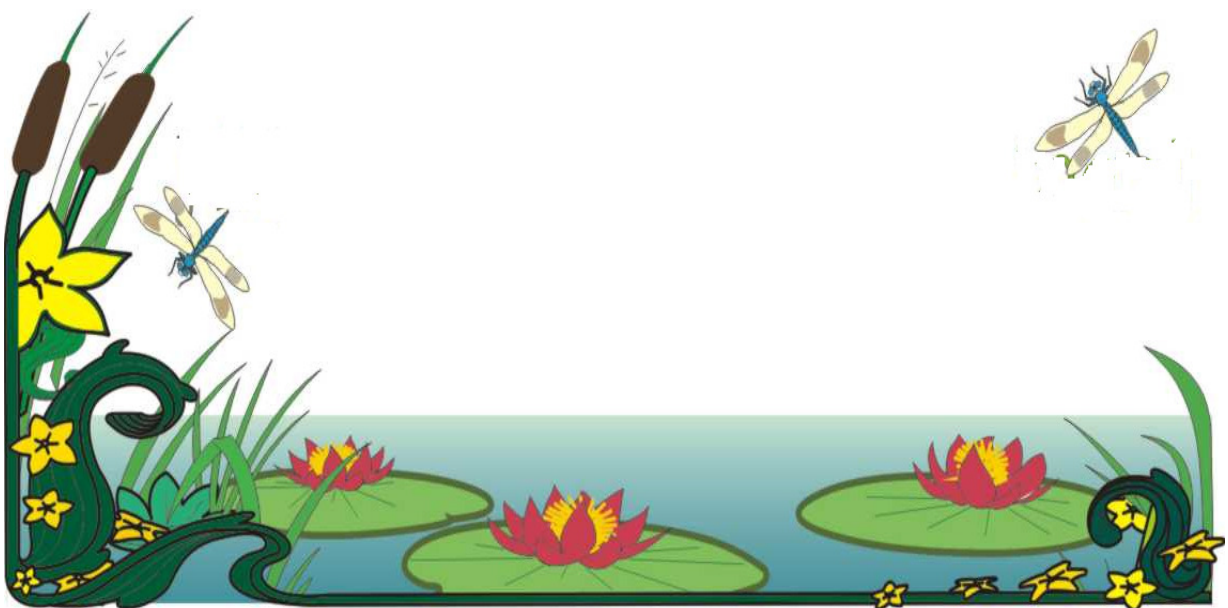

A-Level BIOLOGY

Transition Unit for Year 12 Biology

You should receive this booklet when you register to study A-Level biology at Dormers Wells High School. In preparation for the start of the course please complete the following:

1. The worksheets included in this booklet
2. Revision notes on the topic of Biological Molecules, following completion of the CGP Head Start to A-Level Biology book section 1 (included)
3. A piece of work based on your own research

Completion of the tasks will be assessed early in the course.



Bridging the gap between GCSE and A-Level Biology

Preparatory tasks for A-Level biology

A-Level biology is a very demanding subject, for which reason it is very important that you make a confident start to your studies from the very beginning of year 12. The following tasks should be undertaken in order to prepare you to make such a start.

1. Recap and extension of GCSE content

Please complete the worksheets included in this booklet to help prepare you for the topics you will first encounter in year 12.

2. Making Use of the “Head Start to A-Level Biology” book

You are strongly encouraged to purchase a copy of the CGP ‘Head Start to A-Level Biology’ book designed to bridge the gap between GCSE and A-Level (ISBN 978 1 78294 279 5, www.cgpbooks.co.uk). If you make full use of this book then you will have the required prior knowledge from GCSE, ready for the relevant section of the A-Level biology course; this will make it much easier for you to make the transition from GCSE to A-Level.

Section 1 (Biological Molecules) is attached to this document: please complete it as part of this ‘transition unit’ and make some revision notes on this topic. You are strongly encouraged to complete sections 2 (Cell Structure) and 6 (The Circulatory System) by October half-term, and all remaining sections by the end of the Autumn term.

3. Research

Undertake some individual research based on one of the following topics and present your work (a minimum of 500 words plus relevant diagrams) as a written document; make sure you list and make reference to sources that you have consulted.

Suggested topics:

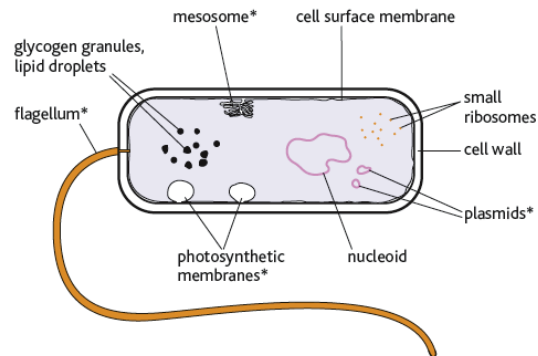
1. The development of systems of classification of organisms, with reference to the domains of life
2. Genetic predisposition and personalised medicine
3. The importance of maintaining biodiversity – you could use a specific example
4. The control of homeostasis
5. Stem cells: totipotency versus pluripotency

Summary sheet 1: Cell structure

Prokaryotes are single celled organisms, including bacteria. They are simpler and smaller than Eukaryotic cells.

Bacterial cells have:

- no nucleus with circular DNA free in the cytoplasm
- cell wall made from peptidoglycan
- no membrane-bound organelles
- small ribosomes.

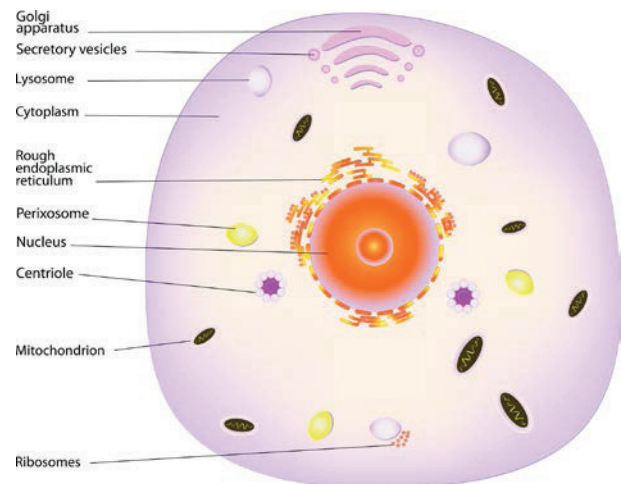


* = not present in all bacteria

Eukaryotic cells include animal and plant cells. They are larger and more complex than prokaryotic cells.

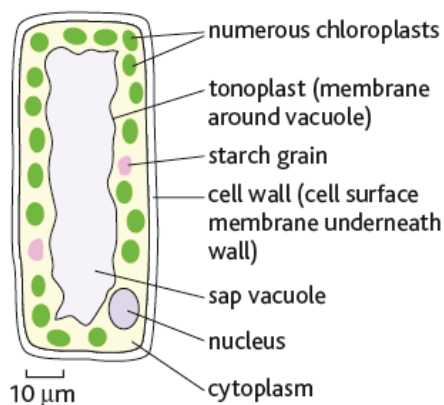
Animal cells have:

- linear DNA contained inside a nucleus
- no cell wall
- larger ribosomes and many membrane-bound organelles including mitochondria where aerobic respiration occurs and endoplasmic reticulum and golgi which are involved in the processing of proteins.



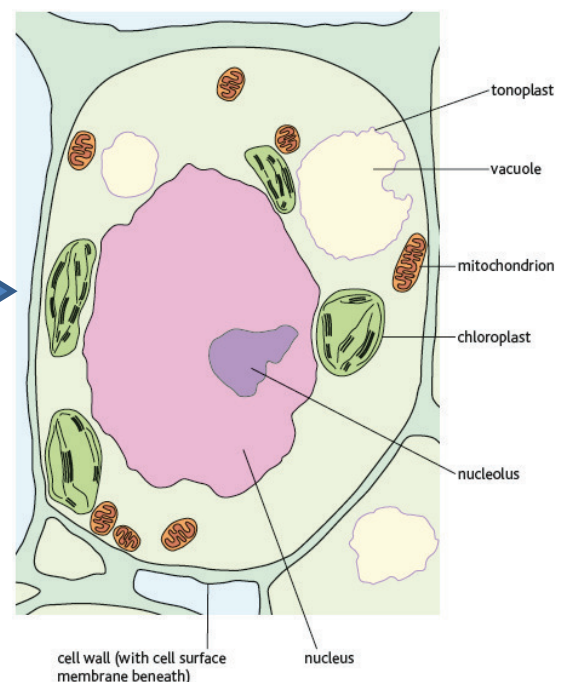
Plant cells have the same organelles as animal cells but they also have:

- a cell wall
- a large vacuole containing cell sap
- chloroplasts for photosynthesis.



10 μ m

greater detail

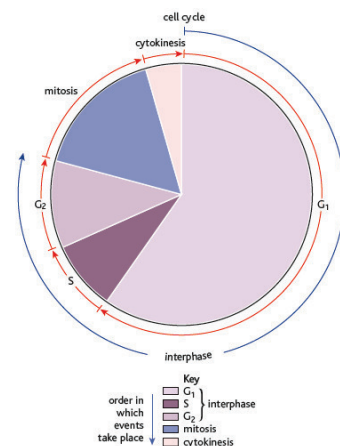


Summary sheet 2: Mitosis

Mitosis results in the production of two genetically identical diploid body cells. It occurs during growth, repair and asexual reproduction.

Mitosis occurs during the cell cycle. The cell cycle consists of a period of cell growth and DNA replication known as interphase and then a period of cell division called mitosis followed by cytokinesis where the cytoplasm divides and the cell membrane constricts to form the two daughter cells.

Mitosis is broken down into stages – prophase, metaphase, anaphase and telophase, followed by cytokinesis.



	A Interphase: before mitosis the tangled, uncoiled mass of chromosomes fills the nucleus. DNA is replicated during this stage.
	B Prophase: the chromosomes coil and condense, each one appearing as two chromatids. The nucleolus breaks down and the centrioles begin to separate and start to form the spindle.
	C Metaphase: the nuclear membrane breaks down. Spindles made of microtubules have been formed by the centrioles. The chromatids line up on the equator.
	D Anaphase: the centromeres separate and each chromatid is pulled along a spindle tubule towards one of the poles centromere first.
	E Early telophase: the chromatids reach the poles of the cell where they are now known as chromosomes. The membrane begins to reform and the cytoplasm to divide. F Late telophase: the chromosomes begin to 'decondense'. The nuclear membranes and nucleoli are fully reformed and centrioles are present again. The division of the cytoplasm continues until two new identical cells are formed which once more enter interphase.

Summary sheet 3: Microscopy

Magnification is how much bigger the image is than the specimen on the microscope slide.

The size of the specimen can be calculated using the formula:

$$\text{length of the specimen} = \frac{\text{length of the image}}{\text{magnification}}$$

With a light microscope the magnification is the combination of the magnification of the objective lens and the eye piece lens.

For example a 40× objective lens and a 10× eye piece lens produce a total magnification of 400×.

When you are doing magnification calculations you must have all the lengths in the same units.

1 cm	10 mm
1 mm	1000 µm
1 µm	1000 nm

Calculation

Calculate the actual size of a cell with a diameter of 8 mm using 100× magnification.

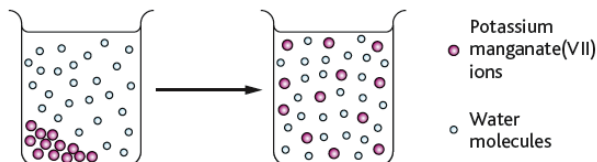
$$\begin{aligned}\text{Actual size} &= \frac{8}{100} = 0.08 \text{ mm} \\ &= 80 \text{ µm}\end{aligned}$$

Resolution is a measure of how easy it is to distinguish between two points that are close together i.e. how much detail can be distinguished. Electron microscopes have a better resolution than light microscopes so they can see more detail.

Summary sheet 4: Diffusion, osmosis and active transport

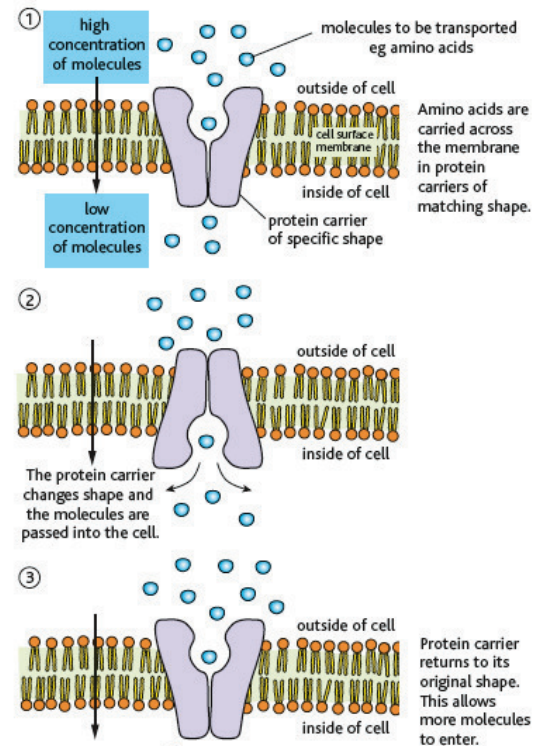
Diffusion

Liquid and gas particles are constantly moving which causes particles to move from an area of high concentration to an area of low concentration.



Observing the process of diffusion. If the beaker is left to stand the random motion of both the water and the purple manganate(VII) ions will ensure they are eventually evenly mixed.

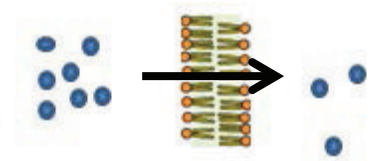
Small particles can diffuse across cell membranes and no energy is required. Some molecules, such as glucose, are too large to diffuse across the cell membrane so they must be helped by carrier proteins. Each molecule has its own carrier protein that allows the molecule through the cell membrane without the need for energy. This is known as facilitated diffusion.



Facilitated diffusion acts as a ferry across the lipid membrane sea. But this is a boat with no oars, sails or engine – it can only work when the tide (the concentration gradient) is in the right direction.

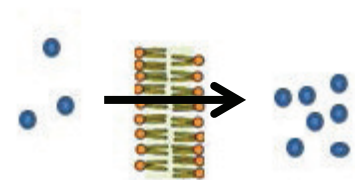
Osmosis

Osmosis is the diffusion of water molecules from an area of higher concentration of water molecules to an area of lower concentration of water molecules across a partially permeable membrane.



Active transport

Active transport uses energy to transport substances across membranes from an area of lower concentration to an area of higher concentration



Worksheet 1: Cell structures 1

Extracting key information from text is an important study skill for A-level candidates.

Read through the passage below about animal, plant and bacterial cells. Use the information and your own knowledge to complete the table to list some of the structural features of animal, plant and bacterial cells.

The plant cell and the animal cell possess a nucleus containing chromosomes and a nucleolus. In a bacterial cell the DNA is located in the cytoplasm. Only the bacterial cell and the plant cell have a cell wall but all three cells have a cell membrane. The plant cell wall is made of cellulose and the bacterial cell wall is made of peptidoglycan.

Centrioles are present only in the animal cell and chloroplasts are found only in the plant cell. Mitochondria and rough endoplasmic reticulum are not present in the bacterial cell. All three cells contain structures called ribosomes which are involved in the synthesis of protein. Bacterial cells can have pili or a capsule.

Features present in animal cells	Features present in plant cells	Features present in bacterial cells

Extension activity – research a function for each feature listed.

Worksheet 2: Cell structures 2

Extracting key information from text is an important study skill for A-level candidates.

Read through the passage below about animal, plant and bacterial cells. Use the information and your own knowledge to draw and label an animal, plant and bacterial cell. You should include the features listed if appropriate.

The plant cell and the animal cell possess a nucleus containing chromosomes and a nucleolus. In a bacterial cell the DNA is located in the cytoplasm. Only the bacterial cell and the plant cell have a cell wall but all three cells have a cell membrane. The plant cell wall is made of cellulose and the bacterial cell wall is made of peptidoglycan.

Centrioles are present only in the animal cell and chloroplasts are found only in the plant cell. Mitochondria and rough endoplasmic reticulum are not present in the bacterial cell. All three cells contain structures called ribosomes which are involved in the synthesis of protein. Bacterial cells can have pili or a capsule.

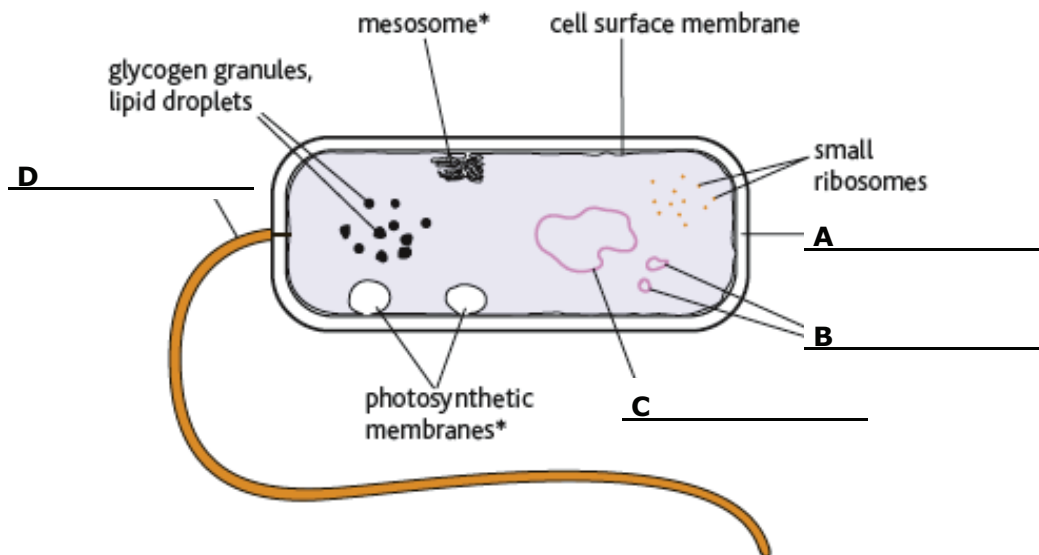
cell wall	nucleus	cell membrane	ribosome	capsule
mitochondria	cytoplasm	chloroplast	plasmid	chromosome

Animal cell	Plant cell
Bacterial cell	

Extension activity – research any unfamiliar features and add them to your cell diagrams.

Practice questions

- 1 The diagram shows a bacterial cell with some of the key features labelled.



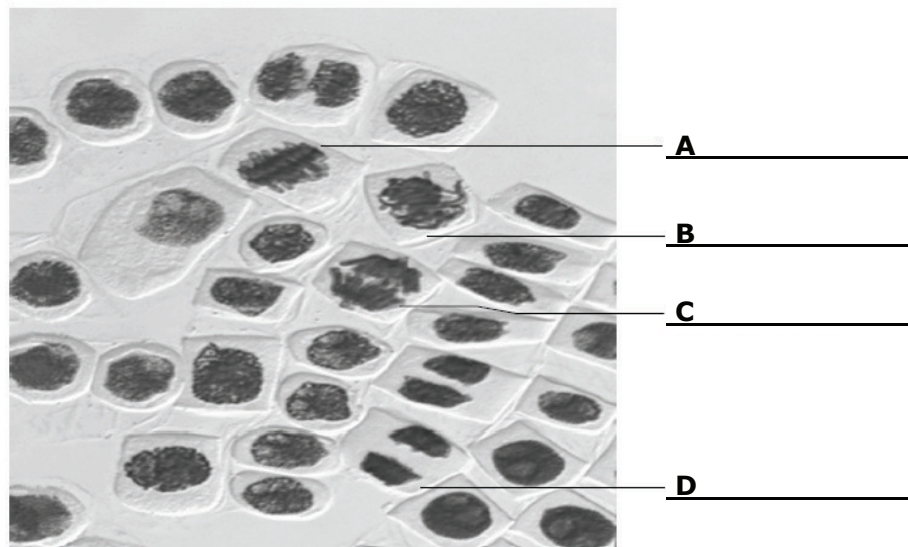
- a Label cell features A, B, C and D.
- b Complete the table to identify three features present in animal cells and describe their function.

Animal cell feature	Function

- c Some antibiotics prevent protein synthesis by targeting the ribosome. Ribosomes in eukaryotes have a different structure to prokaryotes. In no more than 50 words, explain why these types of antibiotics can be used to treat bacterial infections without effecting human cells.

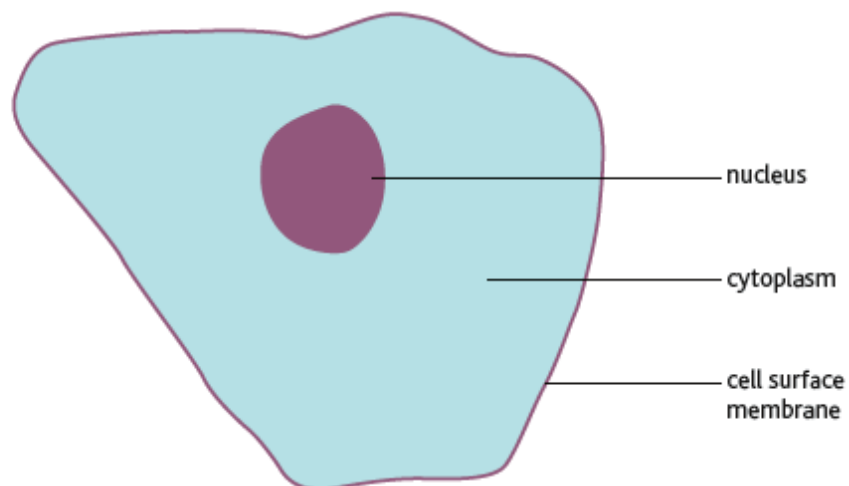
Concise writing which refers to key scientific ideas is effective.

2 The image shows root tip cells at different stages of the cell cycle.



- a** Identify the stages of mitosis for cells A, B, C and D.
- b** The microscope used to view the cells had a 10× eye piece lens. Which objective lens was needed to view the cells at this magnification level?
- c** Calculate the length of cell A.

3 The diagram shows an animal cell with three key features labelled.



- a** Identify three additional features which are found in animal cells and describe their functions.

1

2

3

- b** An image of an animal cell nucleus with a diameter of 6 μm was obtained using a 10 $\times$ eye piece lens and 20 $\times$ objective lens. Calculate the diameter of the nucleus on the image.

Substances can be transported into cells through diffusion, osmosis and active transport.

- 4** Write a definition for diffusion, osmosis and active transport.

Diffusion:

Osmosis:

Active transport:

- 8** A student took 15 identical sized potato chips. The mass of each chip was recorded and the chips were placed in 4 salt solutions (0.1M, 0.2M, 0.3M and 0.4M) and pure water for 30 minutes. The chips were dried and the mass recorded. The mass change and % change in mass was calculated.

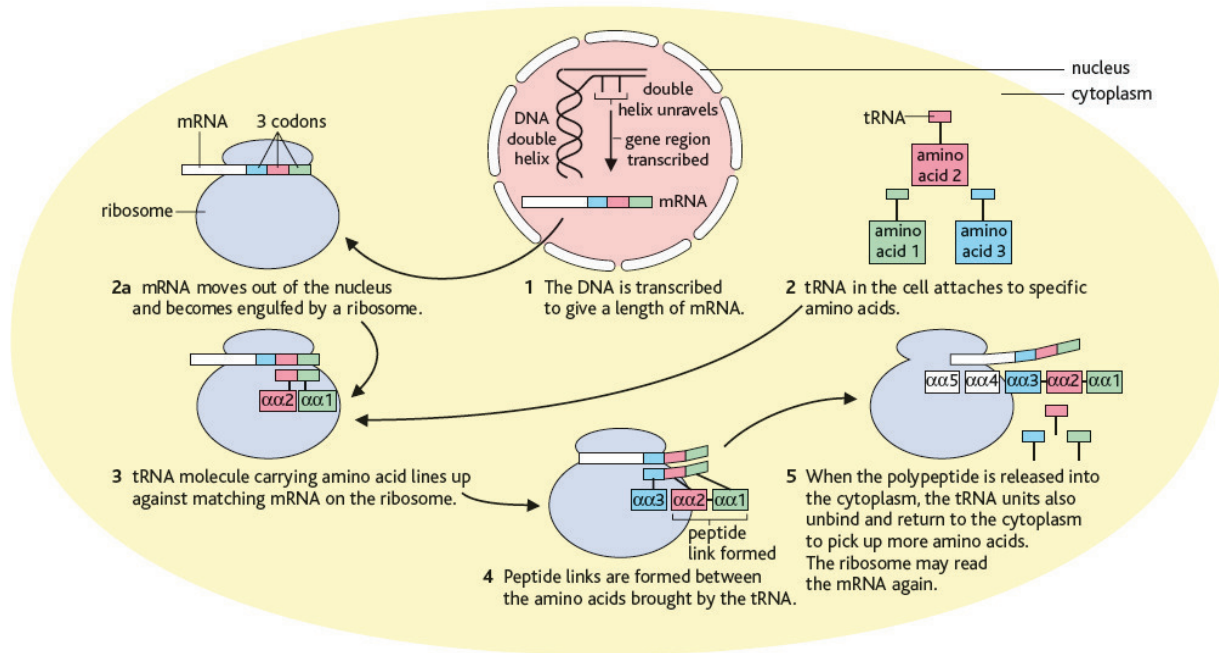
Design a table to record the students raw and processed data.

When recording data in tables units must be included in headers of the tables. All units should be SI.

Summary sheet 1: Protein synthesis

A gene is a sequence of DNA which codes for a protein. Proteins are synthesised in a two-step process – transcription and translation.

Transcription takes place in the nucleus and translation takes place at the ribosome. A complementary mRNA strand is made using the DNA as a template. The mRNA leaves the nucleus and attaches to the ribosome in the cytoplasm. A triplet of bases on the mRNA (a codon) code for specific amino acids. The amino acids are delivered to the ribosome by tRNA. Peptide bonds are formed between the amino acids to make the polypeptide.



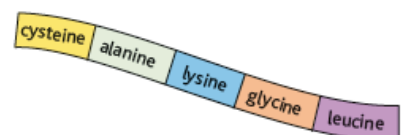
The DNA gene sequence is ACA CGG AAA CCT GAC.

The mRNA sequence is UGU GCC UUU GGA CUG.

This codes for the amino acid sequence is:

Cys-Ala-Lys-Gly-Leu

The protein folds into a specific structure.
For enzymes this means that the active site forms a specific shape that binds specific substrates.



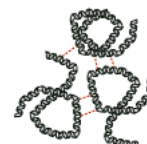
Primary structure – the linear sequence of amino acids in a peptide.



Secondary structure – the repeating pattern in the structure of the peptide chains, such as an α -helix or pleated sheets.



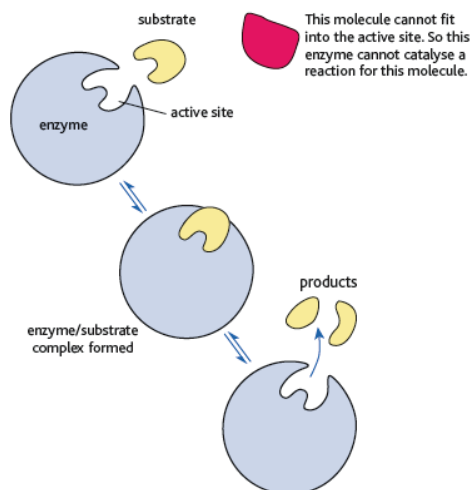
Tertiary structure – the three-dimensional folding of the secondary structure.



Quaternary structure – the three-dimensional arrangement of more than one tertiary polypeptide.

Summary sheet 2: Enzymes activity

Enzymes are biological catalysts that speed up chemical reactions. Enzymes work by reducing the amount of activation energy needed for the reaction to occur.

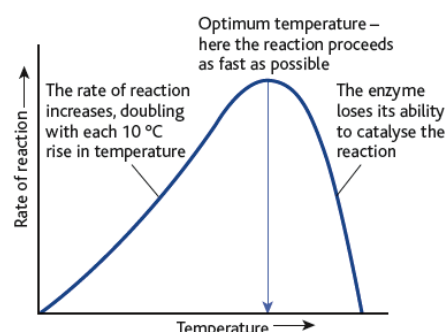


The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

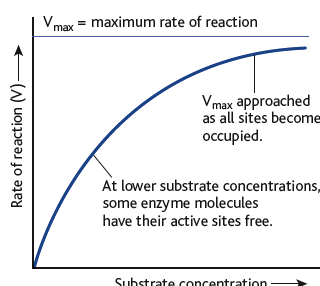
The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

Different factors can affect how quickly the enzymes work. These include temperature, pH, enzyme concentration and substrate concentration.

As temperature increases there is more chance of a collision between the enzyme and substrates, as they have more kinetic energy. This continues until the optimum temperature where the rate of reaction is highest. As the temperature continues to rise the enzyme denatures, as the active site changes shape, when bonds holding the protein together break.



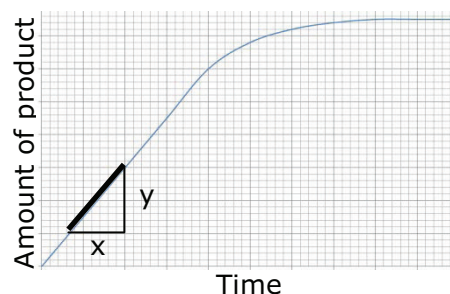
Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.



As the substrate concentration increases there is more chance of a collision between the substrate and the enzyme. The rate of reaction increases until all the active sites are occupied.

The rate of reaction increases as enzyme concentration increases until all the substrate is bound to an enzyme.

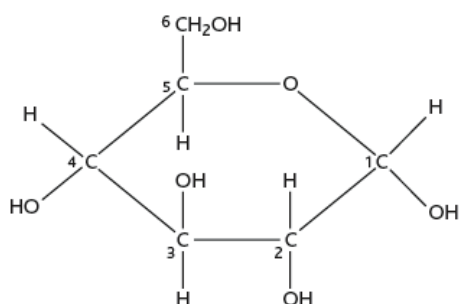
In practical situations you can sometimes measure the amount of product formed over time. The initial rate of the reaction for an enzyme can be calculated by measuring the gradient of the graph. If the line is curved a tangent to the curve can be used : $\text{gradient} = y \div x$.



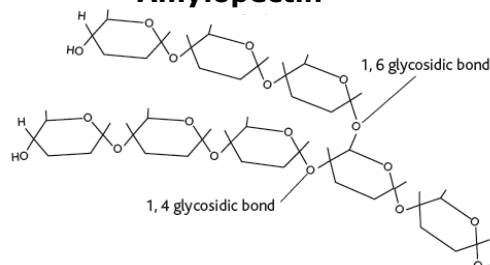
Worksheet 1: Carbohydrates

The diagram shows the chemical structures of some monosaccharides, disaccharides and polysaccharides. Giving a reason, separate the molecules into these three groups.

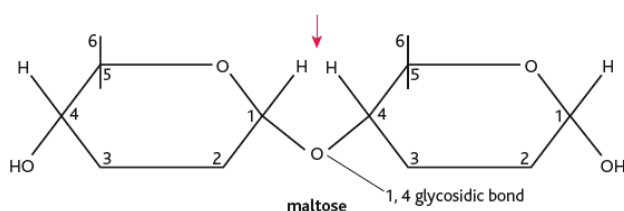
Glucose



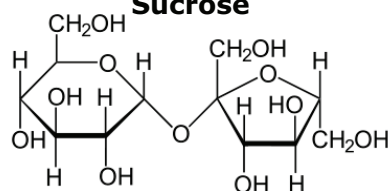
Amylopectin



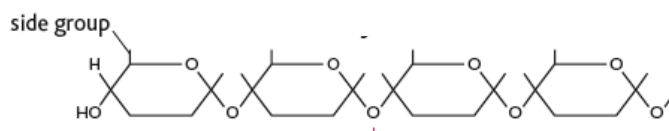
Maltose



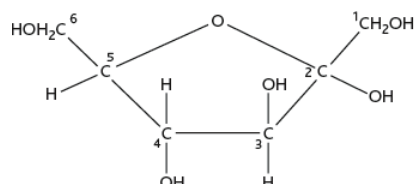
Sucrose



Amylose



Fructose



Monosaccharides	Disaccharides	Polysaccharides

Worksheet 2: Data analysis

Processed data should be recorded to the same number of decimal places as the primary data

This table shows the same data recorded to different numbers of decimal places.

Data set 1	Data set 2
2.4	2.37
3.6	3.55
4.1	4.05
2.8	2.76
3.5	3.51

- 1 Compare the mean values for data set 1 and data set 2.
- 2 Express data set 2 to 1 decimal place. What do you notice?
- 3 Explain why it is incorrect to record 3.28 as the mean for data set 1.

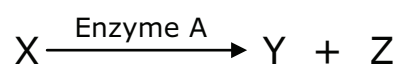
Being able to convert data, using standard form and different units, is an important skill

- 4 Convert the data in the table below.

Data		Value
45 100 g	into standard form	
45 100 g	into kilograms	
34 ms	into seconds	
780 μm	into millimetres	
$0.25 \times 10^{-9} \text{ s}$	into nanoseconds	

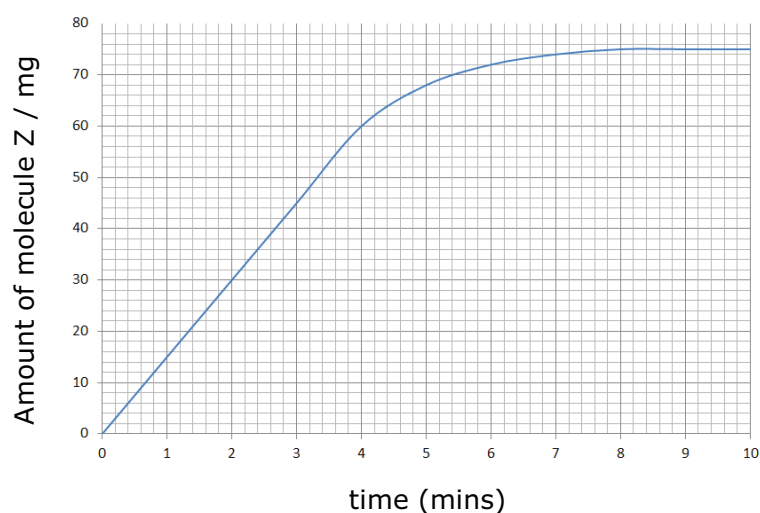
Practice questions

- 1** Enzyme A catalyses the breakdown of molecule X into Y and Z.



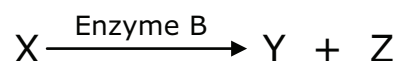
Molecule X and enzyme A were mixed together at 30°C at pH 6.8.

This graph shows the mass of molecule Z formed over a 10 minute time period.



- a** Calculate the initial rate of reaction of enzyme A.
- b** What is the rate of reaction of enzyme A after 8 minutes?
- c** Suggest a reason for the rate of reaction calculated in **b**.

- 2 Enzyme B catalyses the breakdown of molecule X into Y and Z.



Molecule X and enzyme B were mixed together at different temperatures.

This table shows the initial rate of reaction of enzyme B at 15°C, 25°C, 30°C, 35°C, 40°C and 50°C.

Temperature	Initial rate of reaction of enzyme B (mmol.min ⁻¹)
15	8
25	14
30	18
35	20
40	18
50	12

- a The table has some missing information. Add the missing information to the table.
- b Plot the data from the table on graph to show the initial rate of reaction of enzyme B at different temperatures.
You should consider:
- the variable which should be on the x-axis
 - the labels for the axis
 - the title of the graph.



- c Compare different rates of reaction of enzyme B at 20°C, 37°C and 45°C.

For questions which involve the use of data from a graph you must use scientific knowledge to explain the data you have extract from the graph.

3 Mutations in DNA can impact on the activity of enzymes.

This DNA sequence is from the region of the gene which codes for the active site of an enzyme.

GAA GAG AGT GGA CTC ACA GCT CGG

The table shows the amino acid coded for by some codons.

Amino acid/stop signal	DNA triplet codons
Proline	GGT GGG GGA
Alanine	CGG CGA CGT CGC
Cysteine	ACA ACG
Serine	AGG AGA AGT AGC
Leucine	GAA GAG GAT GAC
Arginine	GCA GCG GCT GCC
Glutamine	CTT CTC
Glycine	CCT CCG CCA CCC
Threonine	TGC TGA TGT TGG
Stop signal	ATT ATC ACT

- a** State the amino acid sequence coded for by the sequence above.
- b** Using the information above explain the effect on the protein produced for the following mutations.

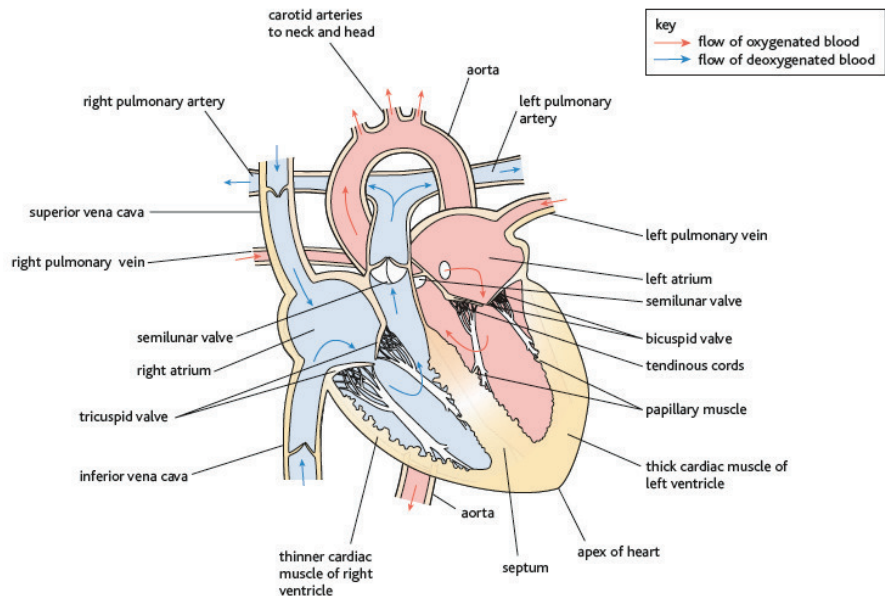
GAA GA^T AGT GGA CTC ACA GCT CGG

GAA GAG AGT GGA CTC ^CCA GCT CGG

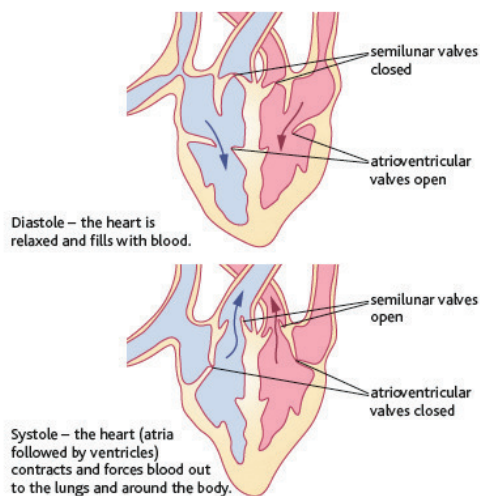
GAA GAG AGT GGA CTC ACA ^ACT CGG

Summary sheet 1: Heart and lungs

The left side of the heart pumps oxygenated blood from the lungs around the body. The blood enters the left atrium from the pulmonary vein. It flows through the atrioventricular or bicuspid valve to the left ventricle. The blood is then pumped into the aorta, through a semi-lunar valve, and around the body.



The right side of the heart pumps deoxygenated blood from the body back to the lungs. The blood returns from the body to the right atrium via the vena cava. It flows through the atrioventricular or tricuspid valve to the right ventricle. The blood is then pumped into the pulmonary artery, through a semi-lunar valve, and to the lungs.

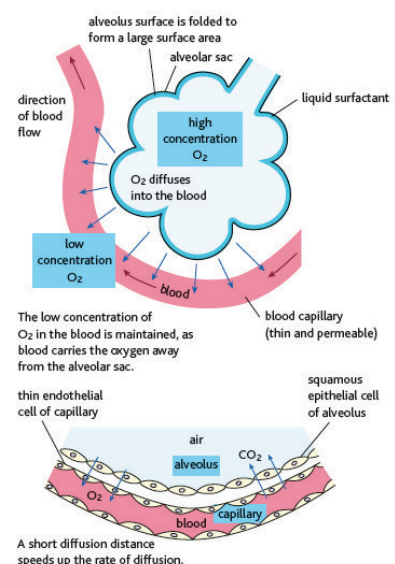


The atrioventricular valves between the atrium and ventricles open to allow blood to flow from the atrium into the ventricles and close when the pressure in the ventricles rises to prevent back flow.

The semi-lunar valves in the aorta and pulmonary artery open to allow blood from the ventricles to flow into the arteries. They close to prevent backflow into the ventricles as the heart relaxes.

Oxygen enters the blood in the alveoli of the lungs. Oxygen in the alveolus is at a high concentration and it diffuses down the concentration gradient into the blood which has a low concentration of oxygen. This low concentration is maintained because the blood is moving and carries the oxygen away.

The walls of the alveolus and capillaries are only one cell thick. This creates a short diffusion distance between the alveolus and the blood allowing a high rate of diffusion.

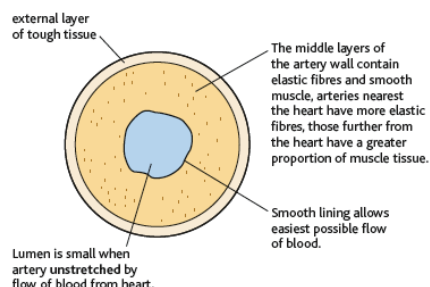
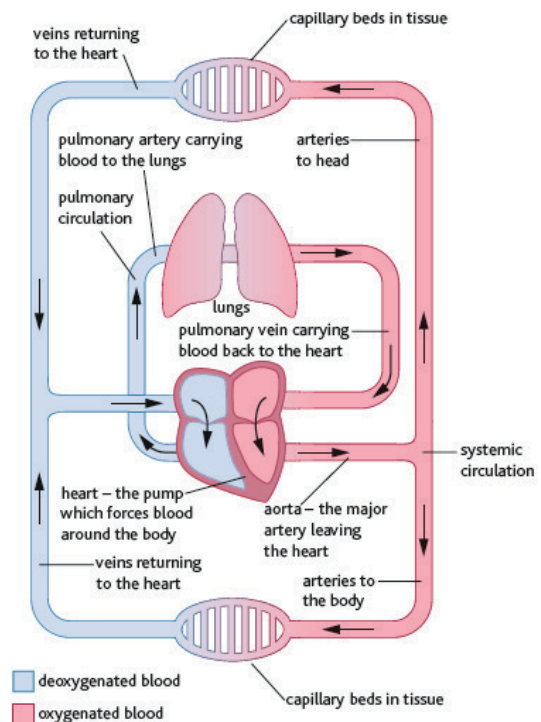


Summary sheet 2: Circulatory system

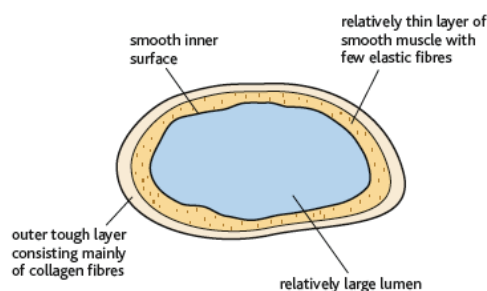
Blood flows around the body via a network of arteries, veins and capillaries.

The double circulation system of mammals means that blood flows through the heart twice in one complete cycle of the body.

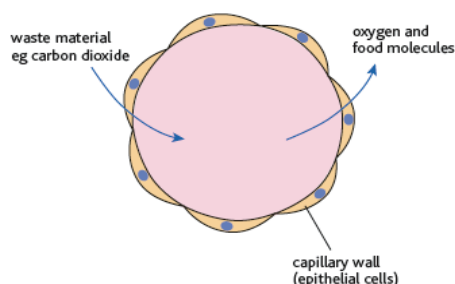
The pulmonary system pumps blood around the lungs and the systemic system pumps blood around the rest of the body.



Arteries carry blood away from the heart. The vessel walls are thick and muscular with elastic fibres to withstand the high pressure generated by the heart.



Veins carry blood from capillary beds back to the heart. The blood is at low pressure and the walls of the vessels are relatively thin with less elastic fibre. The contraction of muscles help push the blood through veins and the vessels have valves to prevent backflow.



Capillaries are thin vessels that form capillary networks around tissues. They allow the exchange of substances such as oxygen, glucose and waste materials between cells and the blood.

Worksheet 1: Prefixes

Scientific terms use common prefixes. Find out the definition/meaning of the prefixes shown in the table.

Word/prefix	Definition/meaning
endo	
exo	
pulmonary	
cardiac	
hepatic	
mono	
di	
photo	
haem	
bio	
chemo	

Worksheet 2: Keywords

Candidates frequently lose marks in examinations because they do not use sufficient key words in detailed responses.

Read the responses to the questions below. Using the keywords from the box write improved answers to the questions.

concentration	capillaries	vein
diffusion	thin	semi-lunar
right	pulmonary	valve
gradient	atrioventricular	left
aorta	vena cava	artery
thick	osmosis	

- 1** Explain how oxygen enters the blood at the alveoli.

In the alveolus oxygen from the air moves into the blood vessels through the walls of the alveolus. The blood is moving so there is always a low concentration in the blood.

- 2** Describe the route blood takes from the lungs to the body.

Blood from the lungs blood travels through a vein to the atrium. The blood is pumped from the atrium into the ventricle and then into the aorta.

Practice questions

- 1 a** Write a definition for each key word in the box. If possible give a structural feature for each key word.

atria	ventricles	aorta	vena cava	pulmonary artery
pulmonary vein		atrioventricular valves		septum
semi-lunar valves		diastolye	systole	

atria:

ventricles:

aorta:

vena cava:

pulmonary artery:

pulmonary vein:

atrioventricular valves:

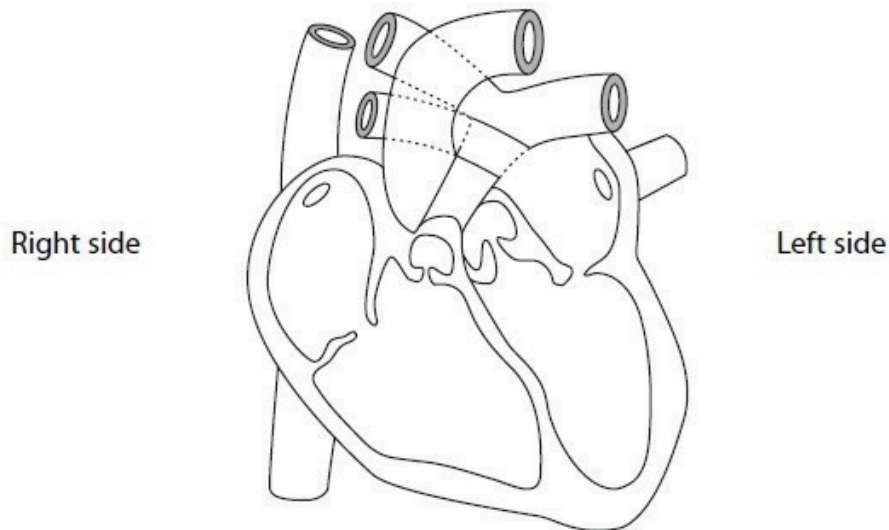
septum:

semi-lunar valves:

diastolye:

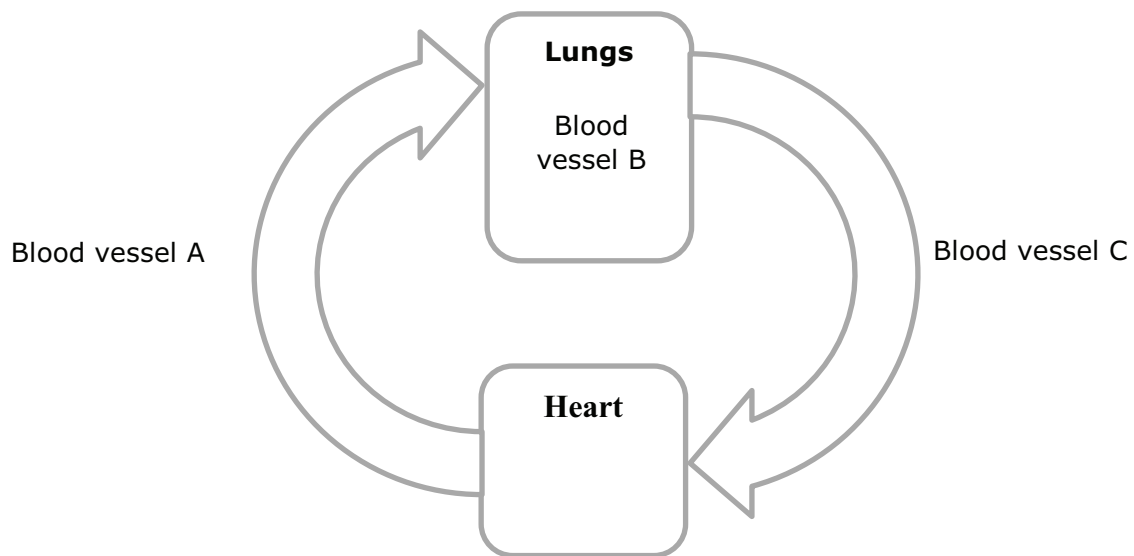
systole:

- b** Label this diagram of the heart using as many of the key words from **1 a** as possible.



- c** Use the keywords from **1 a** in your answers to the following questions.
- i** Explain why the left ventricle has thicker chamber walls than the right ventricle and the atria.
 - ii** Describe the role of the atrioventricular valves.

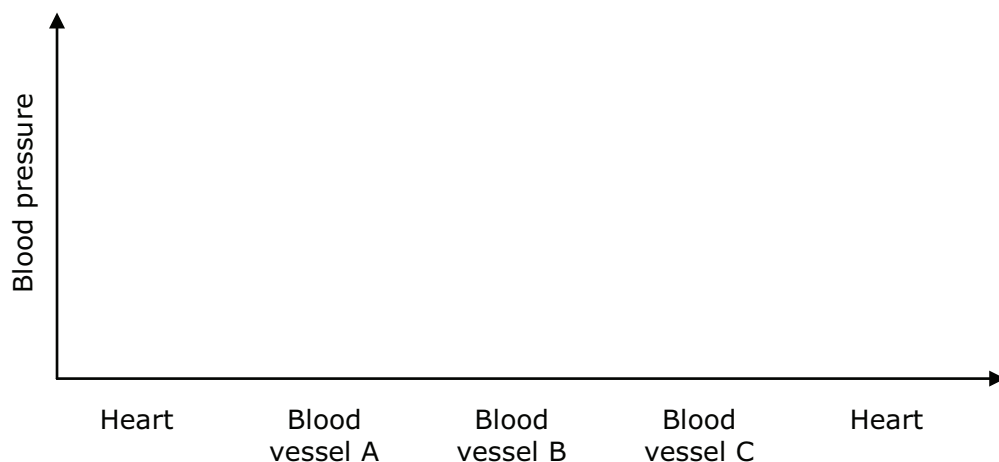
2 This flow diagram shows the part of the circulation system in a mammal.



a Complete a table to show conditions of blood vessel A, B and C.

Blood vessel	Type of vessel	Level of oxygen saturation	Relative pressure of the blood	Valves present in the vessel	Thickness of blood vessel walls
A					
B					
C					

b Draw a line on the axis to show the blood pressure changes in the blood as it flows from the heart to the lungs before returning to the heart.



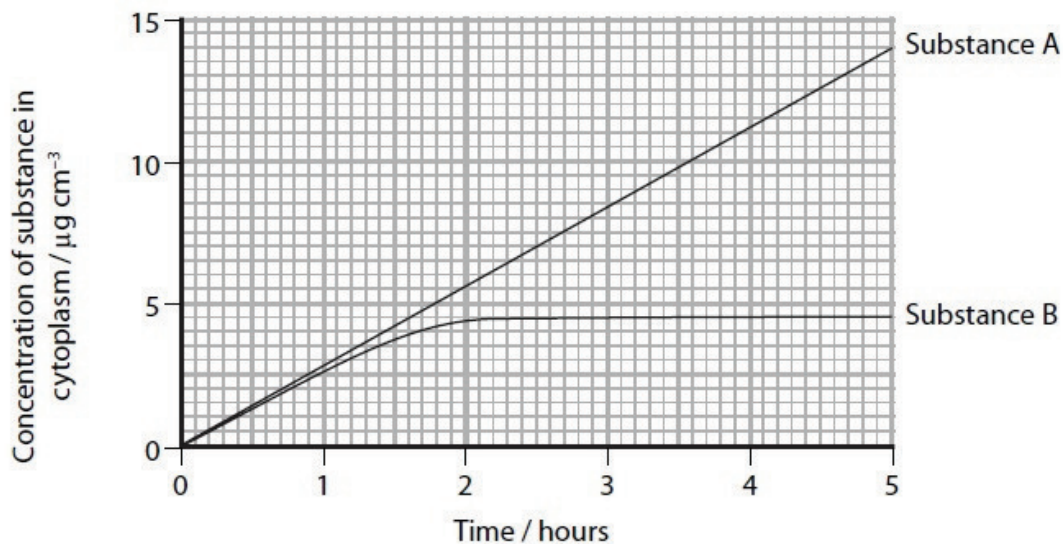
- 3** *Amoeba* is a single-celled aquatic organism. Substances in the water can enter the cell by a variety of mechanisms.

An experiment was carried out to compare the uptake into *Amoeba* of substance A and substance B.

Some of these organisms were placed in a solution containing equal concentrations of both substances and kept at 25°C.

The concentration of substances A and B, in the cytoplasm of these organisms, was measured every 30 minutes over a period of 5 hours.

The results of this experiment are shown in the graph below.

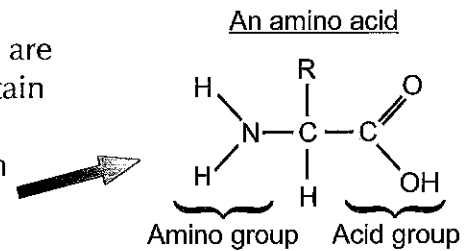


- a** Using the information in the graph, compare the uptake of substance A with the uptake of substance B during this period of 5 hours.
- b** Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.
- c** Substance A enters the cells by active transport. Give **two** differences between active transport and diffusion.
- 1**
- 2**

Proteins

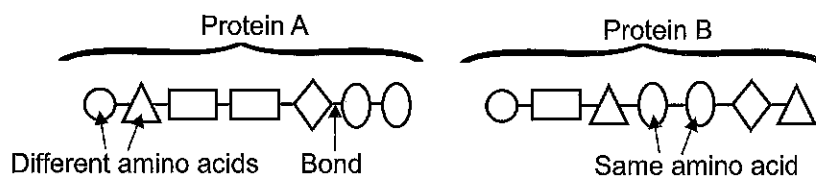
Proteins are Made of Amino Acids

Proteins are composed of long chains of **amino acids**. There are **twenty different** amino acids used in proteins. They all contain carbon, hydrogen, oxygen and nitrogen, and some contain sulfur. All have the **same structure** as the one in the diagram but **R** can be one of twenty different chemical groups.



Proteins are Held Together by Peptide Bonds

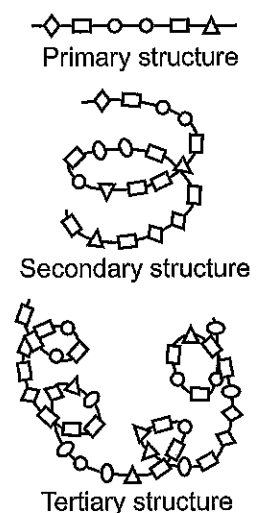
- 1) The chains of amino acids are attached to each other by **strong peptide bonds**.
- 2) The amino acids can be arranged in any sequence and proteins can be up to **several hundred** amino acids long.
- 3) The number of different proteins that are possible is almost unimaginable. Consider that there are several thousand ways of arranging a chain of just three amino acids, with each combination forming a different protein. Add one more amino acid to the chain and the number of possibilities leaps into the hundreds of thousands.
- 4) It's the **order** of the amino acids in a protein that determines its **structure** and it's the structure of a protein that determines **how it works**.



(N.B. Each different shape represents a different amino acid.)

Each Protein has its Own Special Shape

- 1) The order in which the amino acids are arranged in a protein chain is called the **primary structure**.
- 2) Some chains **coil up** or **fold** into pleats that are held together by weak forces of chemical attraction called **hydrogen bonds**. The coils and pleats are the **secondary structure** of a protein.
- 3) Some proteins (especially enzymes) have a **tertiary structure**. The coiled chain of amino acids is folded into a **ball** that's held together by a mixture of weak chemical bonds (e.g. hydrogen bonds) and stronger bonds (e.g. disulfide bonds).
- 4) If the protein has a roughly spherical shape it's called a **globular protein** (e.g. enzymes are classed as globular proteins).



The name's Bond. Peptide Bond...

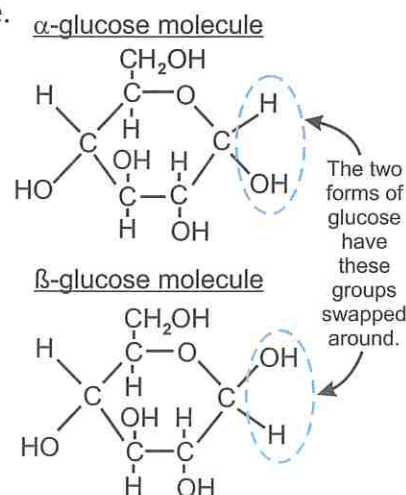
- 1) What is the primary structure of a protein?
- 2) What type of bond holds together the secondary structure of a protein?

Carbohydrates

Carbohydrates Contain Three Elements

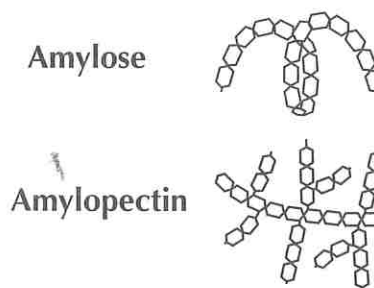
Carbohydrates contain **carbon**, **hydrogen** and **oxygen**. There are several types of carbohydrate, e.g. sugars, starch and cellulose.

- 1) Sugars are **small**, **water-soluble** molecules that taste sweet.
- 2) They're divided into two groups: **monosaccharides** (pronounced: mono-sack-a-rides) and **disaccharides** (die-sack-a-rides).
- 3) Monosaccharides are the single units from which all the other carbohydrates are built. **Glucose** and **fructose** are both monosaccharides. Glucose has two forms — **alpha** (α) and **beta** (β).
- 4) Disaccharides are formed when **two monosaccharides** are joined together by a chemical reaction. A molecule of **water** is also formed (so it's called a **condensation reaction**).



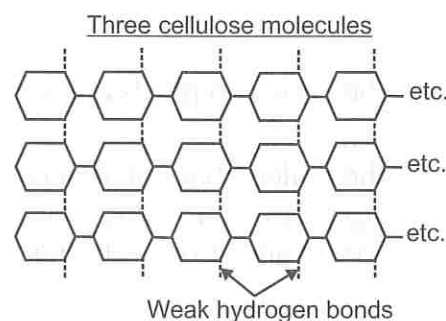
Starch is a Polysaccharide

Polysaccharides are **polymers** — large molecules made up of **monomers** (smaller units). The monomers of polysaccharides are **monosaccharides**. **Starch** molecules are made up of two different polysaccharides — **amylose** and **amylopectin**, which are polymers of glucose. The insoluble, compact starch molecules are an ideal way of **storing glucose**. Starch is **only** found in plant cells.



Cellulose is Also a Polysaccharide

- 1) Like starch, cellulose is a polymer of glucose, but the **bonding** between the glucose units is different.
- 2) As a result, the cellulose molecules are **long** and **straight**.
- 3) Several cellulose molecules can lie side by side to form **microfibrils**.
- 4) The molecules are held together by many weak **hydrogen bonds**.
- 5) Cellulose is only found in plant cells.
- 6) The microfibrils **strengthen** the plant cell wall.



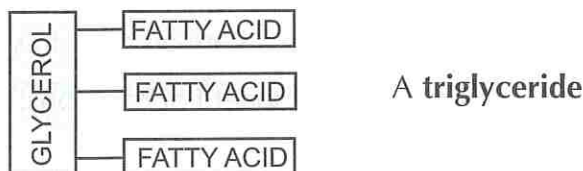
A poly-sack-a-ride — a bunch of kids on a helter skelter...

- 1) Name two monosaccharides.
- 2) Which disaccharide is composed of two molecules of glucose?
- 3) Name two polysaccharides.

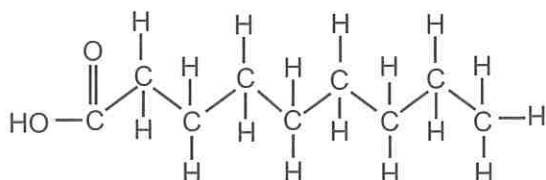
Lipids

Lipids Contain Carbon, Hydrogen and Oxygen

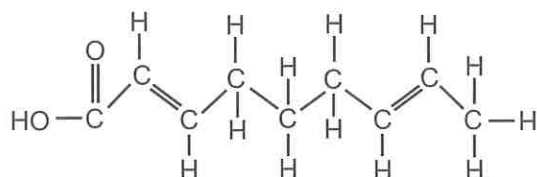
Lipids are **oils** and **fats**. Plant oils and animal fats are mostly made up of a group of lipids called **triglycerides**. A triglyceride consists of a molecule of **glycerol** with **three fatty acids** attached to it.



A fatty acid molecule is a long chain of **carbon atoms** with an **acid group** (-COOH) at one end. **Hydrogen atoms** are attached to the carbon atoms. If every carbon atom in the chain is joined by a **single bond**, we say that the fatty acid is **saturated**. If one or more of the bonds is a **double bond**, it's said to be **unsaturated**. A fatty acid with many double bonds is **polyunsaturated**.



Saturated fatty acid



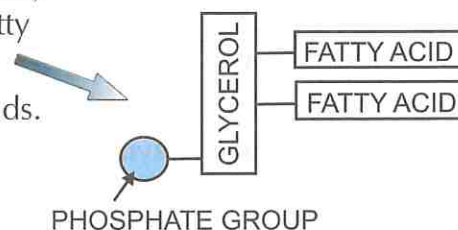
Unsaturated fatty acid



Phospholipids are a Special Type of Lipid

Phospholipids (pronounced: foss-foe-lip-id) are like triglycerides, but instead of having three fatty acid chains, they have **two** fatty acid chains and a **phosphate** group.

Cell membranes are made from a **double layer** of phospholipids.



Acid chain and the phospholipids — sounds like a punk band...

- 1) Which elements are fatty acids composed of?
- 2) What's the difference between saturated fatty acids and unsaturated fatty acids?
- 3) What's the difference between triglycerides and phospholipids?

Enzymes

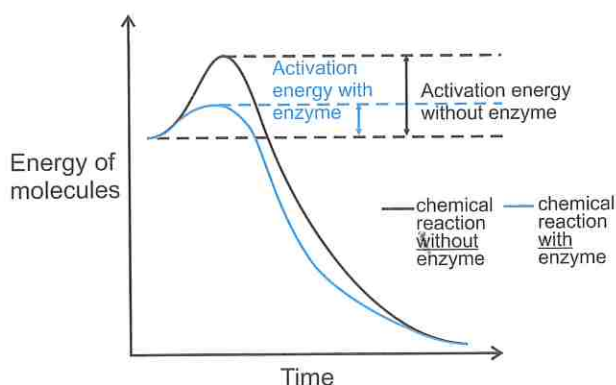
Enzymes Help to Speed up Biochemical Reactions

- 1) In a living cell, thousands of **biochemical reactions** take place every second. The sum of these reactions is called **metabolism**. A single chain of these reactions is called a **metabolic pathway**.
- 2) Without enzymes, these reactions would take place very **slowly** at normal body temperature.
 - 1) Enzymes are **biological catalysts**.
 - 2) They **increase** the **rate** (speed) of reactions.

How do Enzymes Act as Catalysts?

- 1) Even reactions that release energy require an **input of energy** to get them going, e.g. the gas from a Bunsen burner doesn't burn until you provide heat energy from a match.
- 2) This input energy is called the **activation energy**. A reaction that needs a high activation energy can't start at a low temperature of 37 °C (i.e. body temperature).
- 3) Enzymes **reduce** the activation energy.

This graph shows the activation energies of a reaction **with** and **without** an enzyme:



Enzymes are Proteins

- 1) All enzymes are **globular proteins** (because they're roughly spherical).
- 2) It's the order of amino acids in an enzyme that determines its **structure**, and so how it works.
- 3) Enzymes can be involved in **breaking down** molecules or **building** molecules. For example:
 - **Digestive enzymes** are important in the digestive system, where they help to break down food into smaller molecules, e.g. carbohydrases break down carbohydrates.
 - Enzymes involved in **DNA replication** help to build molecules, e.g. DNA polymerase.

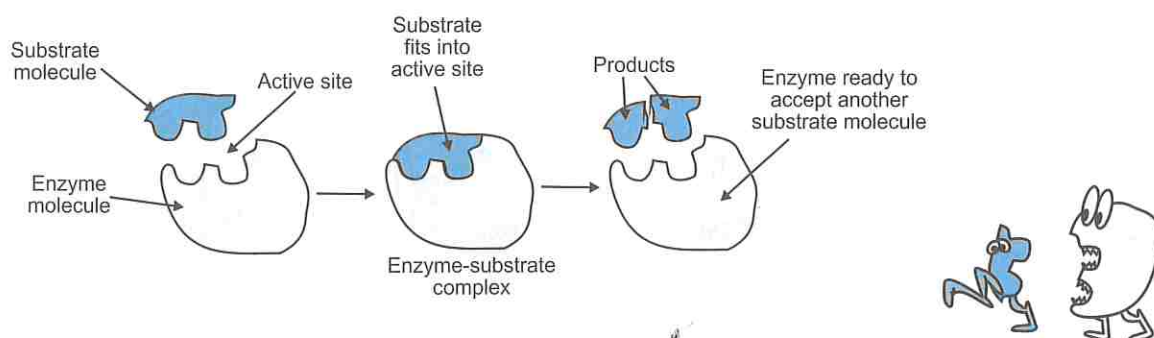
I could really use a catalyst to help me write this gag...

- 1) What is the function of enzymes?
- 2) What is activation energy?
- 3) What do digestive enzymes do?

Enzymes

Enzymes have an **Active Site**

- 1) A substance that's acted upon by an enzyme is called its **substrate**.
- 2) The **active site** is a region on the surface of the enzyme molecule where a substrate molecule can attach itself. It's where the catalysed reaction takes place.
- 3) The shape of the substrate molecule and the shape of the active site are **complementary**, i.e. they fit each other.
- 4) Almost as soon as the **enzyme-substrate complex** has formed, the products of the reaction are released and the enzyme is ready to accept another substrate molecule.



Enzymes are **Specific**

- 1) An enzyme usually catalyses one **specific** chemical reaction.
- 2) The substrate molecule must be the **correct shape** to fit into the active site.
- 3) **Only one substrate** will be the correct shape to fit, so each enzyme only catalyses one specific reaction.
- 4) Anything that **changes** the shape of the active site will **affect** how well the enzyme works.

The **Effect of Temperature on Enzyme Activity**

As temperature **increases**, enzyme reactions become **faster**, because the molecules have more **energy**. However, at high temperatures the atoms of the enzyme molecule vibrate more rapidly and **break** the weak bonds that hold the **tertiary structure** together. The **shape** of the active site **changes** and the substrate can no longer fit in. The enzyme is said to be **denatured**.

The **Effect of pH on Enzyme Activity**

Acids and **alkalis** can denature enzymes. Hydrogen ions (H^+) in acids and hydroxyl ions (OH^-) in alkalis disrupt the **weak bonds** and change the shape of the active site.

Lonely enzyme seeking complementary substrate...

- 1) Why are enzymes described as 'specific'?
- 2) Explain why a denatured enzyme will not function.
- 3) Describe the effect of pH on enzyme activity.