St Mary Redcliffe and Temple School

## St Mary Redcliffe and Temple School Sixth Form

## Year 11 Into Year 12 Transition Task

## Subject: Edexcel A Biology A Level (SNAB)

SMRT Sixth Form takes students from a wide range of schools who have studied a variety of GCSE syllabuses. We want to ensure that everybody is equally able to access the content of the A Level and so the following tasks give you a chance to ensure you are fully prepared.

For students that have not met the required 65 in Combined Science or 6 in Biology, or a 6 in Maths, there will be a separate "Entry Test" to sit on the 6th Form Pre-Enrolment Day. This will comprise questions relating to the content in the consolidation task as well as key maths skills relevant to the Biology course. Completing this test to a satisfactory standard would result in you being accepted on the course.

## To ensure you are ready to fully access the A Level Syllabus you should attempt these tasks:

1. Human proteins and their genes

   We inherit our genes from our parents which then determine our characteristics. In fact, genes code for proteins, so it must proteins that somehow help develop our characteristics. At A level, we explore in detail how genes on DNA code for proteins. Cells work because of the proteins made in them. These proteins do very many important tasks in the body. It makes sense then that we familiarise ourselves with some of the proteins in our bodies. To start you off watch this short TED-Ed talk on proteins and their importance https://ed.ted.com/on/6GPobgr2.

   Your task is to research and produce a poster of a specific protein in humans of your choice and its' gene. (there are hundreds of proteins to choose from e.g. Lysozyme, myoglobin, salivary amylase, lipase, actin, myosin, haemoglobin, myoglobin, insulin, insulin receptor, p53, opsin, collagen, keratin, cytochrome C, channel proteins, active transport proteins, fibrinogen, DNA polymerase, RNA polymerase, LDL receptor, CFTR protein, aquaporin, elastin, sodium pump, potassium voltage dependant channel protein, thromboplastin, prothrombin, histone, plus 1000,s of others as you will see from looking through the resources provided).Your choice. Be adventurous.

   Your poster needs to be word processed, A4, to include name and a picture of the protein molecule, a simple description of its shape, its location and function and 1-2 interesting details of its gene (eg size, exact location) and a picture of which chromosome it is found on. It is to be handed in to your new teacher on the first week back. You will be expected to be an expert on your chosen protein and its' gene, so

expect to talk confidently about it using terms you can explain so avoid strange terminology).

Resources downloadable from the SMRT website:
Proteins as molecular machines poster. Some info on each chromosome/gene:
https://ghr.nlm.nih.gov/gene
Useful website about proteins and DNA:
http://learn.genetics.utah.edu/content/molecules/
Useful website about proteins: http://www.rcsb.org/pdb/home/home.do

2. Complete the baseline assessment (appendix A) to see how much you can recall from GCSE. This is 55 marks. Appendix B provides key resources to support you with this and prepare for the 'entry test' if needed.

Appendix B

# Section A: Cells

## Table of resources in this section

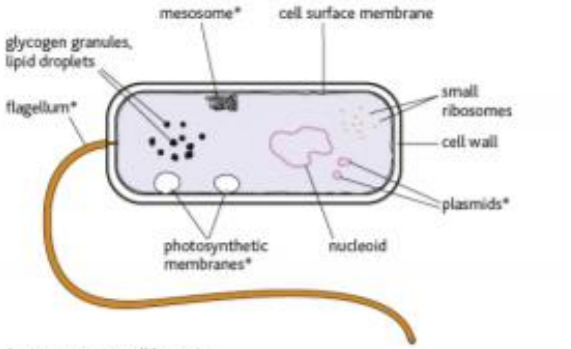
| Topics covered | Type of resource | Resource name | Brief description and notes for resource |
|---|---|---|---|
| • Cells and microscopy<br>• Mitosis<br>• Gram staining<br>• Osmosis | Teacher resource | Suggested activities | Specification references and practical information for the lesson ideas. |
| • Cell structure<br>• Mitosis<br>• Microscopy<br>• Diffusion, osmosis and active transport | Teacher resource | Summary sheets | Information that can used to support practical activities in the lab or completion of the consolidation activities |
| • Cell structures | Student worksheet | Worksheet 1: Cell structures 1 | Extracting information from text to list the features of animal, plant and bacterial cells. |
| • Cell structures | Student worksheet | Worksheet 2: Cell structures 2 | Extracting information from text and using it to draw and label animal, plant and bacterial cells. |
| • Bacterial, animal and plant cell features.<br>• Mitosis and magnification calculations.<br>• Diffusion, osmosis and active transport. | Student questions | Practice questions | Exam questions on section covering KS4 to KS5 content.<br>Checking how far students have progressed at the end of the section. |
| **Lesson ideas** | | | |
| • Microscope work on animal and plant cells.<br>• Identification of cell features from light and electron microscopy images.<br>• Measure cell length and calculate actual cell size.<br>• Root tip squash to show cells undergoing mitosis.<br>• Gram staining of bacteria.<br>• Investigating osmosis in potato chips. | | | |

# 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.

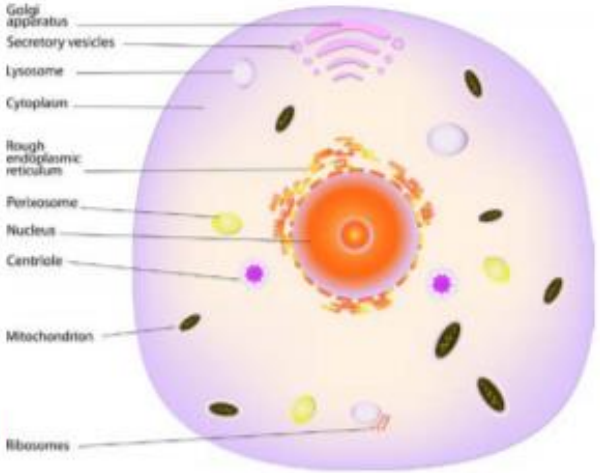



* = not present in all bacteria

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

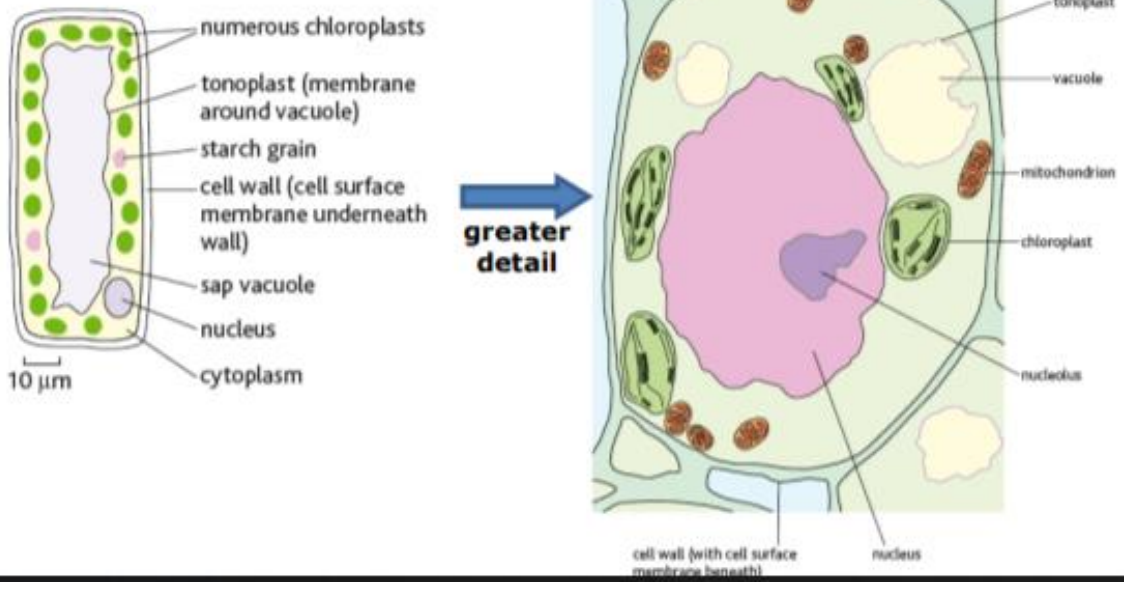
Animal cells have:

- 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.

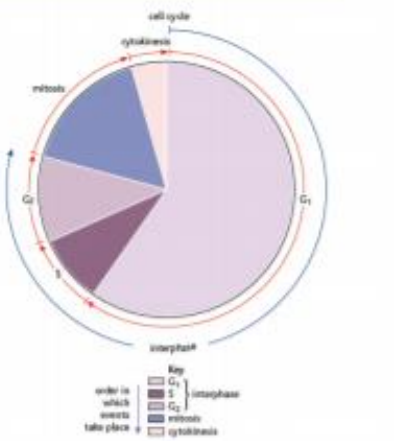


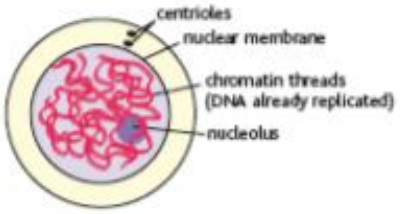
# Summary sheet 2: Mitosis

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

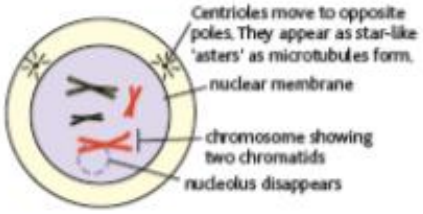
Mitosis occurs during the cell cycle. The cell cycle consists of a period of cell growth and DNA replication known as interphase and then a period of cell division called mitosis followed by cytokinesis where the cytoplasm divides and the cell membrane constricts to form the two daughter cells.

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

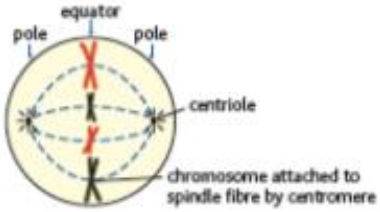


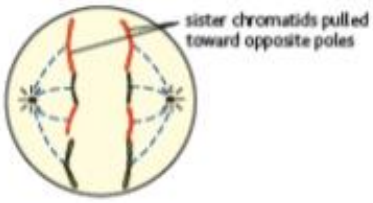

**A Interphase:** before mitosis the tangled, uncoiled mass of chromosomes fills the nucleus. DNA is replicated during this stage.



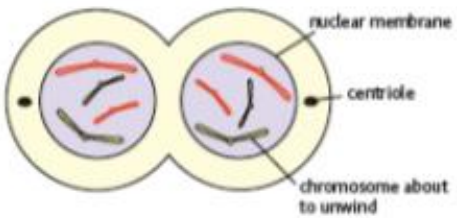

**B Prophase:** the chromosomes coil and condense, each one appearing as two chromatids. The nucleolus breaks down and the centrioles begin to separate and start to form the spindle.




**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.

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

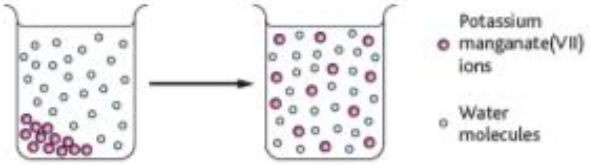
$$= 80 \text{ µm}$$

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

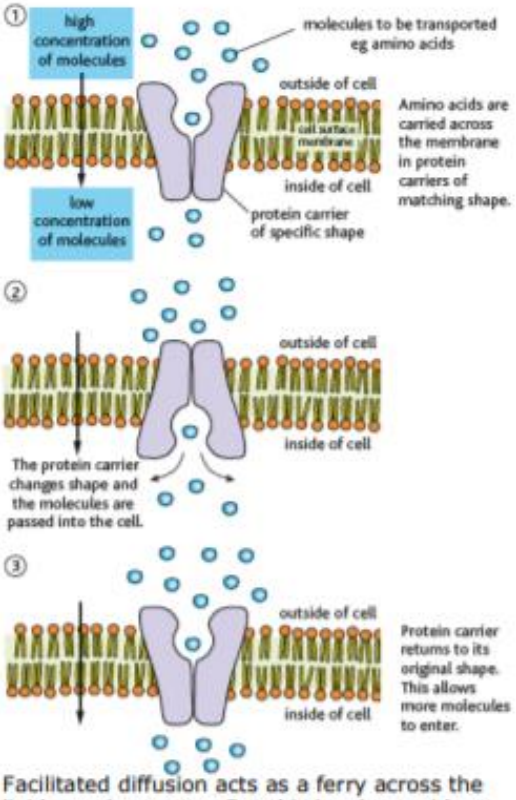
## Diffusion

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.

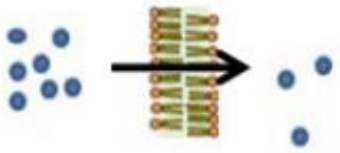
Small particles can diffuse across cell membranes and no energy is required. Some molecules, such as glucose, are too large to diffuse across the cell membrane so they must be helped by carrier proteins. Each molecule has its own carrier protein that allows the molecule through the cell membrane without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

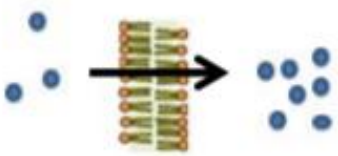
## Osmosis

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

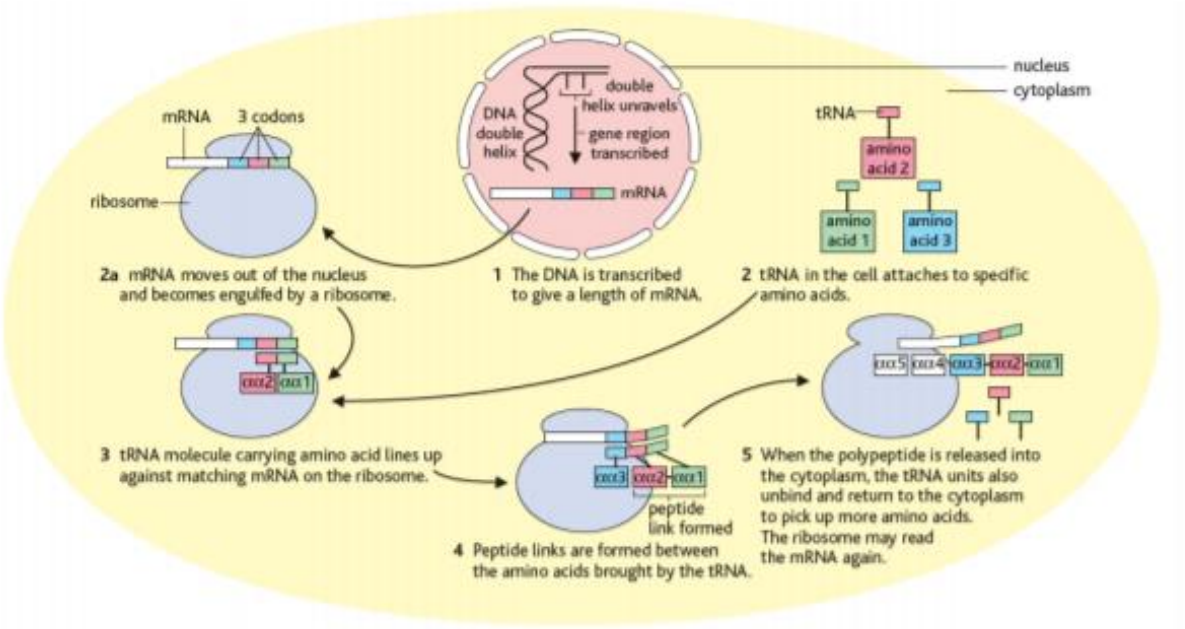
Active transport uses energy to transport substances across membranes from an area of lower concentration to an area of higher concentration



# 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.

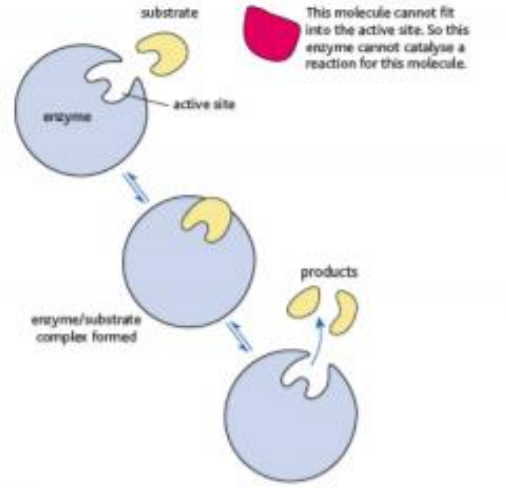
**Secondary structure** – the repeating pattern in the structure of the peptide chains, such as an α-helix or pleated sheets.

**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.

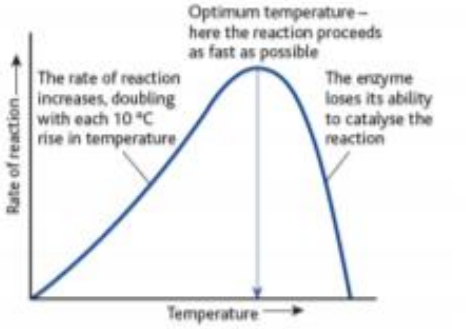



The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

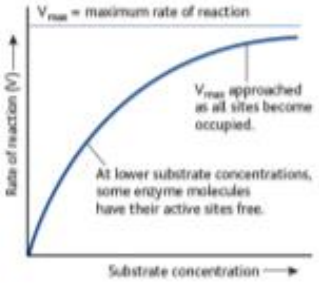
The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

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.



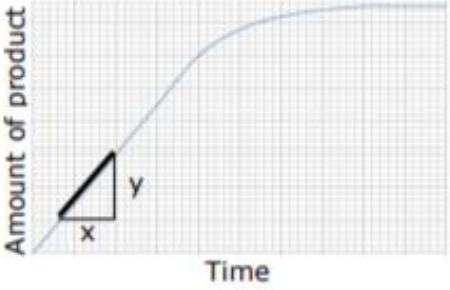

Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.




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.



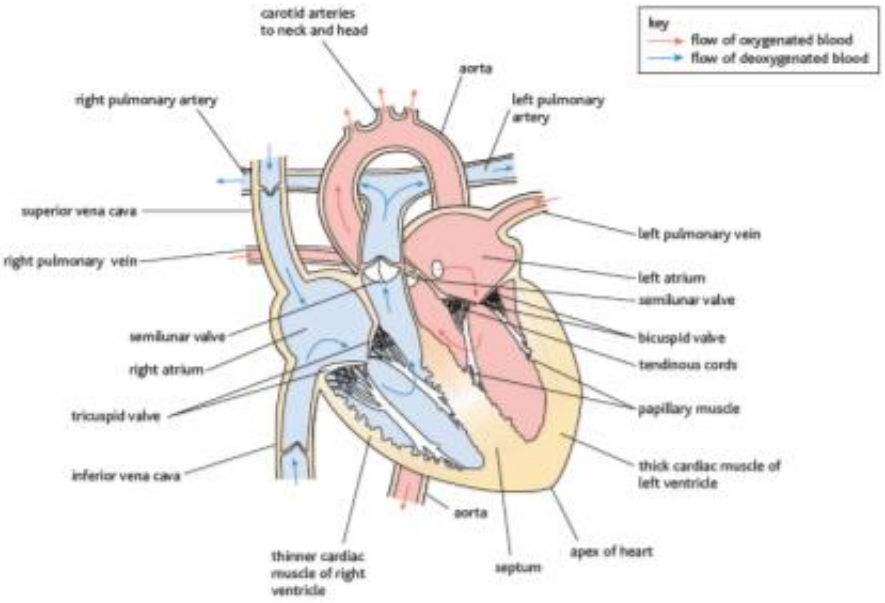
# Section C: Human biology

## Table of resources in this section

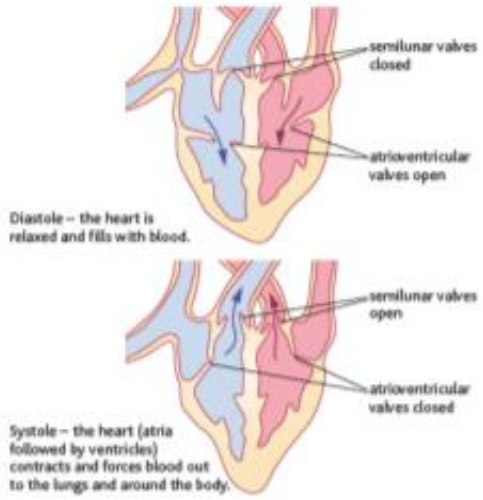
| Topics covered | Type of resource | Resource name | Brief description and notes for resource |
|---|---|---|---|
| • Practical activities on the heart, lungs, blood vessels and diffusion | Teacher resource | Suggested activities | Specification references and practical information for the lesson ideas. |
| • Heart and lungs<br>• Circulatory system | Teacher resource | Summary sheets | Information that can used to support practical activities in the lab or completion of the consolidation activities |
| • Prefixes to scientific terms | Student worksheet | Worksheet 1: Prefixes | Defining the meaning of common prefixes used in scientific terms. |
| • Use of keywords | Student worksheet | Worksheet 2: Keywords | Increasing the level of detail in exam question answers. |
| • Heart structure and the use of keywords in answers.<br>• The circulatory system.<br>• Diffusion and active transport. | Student questions | Practice questions | Exam questions on section covering KS4 to KS5 content.<br>Checking how far students have progressed at the end of the section. |
| **Lesson ideas** | | | |
| • Heart dissection<br>• Lung dissection<br>• Comparing the elasticity of arteries and veins.<br>• Diffusion in agar cubes.<br>• Calculation of surface area: volume ratios. | | | |

# 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.

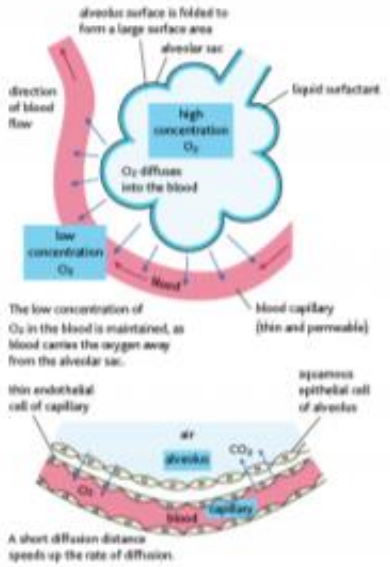


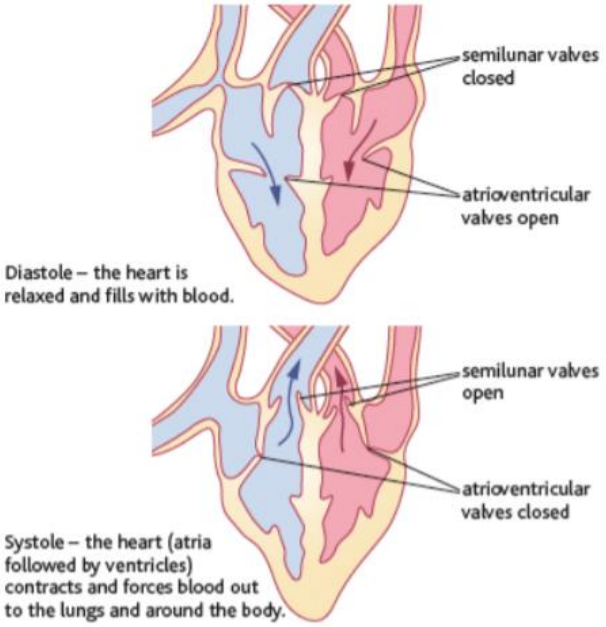

The atrioventricular valves between the atrium and ventricles open to allow blood to flow from the atrium into the ventricles and close when the pressure in the ventricles rises to prevent back flow.

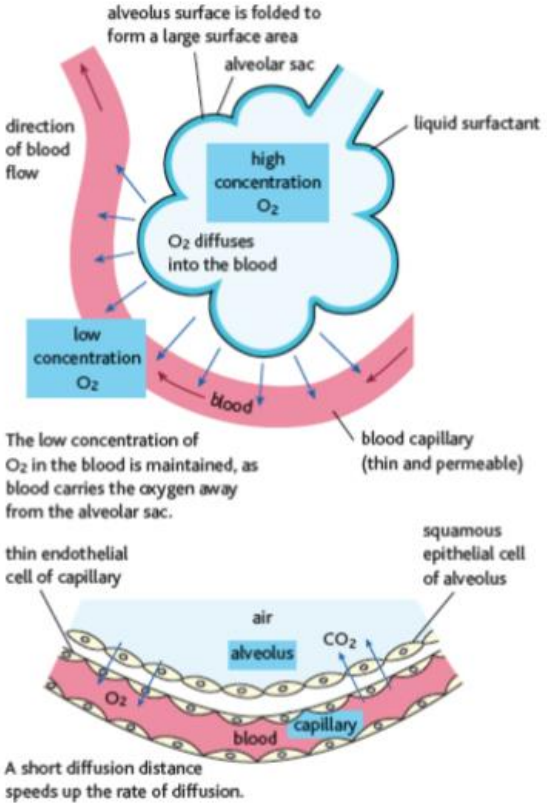
The semi-lunar valves in the aorta and pulmonary artery open to allow blood from the ventricles to flow into the arteries. They close to prevent backflow into the ventricles as the heart relaxes.

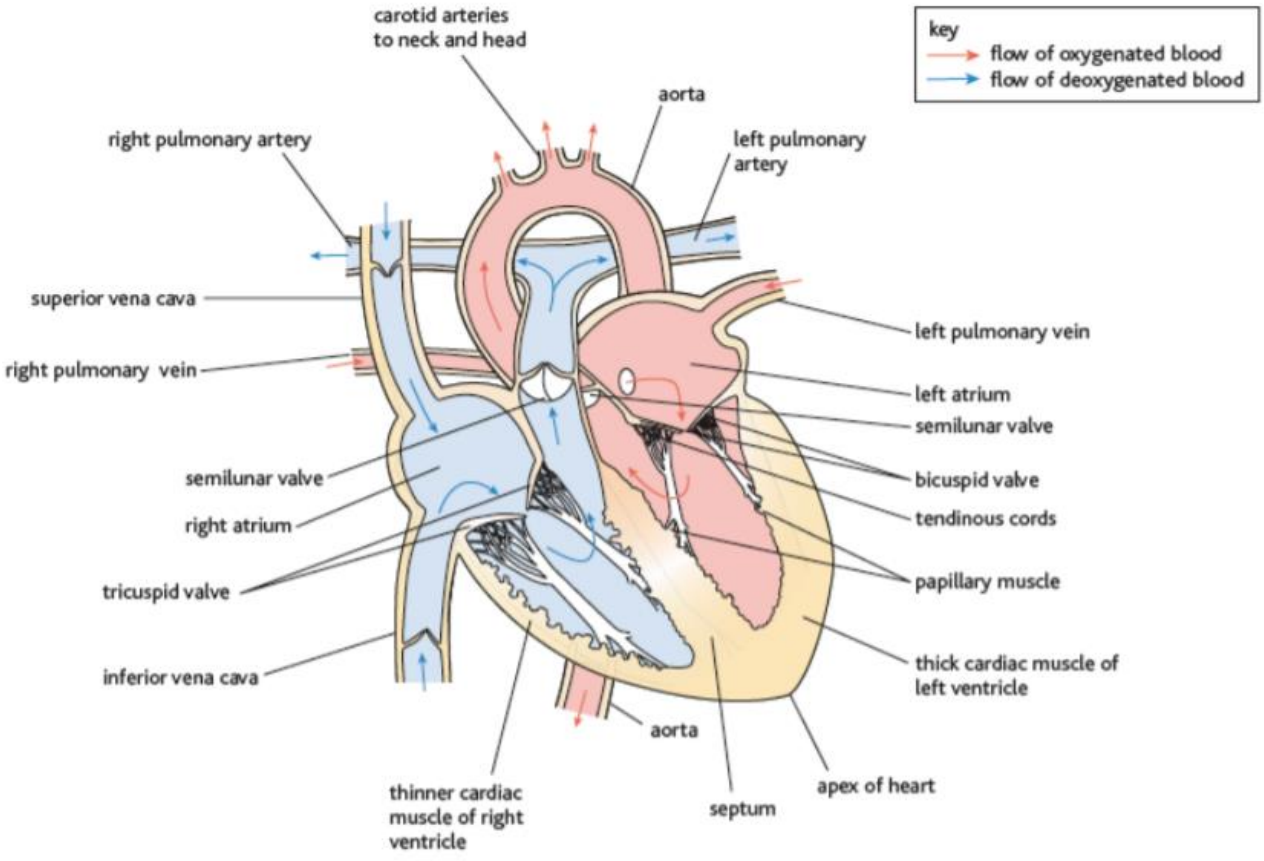
Oxygen enters the blood in the alveoli of the lungs. Oxygen in the alveolus is at a high concentration and it diffuses down the concentration gradient into the blood which has a low concentration of oxygen. This low concentration is maintained because the blood is moving and carries the oxygen away.

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.




semilunar valves closed
atrioventricular valves open
Diastole – the heart is relaxed and fills with blood.
semilunar valves open
atrioventricular valves closed
Systole – the heart (atria followed by ventricles) contracts and forces blood out to the lungs and around the body.

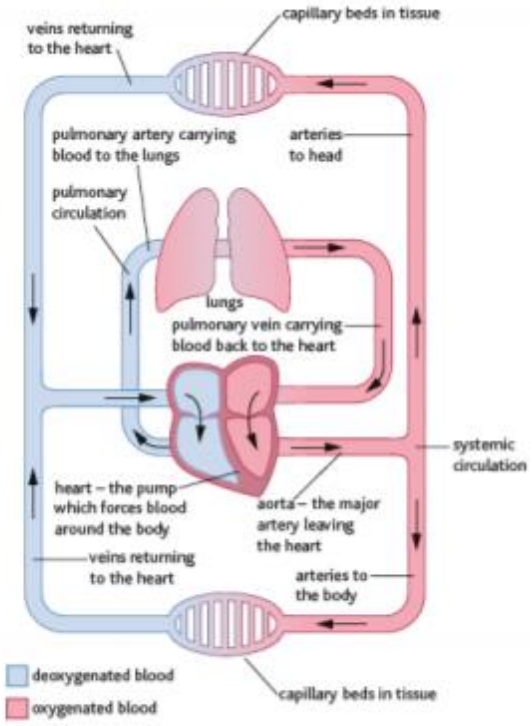

alveolus surface is folded to form a large surface area
alveolar sac
liquid surfactant
direction of blood flow
high concentration $O_2$
$O_2$ diffuses into the blood
low concentration $O_2$
blood
blood capillary (thin and permeable)
The low concentration of $O_2$ in the blood is maintained, as blood carries the oxygen away from the alveolar sac.
thin endothelial cell of capillary
squamous epithelial cell of alveolus
air
alveolus
$CO_2$
$O_2$
blood
capillary
A short diffusion distance speeds up the rate of diffusion.

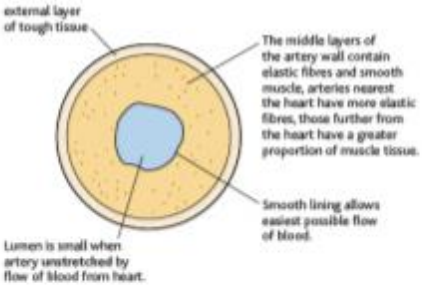

key
flow of oxygenated blood
flow of deoxygenated blood
carotid arteries to neck and head
aorta
right pulmonary artery
left pulmonary artery
superior vena cava
left pulmonary vein
right pulmonary vein
left atrium
semilunar valve
bicuspid valve
semilunar valve
tendinous cords
right atrium
papillary muscle
tricuspid valve
thick cardiac muscle of left ventricle
inferior vena cava
aorta
thinner cardiac muscle of right ventricle
septum
apex of heart

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

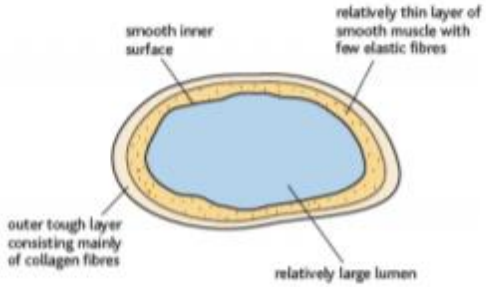
The double circulation system of mammals means that blood flows through the heart twice in one complete cycle of the body.

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

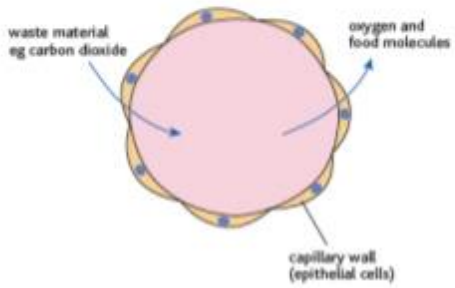



Arteries carry blood away from the heart. The vessel walls are thick and muscular with elastic fibres to withstand the high pressure generated by the heart.




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.

# 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 | |

## 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:**

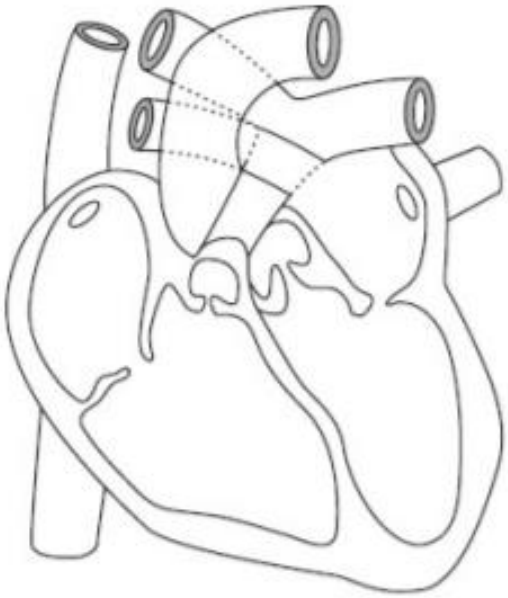
**semi-lunar valves:**

diastole:

systole

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

Right side



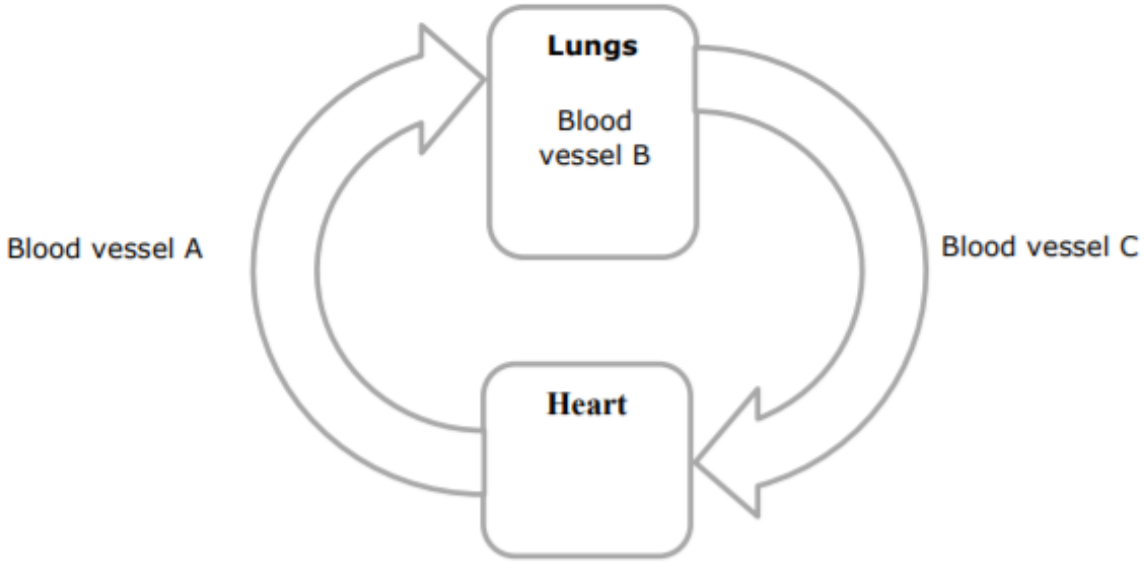
Left side

**c** Use the keywords from **1 a** in your answers to the following questions.

**i** Explain why the left ventricles has thicker chamber walls than the right ventricle and the atriums.

**ii** Describe the role of the atrioventricular valves.

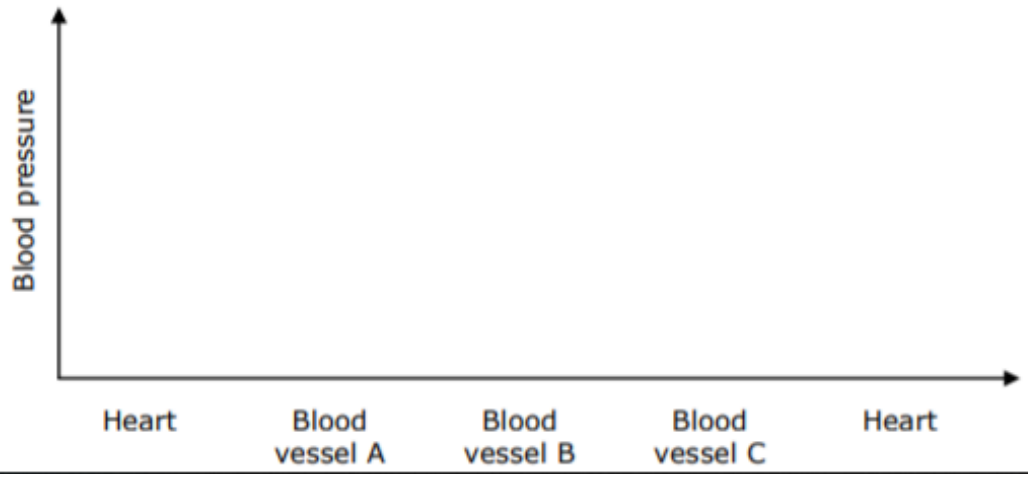
**2** This flow diagram shows the part of the circulation system in a mammal.




**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.



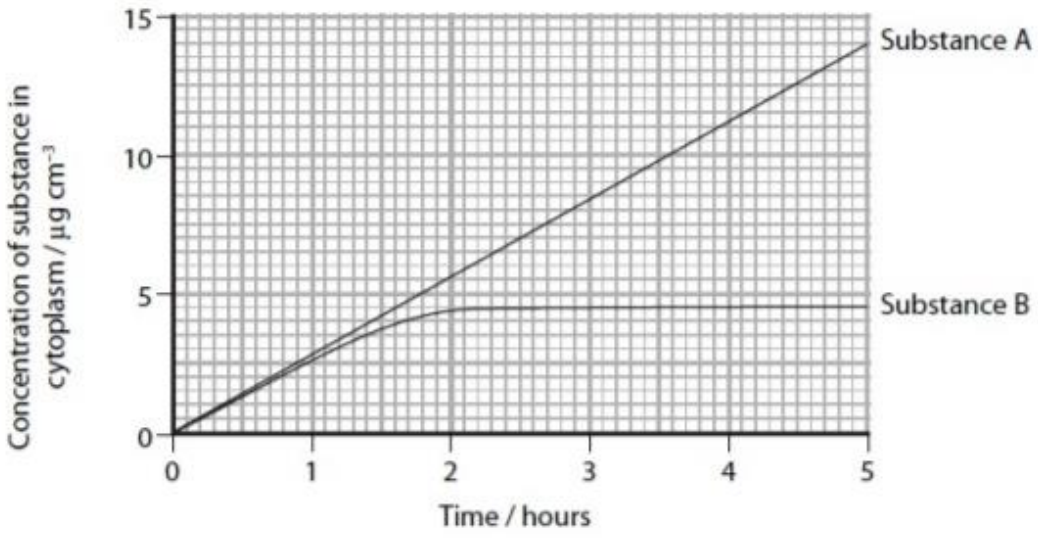
**3** ***Amoeba*** is a single-celled aquatic organism. Substances in the water can enter the cell by a variety of mechanisms.

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 25ºC.

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**