxygenated** blood to the lungs (pulmonary system) to pick up oxygen and removes carbon dioxide. The **oxygenated** blood is then returned to the heart to be pumped out to the organs (systemic system).



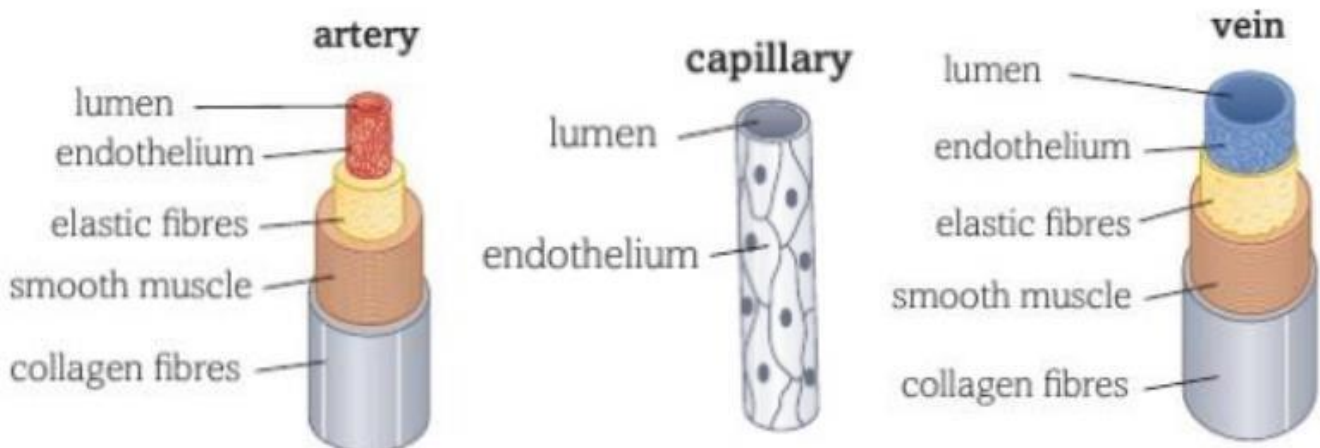
The blood travels through 3 main types of blood vessels:

1) **The Arteries;** carry blood away from the heart. They have a thick layer of elastic tissue and smooth muscle. The elastic 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 into 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.



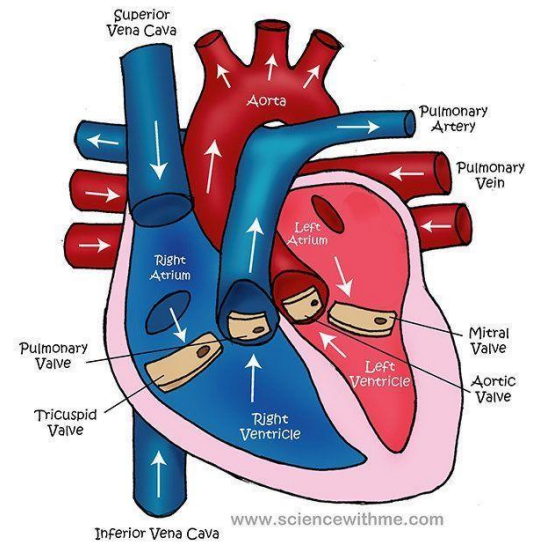
The heart

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.

Blood flows from a region of **higher pressure** to a region of **lower pressure**.

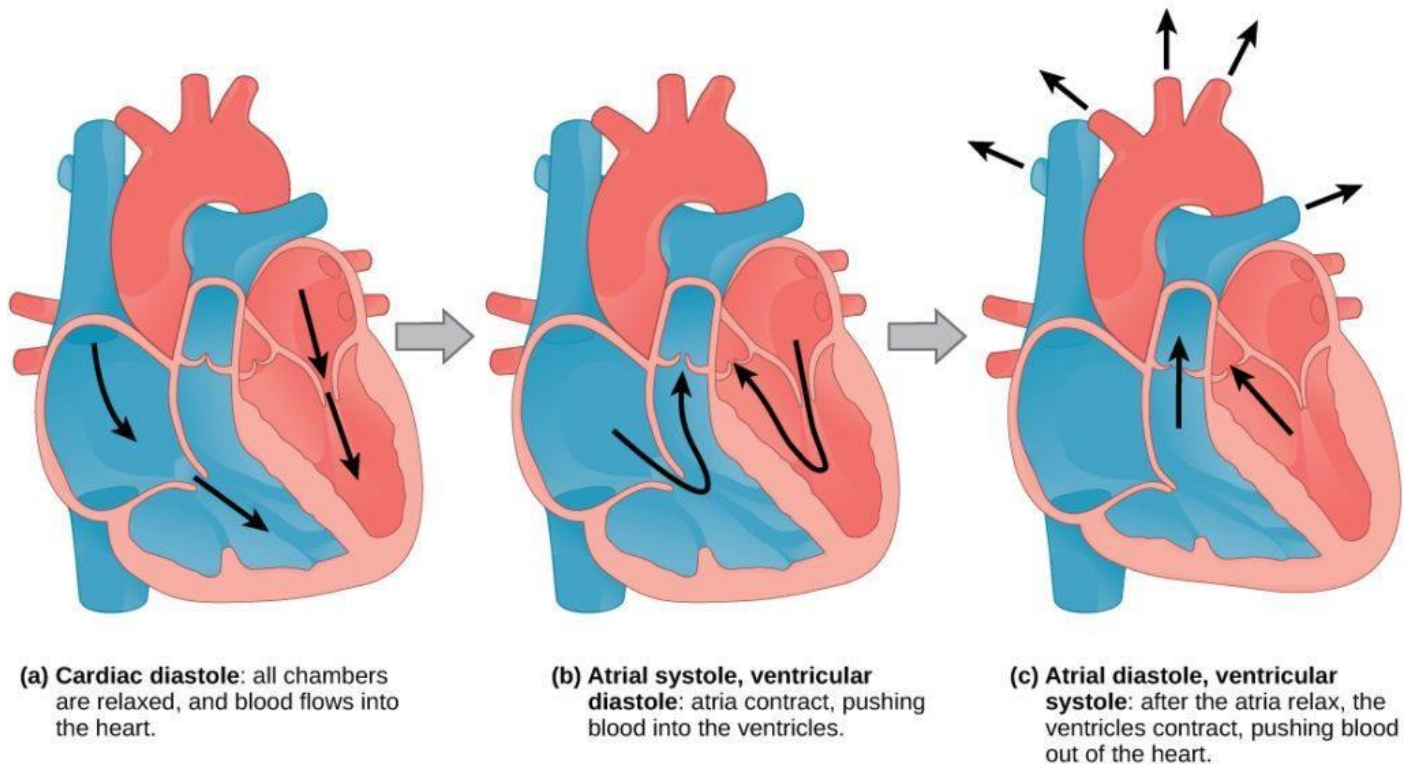
Valves within the heart keep the blood flowing in the correct direction by preventing backflow. Valves open and close in response to the changes of pressure inside the chambers and do not require energy.

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 heart's 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 are very thin and supply the muscle in the heart with blood.



The cardiac cycle

This is the sequence of events that occur in a single heartbeat.



Questions:

1 Name the four chambers around the heart.

2 Name the three main types of blood vessels.

3 In which type of blood vessel are substances exchanged between the blood and the cells?

4 Where does the right-hand side of the lungs pump blood to?

5 What is the function of the valves in the heart?

6 Where does the blood go after leaving the atria?

7 What is the function of the sino-atrial node?

8 Why does the heart muscle require a blood supply?

9 Name the blood vessels that supply blood to the heart muscles.

10 Describe the stages of the cardiac cycle.

Transport in a plant Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. State the two main transport systems in plants (2)			
2. What system transports water? (1)			
3. What system transports sugar? (1)			
4. State a feature of the cells that make the system that transports sugar (1)			
5. What is transpiration? (1)			
6. What apparatus is used to measure transpiration? (1)			
7. What 3 factors can change the rate of transpiration? (3)			
8. Where does gas exchange take place? (1)			
9. What causes water to move up through the xylem? (1)			
10. What controls the opening and closing of the stomata (1)			
TOTAL		/ 13	

4) Genetics

- a) Genetics and Cell Division Key Definitions
- b) Mutations and Evolution
- c) Classification

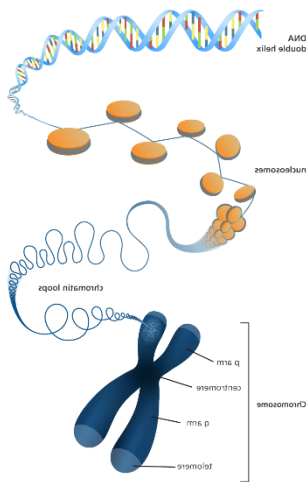
Genetics Key Definitions and Cell Division Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. Define Mutation (1)			
2. Define Allele (1)			
3. Define Chromosome (1)			
4. Define Gene (1)			
5. Define Mitosis (1)			
6. Define Meiosis (1)			
7. Define Biodiversity (1)			
8. Define Adaptations (1)			
9. Define Interdependence (1)			
10. Define Genotype (1)			

11. Define Phenotype (1)			
12. Define Species (1)			
TOTAL / 12			

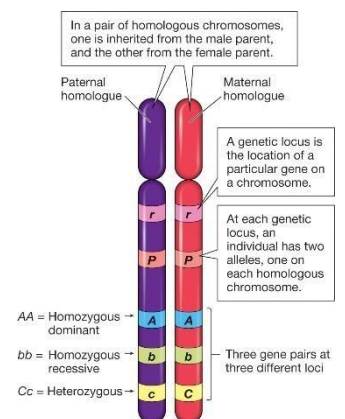
Genetics Key Definitions and Cell Division Building Knowledge

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 the mother and one from the father. These pair up to form 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 just 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.

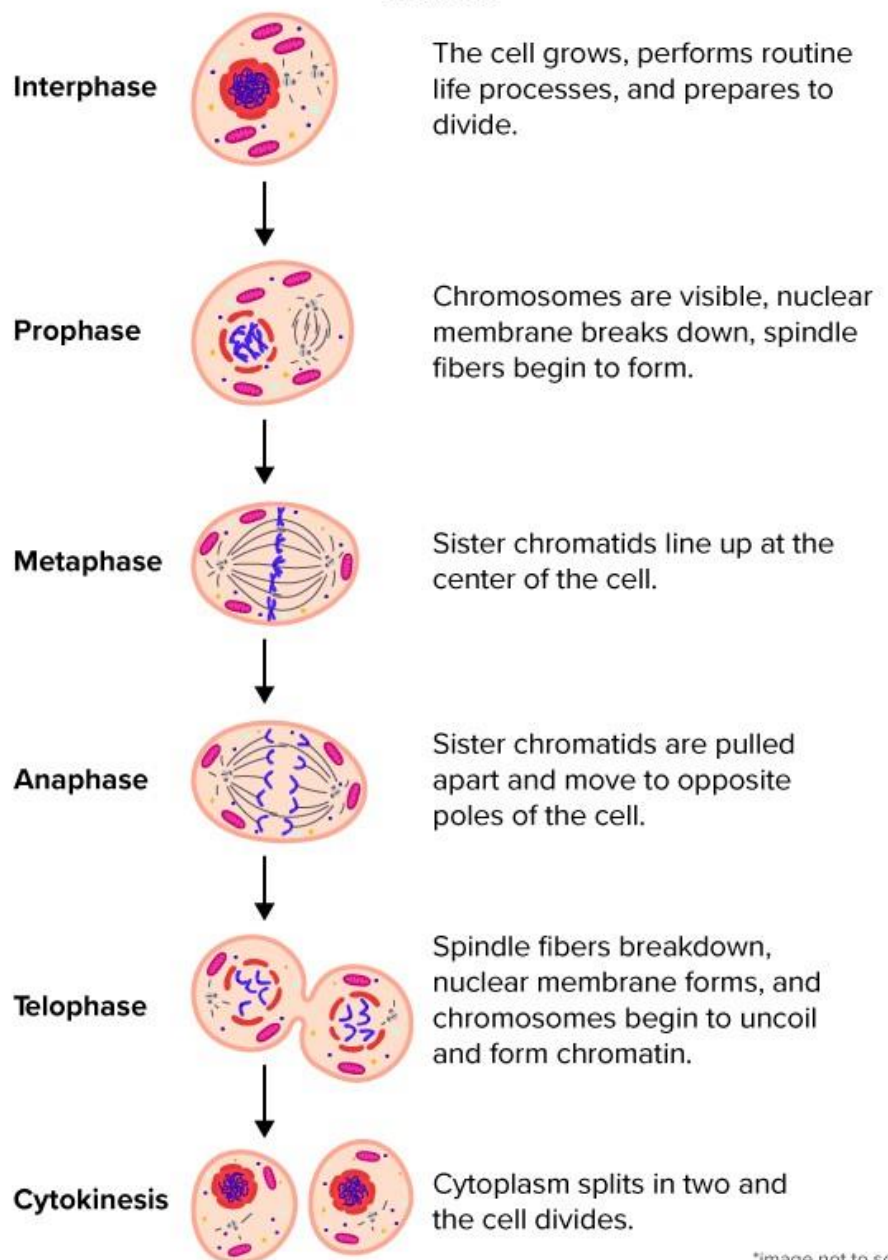
It results in the formation of gametes containing half the original genetic information (**haploid** number). This ensures, that during fertilisation, the embryo obtains two complete sets of genetic information.

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).

Mitosis



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 opposite 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**

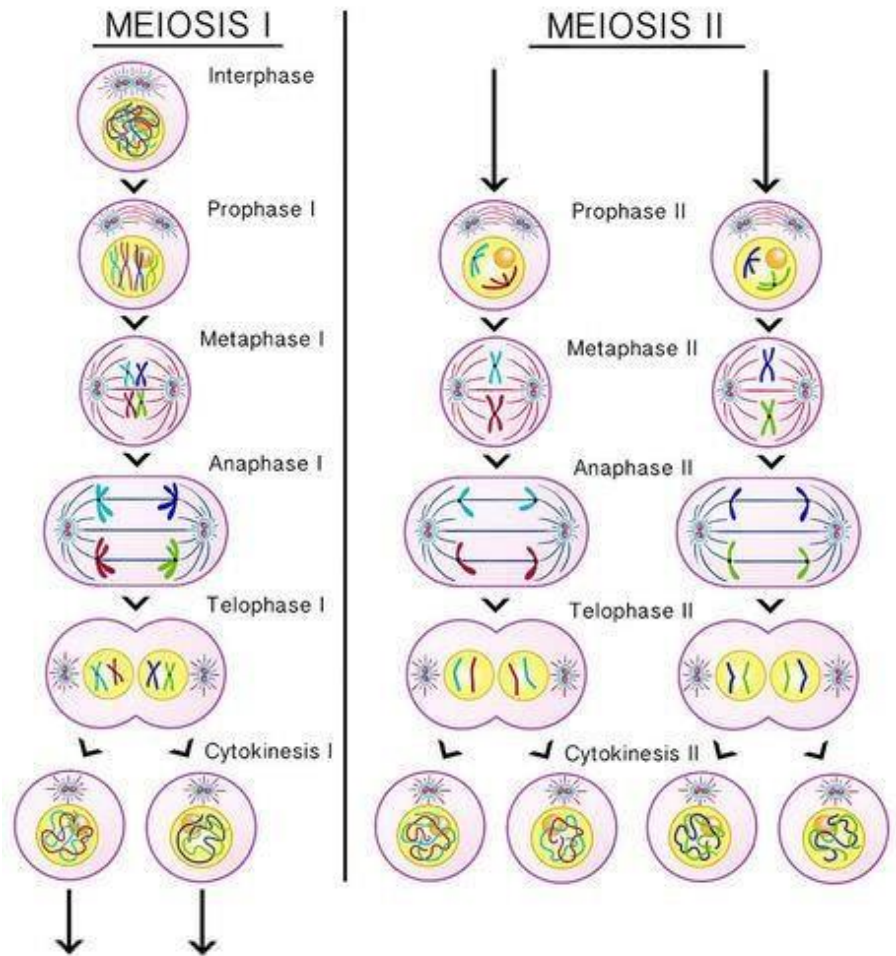
The nuclei's start to reform and the cytoplasm splits to form 4 haploid cells that are genetically different to the parent cells.

Questions:

1 Which cell division forms haploid cells?

2 What happens during prophase?

3 What do centrioles do?



4 Which organs produce haploid cells?

5 What happens in telophase?

Variation and Evolution Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. What proof is there for evolution (1)			
2. How does your answer in question provide proof? (1)			
3. How does sexual reproduction give rise to variation? (1)			
4. State 2 ways there is genetic variation within a population? (2)			
5. How does selective breeding reduce genetic diversity? (1)			
6. Who is Charles Darwin? (1)			
7. Explain Natural Selection (2)			
TOTAL		/ 9	

Variation and Evolution Building Knowledge

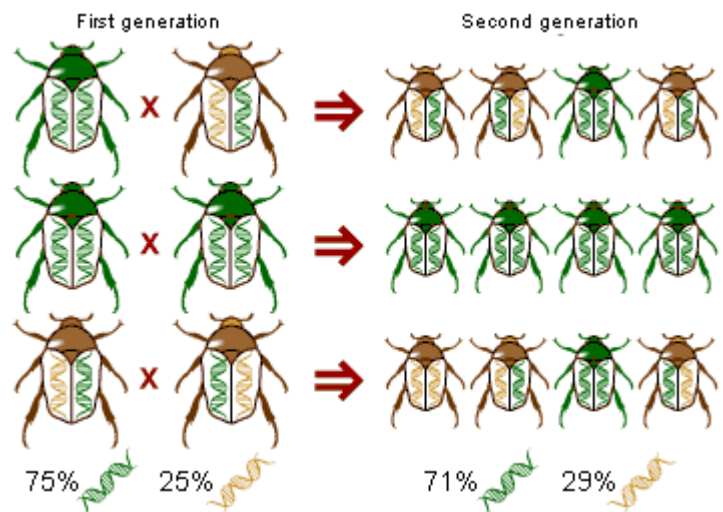
All organisms are different from each other both within species and between species. Organisms of the same species show some variation for example height, weight, favourite colour etc.

Organisms of the same species are very similar because they all have the same genes but they vary because they have alternative versions of those genes, which are called alleles.

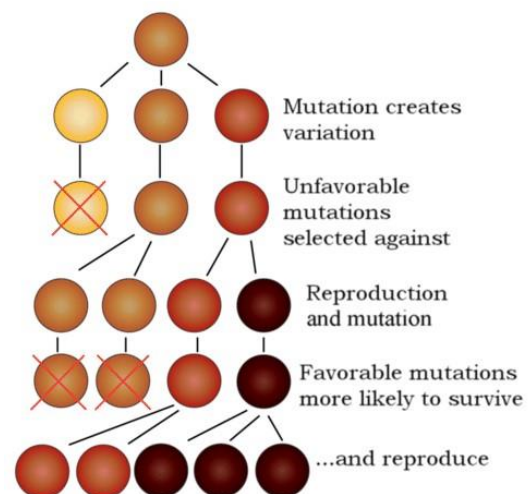
Variation means that some organisms are better adapted.

Adaptations are characteristics that help organisms to survive and reproduce. Polar bears have thick, white fur that enables them to stay warm and camouflage in the snow.

Characteristics vary within populations, so some organisms are better adapted for some environments or conditions than others. The slightly different adaptations you get within species are coded for by **different alleles**.



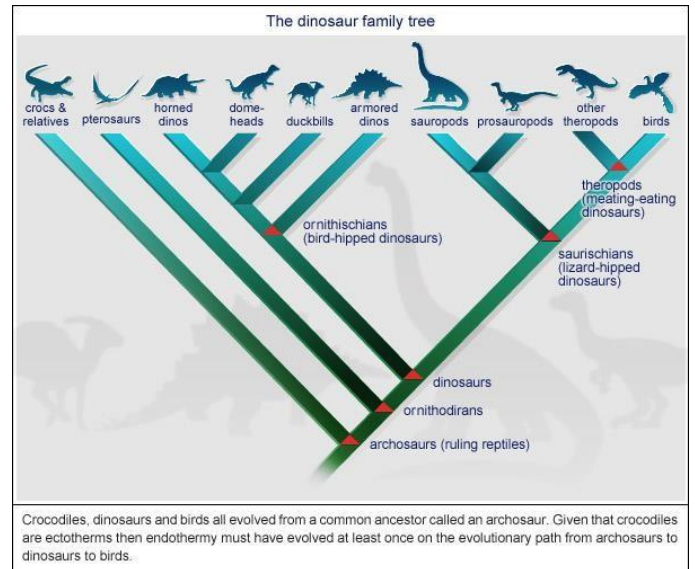
Mice Colour Variation Example



Evolution

The **gradual change** in the characteristics of a population from one generation to the next. The theory of evolution suggests that all organisms evolved from a **common ancestor** over millions of years.

Natural selection is one of the mechanisms by which evolution occurs.



Natural Selection

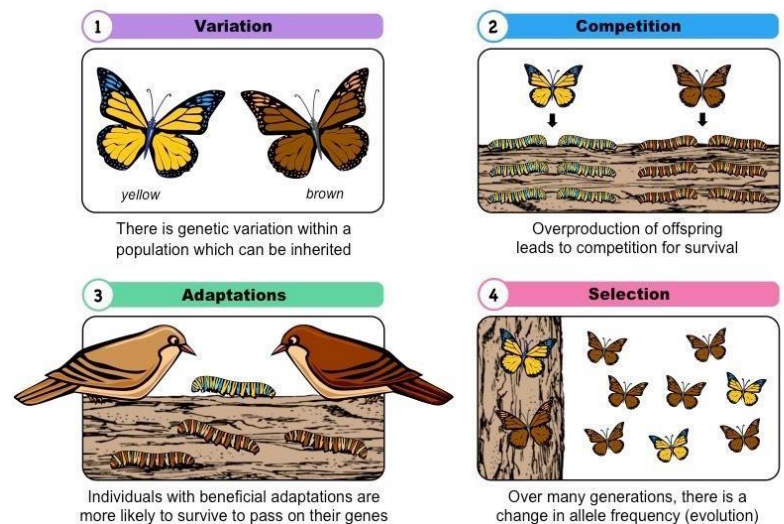
There is **variation** between organisms of the same populations due to mutations and differing alleles.

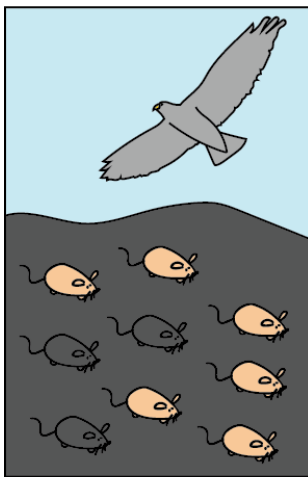
Organisms **compete** with each other for food, shelter, water etc.

Those with **better adaptations** will be **more successful** competitors and more likely to **survive and reproduce**. Their advantageous **alleles** for their better adaptations will be passed on to the **next generation**.

Over time, the number of organisms with alleles for the better adaptations will increase.

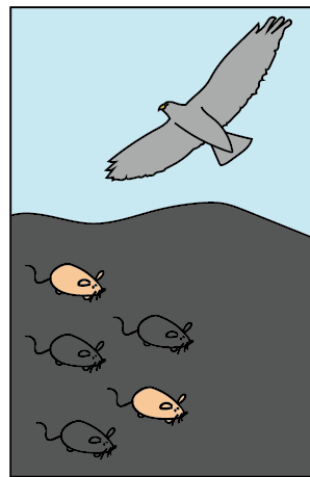
The whole population of organisms **evolve** to have the better adaptations (alleles).





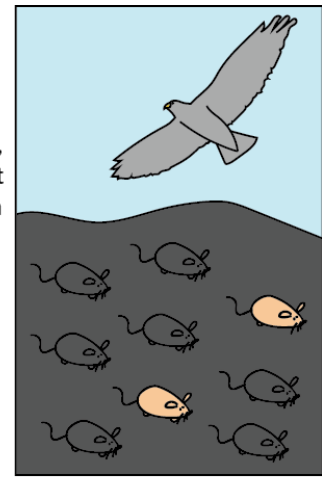
A population of mice has moved into a new area where the rocks are very dark. Due to natural genetic variation, some mice are black, while others are tan.

Some mice are eaten by birds



Tan mice are more visible to predatory birds than black mice. Thus, tan mice are eaten at higher frequency than black mice. Only the surviving mice reach reproductive age and leave offspring.

Mice reproduce, giving next generation



Because black mice had a higher chance of leaving offspring than tan mice, the next generation contains a higher fraction of black mice than the previous generation.

Questions:

1 What is an allele?

2 What is an adaptation?

3 Describe the process of natural selection that may lead to evolution?

4 What does the Theory of Evolution state?

Classification Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. Define Classification (1)			
2. How did Carl Linnaeus classify organisms? (1)			
3. Name the groups Linnaeus used. Starting from the largest (7)			
4. Organisms scientific names are based on which two groups? (2)			
5. What are the rules for writing scientific names? (3)			
6. Name the 6 kingdoms (6)			
7. Archaeobacteria and Eubacteria initially formed which kingdom? (1)			
TOTAL		/ 21	

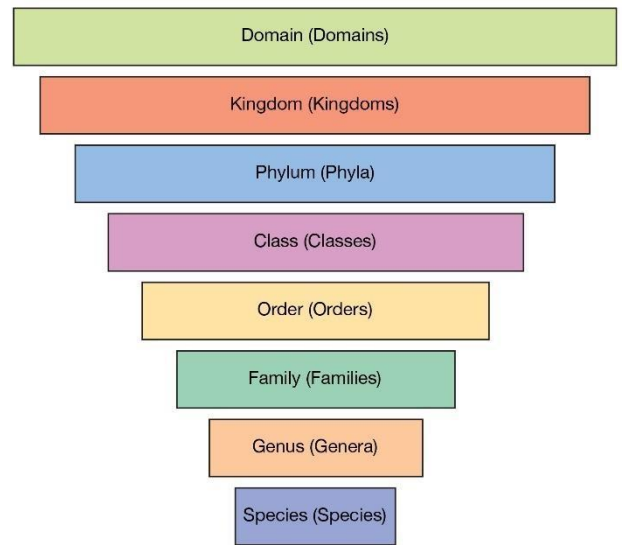
Classification Building Knowledge

Classification involves **grouping** and **naming** organisms.

Classification allows scientists to study organisms without getting confused and being able to **communicate** universally. Organisms are arranged based on their **similarities** and **differences** and are placed into **classification hierarchies**.

The first group has the largest number of organisms, and the last group only has one type of organism.

How animals are classified



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A **species** is a group of organisms that have similar characteristics and can reproduce to give fertile offspring.

Older classification systems are based on only how an organism looks.

New classification systems consider similarity in **DNA** base sequences, **Other molecules** such as proteins and enzymes and **Early development** (how an organism grows from an embryo to a baby).

Questions:

1 What does classification involve?

2 What is a species?

3 List four things newer classification systems use to group organisms.

MATH SKILLS GCSE PRIOR KNOWLEDGE

5) Maths Skills

Averages, Modes and Range Prior Knowledge

QUESTION	ANSWER	MARK (✓ OR X)	CORRECTION (IF NEEDED)
1. What is the mean of these numbers: 3, 5, 7, 9? (1)			
2. Here's a list of pocket money that a class of children get. What's the mean? £3.50, £2.40}, £1.50, £2, £3.30, £2.80, £5, £6, £2.50 (1)			
3. The mean height of 5 children is 1.63m. What's the mean if they're joined by another child who's 1.75m tall? (1)			
4. Here's the number of goals scored in Premier League fixtures one Saturday: 1, 5, 3, 5, 1, 3, 4, 1, 2. What's the median? (1)			
5. Here's the number of goals scored in Premier League fixtures one Saturday: 1, 5, 3,			
5, 1, 3, 4, 1, 2. What's the mode? (1)			
6. Here's a set of marks for a maths class: 12, 45, 78, 66, 39, 98, 25, 48, 66, 41. What's the range? (1)			
7. Here are the results Owen got by throwing a dice a number of times: 1, 5, 3, 4, 2, 5, 5, 3, 6, 2, 1, 3, 2, 5, 4, 3, 3, 5. What's the mode? (1)			
8. Calculate 1% of 8.3 (1)			
9. Calculate 22.5% of 162.4 (1)			
TOTAL			/9

CPAC 2C Identifying and controlling variables task:

Variables

For each of the following case studies name the:-

(A) Independent variable (B) Dependant variable (C) Control variable

Case study 1 – Measuring gravity

The aim of this experiment is to find out how fast objects of different masses take to fall from height. To conduct this experiment, we used a number of different sized steel ball-bearings, which had different masses. Each ball-baring was weighed on scales, before being dropped from a marker exactly 2 m from the floor. The time the ball bearing took to drop was timed on a stopwatch, and repeated 3 times for each ball-bearing to gain an average time.

Case study 2 – The colour of summer

The aim of this experiment is to find out if the colour of water a flower is grown in affects the colour of the flower. Five white roses of a similar size and shape were selected and placed into 5 separate beakers each containing 250 ml of water. Each of the 5 beakers had a few drops of one of five different colours of food dye added to it (red, green, blue, yellow and brown). The beakers were then placed on a windowsill and the colour of the flowers monitored twice a day for two weeks.

Case study 3 – how far does the spring stretch?

The aim of this experiment is to find out how far different masses stretch a spring. A spring was hung from a clamp stand, and its length end to end measured. A 10g mass was then added and the length of the spring measured and recorded. This was repeated adding 10g between 0g and 100g.

Variables – answer sheet:

Case study 1 – Measuring gravity:

(A) Independent variable:

(B) Dependant variable:

(C) Control variables + how/why:

Case study 2 – The colour of summer:

(A) Independent variable:

(B) Dependant variable:

(C) Control variables + how/why:

Case study 3 – How far does the spring stretch?

(A) Independent variable:

(B) Dependant variable:

(C) Control variables + how/why:

Challenge for Top Students

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>
- FutureLearn course on Coronavirus:
<https://www.futurelearn.com/courses/covid19-novel-coronavirus>
- 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/b0b6q3gy/can-science-make-me-perfectwith-alice-roberts>
- Explained: Designer DNA (20 mins)
<https://www.netflix.com/search?q=science&jbv=80216752&jbp=2&jbr=1>
- Unnatural Selection (short series)
<https://www.netflix.com/watch/80208833?trackId=13752289&tctx=0%2C0%2C8bd41505-055d-4d08a8c9-e71150318bb2-44683054%2C%2C>
- In Our Time: Neanderthals <https://www.bbc.co.uk/programmes/b00sq1nv>
- 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/>
- Open University course on diabetes:
<https://www.open.edu/openlearn/science-maths-technology/biology/livingdiabetes/content-section-3.1>

