'Body Works' was developed at Rossmoyne Senior High School to provide students with opportunities to demonstrate achievement of the 'Biological Science' and 'Investigating Inquiry Skill' Outcomes of the Australian Curriculum.

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November, 2002
Revised November, 2008
Australian Curriculum Edition, August, 2013

Australian Curriculum

9.1.1 Biological Sciences: This unit has been divided into two modules, 9.1.1A and 9.1.1B.

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment:

9.1.1A
Be able to describe how the requirements for life (for example oxygen, nutrients, water and removal of waste) are provided through the coordinated function of body systems such as the

- digestive
- circulatory
- respiratory - supplies oxygen/ removes carbon dioxide

9.1.1B
Be able to describe how the body is able to remove wastes, protect the body from infection and coordinate the function of body systems through the

- excretory
- immune
- nervous and
- endocrine systems

- explaining how body systems work together to maintain a functioning body using models, flow diagrams or simulations

- identifying responses using nervous and endocrine systems

- investigating the response of the body to changes as a result of the presence of micro-organisms

- investigating the effects on humans of exposure to electromagnetic radiations such as X-rays and microwaves

OBJECTIVES

Booklet 9.1.1A:

When you have completed the activities in this booklet you should be able to:

- describe what is meant by the word 'food' and how living things form feeding relationships with each other.
- identify the major food groups as being organic or inorganic.
    - Organic Food Groups include carbohydrates, proteins, fats and oils and vitamins.
    - Inorganic Foods include minerals and water.
- explain how small, simple food particles that result from digestion are able to be absorbed by the process of diffusion.
- define diffusion as the random movement of particles from where their concentrations is higher to a region where their concentration is lower.
- identify the membrane enclosing the cell material as a semi-permeable membrane, i.e. one that allows some particles to cross the membrane only if they are small enough.
- identify osmosis as the process where water diffuses through the membranes of cells.
- identify the structures that make up your digestive system and explain their role in this process.
- describe an enzyme as a protein made by a cell that speeds up a chemical reaction, like the breaking down of food molecules to simpler ones in chemical digestion, without itself being used up in this reaction, i.e. it is a biological catalyst.
- list the factors that affect the rate of an enzyme's activity; enzyme concentration, concentration of the target of the enzyme, ph and temperature.
- describe blood as being made up of blood cells suspended in a fluid called plasma.
- understand that blood is important in carrying materials to and from cells.
- identify the blood vessels that contain this blood as arteries, veins and capillaries.
- describe the structure and function of each of these blood vessels.
- identify the main parts of the human heart and the role each part plays.
- describe how the heart rate changes with exercise and be able to explain the reason for such change.
- identify the main pats of the Respiratory System and state the function of each part.
- describe the process of inspiration and expiration, including the role played by the ribs, rib muscles and the diaphragm.
- explain the importance of diffusion in the exchange of oxygen and carbon dioxide between the cells and the blood and between the blood and the air sacs of the lungs.

Life is a puff of air

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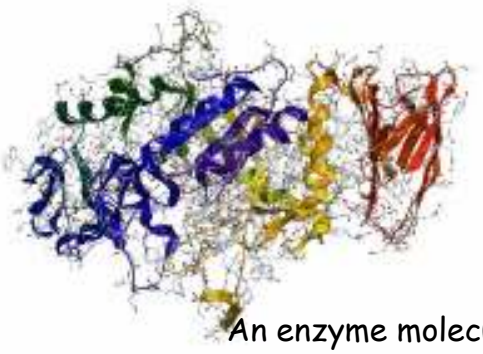


An enzyme molecule

Activity 1: Food & Food Relationships

BACKGROUND INFORMATION

There are 7 life processes that occur in all living organisms. Some of these processes REQUIRE energy, while others RELEASE energy.

- We obtain our food from a variety of sources. Some of these foods we eat raw, while others are processed in various ways before we can eat them.

- Almost all our foods contain energy that our cells can use. This energy has to be released in our cells during cellular respiration (which you will be studying later).

- Some of the foods we eat are of plant origin, while others come from animals. In all cases the energy they contain can be traced back to the Sun.

QUESTIONS

1. Write the word equation (and the chemical equation if you can), which summarizes the process of cellular respiration.

2. Under the heading 'Life Processes' write a list of the 7 life processes and indicate next to each whether you think it requires, or releases energy.

Under the heading 'Nutrition -Uses of Food', mention the uses of food in humans and next to each use give examples of foods, which suit the particular use, e.g., energy - cereals.

3. Under the heading 'My Diet' make a list of at least 10 foods you eat regularly and indicate which of these are derived directly from plant material.

4. Explain why it can be said that all food we eat is derived DIRECTLY or INDIRECTLY from plants?

5. How do most plants obtain their nutrition? (Include the word equation to summarise this process if you can).

6. From this equation, what is the ultimate source of energy for all living things?

Activity 2: Food Groups

We eat a great variety of foods and these foods can be classified into 7 main groups:

1. CARBOHYDRATES
2. FATS
3. PROTEINS
4. VITAMINS
5. MINERALS
6. WATER
7. DIETARY FIBRE

AIM:

To research the importance of these food groups in our diet and to identify foods that are good sources of these food groups.

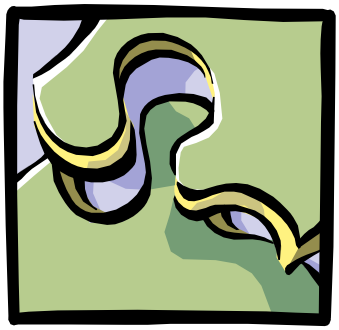
MATERIALS:

- text book and access to reference material.

PROCEDURE:

Draw up a LARGE table like the one below. (Full-page size would be best).

1. Your class group is to find out about one of the food groups in the table and prepare a presentation for the class. The presentation must provide the information needed to complete each column in the table.



Complete the table while each group giving its presentation.

FOOD GROUP	SOURCES OF THE FOODS	FUNCTIONS IN THE BODY	RELATED DISEASES
CARBOHYDRATE			
FATS			
PROTEIN			
VITAMINS			
MINERALS			
WATER			
DIETARY FIBRE			

Activity 3: Foods You Eat

Just as eating too little can be unhealthy, so can eating too much of a particular food type.

AIM:

To evaluate your diet in the light of what you have learned about food groups in the previous activity.

EQUIPMENT:

- text book and reference material.

PROCEDURE:

In this activity you will need to recall all the food items you have eaten in the previous 24 hours.

Draw a table similar to this one:

FOOD EATEN	PROTEIN	FAT	CARBO-HYDRATE	MINERALS	VITAMINS

In the table list each food item you ate yesterday. Tick off the food groups which were in each item of food. (You may need to refer to your textbook or other reference material. Alternatively, class or group discussion may help).

QUESTIONS:

1. Were any food groups not ticked off?
2. Did there seem to be an excess of one group?
3. What is meant by a 'BALANCED DIET'?
4. Was your diet yesterday balanced?
5. What is MALNUTRITION?

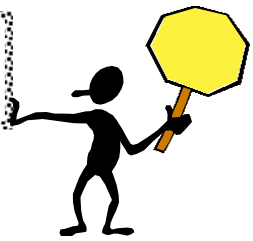
Give at least two examples where eating the wrong amount of a particular type of food, is the cause of malnutrition.

Activity 4: Diffusion

- *Have you ever taken off your shoes and been knocked over by the smell of your own feet?*
- *How did the smell reach your nose?*

We know that hot air rises and this might help to explain in part how the chemical particles stimulate our sense of smell. However, there is also another process at work.

This activity should only be done by your teacher as a demonstration



AIM:

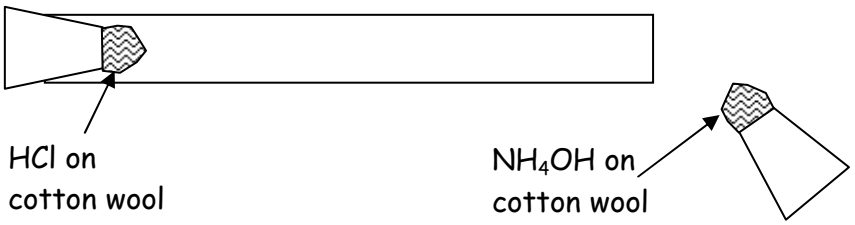
To understand the process of diffusion.

MATERIALS:

- concentrated ammonium hydroxide solution (NH_4OH) and pipette
- concentrated hydrochloric acid (HCl) and pipette
- 25 cm large bore glass tube
- two stoppers, each with a cotton wool ball attached to it with a staple

METHOD:

1. Add a drop of concentred ammonium hydroxide to the cotton wool on one of the stoppers.
2. Insert the stopper into the glass tubing.
3. Add a drop of concentrated HCl to the cotton wool on the second stopper.
4. Insert this into the other end of the glass tubing.



5. Leave the apparatus set up on the bench top until a reaction is observed.

OBSERVATIONS:

What evidence is there that a reaction occurred inside the glass tubing?

DISCUSSION:

1. Explain how the particles of HCl reached the particles of NH_4OH to cause the reaction.
2. With your teacher's help, define what is meant by 'diffusion'.

Activity 5: Semi-Permeable Membranes

AIM:

To investigate the diffusion of water through a semi-permeable membrane.

EQUIPMENT:

- sultanas (some dry and others soaked in water overnight)
- two beakers
- syrup or honey.

PROCEDURE:

1. In your note book/file, make a copy of the table shown below.

2.

DRY SULTANA	SOAKED SULTANA

3. Put two sultanas side by side, one dry and the other soaked.
4. Cut the skins of the two sultanas and gently squeeze them.
5. Fill in the table to show the differences between them. Use the words suggested below.

swollen	jelly-like feel
shrivelled	firm feel
smaller	larger

The sultana membrane also acts like a sieve for water and sugar particles.
It is called a SEMI-PERMEABLE membrane. (The word 'permeable' means 'allows things through'. 'Semi-permeable' means 'allows some things through but not others').

QUESTIONS:

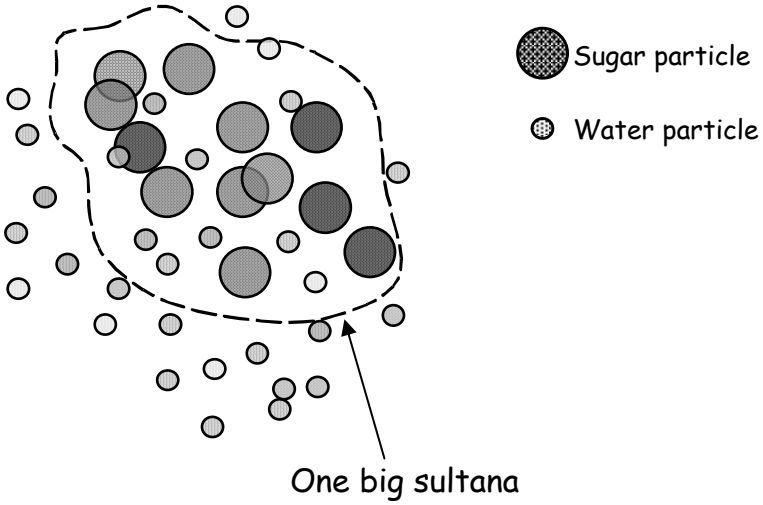
1. The cooks shown here are using a SIEVE to separate currants from flour. Which parts can pass through fine mesh and which cannot? Why?

2. In the sultana, which particles are the larger, sugar or water?

3. Which particle/s can pass through the sieve-like (semi-permeable) membrane?

4. How did the water move inside the soaked sultana?

This diagram, which shows a sultana very much enlarged, has the water and sugar particles labelled.



Copy this diagram and use arrows to show how the water particles can enter the sultana by diffusion.

5. Why is 'semi-permeable' a good phrase to use to describe a membrane.

6. What do you think would happen if the soaked sultanas were left in a strong sugar solution like golden syrup or honey?

7. Explain the following processes. Discussion may help.

Limp lettuce leaves or celery sticks become crisp if they are soaked in water.

(a) If a celery stick is sliced several times part way down it length and then soaked in water, the celery curls over. (Try this if you have not done it before)

(b) The cells of plant roots take up water from the soil.

Activity 6: A Sticky Problem

In the previous activity you learned about membranes that form the boundaries of living cells and the way they allow some particles to pass through them but not others. Such membranes are called semi-permeable for this reason.
In this activity you will study another example of movement of materials through a semi-permeable membrane.

AIM:

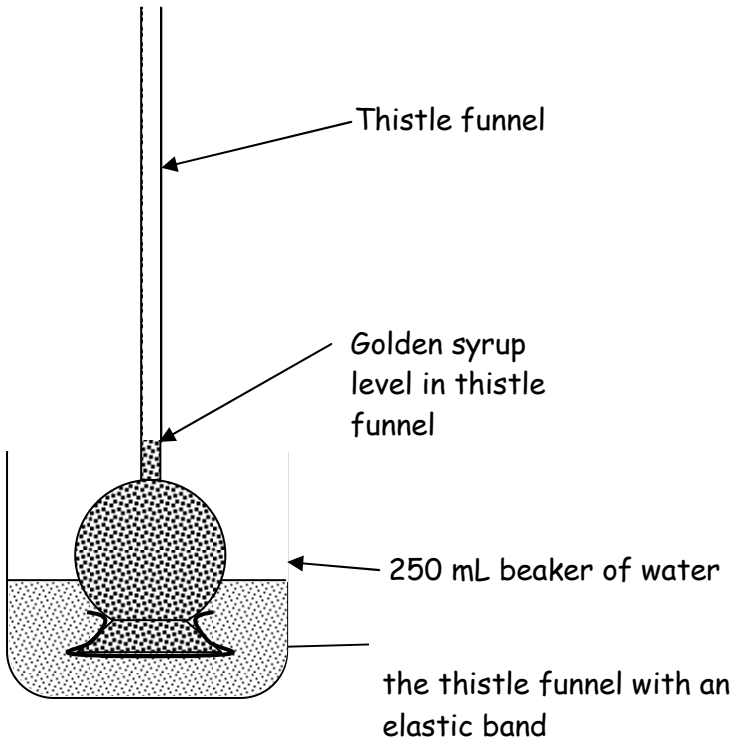
To examine a model of a cell that is immersed in water and explain how it gains or loses materials.

MATERIALS: (for class)

- thistle funnel
- dialysis tubing (semi-permeable membrane)
- 250 ml beaker of water
- golden syrup
- elastic band
- teaspoon

PROCEDURE:

Set up the equipment as shown in the diagram below:



PREDICTIONS:

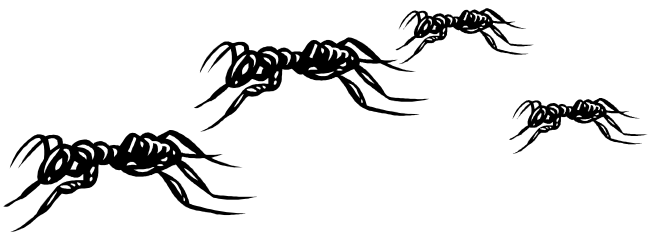
1. What do you think will happen to the level of the syrup in the thistle funnel?
2. Why do you think so?

OBSERVATIONS:

1. Allow the apparatus to stand for 30 minutes.
2. Record observations of the level of the golden syrup in the thistle funnel at 5-minute intervals.

CONCLUSIONS:

1. What evidence do you have that movement of water particles occurred?
2. What evidence do you have of movement of the golden syrup particles?
3. Using your understanding of diffusion, explain what happened in this experiment.
4. Why is the description of dialysis tubing as a 'semi-permeable membrane' appropriate?

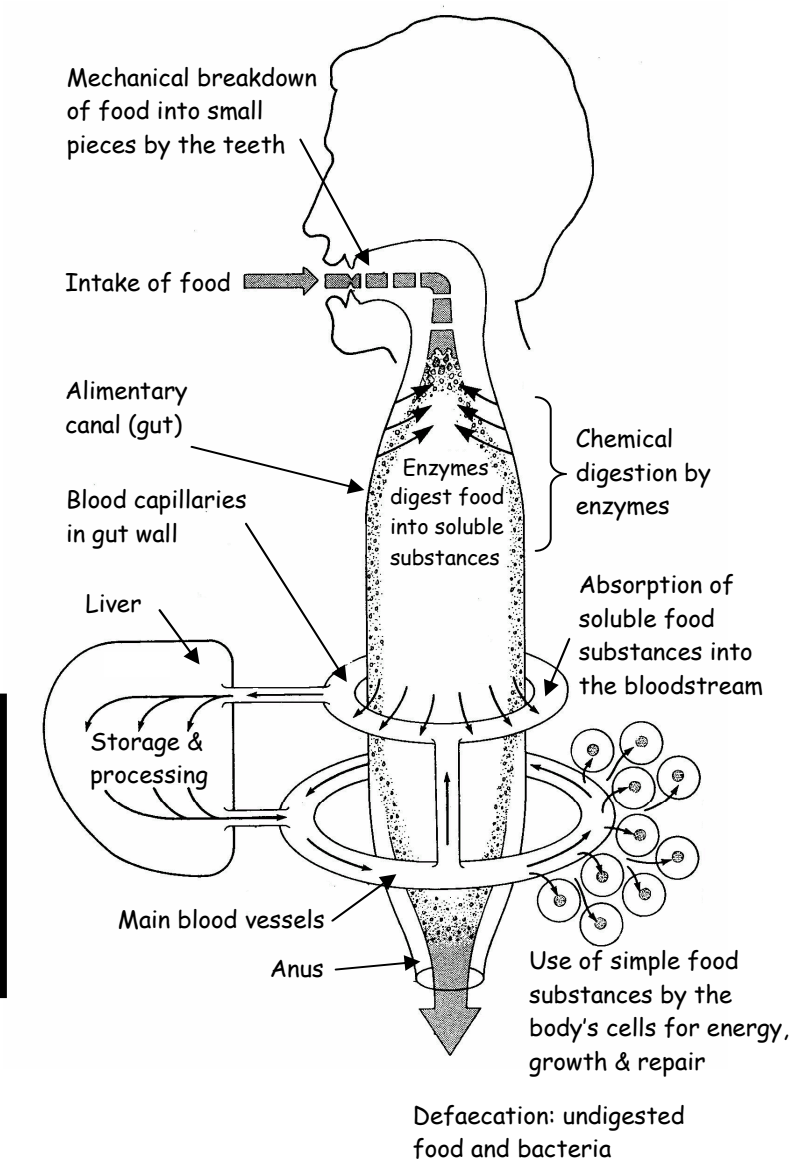


Activity 7: The Digestive System

The ALIMENTARY canal or digestive tube is basically a tube inside a vertebrate animal. Food is taken in one end, digestion takes place, absorption occurs and wastes are eliminated.

In your notebooks…….

Use the diagram of the digestive system to list six key steps associated with the digestive process.



This diagram shows the gut as a straight tube from mouth to anus. Enzymes are released into this tube, food is broken down into soluble form and absorbed into the blood-stream, and indigestible matter is passed out of the anus.

QUESTIONS:

1. Label the following parts on a diagram of the human digestive system

   Mouth, Salivary Glands, Oesophagus (Gullet), Stomach, Liver, Gall Bladder, Pancreas, Small Intestine, Appendix, Large Intestine, Rectum, Anus.

   If a model of a human torso (body) is available, try to find all the parts of the digestive system that you have learned about.

Did you know…….

- Less than half the cells in your body are human!

Find the meanings of the following terms, which are related to the digestion of food.

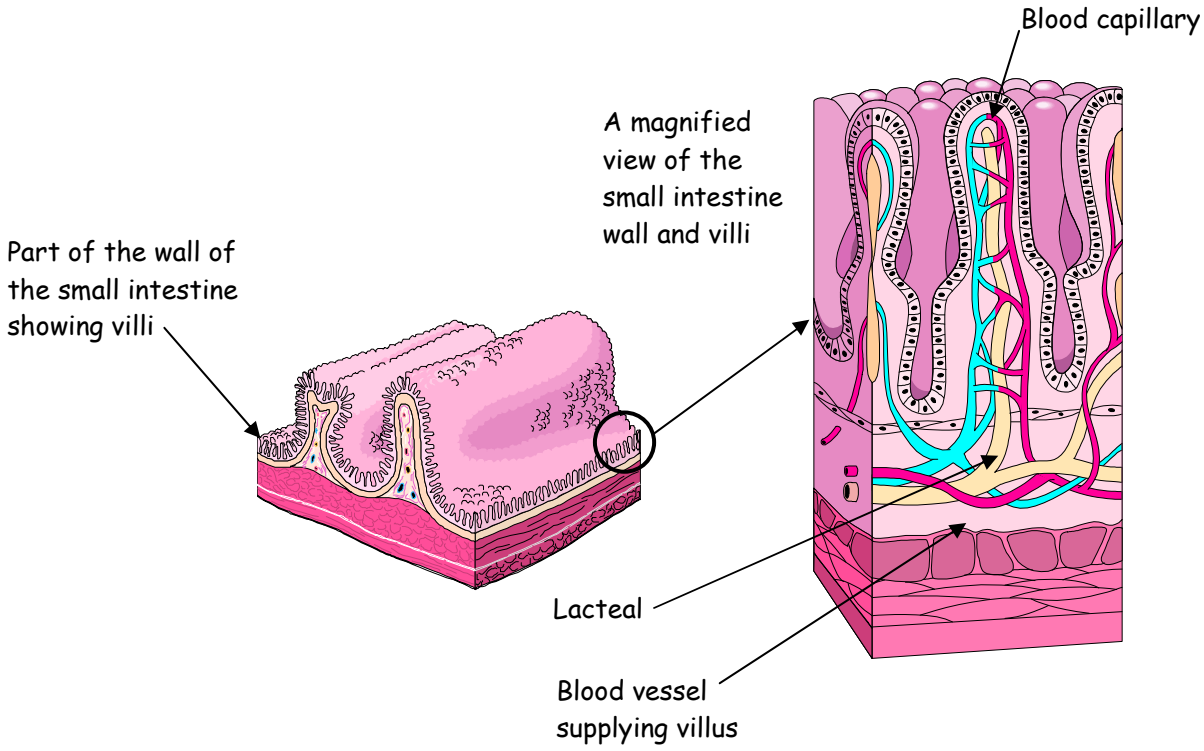
(a) Mechanical digestion
(b) Chemical digestion
(c) Alimentary canal
(d) Duodenum
(e) Gastric
(f) Enzyme
(g) Bile
(h) Peristalsis
(i) Absorption
(j) Faeces.

Did you know……

- The small intestine is 5m long while the large intestine is 2m long!
- The surface area of the small intestine is about the same as a tennis court!
- There are millions of villi in your small intestine!

Why does the food need to be digested?

2. Where does the food that you eat eventually go to in your body?
3. What is the food used for?
4. Why does the digestive tube have muscle in its walls?
5. What are VILLI? Where are villi found and how do they aid the absorption of food?
6. Is the liver a part of the alimentary canal? Explain.
7. The liver is part of the digestive system. Explain.



Activity 8: Construct-a-Gut

Obtain 'Construct-A-Gut' worksheet from your teacher and complete it as a homework assignment. Add suitable colour to your construction.

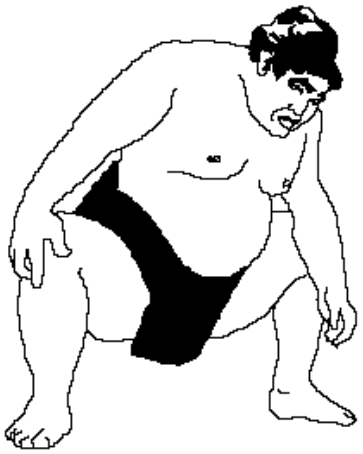
1. Use your textbook to find information on what processes take place in each part of the alimentary canal that you assemble.

   Explain the processes under these headings

   (a) MOUTH
   (b) OESOPHAGUS
   (c) STOMACH
   (d) SMALL INTESTINE
   (e) PANCREAS
   (f) LARGE INTESTINE
   (g) ANUS.

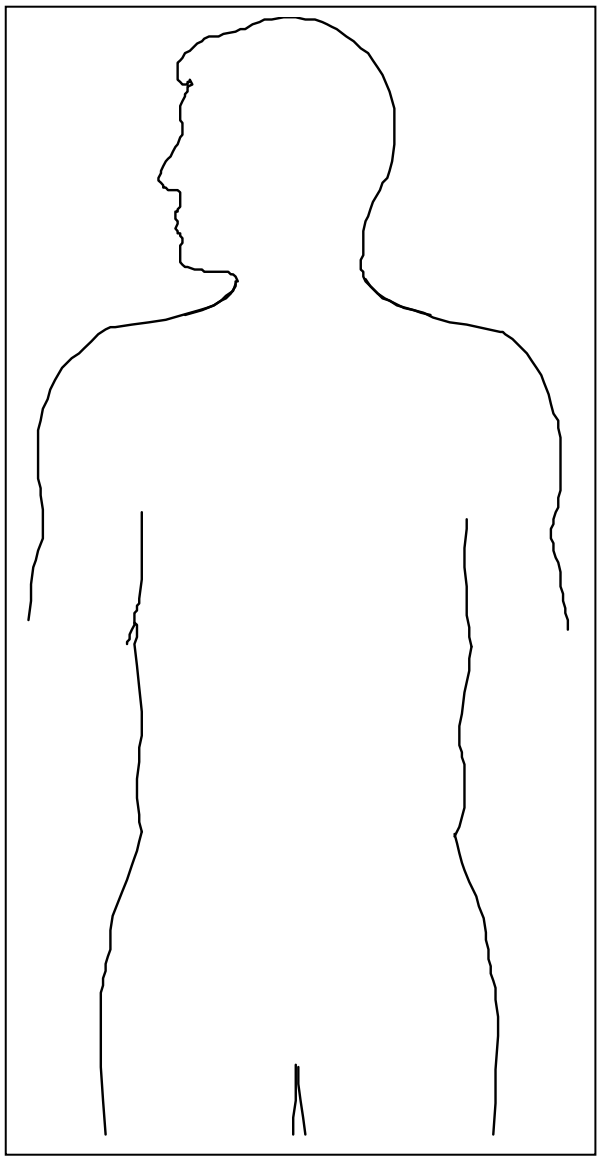
   Add this information to your Construct-a Gut.

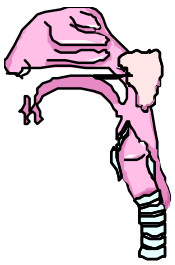
   Your teacher may choose to review this activity using the 'line up' activity to be found on the shared drive.

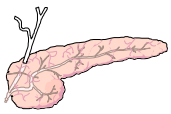


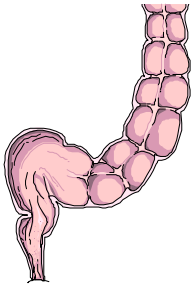
Construct a Gut

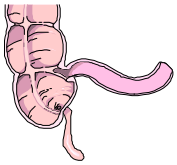
Carefully cut out the parts of the digestive system. Overlay the various parts in their correct positions. Attach the parts to the outline body using thin strips of adhesive tape so that the uppermost pieces can be lifted up to show what is underneath.

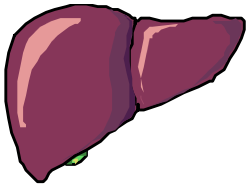


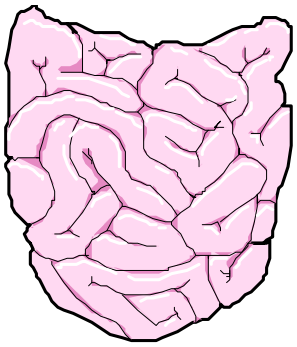


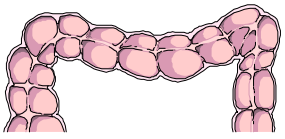








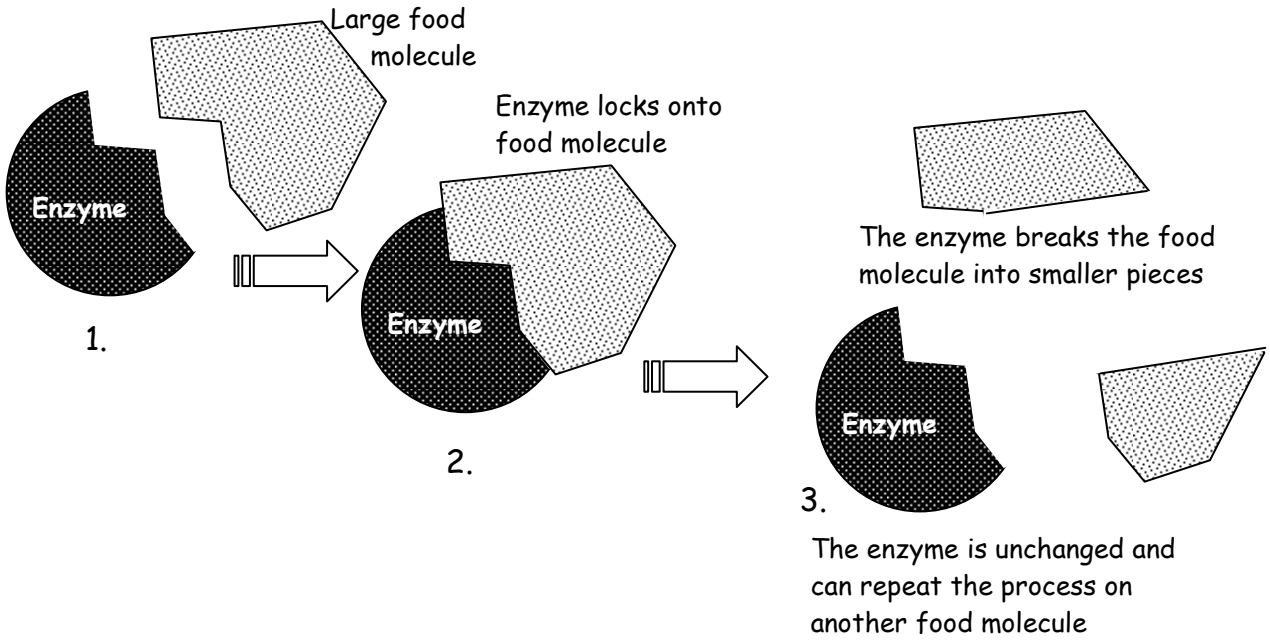




Activity 9: Enzymes

Enzymes are chemicals, which speed the chemical changes that take place in our body. They can be thought to be reaction 'helpers'- without them chemical reactions in our bodies would not happen.
The enzymes themselves do not change as a result of the reactions and can be re-used over and over. Therefore, only a very small amount of an enzyme is needed.

HOW ENZYMES WORK



A number of different enzymes are involved in the chemical digestion of food.
Each type of enzyme has its own special shape so it can only lock onto a particular type of food the type having the enzyme's shape.

This means that enzymes are SPECIFIC in their action.

Enzymes also have OPTIMUM working conditions or conditions under which they work best.

These conditions include:

(a) correct level of acidity or pH
(b) correct temperature
(c) correct substrate (food substance)

If the temperature is too high or the pH too high or low, the enzyme molecule's shape can be changed. This will stop it from fitting the target food substance.

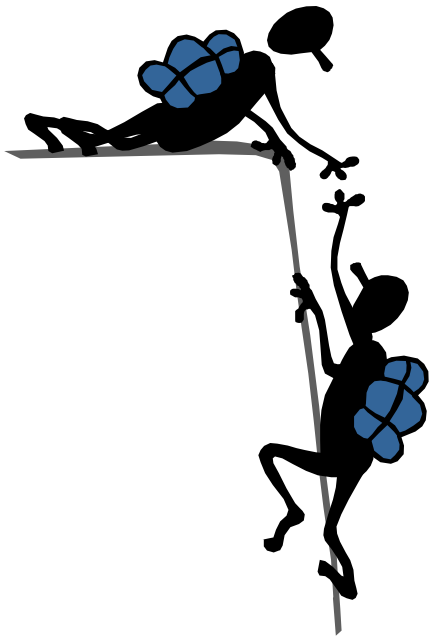
http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__how_enzymes_work.html
http://highered.mcgraw-hill.com/sites/0072507470/student_view0/chapter25/animation__enzyme_action_and_the_hydrolysis_of_sucrose.html

QUESTIONS:

1. Find the names of the 3 main classes of enzyme found in the digestive system.
2. Make a summary of what you have learned about enzymes.
    - What are enzymes?
    - Why is the shape of the enzyme important?
    - What conditions are needed for an enzyme to function best?
    - Why might the concentration of the enzyme make a difference to how fast the reaction works?
    - Why can enzymes be re-used?
    - How are enzymes thought to work? (A diagram might help to model this idea)

Did you know……

- You make 1-1.5 L of saliva every day. This is similar to the amount of urine you pass each day!



Activity 10: Factors Affecting Enzyme Activity

INTRODUCTION

There are countless enzyme molecules in the body. Some are inside cells controlling the many chemical reactions involved in the life processes of the cell. Others, such as digestive enzymes, perform their functions outside cells (e.g. in the digestive tract). However, all enzymes have similar properties and their activity is dependent on factors such as temperature and acidity.

RENNIN is a digestive enzyme made by the stomach of mammals, particularly baby mammals. Rennin starts the breakdown of milk protein, which explains its importance in baby mammals. The action of rennin can be seen easily, since it causes the milk protein to become solidified. (You might have seen the curdled milk regurgitated by a young baby). This property of rennin is used in junkets (a milk dessert). Junket tablets contain rennin extracted from the stomachs of young calves.

Your teacher may perform this experiment as a demonstration or have you do it yourselves.

AIM:

To investigate the effect of

- low temperatures
- high temperatures
- acidity levels on the action of the digestive enzyme RENNIN.

EQUIPMENT:

Per group

- 4 x test tubes
- 20 mL of milk
- 4 mL rennin solution
- 2 drops 1M NaOH
- thermometer
- 2 x 500 mL beaker
- Pasteur pipettes

Per class

- 10 mL measuring cylinder
- ice
- kettle
- 1 rennin tablet in 200mL of water
- 100 mL of boiled rennin mixture
- Safety glasses

WARNING!

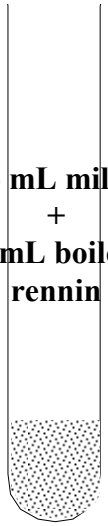
Sodium hydroxide is very corrosive – avoid eye contact

PROCEDURE:

1. The teacher must separate 100mL of the rennin mixture into another beaker and bring to the boil for at least 2 minutes, then cool it in a water bath.
2. Label the test tubes A, B, C and D.
3. Add 5 mL of milk and 1mL of boiled rennin to test tube A.
4. Add 5mls of milk and 1 mL of unboiled rennin to test tube B.
5. Add 5 mL of milk and 1 mL of unboiled rennin, plus 2 drops of 1M NaOH to test tube C.

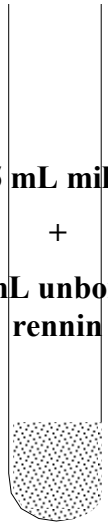
6. Add 5 mL of milk and 1 ml of unboiled rennin to test tube D.
7. Make a water bath by mixing hot and cold water to one of the 500mL beakers to obtain a temperature of 35-40 °C. At least half fill the beaker with water.
8. Half fill the second beaker with water then add ice to make a cold-water bath.

Treat the test tubes as shown in the diagrams below:



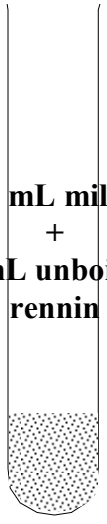
Test tube A:

- **BOILED ENZYME**
- In warm water bath



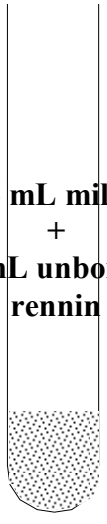
Test tube B:

- **COLD CONDITIONS**
- In cold water bath



Test tube C:

- **CHANGED ACIDITY**
- In warm water bath



Test tube D:

- **NORMAL BODY TEMPERATURE**
- In warm water bath

Leave all four test tubes for 30 minutes. Keep the warm water bath at the correct temperature by adding small amounts of hot water. Make observations of any changes.

Meanwhile, answer the following questions:

1. Under the heading 'Factors Affecting Enzyme Activity', copy the aim of this exercise.

2. Summarise the conditions in each of the four test tubes in similar diagrammatic form to that shown, as part of the procedure.

Under the sub heading 'OBSERVATIONS', record in a table the changes (if any) that occurred in each beaker after 30 minutes.

This exercise is actually three separate experiments performed at the same time.

Under a sub heading 'CONCLUSIONS', summarise your findings for each experiment in a copy of the following table:

EXPERIMENTAL VARIABLE	TEST TUBES INVOLVED	EFFECT OF VARIABLE ON ENZYME ACTIVITY
1. HIGH TEMPERATURE		

When we have an infection our body temperature often rises (i.e. we have a fever). Suggest how this may help us to fight the infection.

3. Our normal body temperature is around 37ºC. If a person's fever gets as high as 44º - 45ºC, it may be necessary to place them in a cold bath. Suggest a reason for this action.

Did you know……..

Saliva is

- 97 – 99.9 % water
- slightly acidic pH 6.75-7.00
- contains:
  - dissolved Na^+, K^+, Cl^-, PO_4^- and HCO_3^- ions
  - an enzyme
  - slimy mucous
  - nitrogen wastes
  - antibodies to fight disease

http://www.youtube.com/watch?v=AEsQxzeAry8

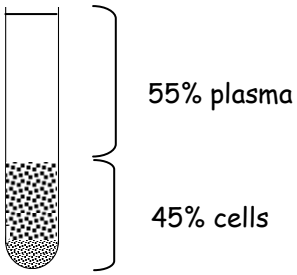
Activity 11: Blood

BACKGROUND:

We have already seen that the cells in the body require food molecules and oxygen to release the energy they need in order to live. The waste products from this process must also be removed.

In large organisms, like man, a transport system is required to enable the food, oxygen and wastes to be carried between active cells the body surfaces. This system is a series of tubes of different sizes (arteries and veins) connected to a pump (the heart) and carrying a fluid (blood).

Blood looks like a red liquid when you see it, but it is really a complex mixture. It consists of a fluid called plasma in which different types of cells are floating.

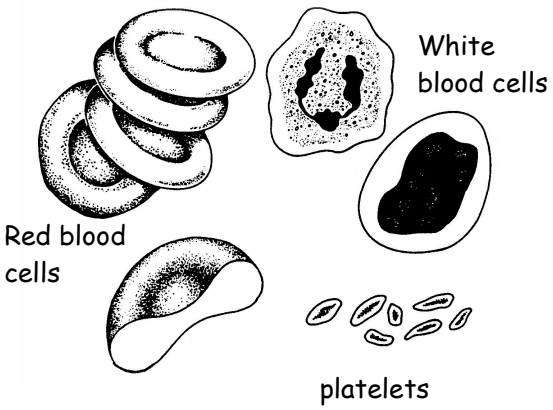


AIM:

To investigate the composition and function of blood.

EQUIPMENT:

- reference book or computer



Did you know…….

- An adult human has about 7 litres of blood.

QUESTIONS:

1. Draw up the following table in your notebook.

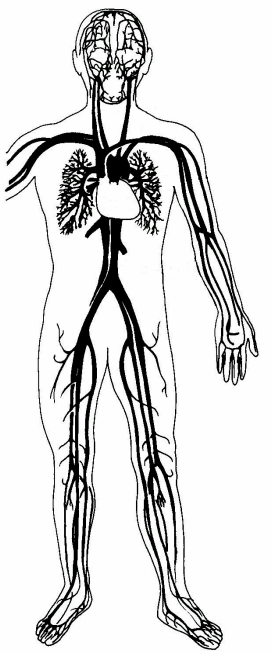
Blood Component	Function (what it does)
Plasma	Transport of a. b. c. d. e. f.
Red Blood Cell	
White Blood Cells	
Platelets	

2. Use a reference book or Internet to find the information to complete the chart.
3. Where in the body are new blood cells made?
4. What is the name of the pigment that gives red blood cells their colour?
5. What is the purpose of this pigment?
6. What is ‘anaemia’ and how is it caused?

Activity 12: Blood Vessels

BACKGROUND INFORMATION

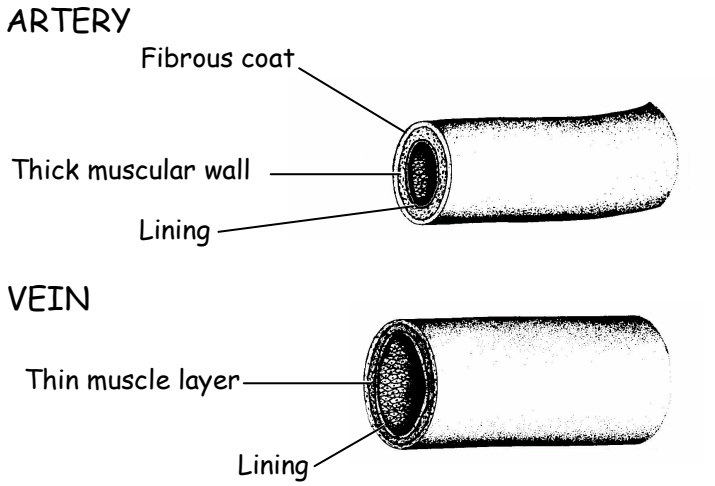
Blood in vertebrates is normally confined to a closed system of vessels through which blood circulates over and over. The vessels that make up this closed circuit must perform different functions in different parts of the body.



a. **LEAVING THE HEART**: The vessels must carry blood at very high pressure and take it rapidly to all parts of the body.

b. **IN THE BODY ORGANS:** Vessels must allow rapid exchange of nutrients and wastes to and from the body's cells.

c. **RETURNING TO THE HEART:** The vessels must carry blood at low pressure; yet ensure that it returns at a sufficient rate.



AIM:

To observe and investigate the different types of blood vessels.

EQUIPMENT:

- A reference book.

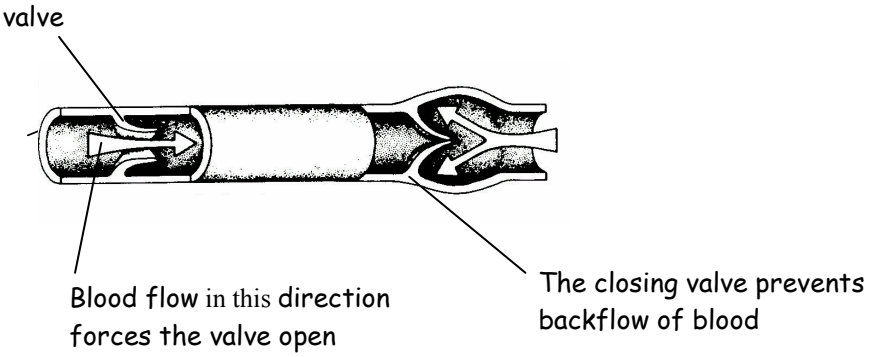
PROCEDURE:

1. Draw up a table like the one below in your books and use your reference book to fill in the missing information.

Vessel	Structure of vessel wall	Function
Artery		
Vein		
Capillary		

QUESTIONS:

1. Why is the wall of the arteries so much thicker than that of the veins?



2. The above diagram shows valves in the veins. Why are these valves necessary?

DISCUSSION TOPIC: Fighting the Force

Remember the force called gravity? Blood from the legs and lower body needs to be lifted back to the heart against the force. Valves in the veins help. So does the squeezing action of muscles as they contract and relax.

Bearing this in mind, can you suggest why:

- People sometimes faint if they have to stand for long periods.
- You should lay someone down who faints, and elevate his or her legs a little.
- Varicose veins are mostly found in legs.

FURTHER RESEARCH…… when things go wrong

Read each of the following statements then research an explanation for the underlined statement.

- The teacher was furious as she looked at Wendy's sloppy work. "Calm down", she told herself, "Your blood pressure's rising".

- Lester found his dad slumped in a chair. His face was twisted with pain, and he clutched at his chest. "Call an ambulance", he groaned, "I think I'm having a heart attack".

- Tania's mum needed a lot of extra help now. She'd had a stroke and couldn't use the muscles of one side of her body.

Activity 13: The Heart

AIM:

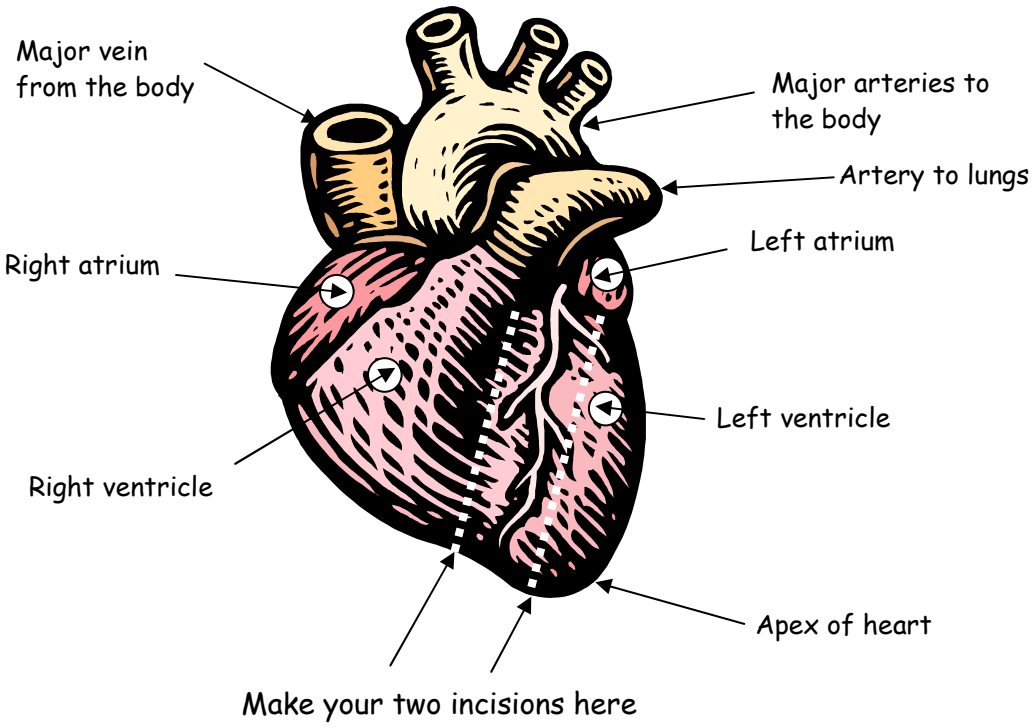
To investigate the structure and function of the mammalian heart through dissection.

EQUIPMENT:

- reference book
- dissecting tray and instruments
- sheep's heart
- worksheet 'Heart Structure'

PROCEDURE:

1. Study the outside of the heart carefully and identify the structures in the diagram below.

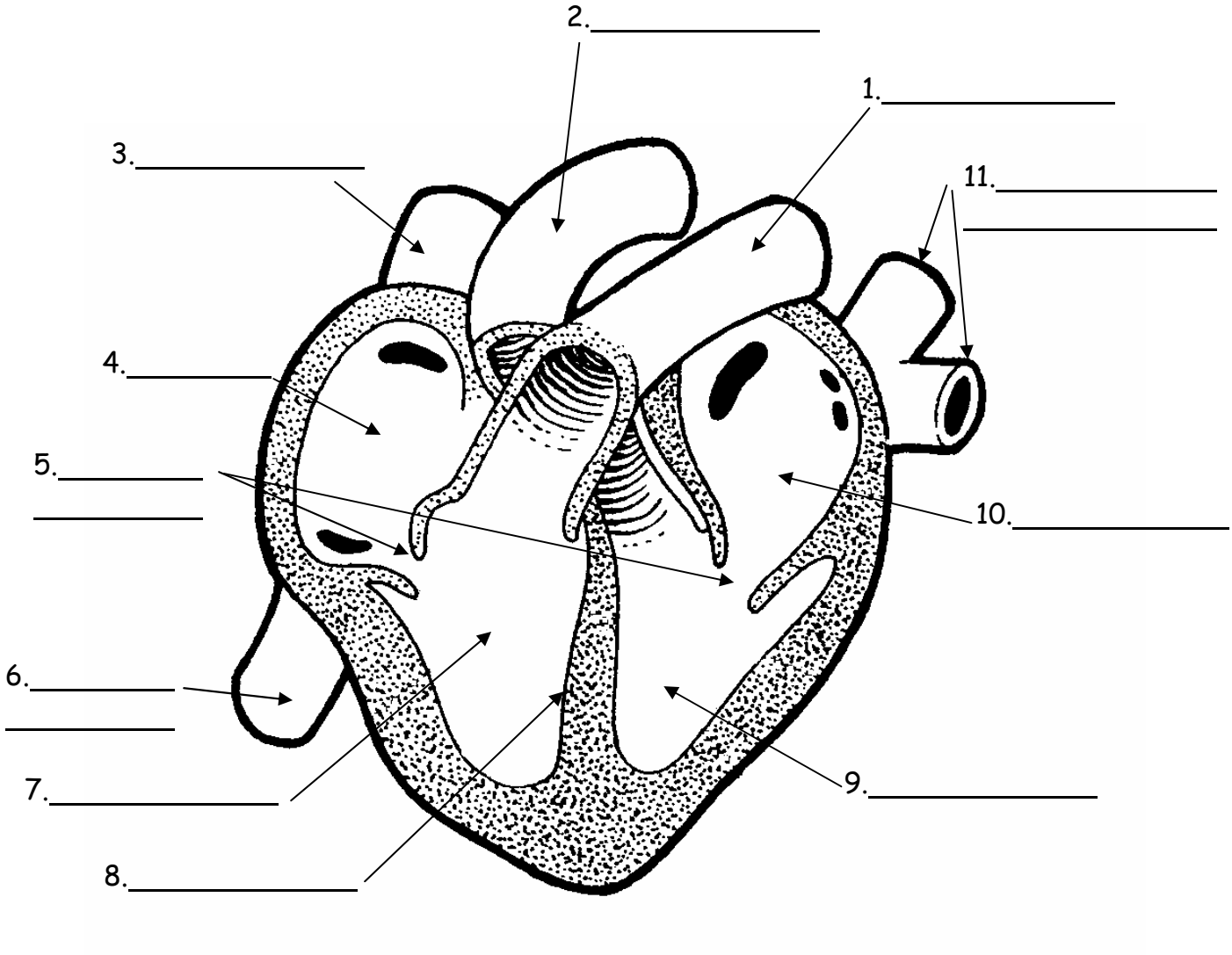


2. With a scalpel blade or a Gem blade, make 2 incisions on either side of the groove of the heart. (See diagram above).

QUESTIONS:

1. Why is there a difference in thickness between the walls of the atria and ventricles?
2. How do you think the flaps of tissue (valves) between the atria and ventricles work?
3. What is the function of the cords that attach the valve flaps to the ventricle walls?
4. Why does the heart pump twice during each beat?
5. Why does a thick wall separate both ventricles?
6. On your worksheet use arrows to show the path followed by blood through the heart.

HEART STRUCTURE WORKSHEET



SELECT FROM THESE LABELS:

Right atrium
Left atrium
Right ventricle
Left ventricle
A-V valve
Septum
Vein from the lower body
Vein from the upper body
Aorta
Artery to the lungs
Pulmonary veins

EXTRAS FOR EXPERTS:

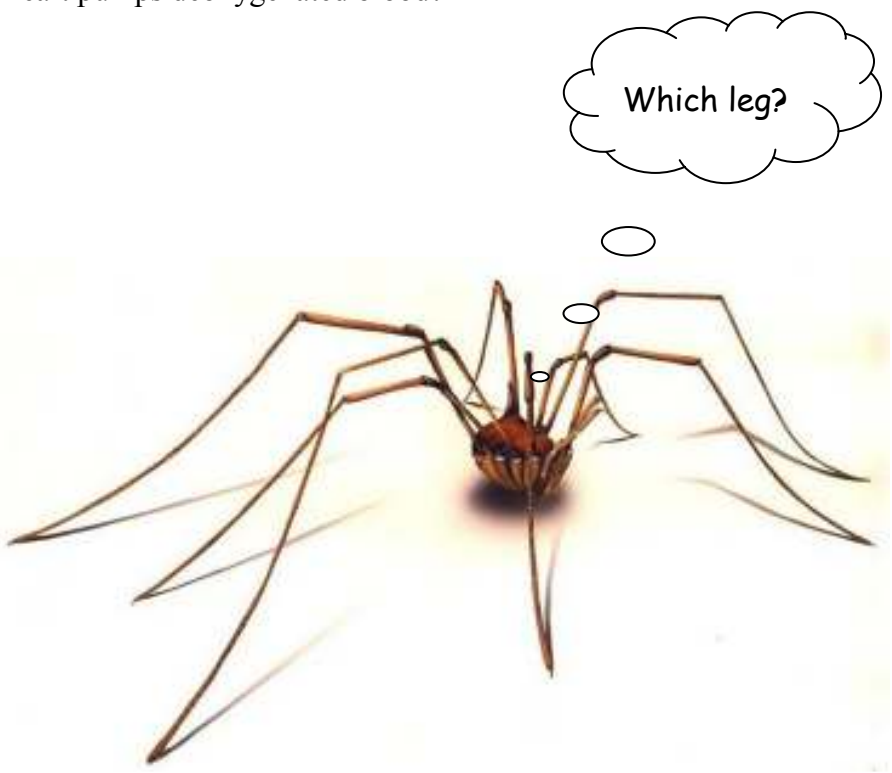
Add these structures or labels to the diagram:

Apex
Inferior vena cava
Pulmonary artery
Heartstrings (chordae tendinae)
Semi-lunar valves
Superior vena cava
Pulmonary vein

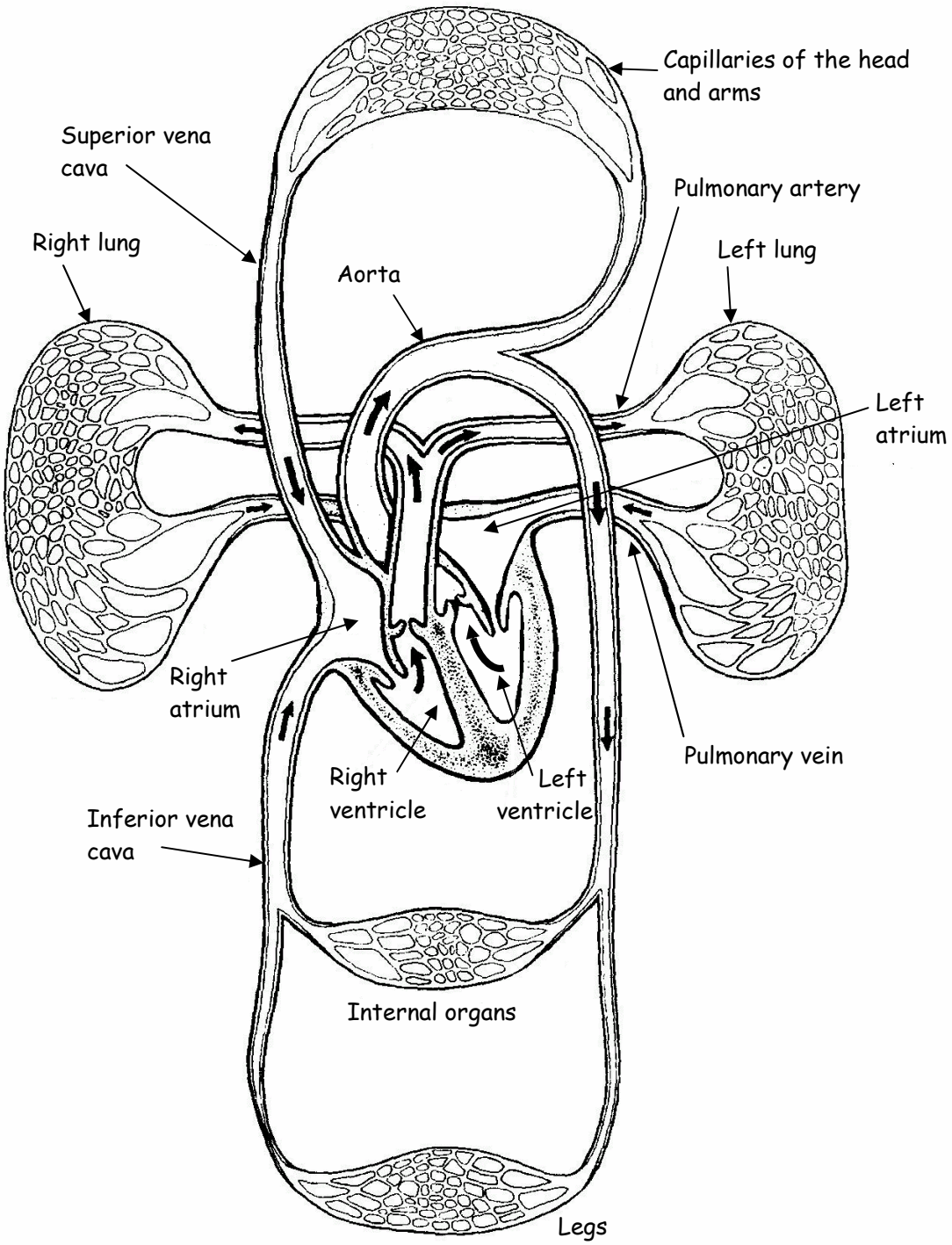
Activity 14: Where Does The Blood Go?

Use the diagram of the circulatory system shown on the next page to answer the following questions.

1. Consider a red blood cell in one of your legs. List the structures it will pass through before it returns to the same leg.
2. How many times did it pass through the heart before it returns to the legs?
3. Does blood pass first into the atrium or ventricle of the heart?
4. What are the tubes that carry blood to the body organs called?
5. What do we call those that carry blood back from the organs to the heart?
6. Deoxygenated blood contains much carbon dioxide and little oxygen. How does oxygenated blood compare?
7. Where is the blood oxygenated?
8. Where does carbon dioxide in the blood come from?
9. Where is it removed from the body?
10. Which side of the heart pumps deoxygenated blood?



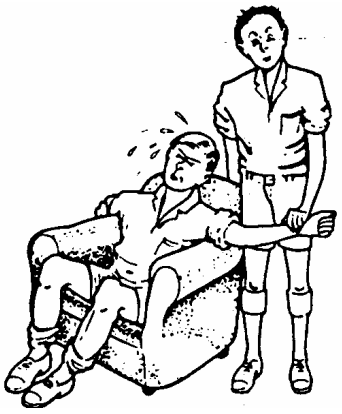
The Circulatory System



Activity 15: Heart Rate and Exercise

By now you know why and how
- your heart beats
- your lungs breathe
- your muscles move.

Consider how these activities are inter-related as you try this fitness test.



AIM:

To investigate the effect of exercise on heart rate and to use this information to estimate your level of fitness.

EQUIPMENT:

- stop clock
- graph paper

PROCEDURE:

- Work in pairs with one person being the Exerciser, the other the Recorder.
- Recorder takes Exerciser's resting pulse (beats/minute) and resting-breathing rate (breaths/minute).
- Exerciser-follows a pre-set exercise routine as indicated by your teacher. The Recorder times the length of the exercise.
- The Recorder takes Exerciser's pulse rate and breathing rate
  (a) immediately after exercise.
  (b) then at three minute intervals until the resting rate is reached again.
- Swap roles so that everyone gets a turn to exercise.

Exercise gives your heart a 'workout'. But to be effective, you need to push your pulse high enough to reach a target zone. Find your target zone on this chart.

Resting pulse is	Your pulse should rise to
below 50	136 - 156
50 - 54	138 - 167
55 - 59	140 - 168
60 - 64	142 - 169
65 - 69	144 - 170
70 - 74	146 - 171
75 - 79	148 - 171
80 - 85	150 - 173
85 + over	152 - 174

NB: These target zones are for under 25's only. Target zones get less as age increases.

RESULTS:

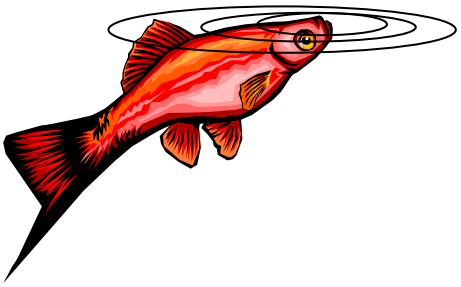
1. Construct a suitable table in which you can record your data.
2. Present your results in a suitable graph.

QUESTIONS:

1. Why does exercise cause heart and breathing rates to increase?
2. Why do they take time to slow down afterwards?
3. What does fitness do to pulse and breathing rates? Why?
4. What other evidence was there to show that you had been exercising?

.

Activity 16: The Respiratory System



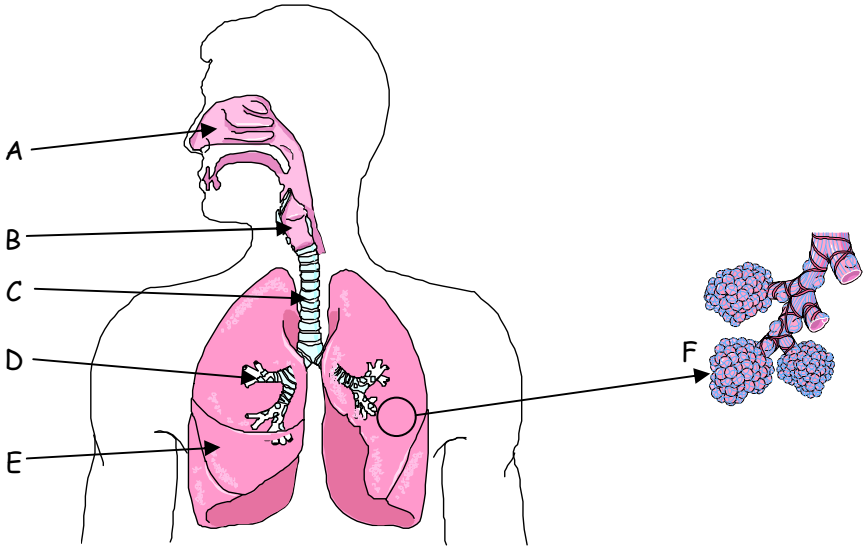
You might remember that cells must respire in order to get energy from food substances. It is necessary for cells to obtain oxygen from their surroundings and release carbon dioxide to the surroundings. This process is called 'gas exchange'. Since only very few of the cells of a large organism are in direct contact with air, a special respiration system is needed to exchange gases for all the cells of the body.

AIM:

To research the function of the respiratory system and to label the structures involved.

WHAT YOU WILL NEED:

- text book diagram of the human respiratory system.
- a copy of the worksheet 'The Respiratory System'



QUESTIONS:

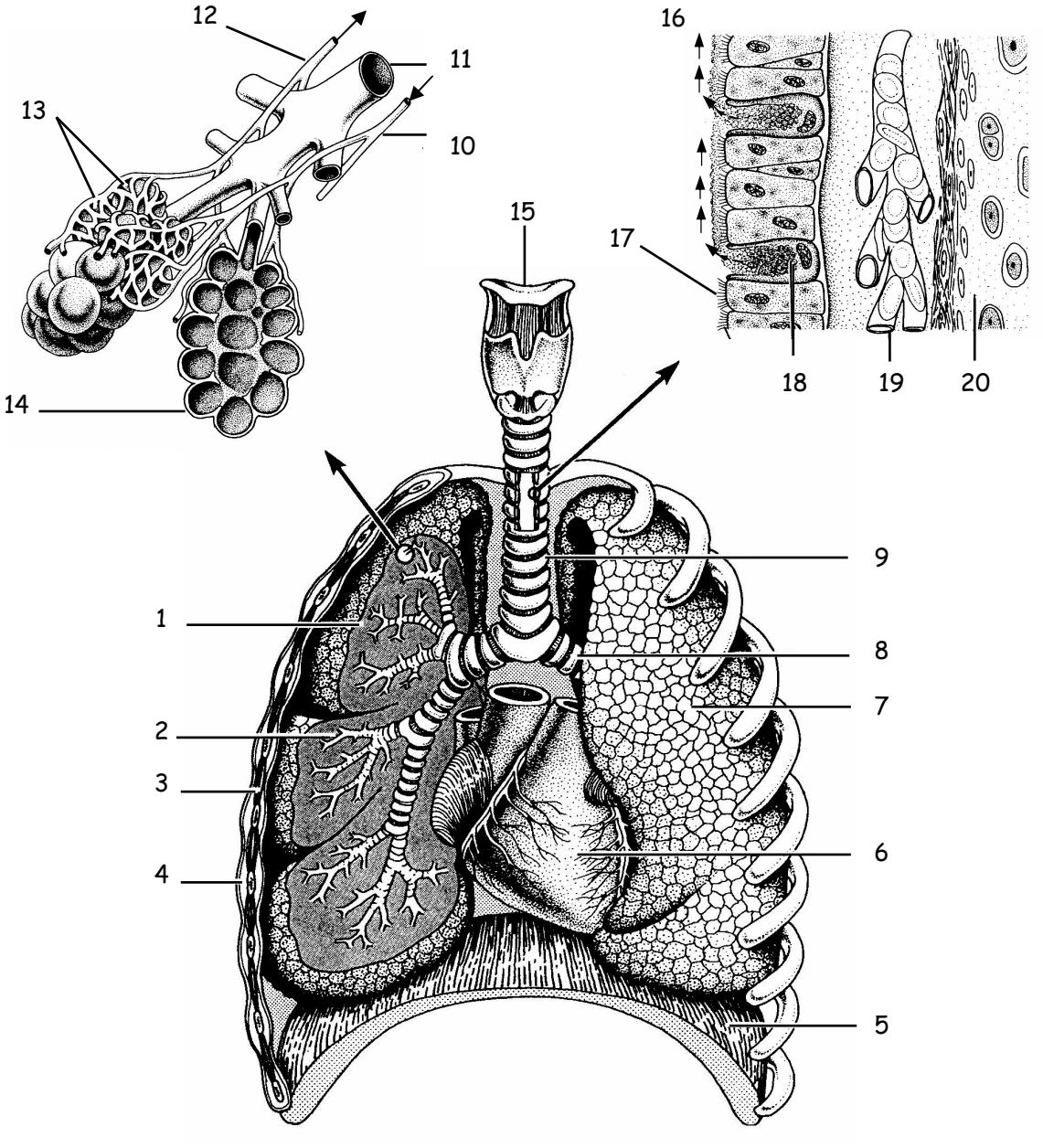
1. Sequence the following into an equation for respiration:
   - Food
   - Carbon dioxide
   - Water
   - Energy
   - Oxygen
2. Describe in one or two sentences the overall function of the respiratory system, naming the gases involved.
3. What is the difference between 'breathing' and 'respiration'?
4. Humans breathe with lungs. Name at least two other ways organisms may breathe.
5. In your notebook write a short sentence to describe the function(s) of each of the parts labelled on the diagram above.

Worksheet: The Respiratory System

1. Match the numbers on the diagrams with the labels which appear below:

	Rib		Blood low in oxygen to air sacs
	Rib muscle		Blood rich in oxygen from air sacs
	Wind-pipe (trachea)		Air sacs cut open
	Bronchiole		Bronchiole
	Right lung		Mucus making cell
	Diaphragm		Flow of mucus
	Left bronchus		Blood vessel in windpipe
	Left lung		Cartilage of windpipe
	Air sacs covered with blood capillaries		Hair-like cilia
	Heart		Voice box (larynx)

2. Colour in the blood vessels serving the air sacs. Use blue for blood low in oxygen and red for blood rich in oxygen.



Activity 17: Examination of Sheep Lungs

A sheep's respiratory system is very similar to a human's in size, structure and function. This makes it a useful study to learn more about our lungs.

Your teacher will most probably elect to do this activity as a class demonstration, since there is a chance (although only remote) that humans may contract parasitic infections as a result of handling animal organs such as these. For this reason also, plastic disposable gloves should be worn at all times by anyone handling the lung set.

AIM:

To examine the structure of a set of sheep lungs or a sheep pluck (heart and lungs together).

EQUIPMENT:

1. sheep pluck (or lung set)
2. dissecting equipment
3. bowl of water
4. diagram of the human respiratory system (from Activity 14)
5. disposable plastic gloves
6. hand lens
7. pump

PROCEDURE 1:

1. Refer to the diagram of the human respiratory system from Activity 14.
2. Use your textbook to help you identify all structures of the sheep's lungs.

WARNING: at no time should the mouth come into contact with the lung set due to the risk of bacterial and parasitic infection. Nor should air from the lungs be re-inhaled.

3. Your teacher may now gently inflate the lungs. To do this he/she will place a clean plastic tube into the trachea and blow air into the tube using a pump.

4. Your teacher will now cut the trachea open down its length.

   Notice the following features

   - cartilage rings
   - the lining of mucus.

Did you know……

- When you cough air moves out through your trachea at up to 160 kph!
- You have about 300 million air sacs in your lungs!

QUESTIONS:

1. Identify the following structures on the lungs and check they are labelled on your sheet:
   - trachea
   - bronchi
   - left and right lungs.

2. Which structures of the respiratory system are not present in a lung set?

3. By how much did the lungs expand? Do you think they were fully inflated?

4. What is the purpose of the cartilage rings?

5. Why don't they go all the way round the trachea?

(Hint: The gap in the cartilage rings is next to the oesophagus or gullet, which carries swallowed food to the stomach).

6. Suggest a function for the mucus found in the trachea.

PROCEDURE 2:

Continue the cut down into one of the bronchi and follow a branch until it seems to disappear. Cut a large piece from the lung tissue (about golf ball size). Inspect the cut surface with a hand lens. Predict what would happen if we placed the piece of lung in bowl of water. Check your prediction.
Below is an equation, which summarizes what happens to the oxygen once it enters the body's cells:

FOOD (GLUCOSE) + OXYGEN ⟶ CARBON DIOXIDE + WATER + ENERGY

Both carbon dioxide and water are waste products

QUESTIONS:

7. What is the name given to the fine branches of a bronchus?

8. Describe the blood supply of the lung. Locate the blood vessels that lead to and from the lungs. To what organ are they connected? What function does this organ serve?

Describe the internal structure of lung tissue.

9. Describe what you observed when the piece of lung was placed in water.
   EXPLAIN your observations.

10. Compare and contrast the structure of lungs with the balloons used to represent lungs in the model of the respiratory system in the previous activity.

11. How do you think carbon dioxide and water are excreted from the body?

Activity 18: The Mechanism of Breathing

AIM:

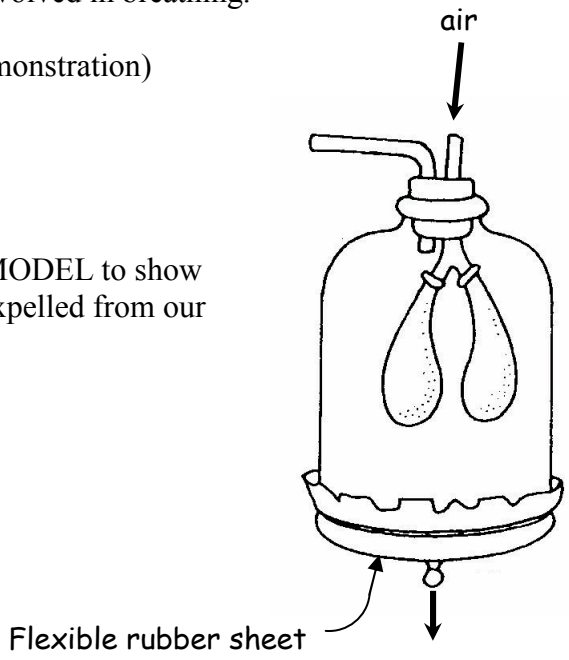
To investigate the mechanism involved in breathing.

EQUIPMENT: (For teacher demonstration)

- Bell jar model of lungs

PROCEDURE:

Your teacher will use a LUNG MODEL to show you how air is drawn into and expelled from our lungs.



A 'model' is a simplified representation of an idea or concept that can help understanding. This model gives an idea of how our breathing mechanism works. However, it is not exactly the same.

Put your hands on your diaphragm (below your ribs) and feel what happens as you breathe deeply in and out.

QUESTIONS

Draw a diagram of the lung model showing the balloons ('lungs') empty of air.

1. Draw another diagram showing how the lung model must change for the balloons to take in air.

2. Write a short paragraph to describe how air is drawn into and out of the balloons in the model. You should mention what happens to the volume and air pressure in the bell jar when the diaphragm (rubber sheet) is pulled.

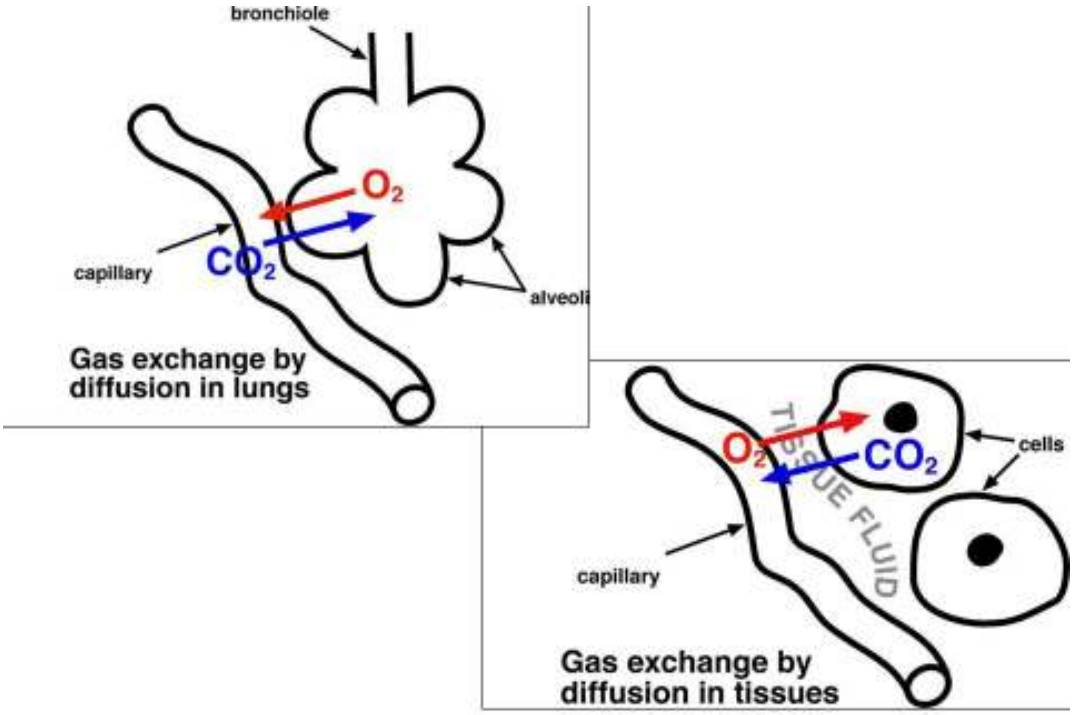
Write down what happens to your chest, as you breathe in and out.

4. How is this different to the lung model you have been using? A table might be a good way to show the differences.

5. Using this information and with the help of your textbook, write a short paragraph describing how we get air into and out of our lungs.

Activity 19: Gas Exchange

The process that causes oxygen to pass into the blood capillaries around the alveoli of our lungs is diffusion. You defined this process in Activity 4. Can you remember the definition? The air we breathe in has a higher concentration of oxygen in it than in the blood capillaries. Like a bike rolling down a hill, the oxygen moves across the alveolus wall into the blood, moving from where its concentration is high to where its concentration is lower.



When the blood reaches say a muscle cell that has been working hard, the oxygen concentration in the fluid that bathes the muscle is lower than the level of oxygen in the blood. Oxygen diffuses from where its pressure is high to where its pressure is lower. Watch this video clip.

http://www.youtube.com/watch?v=EFCj9STCvdI

In the table below the percentage of gases in the air we breathe in and out is contrasted:

Gas	Inhaled air %	Exhaled air %
nitrogen	78	78
oxygen	21	15
carbon dioxide	0.04	4

QUESTIONS:

1. How has the concentration of each gas changed?
2. Account for any difference in the % of each gas in the air we exhale.
3. Explain how CO_2 passes from the blood in the capillaries into the alveolus they surround.