new brinsworth Sixth Form

Science Department

Year 11 into Y12 Bridging Unit

Taking the next steps into A-Level…

BIOLOGY

Dear Student,

Thank you for expressing an interest in continuing to study science here at Brinsworth Academy.

The aim of this unit of work is to provide you with an insight into some of the content that you will be studying as you move from GCSE Science into A-Level Science and, hopefully, get you off to a flying start in September!

Please complete your work electronically and submit it via email to your teachers next year.

We to seeing you in A-Level lessons in September!

Best wishes,

The Science Department

The Overview

The bridging unit has been split into 6 packages of work.

The table below provides you with an overview of this work.

Package	Topic Theme	GCSE Extension or New Content	Aims	Tasks
1	Cells & Microscopes	Both	1. To build on your knowledge of cell structure at GCSE and to develop new terminology in this area. 2. To manipulate the equation for magnification (I = A x M).	1. Worksheet: Cells & Magnification
2	Enzymes	GCSE Ext.	1. To consolidate the mechanism of enzyme action. 2. To interpret data collected from enzyme investigations.	1. Worksheet: Enzyme Calculations
3	Transport Across Cell Surface Membranes	Both	1. To develop an understanding of how diffusion, osmosis and active transport work.	1. Worksheet: Active Transport
4	The Cell Cycle & Mitosis	Both	1. To extend your understanding of the events that take place in the cell cycle. 2. To develop an understanding of the events that take place during Mitosis.	1. Worksheet: Mitosis
5	Stem Cells	Both	1. To state the different types of stem cells and how they can be used medically. 2. To use researched data to	1. Worksheet: Stem Cell Research

			evaluate the use of stem cells in science.	
6	The Heart	Both	1. To identify key structures that make up the mammalian heart. 2. To discuss the flow of blood through the mammalian heart and how valves regulate this.	1. Worksheet: Heart Diagram 2. Worksheet: Valves

Package 1: Cells & Microscopes

Part 1: Background Research

Watch the following videos:

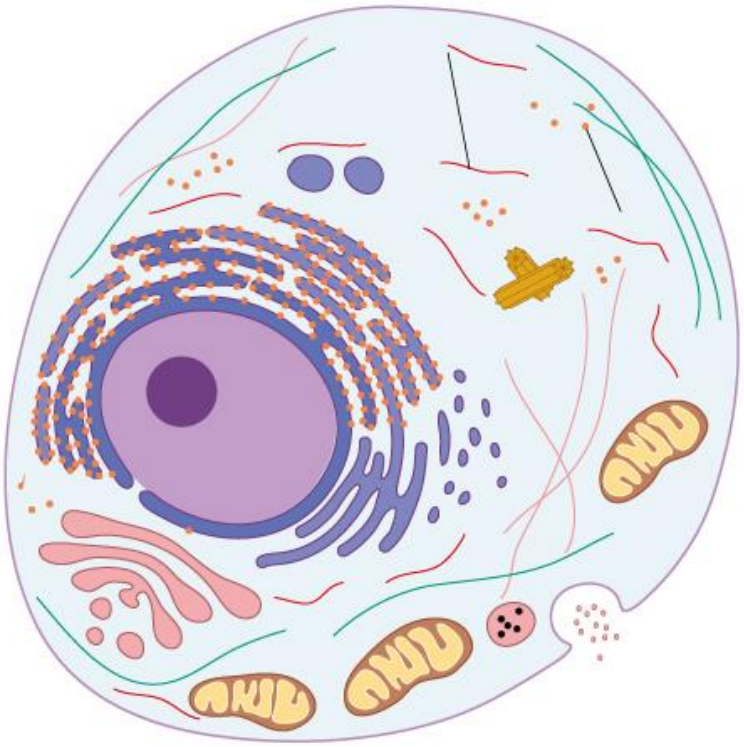
1. SnapRevise - Eukaryotic Cells & Organelles

https://www.youtube.com/watch?v=dLJdRs5w4u4

Part 2: Written Work

Complete the following written tasks.

1. Worksheet: Labelling a Eukaryotic Cell
2. Worksheet: Functions of Organelles



Task:

Using your research skills, label all of the organelles in the cell diagram above.

Try to keep your label lines **<u>horizontal</u>** with the top of the page. This is standard practice when labelling images in Biology.

Eukaryotic Cell Organelles

Task: Using your research skills, complete the table below to outline the role of the organelles found within eukaryotic cells and which type of cell they are found in.

Organelle	Function / Description	Animal, Plant or Both?
Cell Wall		
Centriole		
Chloroplast		
Flagellum		
Golgi Apparatus		
Mitochondrion		
Nucleus		
Plasma Membrane		
Ribosome		
Rough Endoplasmic Reticulum (RER)		
Smooth Endoplasmic Reticulum (SER)		
Vacuole (permanent)		
Vesicle		

Package 2: Enzymes

Part 1: Background Research

Watch the following videos:

1. Cognito – Enzymes

https://www.youtube.com/watch?v=gUncqL1ul8Q

2. Cognito – Factors that affect Enzymes

https://www.youtube.com/watch?v=n9He_FK6nao

Part 2: Written Work

Complete the following written task.

1. Worksheet: Enzyme Calculations

Enzyme calculations

Specification reference:

- B2.2.1 The human digestive system
- WS 3.3, 4.6

Aims

You will be learning how to calculate the rate of an enzyme-catalysed reaction.

Learning outcomes

After completing this worksheet, you should be able to:

- calculate the rate of a reaction using gradients and tangents
- give your answer to an appropriate number of significant figures.

Overview

The rate of a reaction is how fast it takes place.

Scientists will calculate and compare rates of reaction when investigating how different variables affect a reaction.

As in all calculations, scientists are careful to use an appropriate number of significant figures in calculations. The answer to a calculation should normally have the same number of significant figures as the question.

Worked example

You might be asked to calculate the rate of a reaction. In biology it will be a reaction catalysed by an enzyme.

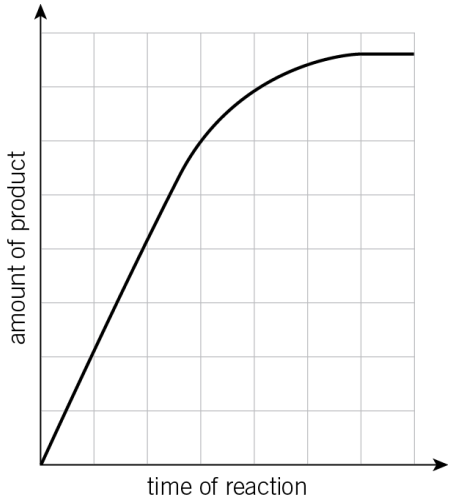
You can calculate the average rate of a reaction by using:

$$\text{Rate of reaction} = \frac{\text{amount of product formed}}{\text{time}}$$

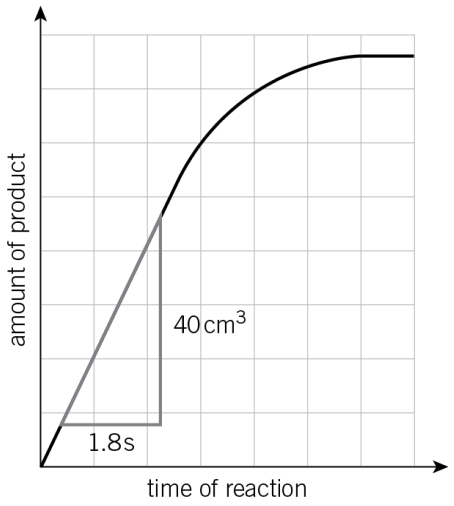
or

$$\text{Rate of reaction} = \frac{\text{amount of reactant used}}{\text{time}}$$

Normally, the rate will change throughout the reaction so you will get a curved line.



You can calculate the rate of reaction at each section of the graph by calculating the gradient.



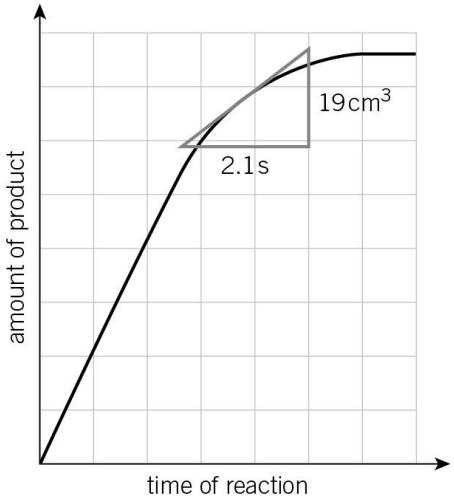
For this example, the rate of reaction will be:

$$\frac{40\ \text{cm}^3}{1.8\ \text{s}}$$

$= 22\ \text{cm}^3/\text{s}$

Note: the answer is rounded to two significant figures as both of the numbers in the calculation are to two significant figures.

This will only be possible on a section where the line is straight. For a curved section you need to draw a tangent to the line and calculate the gradient from this.



For this section of the graph, the rate of reaction is:

$$\frac{19\ \text{cm}^3}{2.1\ \text{s}}$$

$= 9.0\ \text{cm}^3/\text{s}$

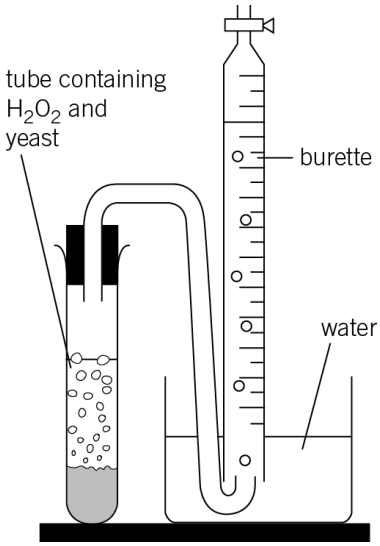
Again, the answer is given to two significant figures.

You can see that as time increases the reaction is slowing down.

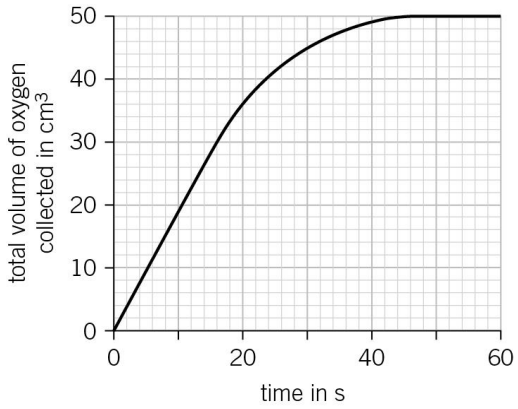
Task

Catalase is an enzyme found in living cells. It catalyses the breakdown of hydrogen peroxide into water and oxygen.

A student measured the volume of oxygen produced when yeast was added to a hydrogen peroxide solution. She used the equipment shown below.



She plotted a graph of her results.



Use the graph to calculate the rate of reaction:

A for the first 20 seconds

B at 30 seconds

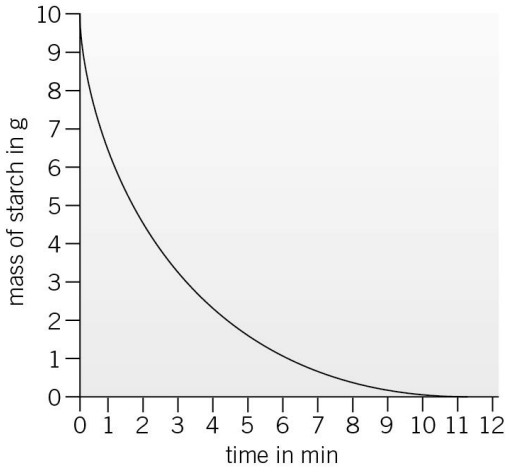
C between 40 and 60 seconds

Give your answers to an appropriate number of significant figures.

Question

1 Amylase is an enzyme that catalyses the breakdown of starch into simple sugars.

A scientist added some amylase to a starch suspension and measured the mass of starch present over time. The graph below shows his results.



a Describe what happened to the rate of the reaction between 0 and 10 minutes.

.....

.....

..... (*1 mark*)

b Calculate the average rate of reaction over this time. Give your answer to an appropriate number of significant figures.

.....

.....

..... (*3 marks*)

Package 3: Transport Across Cell Surface Membranes

Part 1: Background Research

Watch the following videos:

1. SnapRevise – Active Transport

https://www.youtube.com/watch?v=Acjt4mPT4dM

2. Free Science Lessons – Omosis & Water Potential

https://www.youtube.com/watch?v=wZM3xRZiVyo

Part 2: Written Work

Complete the following written tasks.

1. Worksheet B1.7 Investigating Osmosis

2. Worksheet B1.9 Active Transport

Active transport

Specification reference:

- B1.3.3 Active transport

Aims

All cells need to move substances in and out. Water often moves across cell boundaries by osmosis. However, dissolved substances also need to move in and out of cells. There are two main ways in which this happens – by diffusion, where substances move down a concentration gradient, and by active transport. In this activity you will find out more about how substances can be moved against (up) a concentration gradient by active transport.

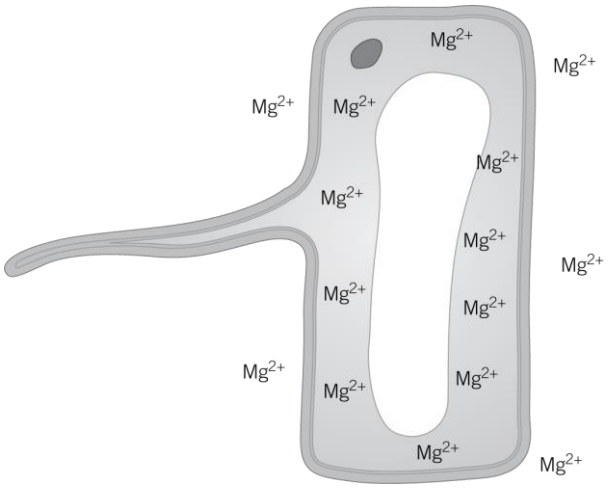
Learning outcomes

After completing this activity, you should be able to:

- understand how materials are transported into cells against a concentration gradient by active transport
- relate the structure of a root hair cell to its function.

Task

Look at this diagram of a root hair cell and answer the questions below.



Questions

2 Look at the concentration of magnesium ions in the root hair cell and the concentration of magnesium ions in the soil solution. Suggest which way you expect the magnesium ions to move by diffusion.

.....

.....

3 Explain how the root hair cell uses active transport to take up the ions.

.....

.....

.....

4 Explain the difference between active transport and diffusion in terms of movement of particles with respect to concentration gradient.

.....

.....

.....

5 State **two** other examples of situations where active transport occurs.

.....

.....

.....

6 The following statement about active transport contains three errors. Read it through and then write it out correctly.

The concentration of magnesium ions inside the root hair cell is lower than the concentration in the soil. The diffusion gradient for the magnesium ions is out of the root hair and into the soil. The root hair cells are still able to take magnesium ions in by a process called active transport. Active transport is an energy-releasing process by which substances are transported down a concentration gradient.

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Investigating osmosis

Specification references:

- B1.3.2 Osmosis
- WS 1.2

Aims

In this activity, you will observe osmosis taking place and consider the movement of water in different situations.

Learning outcomes

After completing this activity, you should be able to:

- describe what osmosis is
- write a prediction using scientific knowledge of osmosis
- explain how a model shows osmosis in a cell.

Setting the scene

Osmosis is a special type of diffusion. It is the movement of water molecules down a water potential gradient from a higher water potential (a more dilute solution) to a lower water potential (a more concentrated solution) through a partially permeable (selectively permeable) membrane.

Water potential is a measure of the concentration of water molecules. Pure water has the highest possible water potential. The more concentrated a solution becomes, the lower the water potential.

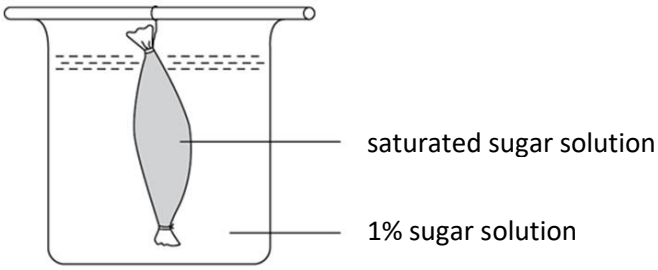
Cells are surrounded by partially permeable cell membranes. This type of membrane does not let all types of particles through, but water can move across partially permeable membranes by osmosis.

Your teacher is going to demonstrate a model of osmosis in a cell. After watching this demonstration you are going to make predictions about the movement of water across a partially permeable membrane.

Task

Predict what will happen in each of the following model cells and explain why.

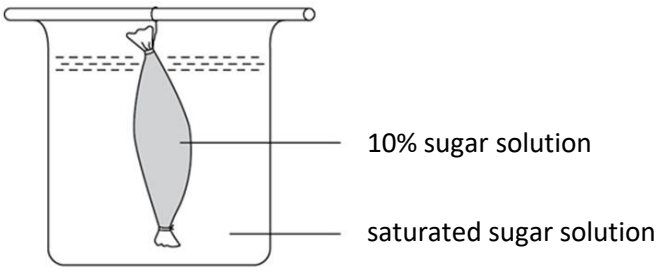
1



.....

..... (*3 marks*)

2



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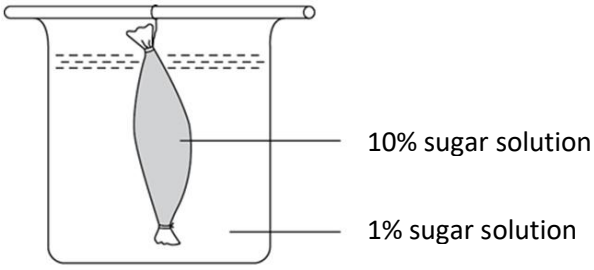
..... (*3 marks*)

3



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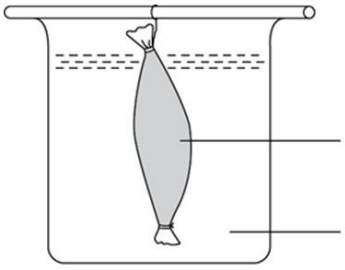
..... (*3 marks*)

4



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..... (*3 marks*)

Questions

1 What is meant by a *saturated solution*?

..... (*1 mark*)

2 Visking tubing is *partially permeable* (selectively permeable). What does this mean?

.....

..... (*1 mark*)

3 Write down one way that the Visking tubing and sugar solution is a realistic model of a cell.

..... (*1 mark*)

4 Write down one way that the Visking tubing and sugar solution is not a realistic model of a cell.

..... (*1 mark*)

.....

.....

5 When people donate blood, the red blood cells can be stored for future use.

They are stored in a solution containing glucose, sodium, and other substances.

This solution has a similar water potential to that normally inside red blood cells.

Use your scientific knowledge to explain why it is important that this solution has a similar water potential to that inside red blood cells.

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..... (*6 marks*)

Package 4: The Cell Cycle & Mitosis

Part 1: Background Research

Watch the following videos:

1. SnapRevise – The Cell Cycle

https://www.youtube.com/watch?v=pIL4IP9dpIY

2. SnapRevise – Mitosis

https://www.youtube.com/watch?v=0dMLBzaIcsc

Part 2: Written Work

Use the information from the videos and other sources to help you complete the worksheet below. Try to explain what happens in each stage of mitosis in as much detail as you can.

1. Worksheet: Mitosis

Mitosis

Specification reference:

- B1.2.2 Mitosis and the cell cycle

Aims

This Go Further worksheet aims to deepen your understanding of the process
of mitosis.

Learning outcomes

After completing this worksheet, you should be able to:

- explain how cells divide by mitosis
- describe the stages in the process of mitosis.

Setting the scene

New cells are needed for organisms to grow. They are also needed to replace cells that have become worn out and to repair damaged tissue. These new cells must have exactly the same genetic information as the original cells as they are doing the same job. The cell division that takes place in normal body cells is called mitosis.

The cell cycle is the process that all body cells use to grow and divide. The cell cycle consists of a period of cell growth and DNA replication called interphase, and a period of cell division called mitosis. Mitosis is a continuous process but it can be split into four main stages. On the next page is a table with diagrams of the main stages in the cell cycle. Your task is to research what happens to the cell in each stage, and use this information to complete the table. After this, answer the questions that follow.

Questions

7 What is meant by the cell cycle?

.....

8 Why is the cell cycle needed?

.....

.....

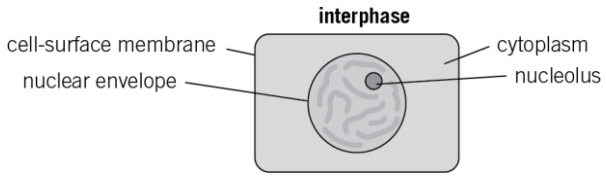
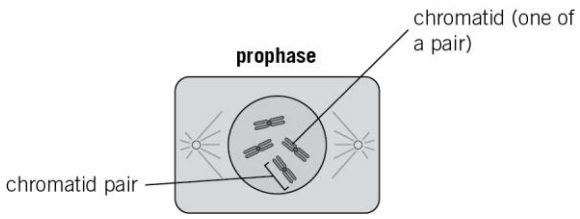
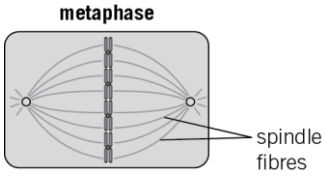
9 How many cells are produced during mitosis?

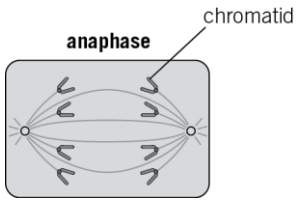
.....

10 During which period of the cell cycle does cell growth occur?

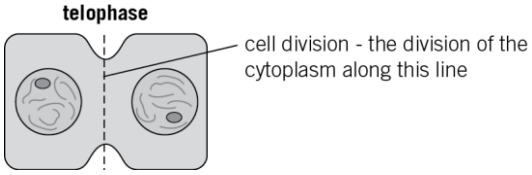
.....

11 There are several other stages that take place during mitosis and the cell cycle. These are listed in the table. Research mitosis and use the information you find to fill in the table.

	What happens during this stage of the cycle
Interphase 	
Prophase 	
Metaphase 	
Anaphase	


chromatid
anaphase

Telophase


telophase
cell division - the division of the cytoplasm along this line

Package 5: Stem Cells

Part 1: Background Research

Watch the videos below:

1. SnapRevise – Stem Cells

https://www.youtube.com/watch?v=3-1z5jNxM4I

Part 2: Written Tasks

Carry out some independent research and put together a piece of work that discusses what stem cells are and why they are sometimes considered a controversial subject.

The attached sheet provides you with some background information and outlines the task that you need to complete. Use the bullet points to help you structure your work.

There are websites on the sheet that will provide you with a starting point for your research.

There is no limit to what you can do with this task!

Stem cells in medical developments

Specification references:

- B1.2.3 Stem cells
- WS 1.4, 1.5

Aims

Stem cells are undifferentiated cells. Whilst sources of stem cells are abundant in plants, but they are less common in adult animals. Stem cells offer a wealth of potential medical treatments, although some people have raised ethical objections. Here you will investigate the current and potential future uses of stem cells in medicine.

Learning outcomes

After completing this activity, you should be able to:

- describe the different types of stem cell found in humans
- describe the use of stem cells in medicine.

Task

You will research the different types of stem cells present in humans and their uses in medical science. You will present your findings in either a report or a poster presentation. In particular, you should find answers to the following questions:

- What are the differences between totipotent, pluripotent, and multipotent stem cells?
- What are the sources of stem cells in humans?
- How are stem cells currently used in medicine?
- What are induced pluripotent stem cells, and what are the benefits they provide compared to current stem cell therapies?

Possible resources for your research include the following websites:

https://stemcells.nih.gov/info/basics/1.htm

http://www.sigmaaldrich.com/life-science/stem-cell-biology/ipsc/ipsc-faqs.html (which provides an outline of induced pluripotent stem cells)

http://www.nature.com/news/how-ips-cells-changed-the-world-1.20079

http://www.eurostemcell.org/ips-cells-and-reprogramming-turn-any-cell-body-stem-cell

Package 6: The Heart

Part 1: Background Research

Watch the video below:

1. SnapRevise – The Human Heart

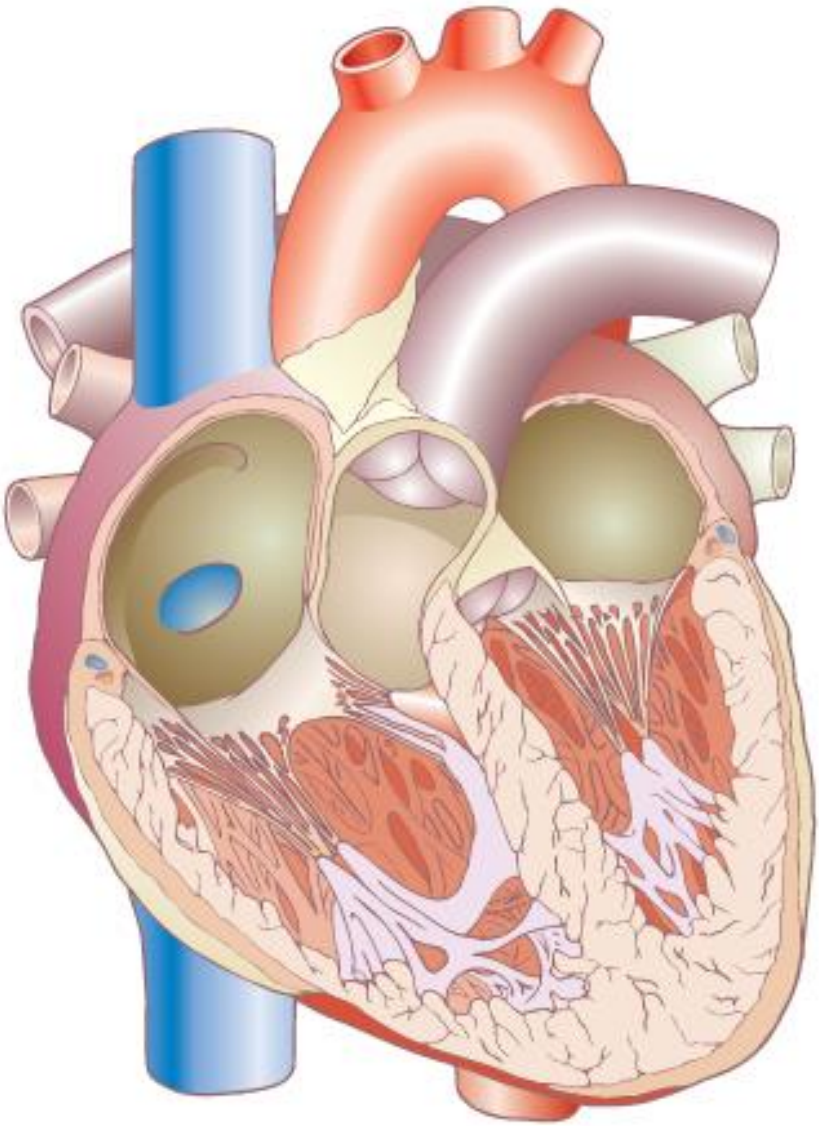
https://www.youtube.com/watch?v=jfsnUFpwqhQ

Part 2: Written Tasks

a. Complete the attached worksheet which looks at the role of valves in the circulatory system.

b. Annotate the diagram of the heart to show:

- i. all of the key structures in the mammalian heart
- ii. the flow of blood through the heart



Valves and blood flow

Specification references

- 4.2.2.2 The heart and blood vessels

Aims

You will by now be familiar with the structure of the heart and that it is made up of two pumps, each with chambers separated by valves. On completion of this activity you will be able to describe how the valves in the heart open and close due to blood pressure changes in the chambers and vessels and explain why this is important to maintain the correct direction of blood flow.

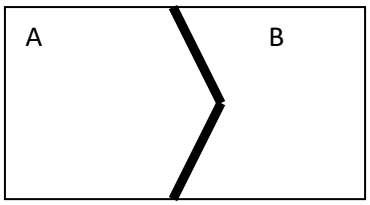
Learning outcomes

After completing this worksheet, you should be able to:

- describe the role of blood pressure in the chambers of the heart in opening and closing valves
- explain why this is important.

Questions

Imagine two rooms full of people that are connected by a set of doors which overlap so that they can only open one way, shown in the diagram below by the thick diagonal lines. They can only open to the right. If they are pushed to the left they will shut.



1 **a** If the people pushing on the walls and doors of room A pushed harder than those in room B, what would happen to the doors?

.....(*1 mark*)

b Where would the people move if this happened?

.....(*1 mark*)

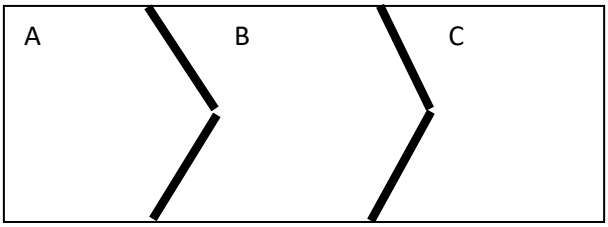
c If the people in room B were pushing harder than those in room A, what would happen to the doors?

.....(*1 mark*)

d Could the people move back into room A if this happened?

.....(*1 mark*)

Now imagine there is a third room of people, room C, again connected by doors that will only open one way.



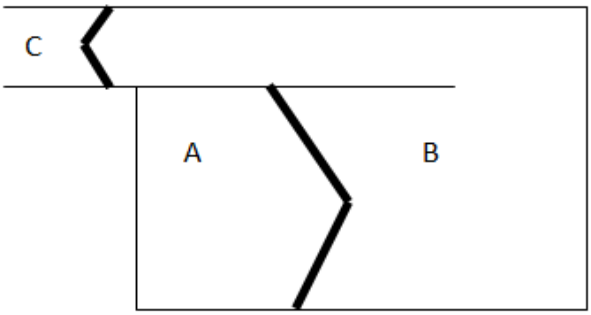
2 **a** If the people pushing on the walls and doors of room B pushed harder than those in room C, what would happen to the doors?

.....(*1 mark*)

b Where would the people move if this happened?

.....(*1 mark*)

Now imagine that room B is bent around into a corridor with the doors to room C at the top. Note that the doors are still pointing in towards room C, even though they look like they are going in the opposite direction due to the bent corridor. This time room C has no end wall.



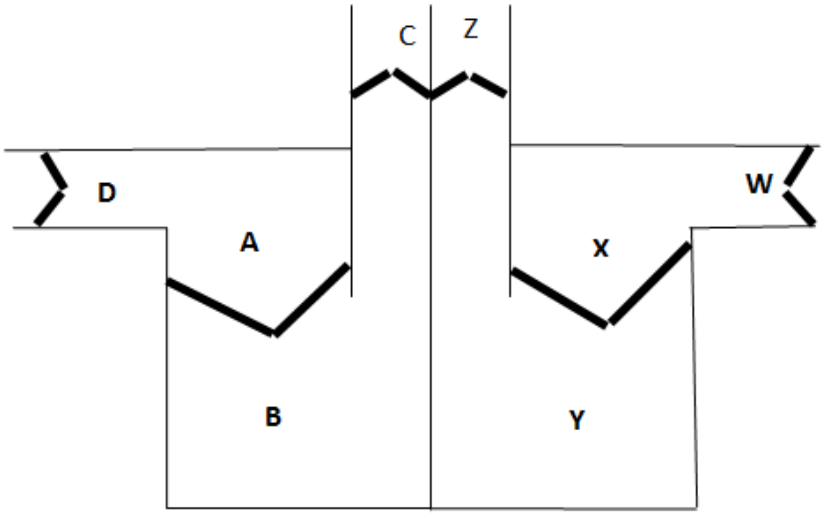
3 **a** Would this work in the same way as the previous diagram?

.....(*1 mark*)

b Where would the people eventually have to leave the set of rooms?

.....(*1 mark*)

Now suppose we turn the rooms sideways and put a corridor with no doors labelled D, which leads into room A. We also have a mirror image set of rooms opposite, with rooms and corridors labelled W, X, Y, and Z. There are sets of one-way doors in the corridors W and D.



4 **a** Suppose corridor Z eventually leads to corridor D and corridor C leads to corridor W. Write down the only order of letters possible to pass through whilst going through this set-up, starting with A

..... (*1 mark*)

b What opens the doors?

..... (*1 mark*)

c What closes the doors?

..... (*1 mark*)

This represents how the heart works, with chambers and blood vessels instead of rooms and corridors, and blood instead of people.

d Which type of blood vessels are D and W?

..... (*1 mark*)

e Which type of blood vessels are C and Z?

..... (*1 mark*)

f What would there be between C and W?

.....(*1 mark*)

g What would there be between Z and D?

.....(*1 mark*)

Extension

5 Draw a sketch graph with two lines on it to show how the pressure would change over time in Y and Z during a heartbeat. (*2 marks*)

6 Why is it important that blood only flows in one direction? (Think about the answers to Questions 4f and 4g.) (*2 marks*)

7 Name the vessel or chamber shown by each letter. (*8 marks*)