edexcel

AS and A Level Biology

TRANSITION GUIDE

Reinforcing knowledge, skills and literacy in biology

ALWAYS LEARNING

PEARSON

Baseline assessment

Name:_____Form: _____

Biology group: _____

GCSE Biology/Science grade: _____

Date: _____

Targets for improvement

- ☐ DNA structure and genetics
- ☐ Protein synthesis and enzymes
- ☐ Cell structures
- ☐ Biodiversity
- ☐ Heart and bloodflow

Question	Marks
1	/5
2	/6
3	/4
4	/4
5	/4
6	/8
7	/9
8	/9
9	/7
Total	/55
%	
Grade	

Target grade

- ☐ **OT**
- ☐ **BT**
- ☐ **AT**

1 Read through the following passage on the structure of DNA, then fill in the most appropriate word or words to complete the passage.

A DNA molecule consists of two strands of mononucleotides. Each of these strands is twisted around the other, forming a_____.

Each mononucleotide consists of a pentose sugar called deoxyribose, a base and a phosphate. The two strands are held together by complementary base pairing.

Adenine bonds with_____and cytosine bonds with _____. The name of the bond that forms between these bases is a_____bond. A DNA molecule that is composed of 34% adenine will be composed of_____% cytosine.

(6 marks)

2 Cystic fibrosis and albinism are examples of recessive genetic disorders. Krabbe disease is another example of a recessive genetic disorder.

Krabbe disease is caused by mutations in the GALC gene, resulting in a deficiency of an enzyme called galactocerebrosidase.

a Explain the meaning of each of the following terms.

i Mutation

(2 marks)

ii Recessive

(1 mark)

b Explain how a mutation in the GALC gene could result in a change in the enzyme galactocerebrosidase.

(3 marks)

3 Transcription and translation are two main stages in protein synthesis.

a Complete the table below by writing the word **transcription** or **translation** next to the appropriate statement about protein synthesis.

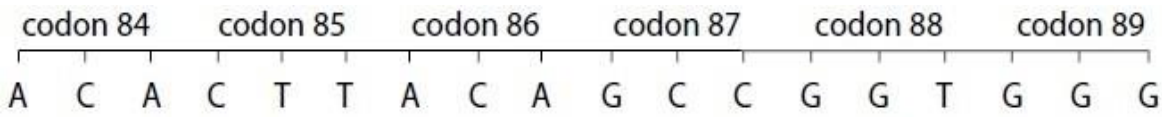
Statement	**Stage of protein synthesis**
Ribosomes are involved.	
DNA acts a s a template.	
tRNA is involved.	
Peptide bonds are made.	
mRNA is made.	

(5 marks)

b The table below shows some amino acids and their corresponding DNA triplet codons. The DNA triplet codons for a stop signal are also shown.

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		
Gkycine	CCT	CCG	CCA	CCC
Threonine	TGC	TGA	TGT	TGG
Stop signal	ATT	ATC	ACT	

The diagram below shows part of a DNA molecule.



i Place a cross (☒) in the box next to the amino acid coded for by codon 85.

A Leucine ☐

B Glutamine ☐

C Glycine ☐

D Serine ☐

(1 mark)

ii Place a cross (☒) in the box next to the sequence of amino acids found in the polypeptide chain that is coded for by this part of the DNA strand.

A cysteine glutamine cysteine arginine proline proline ☐

B threonine leucine threonine alanine glycine glycine ☐

C cysteine glutamine cysteine arginine glycine glycine ☐

D cysteine proline cysteine arginine proline proline ☐

(1 mark)

iii Place a cross (☒) in the box next to the sequence of bases on a molecule of messenger RNA (mRNA) synthesised from this part of the DNA molecule.

A A C A C T T A C A G C C G G T G G G ☐

B T G T G A A T G T C G G C C A C C C ☐

C U G U G A A U G U C G G C C A C C C ☐

D A G A C U U A G A C G G C C U G G G ☐

(1 mark)

4 Animal and plant cells are eukaryotic. Bacterial cells are prokaryotic.

Name **three** structures that are present in prokaryotic cells but absent in animal cells.

1

2

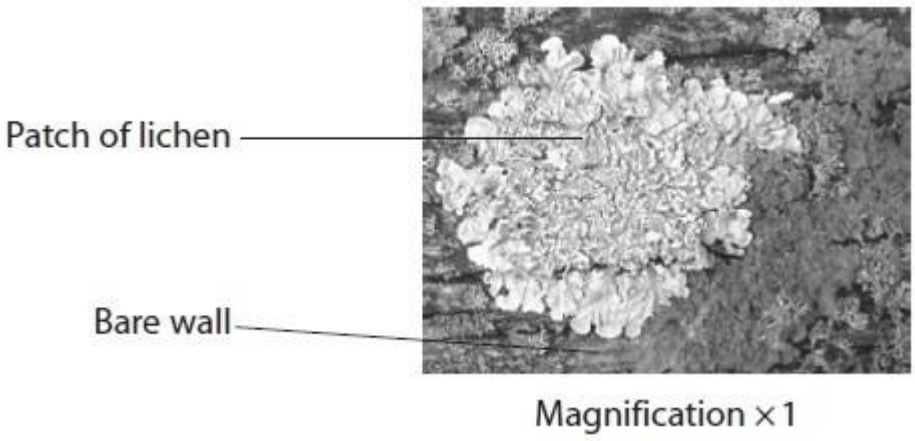
3

(3 marks)

5 Lichen consists of two organisms, an alga and a fungus, growing together.

The alga photosynthesises producing carbohydrate for the two organisms and the fungus absorbs and retains water so that the lichen does not dry out.

The photograph below shows a patch of lichen growing on a wall.



Algae and fungi are eukaryotic organisms.

a Place a cross (☒) in the box next to one difference in cell structure between these two eukaryotic organisms.

A algae have chloroplasts, fungi do not ☐

B algae have circular DNA, fungi have linear DNA ☐

C fungi have chloroplasts, algae do not ☐

D fungi have circular DNA, algae have linear DNA ☐

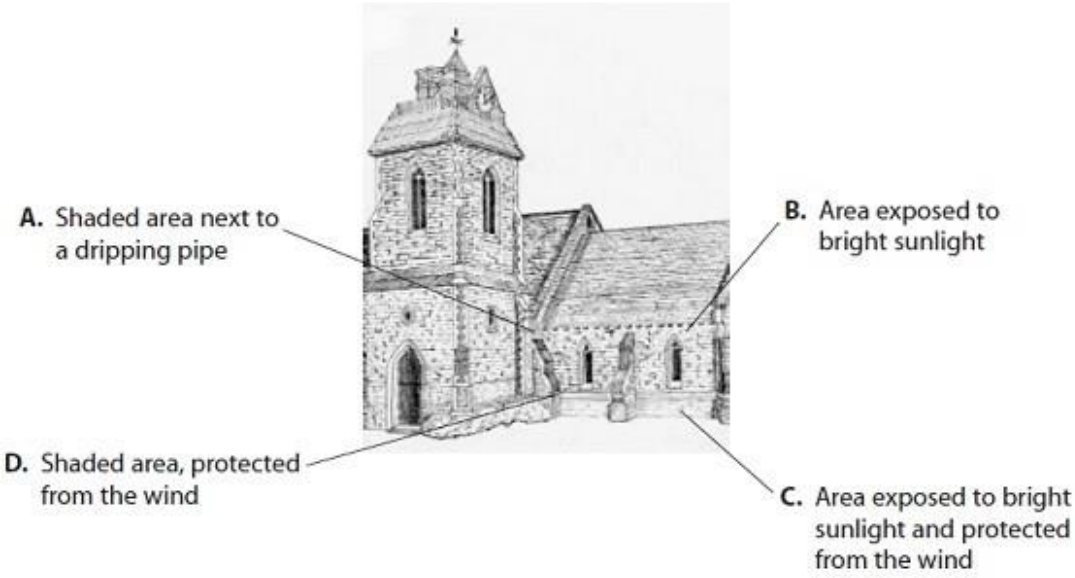
(1 mark)

b Lichens can reproduce sexually and asexually. Sexual reproduction involves meiosis and asexual reproduction involves mitosis.

Describe the advantages to lichens of being able to reproduce both sexually and asexually.

(2 marks)

c The diagram below shows the conditions at four positions, A, B, C and D, on a building.



Place a cross (☒) in the box next to one difference in cell structure between these two eukaryotic organisms.

A ☐

B ☐

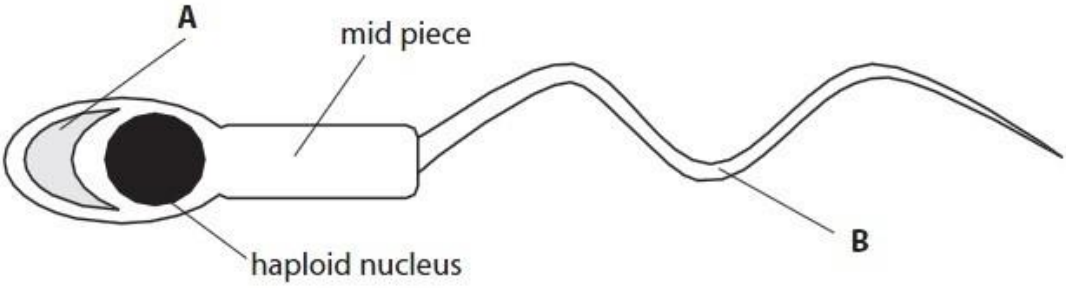
C ☐

D ☐

(1 mark)

6 Fertilisation involves the fusion of haploid nuclei.

a The diagram below shows a human sperm cell.



Name the structures labelled **A** and **B**.

A

B

(2 marks)

b Explain why it is important that the sperm has a nucleus that is haploid.

(2 marks)

7 Rhododendrons are shrubby plants that are widely distributed throughout the northern hemisphere.

The flowering periods and habitats of two species of rhododendron, found on Yakushima Island in Japan, are shown in the table below.

Species	Flowering period	Main flowering period	Habitat
Rhododendron eriocarpum	April to July	May	Rocky areas in lowland regions
Rhododendron indicum	May to July	June	High mountainous regions

Where these populations overlap, hybrid plants are found that have arisen as a result of cross-fertilisation between these two species. These hybrid plants are capable of flowering and producing viable seeds.

a Describe the reasons why some scientists might prefer to classify *Rhododendron eriocarpum* and *Rhododendron indicum* as varieties within the same species rather than as two separate species.

(3 marks)

b Explain why there is likely to be a greater genetic diversity in the hybrid plants than in either of the two separate species.

(2 marks)

c Adaptation can occur within the same species.

Leopards and panthers are members of the same species found in Africa.

Leopards have spotted fur and hunt in open grasslands, whilst panthers have black fur and hunt in forests.

Suggest how natural selection has led to the evolution of these two different forms of the same species.

(4 marks)

8 In an osmosis investigation, a student prepared five pieces of raw potato of equal mass and a range of sucrose solutions of different concentrations.

One piece of potato was placed in each sucrose solution. After two hours, the potato pieces were removed and blotted dry and the change in mass of each potato piece was calculated.

The results are shown in the table below.

Concentration of sucrose solution/mol dm^{-3}	**Change in mass of potato piece/g**
0.2	+1.34
0.4	+0.82
0.6	+0.31
0.8	–0.11
1.0	–0.65

a Explain the meaning of the term **osmosis**.

(2 marks)

b **i** Explain why the piece of potato placed in 0.2 mol dm^{-3} sucrose solution had the largest change in mass.

(3 marks)

ii The student suggested that there would be no change in the mass of a piece of potato placed in a sucrose solution of 0.75 mol dm^{-3}. Give an explanation for this suggestion.

c The student repeated this investigation using another potato and the results were different.

The student concluded that there was a difference in water content of the two potatoes. Describe **two** reasons for this difference in water content.

1

2

(2 marks)

9 **a** Read through the following passage about the heart and its major blood vessels, then fill in the most appropriate word or words to complete the passage.

The mammalian heart consists of four chambers, two upper chambers called

_____ and two lower chambers called ventricles.

The_____carries oxygenated blood away from the

_____ ventricle to the cells of the body and the pulmonary

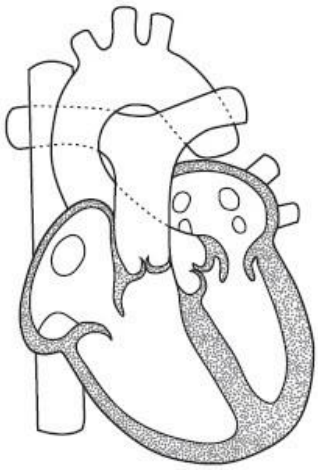
_____ carries deoxygenated blood to the lungs. The

_____ returns deoxygenated blood back to the heart from the

body.

(5 marks)

b The diagram below shows the structure of the heart.



Describe the stage of the cardiac cycle which is shown in the diagram and give a reason for your answer.

(2 marks)

-End of assessment-

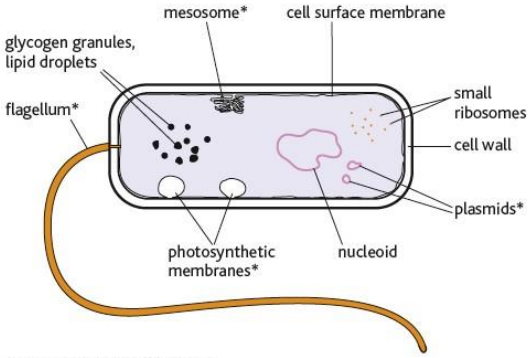
Section A: Cells

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.

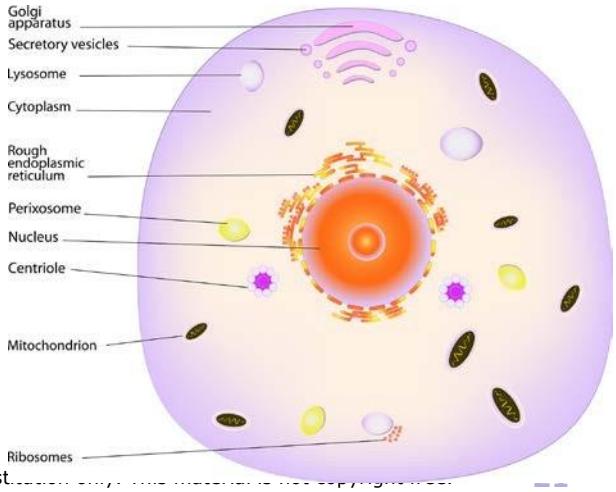


* = not present in all bacteria

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

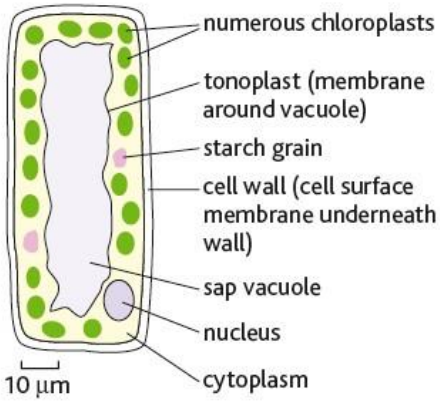
Animal cells have:

- 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.

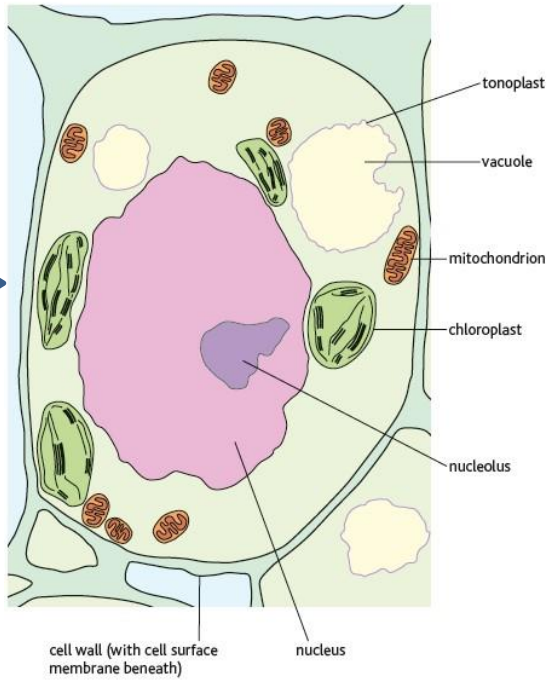


Plant cells have the same organelles as animal cells but they also have:

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



greater detail

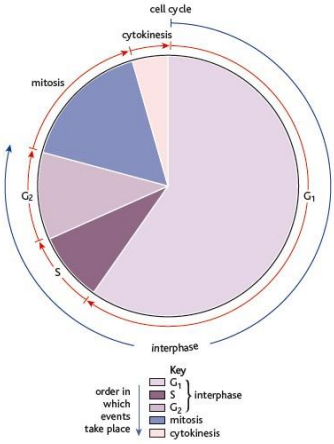


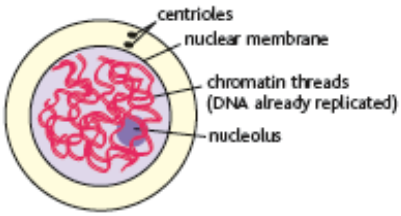
Summary sheet 2: Mitosis

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

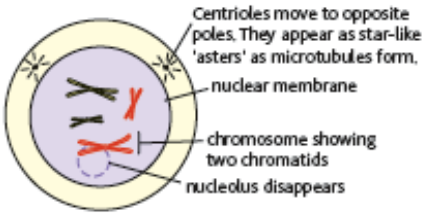
Mitosis occurs during the cell cycle. The cell cycle consists of a period of cell growth and DNA replication known as interphase and then a period of cell division called mitosis followed by cytokinesis where the cytoplasm divides and the cell membrane constricts to form the two daughter cells.

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

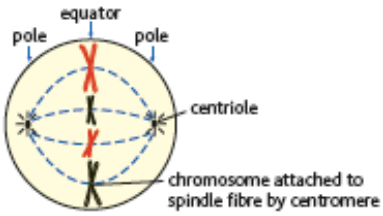




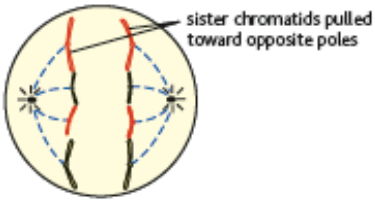
A **Interphase:** before mitosis the tangled, uncoiled mass of chromosomes fills the nucleus. DNA is replicated during this stage.



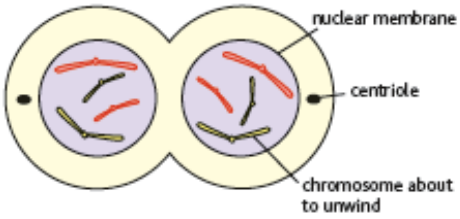
B **Prophase:** the chromosomes coil and condense, each one appearing as two chromatids. The nucleolus breaks down and the centrioles begin to separate and start to form the spindle.



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 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:

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

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.

$$\text{Actual size} = \frac{8}{100} = 0.08 \text{ mm}$$

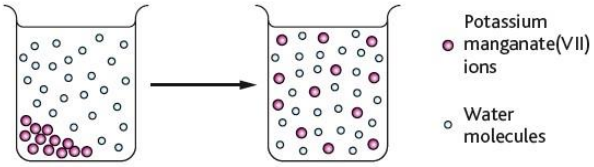
$$= 80 \text{ μm}$$

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

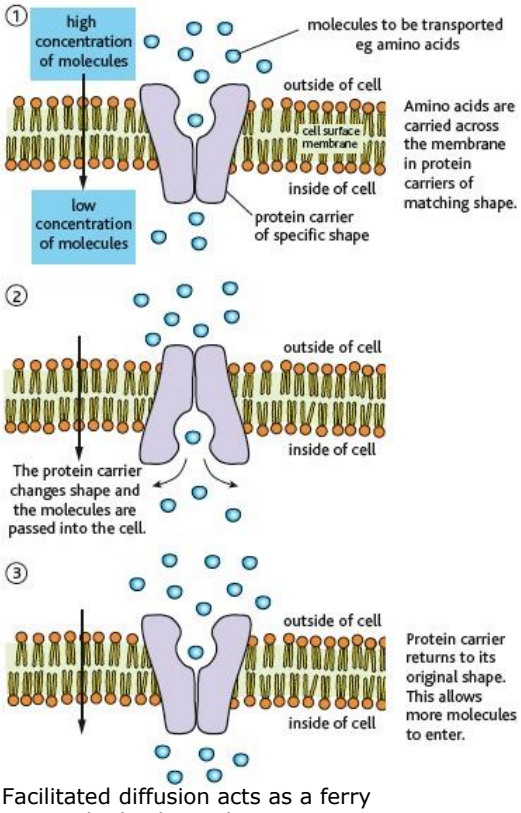
Diffusion

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 manganite(VII) ions will ensure they are eventually evenly mixed.

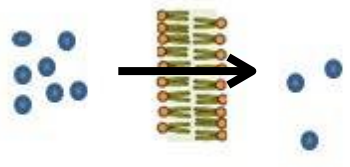
Small particles can diffuse across cell membranes and no energy is required. Some molecules, such as glucose, are too large to diffuse across the cell membrane so they must be helped by carrier proteins. Each molecule has its own carrier protein that allows the molecule through the cell membrane without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

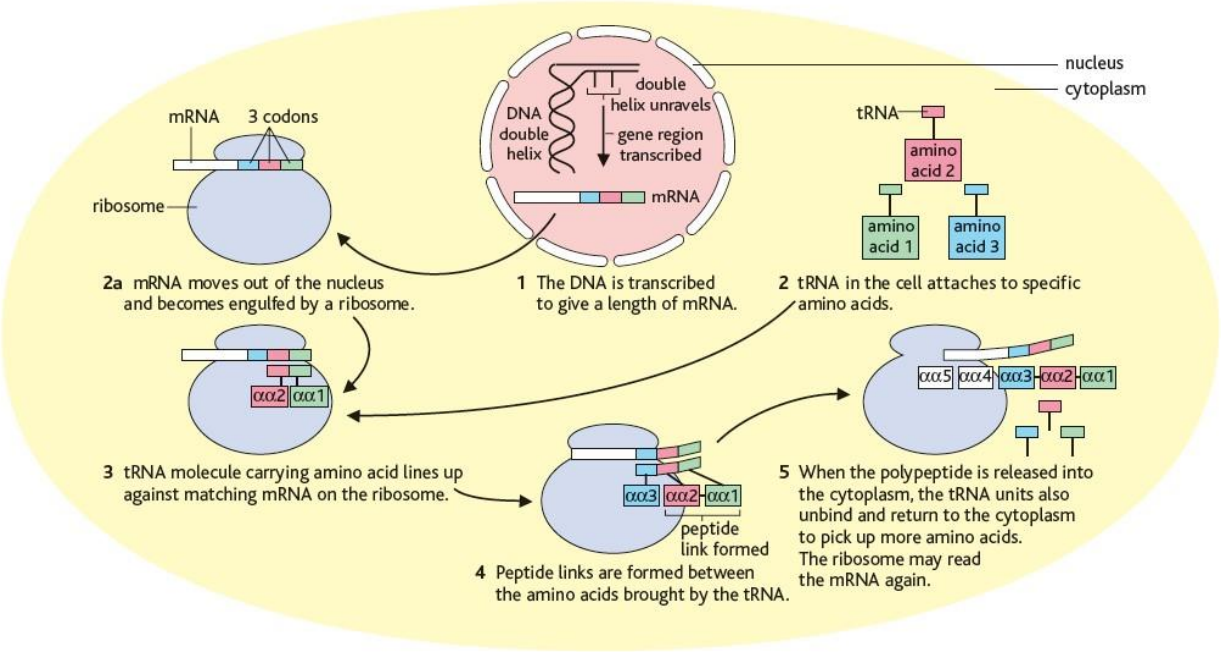
Active transport uses energy to transport substances across membranes from an area of lower concentration to an area of higher concentration

Section B: Molecules

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.



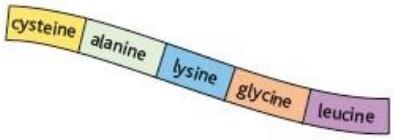
The DNA gene sequence is ACA CGG AAA CCT GAC.

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.

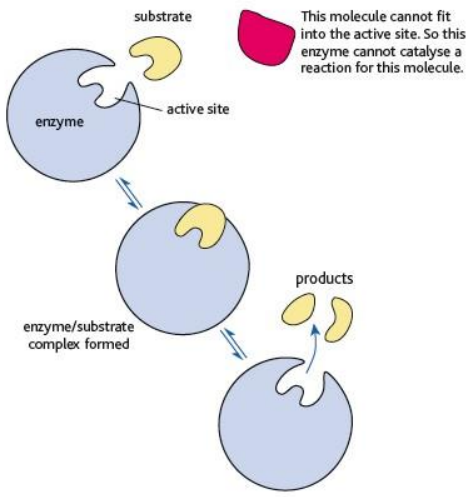
Secondary structure – the repeating pattern in the structure of the peptide chains, such as an α-helix or pleated sheets.

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.

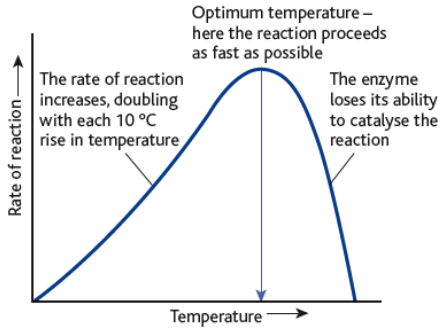


The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

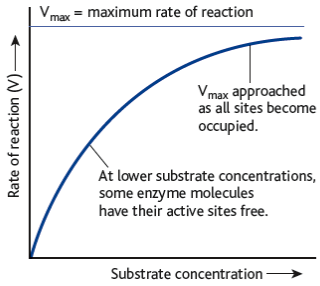
The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

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.



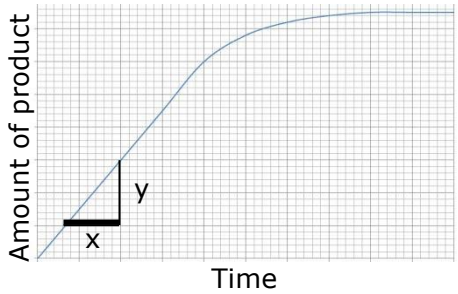
Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.



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 actives sites are occupied.

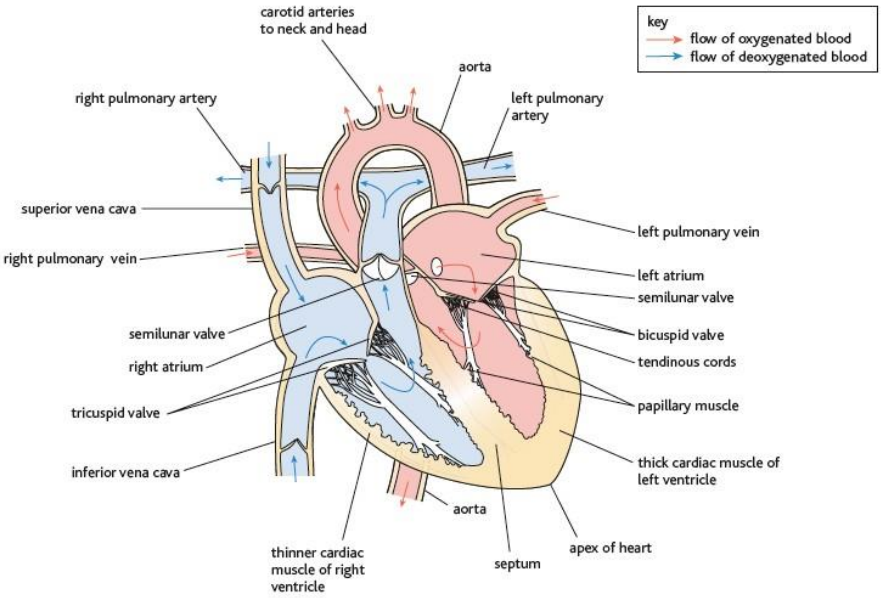
The rate of reaction increases as enzyme concentration increases until all the substrate is bound to an enzyme.

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 : gradient = y ÷ x.

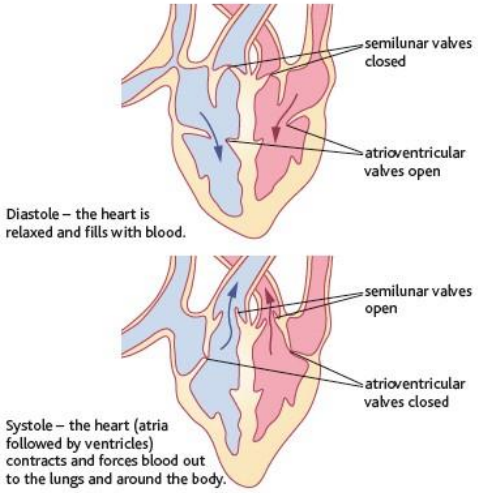


Summary sheet 1: Heart and lungs

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 atrioventicular 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 atrioventicular 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.

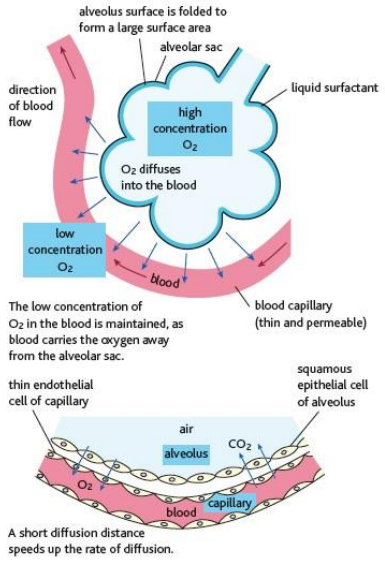


The atrioventricular valves between the atrium and ventricles open to allow blood to flow from the atrium into the ventricles and close when the pressure in the ventricles rises to prevent back flow.

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.

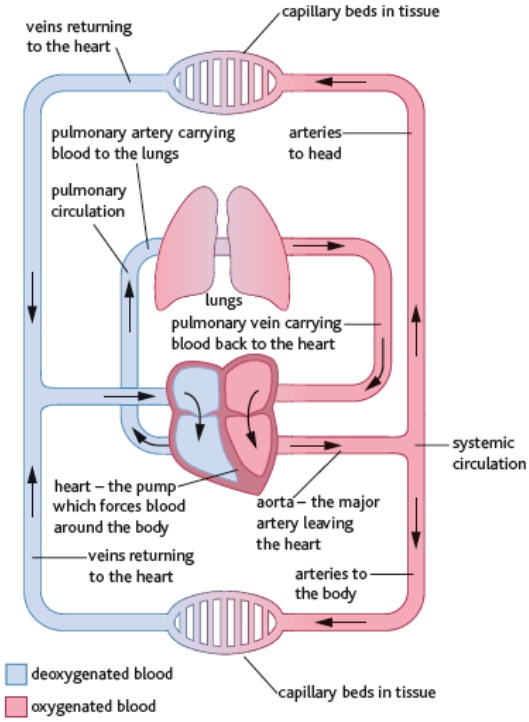


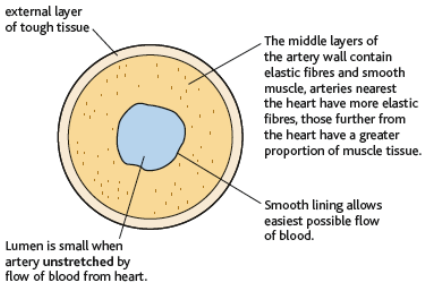
Summary sheet 2: Circulatory system

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

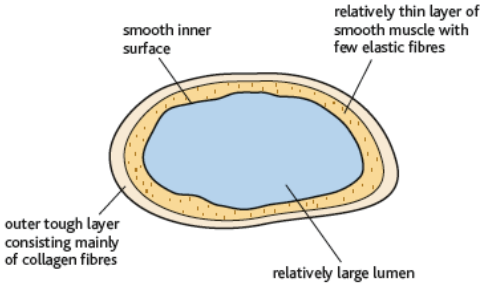
The double circulation system of mammals means that blood flows through the heart twice in one complete cycle of the body.

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

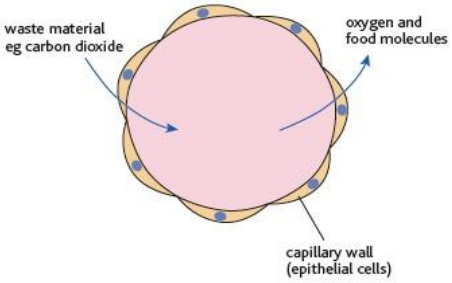




Arteries carry blood away from the heart. The vessel walls are thick and muscular with elastic fibres to withstand the high pressure generated by the heart.



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 though 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

Appendices

Appendix 1: Biology A Specification mapping

Key

	5BI1F/H – Core Science
	5BI2F/H –Additional Science
	5BI3F/H –Extension Unit or Further Additional Science

The table on the following pages maps certain topics from the new AS level Biology A specification across to relevant sections within the GCSE specification.

Topic 1 – Lifestyle, Health and Risk	**GCSE**
1.1 Understand why many animals have a heart and circulation (mass transport to overcome limitations of diffusion in meeting the requirements of organisms).	2.3 Define diffusion as the movement of particles from an area of high concentration to an area of lower concentration.
1.3 Understand how the structures of blood vessels (capillaries, arteries and veins) relate to their functions.	3.11 Describe how the circulatory system transports substances around the body, including: a arteries transport blood away from the heart b veins transport blood to the heart c capillaries exchange materials with tissues.

Topic 1 – Lifestyle, Health and Risk	GCSE
1.4 i) Know the cardiac cycle (atrial systole, ventricular systole and cardiac diastole) and relate the structure and operation of the mammalian heart, including the major blood vessels, to its function. ii) Know how the relationship between heart structure and function can be investigated practically.	3.10 Explain how the structure of the heart is related to its function, including: a the four major blood vessels associated with the heart (pulmonary artery, pulmonary vein, aorta, vena cava) b left atrium and ventricle to pump oxygenated blood c right atrium and ventricle to pump deoxygenated blood d valves to prevent backflow (names not required) e left ventricle has a thicker muscle wall than the right ventricle f the direction of blood flow through the heart.
1.6 Understand the blood-clotting process (thromboplastin release, conversion of prothrombin to thrombin and fibrinogen to fibrin) and its role in cardiovascular disease (CVD).	3.8 Recall the structure and function of the following parts of the blood, including: a red blood cells b white blood cells c plasma d platelets.
1.8 Be able to analyse and interpret quantitative data on illness and mortality rates to determine health risks, including distinguishing between correlation and causation and recognising conflicting evidence.	2.12 Explain how Type 2 diabetes can be controlled by diet and physical activity. 2.13 Evaluate the correlation between obesity (including calculations of BMI) and Type 2 diabetes.
1.13 Know how monosaccharides join to form disaccharides (sucrose, lactose and maltose) and polysaccharides (glycogen and amylose) through condensation reactions forming glycosidic bonds, and how these can be split through hydrolysis reactions.	3.14 Explain the role of digestive enzymes, including: a carbohydrases, including amylase, which digest starch to simple sugars. b proteases, including pepsin, which digest proteins to amino acids. c lipase, which digests fats to fatty acids and glycerol.

Topic 1 – Lifestyle, Health and Risk	GCSE
1.14 i) Know how a triglyceride is synthesised by the formation of ester bonds during condensation reactions between glycerol and three fatty acids. ii) Know the differences between saturated and unsaturated lipids.	3.14 Explain the role of digestive enzymes, including: a carbohydrases, including amylase, which digest starch to simple sugars b proteases, including pepsin, which digest proteins to amino acids c lipase, which digests fats to fatty acids and glycerol.
1.16 Understand how people use scientific knowledge about the effects of diet, including obesity indicators, body mass index and waist-to-hip ratio, exercise and smoking to reduce their risk of coronary heart disease.	2.13 Evaluate the correlation between obesity (including calculations of BMI) and Type 2 diabetes.
CORE PRACTICAL 1: Investigate the effect of caffeine on heart rate in daphnia.	3.2 Describe the general effects of: a painkillers that block nerve impulses, including morphine b hallucinogens that distort sense perception, including LSD c stimulants that increase the speed of reactions and neurotransmission at the synapse, including caffeine d depressants that slow down the activity of the brain, including alcohol. 3.3 *Investigate reaction times.*

Topic 2 – Genes and health	GCSE
2.1 i) Know the properties of gas exchange surfaces in living organisms (large surface area to volume ratio, thickness of surface, difference in concentration). ii) Understand how the rate of diffusion is dependent on these properties and can be calculated using Fick's Law of Diffusion. iii) Understand how the structure of the mammalian lung is adapted for rapid gaseous exchange.	3.11 Describe how the circulatory system transports substances around the body, including: a arteries transport blood away from the heart b veins transport blood to the heart c capillaries exchange materials with tissues 2.3 Define diffusion as the movement of particles from an area of high concentration to an area of lower concentration.
2.2 i) Know the structure and properties of cell membranes. ii) Understand how models such as the fluid mosaic model of cell membranes are interpretations of data used to develop scientific explanations of the structure and properties of cell membranes.	1.1 Describe the function of the components of a bacterial cell including chromosomal DNA, plasmid DNA, flagella and cell wall. 1.2 Describe the function of the components of a plant cell including chloroplast, large vacuole, cell wall, cell membrane, mitochondria, cytoplasm and nucleus. 1.3 Describe the function of the components of an animal cell including cell membrane, mitochondria, cytoplasm and nucleus.
2.3 Understand what is meant by osmosis in terms of the movement of free water molecules through a partially permeable membrane (consideration of water potential is not required).	2.20 Define osmosis as the movement of water molecules from an area of higher concentration of water to an area of lower concentration of water through a partially permeable membrane.

Topic 2 – Genes and health	GCSE
2.4 i) Understand what is meant by passive transport (diffusion, facilitated diffusion), active transport (including the role of ATP as an immediate source of energy), endocytosis and exocytosis. ii) Understand the involvement of carrier and channel proteins in membrane transport.	2.3 Define diffusion as the movement of particles from an area of high concentration to an area of lower concentration. 2.20 Define osmosis as the movement of water molecules from an area of higher concentration of water to an area of lower concentration of water through a partially permeable membrane. 2.18 Explain how water, glucose and mineral salts are transported through a plant, including: a mineral uptake in roots by active transport.
2.5 i) Know the basic structure of mononucleotides (deoxyribose or ribose linked to a phosphate and a base, including thymine, uracil, cytosine, adenine or guanine) and the structures of DNA and RNA (polynucleotides composed of mononucleotides linked through condensation reactions). ii) Know how complementary base pairing and the hydrogen bonding between two complementary strands are involved in the formation of the DNA double helix.	1.7 Describe a DNA molecule as: a two strands coiled to form a double helix b strands linked by a series of complementary base pairs joined together by weak hydrogen bonds: i adenine (A) with thymine (T) ii cytosine (C) with guanine (G).

Topic 2 – Genes and health	GCSE
2.6 i) Understand the process of protein synthesis (transcription) including the role of RNA polymerase, translation, messenger RNA, transfer RNA, ribosomes and the role of start and stop codons. ii) Understand the roles of the DNA template (antisense) strand in transcription, codons on messenger RNA and anticodons on transfer RNA.	1.22 Describe how the order of bases in a section of DNA decides the order of amino acids in the protein. 1.23 Demonstrate an understanding of the stages of protein synthesis, including transcription and translation: a the production of complementary mRNA strand in the nucleus b the attachment of the mRNA to the ribosome c the coding by triplets of bases (codons) in the mRNA for specific amino acids d the transfer of amino acids to the ribosome by tRNA e the linking of amino acids to form polypeptides.
2.7 Understand the nature of the genetic code (triplet code, non-overlapping and degenerate).	1.22 Describe how the order of bases in a section of DNA decides the order of amino acids in the protein. 1.23 Demonstrate an understanding of the stages of protein synthesis, including transcription and translation: a the production of complementary mRNA strand in the nucleus b the attachment of the mRNA to the ribosome c the coding by triplets of bases (codons) in the mRNA for specific amino acids d the transfer of amino acids to the ribosome by tRNA e the linking of amino acids to form polypeptides.
2.8 Know that a gene is a sequence of bases on a DNA molecule that codes for a sequence of amino acids in a polypeptide chain.	1.22 Describe how the order of bases in a section of DNA decides the order of amino acids in the protein.

Topic 2 – Genes and health	GCSE
2.10 i) Understand the mechanism of action and the specificity of enzymes in terms of their three-dimensional structure. ii) Understand that enzymes are biological catalysts that reduce activation energy. iii) Know that there are intracellular enzymes catalysing reactions inside cells and extracellular enzymes produced by cells catalysing reactions outside of cells.	1.26 Describe enzymes as biological catalysts. 1.27 Demonstrate an understanding that enzymes catalyse chemical reactions occurring inside and outside living cells, including: a DNA replication b protein synthesis c digestion. 1.28 Describe the factors affecting enzyme action, including: a temperature b substrate concentration c pH. 1.29 Recall that enzymes are highly specific for their substrate. 1.30 Demonstrate an understanding of the action of enzymes in terms of the 'lock-and-key' hypothesis. 1.31 Describe how enzymes can be denatured due to changes in the shape of the active site. *1.32 Investigate the factors that affect enzyme activity.*
CORE PRACTICAL 4: Investigate the effect of enzyme and substrate concentrations on the initial rates of reactions.	1.32 *Investigate the factors that affect enzyme activity.*
2.12 i) Understand how errors in DNA replication can give rise to mutations. ii) Understand how cystic fibrosis results from one of a number of possible gene mutations.	1.25 Demonstrate an understanding of how gene mutations change the DNA base sequence and that mutations can be harmful, beneficial or neither.

Topic 2 – Genes and health	GCSE
2.13 i) Know the meaning of the terms: gene, allele, genotype, phenotype, recessive, dominant, incomplete dominance, homozygote and heterozygote. ii) Understand patterns of inheritance, including the interpretation of genetic pedigree diagrams, in the context of monohybrid inheritance.	1.21 Demonstrate an understanding that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics. 1.22 Recall the meaning of, and use appropriately, the terms: dominant, recessive, homozygous, heterozygous, phenotype and genotype. 1.23 Analyse and interpret patterns of monohybrid inheritance using a genetic diagram, Punnett squares and family pedigrees. 1.24 Calculate and analyse outcomes (using probabilities, ratios and percentages) from monohybrid crosses.
2.14 Understand how the expression of a gene mutation in people with cystic fibrosis impairs the functioning of the gaseous exchange, digestive and reproductive systems.	1.25 Describe the symptoms of the genetic disorders: a sickle cell disease b cystic fibrosis.
2.15 i) Understand the uses of genetic screening, including the identification of carriers, pre-implantation genetic diagnosis (PGD) and prenatal testing, including amniocentesis and chorionic villus sampling. ii) Understand the implications of prenatal genetic screening.	1.26 Evaluate the outcomes of pedigree analysis when screening for genetic disorders: a sickle cell disease b cystic fibrosis.

Topic 3 – Voice of the genome	GCSE
3.2 Know the ultrastructure of eukaryotic cells, including nucleus, nucleolus, ribosomes, rough and smooth endoplasmic reticulum, mitochondria, centrioles, lysosomes, and Golgi apparatus.	1.2 Describe the function of the components of a plant cell including chloroplast, large vacuole, cell wall, cell membrane, mitochondria, cytoplasm and nucleus. 1.3 Describe the function of the components of an animal cell including cell membrane, mitochondria, cytoplasm and nucleus.
3.4 Know the ultrastructure of prokaryotic cells, including cell wall, capsule, plasmid, flagellum, pili, ribosomes, mesosomes and circular DNA.	1.1 Describe the function of the components of a bacterial cell including chromosomal DNA, plasmid DNA, flagella and cell wall.
3.5 Be able to recognise the organelles in 3.2 from electron microscope (EM) images.	1.5 Demonstrate an understanding of how changes in microscope technology have enabled us to see cells with more clarity and detail than in the past, including simple magnification calculations.
3.6 Understand how mammalian gametes are specialised for their functions (including the acrosome in sperm and the zona pellucida in the egg).	1.14 Explain how the structure of an egg is adapted to its function: a cytoplasm to provide nutrients b haploid nucleus containing one set of the genetic material c immediately after fertilisation the cell membrane around the egg changes to block entry of other sperm. 1.15 Explain how the structure of a sperm cell is adapted to its function, including: a acrosome containing enzymes b haploid nucleus containing one set of the genetic material c middle section containing mitochondria d tail for motility.

Topic 3 – Voice of the genome	GCSE
3.7 Know the process of fertilisation in mammals, including the acrosome reaction, the cortical reaction and the fusion of nuclei.	1.15 Recall that, at fertilisation, haploid gametes combine to form a diploid zygote.
3.8 i) Know that a locus (loci) is the location of genes on a chromosome. ii) Understand the linkage of genes on a chromosome and sex linkage.	1.19 Explain (using probabilities, ratios and percentages) how sex-linked genetic disorders are inherited, including: a haemophilia b colour blindness.
3.9 Understand the role of meiosis in ensuring genetic variation through the production of non-identical gametes as a consequence of independent assortment of chromosomes and crossing over of alleles between chromatids (details of the stages of meiosis are not required).	1.16 Describe the division of a cell by meiosis as the production of four daughter cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes.
3.10 Understand the role of mitosis and the cell cycle in producing identical daughter cells for growth and asexual reproduction.	1.13 Describe the division of a cell by mitosis as the production of two daughter cells, each with identical sets of chromosomes in the nucleus to the parent cell, and that this results in the formation of two genetically identical diploid body cells. 1.14 Recall that mitosis occurs during growth, repair and asexual reproduction.
CORE PRACTICAL 5: Prepare and stain a root tip squash to observe the stages of mitosis.	1.13 Describe the division of a cell by mitosis as the production of two daughter cells, each with identical sets of chromosomes in the nucleus to the parent cell, and that this results in the formation of two genetically identical diploid body cells. 1.14 Recall that mitosis occurs during growth, repair and asexual reproduction.

Topic 3 – Voice of the genome	GCSE
3.11 i) Understand what is meant by the terms 'stem cell, pluripotency and totipotency'. ii) Be able to discuss the way society uses scientific knowledge to make decisions about the use of stem cells in medical therapies.	1.20 Recall that stem cells in the embryo can differentiate into all other types of cells, but that cells lose this ability as the animal matures. 1.21 Demonstrate an understanding of the advantages, disadvantages and risks arising from adult and embryonic stem cell research.
3.12 Understand how cells become specialised through differential gene expression, producing active mRNA leading to synthesis of proteins, which in turn control cell processes or determine cell structure in animals and plants, including lac operon	1.20 Recall that stem cells in the embryo can differentiate into all other types of cells, but that cells lose this ability as the animal matures.
3.13 Understand how the cells of multicellular organisms are organised into tissues, tissues into organs and organs into systems.	3.9 Describe the grouping of cells into tissues, tissues into organs, and organs into organ systems.
3.14 i) Understand how phenotype is the result of an interaction between genotype and the environment. ii) Know how epigenetic changes, including DNA methylation and histone modification, can modify the activation of certain genes. iii) Understand how epigenetic changes can be passed on following cell division.	1.16 Demonstrate an understanding of the causes of variation, including: a genetic variation – different characteristics as a result of mutation or reproduction b environmental variation – different characteristics caused by an organism's environment (acquired characteristics).
3.15 Understand how some phenotypes are affected by multiple alleles for the same gene at many loci (polygenic inheritance) as well as the environment and how this can give rise to phenotypes that show continuous variation.	1.13 Describe variation as continuous or discontinuous. *1.14 Investigate the variations within a species to illustrate continuous variation and discontinuous variation.*

Topic 4 – Exchange and transport	GCSE
4.1 Know that over time the variety of life has become extensive but is now being threatened by human activity.	3.20 Analyse, interpret and evaluate data on global population change. 3.21 Explain how the increase in human population contributes to an increase in the production of pollutants, including phosphates, nitrates and sulfur dioxide.
4.3 Understand the concept of niche and be able to discuss examples of adaptation of organisms to their environment (behavioural, physiological and anatomical).	2.6 Describe the different behaviours exhibited by animals, including: a innate behaviour b imprinting c habituation d classical conditioning e operant conditioning.

Topic 4 – Exchange and transport	GCSE
4.4 Understand how natural selection can lead to adaptation and evolution.	1.12 Demonstrate an understanding of Darwin's theory of evolution by natural selection including: a variation – most populations of organisms contain individuals which vary slightly from one to another b over-production – most organisms produce more young than will survive to adulthood c struggle for existence – because populations do not generally increase rapidly in size there must therefore be considerable competition for survival between the organisms d survival – those with advantageous characteristics are more likely to survive this struggle e advantageous characteristics inherited – better adapted organisms are more likely to reproduce successfully passing on the advantageous characteristics to their offspring f gradual change – over a period of time the proportion of individuals with the advantageous characteristics in the population will increase compared with the proportion of individuals with poorly adapted characteristics, and the poorly adapted characteristics may eventually be lost.
4.5 i) Understand how the Hardy-Weinberg equation can be used to see whether a change in allele frequency is occurring in a population over time. ii) Understand that reproductive isolation can lead to accumulation of different genetic information in populations potentially leading to the formation of new species.	1.17 Demonstrate an understanding of how speciation occurs as a result of geographic isolation.

Topic 4 – Exchange and transport	GCSE
4.6 i) Understand that classification is a means of organising the variety of life based on relationships between organisms using differences and similarities in phenotypes and in genotypes, and is built around the species concept. ii) Understand the process and importance of critical evaluation of new data by the scientific community, which leads to new taxonomic groupings, including the three domains of life based on molecular phylogeny, which are Bacteria, Archaea, Eukaryota.	1.1 Demonstrate an understanding of how biologists classify organisms according to how closely they are related to one another including: a Species – groups of organisms that have many features in common b Genus – contains several species with similar characteristics c Family – comprising of several genera d Order – comprising of several families e Class – comprising of several orders f Phylum – comprising of several classes g The Five Kingdoms – animalia, plantae, fungi, protoctista and prokaryotes. 1.2 Describe the main characteristics of the five kingdoms including: a Animalia – multicellular, do not have cell walls, do not have chlorophyll, feed heterotrophically b Plantae – multicellular, have cell walls, have chlorophyll, feed autotrophically c Fungi – multicellular, have cell walls, do not have chlorophyll, feed saprophytically d Protoctista – unicellular, have a nucleus e Prokaryotes – unicellular, have no nucleus. 1.3 Explain why scientists do not classify viruses in any of the five kingdoms and regard them as non-living.
4.7 Know the ultrastructure of plant cells (cell walls, chloroplasts, amyloplasts, vacuole, tonoplast, plasmodesmata, pits and middle lamella) and be able to compare it with animal cells.	1.2 Describe the function of the components of a plant cell including chloroplast, large vacuole, cell wall, cell membrane, mitochondria, cytoplasm and nucleus.

Topic 4 – Exchange and transport	GCSE
4.8 Be able to recognise the organelles in 4.7 from electron microscope (EM) images.	1.5 Demonstrate an understanding of how changes in microscope technology have enabled us to see cells with more clarity and detail than in the past, including simple magnification calculations.
4.10 Understand how the arrangement of cellulose microfibrils and secondary thickening in plant cell walls contributes to the physical properties of xylem vessels and sclerenchyma fibres in plant fibres that can be exploited by humans.	2.18 Explain how water, glucose and mineral salts are transported through a plant, including: a mineral uptake in roots by active transport b the role of the xylem and phloem vessels.
CORE PRACTICAL 6: Identify sclerenchyma fibres, phloem sieve tubes and xylem vessels and their location within stems through a light microscope.	2.18 Explain how water, glucose and mineral salts are transported through a plant, including: a mineral uptake in roots by active transport b the role of the xylem and phloem vessels.
4.11 Know the similarities and differences between the structures, position in the stem and function of sclerenchyma fibres (support), xylem vessels (support and transport of water and mineral ions) and phloem (translocation of organic solutes).	2.18 Explain how water, glucose and mineral salts are transported through a plant, including: a mineral uptake in roots by active transport b the role of the xylem and phloem vessels.
4.14 Understand the conditions required for bacterial growth.	1.27 Demonstrate an understanding of Louis Pasteur's contribution to the development of aseptic techniques. *1.28 Investigate the conditions affecting growth of microorganisms (using resazurin dye).*

Topic 4 – Exchange and transport	GCSE
CORE PRACTICAL 9: Investigate the antimicrobial properties of plants, including aseptic techniques for the safe handling of bacteria.	3.11 Demonstrate an understanding that plants produce chemicals that have antibacterial effects in order to defend themselves, some of which are used by humans. 3.15 *Investigate the effects of antiseptics or antibiotics on microbial cultures.*
	1.27 Demonstrate an understanding of Louis Pasteur's contribution to the development of aseptic techniques.

Appendix 2: Biology B Specification mapping

Key

	5BI1F/H – Core Science
	5BI2F/H –Additional Science
	5BI3F/H –Extension Unit or Further Additional Science

The table on the following pages maps certain topics from the new AS level Biology B specification across to relevant sections within the GCSE specification.

Topic 1 – Biological molecules	**GCSE**
1.1 i) Know the difference between monosaccharides, disaccharides and polysaccharides. ii) Know the structure of the hexose glucose (alpha and beta) and the pentose ribose. iii) Understand how monosaccharides (glucose, fructose, galactose) join to form disaccharides (sucrose, lactose and maltose) and polysaccharides (starch formed from amylose and amylopectin; glycogen) through condensation reactions forming glycosidic bonds, and how these can be split through hydrolysis reactions. iv) Understand how the structure of glucose, starch, glycogen and cellulose relates to their function.	3.14 Explain the role of digestive enzymes, including: a carbohydrases, including amylase, which digest starch to simple sugars b proteases, including pepsin, which digest proteins to amino acids c lipase, which digests fats to fatty acids and glycerol.

Topic 1 – Biological molecules	GCSE
1.2 i) Understand how a triglyceride is synthesised including the formation of ester bonds during condensation reactions between glycerol and three fatty acids. ii) Know the differences between saturated and unsaturated lipids. iii) Understand how the structure of lipids relates to their role in energy storage, waterproofing and insulation. iv) Understand how the structure and properties of phospholipids relate to their function in cell membranes.	3.14 Explain the role of digestive enzymes, including: a carbohydrases, including amylase, which digest starch to simple sugars b proteases, including pepsin, which digest proteins to amino acids c lipase, which digests fats to fatty acids and glycerol.
1.3 i) Know the structure of an amino acid (structures of specific amino acids are not required). ii) Understand the formation of polypeptides and proteins (as amino acid monomers linked by peptide bonds in condensation reactions). iii) Understand the role of ionic, hydrogen and disulphide bonding in the structure of proteins. iv) Understand the significance of the primary, secondary, tertiary and quaternary structure of a protein in determining the properties of fibrous and globular proteins, including collagen and haemoglobin. v) Understand how the structure of collagen and haemoglobin are related to their function.	1.22 Describe how the order of bases in a section of DNA decides the order of amino acids in the protein.

Topic 1 – Biological molecules	GCSE
1.4 i) Know the structure of DNA, including the structure of the nucleotides (purines and pyrimidines), base pairing, the two sugar-phosphate backbones, phosphodiester bonds and hydrogen bonds. ii) Understand how DNA is replicated semi-conservatively, including the role of DNA helicase, polymerase and ligase. iii) Know that a gene is a sequence of bases on a DNA molecule coding for a sequence of amino acids in a polypeptide chain. iv) Know the structure of mRNA including nucleotides, the sugar phosphate backbone and the role of hydrogen bonds. v) Know the structure of tRNA, including nucleotides, the role of hydrogen bonds and the anticodon. vi) Understand the processes of transcription in the nucleus and translation at the ribosome, including the role of sense and anti-sense DNA, mRNA, tRNA and the ribosomes. vii) Understand the nature of the genetic code, including triplets coding for amino acids, start and stop codons, degenerate and non-overlapping nature, and that not all the genome codes for proteins. viii) Understand the term gene mutation as illustrated by base deletions, insertions and substitutions. ix) Understand the effect of point mutations on amino acid sequences, as illustrated by sickle cell anaemia in humans.	1.7 Describe a DNA molecule as: a two strands coiled to form a double helix b strands linked by a series of complementary base pairs joined together by weak hydrogen bonds: i adenine (A) with thymine (T) ii cytosine (C) with guanine (G). 1.22 Describe how the order of bases in a section of DNA decides the order of amino acids in the protein. 1.23 Demonstrate an understanding of the stages of protein synthesis, including transcription and translation: a the production of complementary mRNA strand in the nucleus b the attachment of the mRNA to the ribosome c the coding by triplets of bases (codons) in the mRNA for specific amino acids d the transfer of amino acids to the ribosome by tRNA e the linking of amino acids to form polypeptides. 1.24 Describe each protein as having its own specific number and sequence of amino acids, resulting in different-shaped molecules that have different functions, including enzymes. 1.25 Demonstrate an understanding of how gene mutations change the DNA base sequence and that mutations can be harmful, beneficial or neither.

Topic 1 – Biological molecules	GCSE
1.5 i) Know the structure of enzymes as globular proteins. ii Understand the concepts of specificity and the induced fit hypothesis. iii) Understand that enzymes are catalysts that reduce activation energy. iv Understand how temperature, pH, substrate and enzyme concentration affect the rate of enzyme activity. CORE PRACTICAL 1: Investigate a factor affecting the initial rate of an enzyme– controlled reaction. v) Understand how the initial rate of enzyme activity can be measured and why this is important. vi) Understand how enzymes can be affected by competitive, non-competitive and end-product inhibition. vii) Know that enzymes catalyse a wide range of intracellular reactions as well as extracellular ones.	1.26 Describe enzymes as biological catalysts. 1.27 Demonstrate an understanding that enzymes catalyse chemical reactions occurring inside and outside living cells, including: a DNA replication b protein synthesis c digestion. 1.28 Describe the factors affecting enzyme action, including: a temperature b substrate concentration c pH. 1.29 Recall that enzymes are highly specific for their substrate. 1.30 Demonstrate an understanding of the action of enzymes in terms of the 'lock-and-key' hypothesis. 1.31 Describe how enzymes can be denatured due to changes in the shape of the active site. *1.32 Investigate the factors that affect enzyme activity.*

Topic 1 – Biological molecules	GCSE
1.6 i) Understand the role in plants of: • nitrate ions – to make DNA and amino acids • calcium ions – to form calcium pectate for the middle lamellae • magnesium ions – to produce chlorophyll • phosphate ions – to make ADP and ATP.	3.27 Demonstrate an understanding of how nitrogen is recycled: a nitrogen gas in the air cannot be used directly by plants and animals b nitrogen-fixing bacteria living in root nodules or the soil can fix nitrogen gas c the action of lightning can convert nitrogen gas into nitrates d decomposers break down dead animals and plants e soil bacteria convert proteins and urea into ammonia f nitrifying bacteria convert this ammonia to nitrates g plants absorb nitrates from the soil h nitrates are needed by plants to make proteins for growth i nitrogen compounds pass along a food chain or web j denitrifying bacteria convert nitrates to nitrogen gas.

Topic 2 – Cells, Viruses and Reproduction of Living Things	GCSE
2.1 i) Understand that cell theory is a unifying concept that states that cells are a fundamental unit of structure, function and organisation in all living organisms. ii) Understand that in complex organisms, cells are organised into tissues, organs, and organ systems. iii) Know the ultrastructure of prokaryotic cells and the structure of organelles, including: nucleoid, plasmids, 70S ribosomes and cell wall. iv) Be able to distinguish between Gram positive and Gram negative bacterial cell walls and understand why each type reacts differently to some antibiotics. v) Know the ultrastructure of eukaryotic cells and the functions of organelles, including: nucleus, nucleolus, 80S ribosomes, rough and smooth endoplasmic reticulum, mitochondria, centrioles, lysosomes, Golgi apparatus, cell wall, chloroplasts, vacuole and tonoplast. vi) Know how magnification and resolution can be achieved using light and electron microscopy. vii) Understand the importance of staining specimens in microscopy. CORE PRACTICAL 2: Use of the light microscope, including simple stage and eyepiece micrometers and drawing small numbers of cells from a specialised tissue.	1.1 Describe the function of the components of a bacterial cell including chromosomal DNA, plasmid DNA, flagella and cell wall. 1.2 Describe the function of the components of a plant cell including chloroplast, large vacuole, cell wall, cell membrane, mitochondria, cytoplasm and nucleus. 1.3 Describe the function of the components of an animal cell including cell membrane, mitochondria, cytoplasm and nucleus. 1.4 Describe how plant and animal cells can be studied in greater detail with a light microscope. 1.5 Demonstrate an understanding of how changes in microscope technology have enabled us to see cells with more clarity and detail than in the past, including simple magnification calculations.

Topic 2 – Cells, Viruses and Reproduction of Living Things	GCSE
2.3 i) Know that the cell cycle is a regulated process in which cells divide into two identical daughter cells, and that this process consists of three main stages: interphase, mitosis and cytokinesis. ii) Understand what happens to genetic material during the cell cycle, including the stages of mitosis. iii) Understand how mitosis contributes to growth, repair and asexual reproduction. CORE PRACTICAL 3: Make a temporary squash preparation of a root tip to show stages of mitosis in the meristem under the light microscope. iv) Understand how meiosis results in haploid gametes, including the stages of meiosis. v) Understand that meiosis results in genetic variation through recombination of alleles, including independent assortment and crossing over. vi) Understand what chromosome mutations are, as illustrated by translocations. vii) Understand how non-disjunction can lead to polysomy, including Down's syndrome, and monosomy, including Turner's syndrome.	1.13 Describe the division of a cell by mitosis as the production of two daughter cells, each with identical sets of chromosomes in the nucleus to the parent cell, and that this results in the formation of two genetically identical diploid body cells. 1.14 Recall that mitosis occurs during growth, repair and asexual reproduction. 1.16 Describe the division of a cell by meiosis as the production of four daughter cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes.
2.4 i) Understand the process of oogenesis and spermatogenesis. ii) Understand the events of fertilisation from the first contact between the gametes to the fusion of nuclei. iii) Understand the early development of the embryo to blastocyst stage.	1.15 Recall that, at fertilisation, haploid gametes combine to form a diploid zygote.

Topic 3 – Classification and Biodiversity	GCSE
3.1 i) Know that the classification system consists of a hierarchy of domain, kingdom, phylum, class, order, family, genus and species. ii) Understand the limitations of the definition of a species as a group of organisms with similar characteristics that interbreed to produce fertile offspring. iii) Understand why it is often difficult to assign organisms to any one species or to identify new species. iv) Understand how gel electrophoresis can be used to distinguish between species and determine evolutionary relationships. v) Know that DNA sequencing and bioinformatics can be used to distinguish between species and determine evolutionary relationships. vi) Understand the role of scientific journals, the peer review process and scientific conferences in validating new evidence supporting the accepted scientific theory of evolution. vii) Understand the evidence for the three-domain model of classification as an alternative to the five-kingdom model and the role of the scientific community in validating this evidence.	1.1 Demonstrate an understanding of how biologists classify organisms according to how closely they are related to one another including: a Species – groups of organisms that have many features in common b Genus – contains several species with similar characteristics c Family – comprising of several genera d Order – comprising of several families e Class – comprising of several orders f Phylum – comprising of several classes g The Five Kingdoms – animalia, plantae, fungi, protoctista and prokaryotes. 1.6 Demonstrate an understanding of the problems associated with assigning vertebrates to a specific group based on their anatomy and reproduction methods and why many vertebrates are difficult to classify. 1.7 Discuss why the definition of a species as organisms that produce fertile offspring may have limitations: some organisms do not always reproduce sexually and some hybrids are fertile. 1.19 Explain the role of the scientific community in validating new evidence, including the use of: a scientific journals b the peer review process c scientific conferences.

Topic 3 – Classification and Biodiversity	GCSE
3.2 i) Understand how evolution can come about through natural selection acting on variation bringing about adaptations. ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations. iii) Understand how reproductive isolation can lead to allopatric and sympatric speciation. iv) Understand that there is an evolutionary race between pathogens and the development of medicines to treat the diseases they cause.	1.12 Demonstrate an understanding of Darwin's theory of evolution by natural selection including: a variation – most populations of organisms contain individuals which vary slightly from one to another b over-production – most organisms produce more young than will survive to adulthood c struggle for existence – because populations do not generally increase rapidly in size there must therefore be considerable competition for survival between the organisms d survival- those with advantageous characteristics are more likely to survive this struggle e advantageous characteristics inherited – better adapted organisms are more likely to reproduce successfully passing on the advantageous characteristics to their offspring f gradual change – over a period of time the proportion of individuals with the advantageous characteristics in the population will increase compared with the proportion of individuals with poorly adapted characteristics, and the poorly adapted characteristics may eventually be lost. 1.17 Demonstrate an understanding of how speciation occurs as a result of geographic isolation.

Topic 4 – Exchange and transport	GCSE
4.2 i) Know the structure of the cell surface membrane with reference to the fluid mosaic model. ii) Understand how passive transport is brought about by: • diffusion • facilitated diffusion (through carrier proteins and protein channels) • osmosis. iii) Understand how the properties of molecules affects how they are transported, including solubility, size and charge. iv) Know that large molecules can be transported into and out of cells through the formation of vesicles, in the processes of endocytosis and exocytosis. CORE PRACTICAL 5: Investigate the effect of temperature on beetroot membrane permeability. CORE PRACTICAL 6: Determine the water potential of a plant tissue. Water potential = turgor pressure + osmotic potential $\psi\psi = P + \pi$ v) Understand the process of active transport, including the role of ATP. vi) Know that phosphorylation of ADP requires energy and that hydrolysis of ATP provides an accessible supply of energy for biological processes.	2.3 Define diffusion as the movement of particles from an area of high concentration to an area of lower concentration. 2.20 Define osmosis as the movement of water molecules from an area of higher concentration of water to an area of lower concentration of water through a partially permeable membrane. 2.18 Explain how water, glucose and mineral salts are transported through a plant, including: a mineral uptake in roots by active transport.

Topic 4 – Exchange and transport	GCSE
4.3 i) Understand how insects, fish and mammals are adapted for gas exchange. CORE PRACTICAL 7: Dissect an insect to show the structure of the gas exchange system taking into account the safe and ethical use of organisms. ii) Understand gas exchange in flowering plants, including the role of stomata, gas exchange surfaces in the leaf and lenticels.	2.13 Describe how the structure of a leaf is adapted for photosynthesis, including: a large surface area b containing chlorophyll in chloroplasts to absorb light c stomata for gas exchange (carbon dioxide, oxygen and water vapour).
4.4 i) Know the structure of the heart, arteries, veins and capillaries. ii) Understand the advantages of a double circulatory system in mammals over the single circulatory systems in bony fish, including the facility for blood to be pumped to the body at higher pressure and the splitting of oxygenated and deoxygenated blood. iii) Know the sequence of events of the cardiac cycle. iv Understand myogenic stimulation of the heart, including the roles of the sinoatrial node (SAN), atrioventricular node (AVN) and bundle of His. v) Be able to interpret data showing ECG traces and pressure changes during the cardiac cycle. vi) Know the structure of blood as plasma and blood cells, to include erythrocytes and leucocytes (neutrophils, eosinophils, monocytes and lymphocytes). vii) Know the function of blood as transport, defence, and formation of lymph and tissue fluid. viii) Understand the role of platelets and plasma proteins in the sequence of events leading to blood clotting,	3.8 Recall the structure and function of the following parts of the blood, including: a red blood cells b white blood cells c plasma d platelets. 3.10 Explain how the structure of the heart is related to its function, including: a the four major blood vessels associated with the heart (pulmonary artery, pulmonary vein, aorta, vena cava) b left atrium and ventricle to pump oxygenated blood c right atrium and ventricle to pump deoxygenated blood d valves to prevent backflow (names not required) e left ventricle has a thicker muscle wall than the right ventricle f the direction of blood flow through the heart. 3.11 Describe how the circulatory system transports substances around the body, including: a arteries transport blood away from the heart

Topic 4 – Exchange and transport	GCSE
including: • platelets form a plug and release clotting factors, including thromboplastin • prothrombin changes to its active form, thrombin • soluble fibrinogen forms insoluble fibrin to cover the wound. ix) Understand the stages that lead to atherosclerosis, its affect on health and the factors that increase the risk of its development	b veins transport blood to the heart c capillaries exchange materials with tissues.
4.7 i) Understand the structure of xylem and phloem tissues in relation to their role in transport. ii) Understand how water can be moved through plant cells by the apoplastic and symplastic pathways. iii) Understand how the cohesion-tension model explains the transport of water from plant roots to shoots. iv) Understand how temperature, light, humidity and movement of air affect the rate of transpiration. v) Understand the strengths and weaknesses of the mass-flow hypothesis in explaining the movement of sugars through phloem tissue. CORE PRACTICAL 8: Investigate factors affecting water uptake by plant shoots using a potometer.	2.17 Explain how the loss of water vapour from leaves drives transpiration. 2.18 Explain how water, glucose and mineral salts are transported through a plant, including: a mineral uptake in roots by active transport b the role of the xylem and phloem vessels. 2.19 Describe how root hair cells are adapted to take up water by osmosis.

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