Book 1

Year 9

Science

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GOVERNMENT OF SĀMOA
MINISTRY OF EDUCATION, SPORTS AND CULTURE

Acknowledgements

The Ministry of Education, Sports and Culture would like to thank the following writers for their vision, patience and hard work in putting together this valuable book.

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Produced by Egan Reid Ltd, Auckland, as part of the Sāmoa Secondary Education Curriculum and Resources Project for:

Reprinted 2004 and 2006 through Egan Reid Ltd.

Funded by the New Zealand Agency for International Development, Nga Hoe Tuputupu-mai-tawhiti.

Managing Contractor: UniServices Limited, Auckland.

ISBN 982-517-006-9

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Unit 1: PLANTS

Introduction
In this unit, you will investigate the main parts of plants and learn why the main parts of plants are arranged in different ways.

Plant parts
Plants are living things that carry out the same life processes that animals do. Plants grow, respire, sense, move and reproduce. They also need **nutrients** (food) and have to get rid of wastes.

The main parts of plants are the roots, stem (or trunk) and branches, leaves and flowers. Each part helps the plant to carry out life processes.

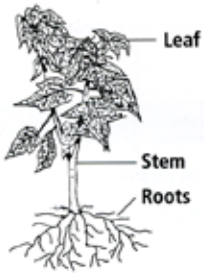


Diagram 1.1
Main parts of Laupele.

Part	**Function**: What the part does
Roots	Hold the plant in the soil and take in water and minerals from the soil.
Stem, Trunk and Branches	Hold the leaves up and spread them out so that each leaf gets as much light as possible. They help to move water and sugars around the plant.
Leaves	Use light, water and carbon dioxide to make sugars.
Flowers	Used when the plant is carrying out reproduction.

Language Note: one *leaf* (singular), two or more *leaves* (plural).

The parts on different plants can have very different sizes and shapes even though they carry out the same function, *e.g. The leaves of some plants are long and narrow and on others they are short and wide.* Look at the differences in the diagrams below.

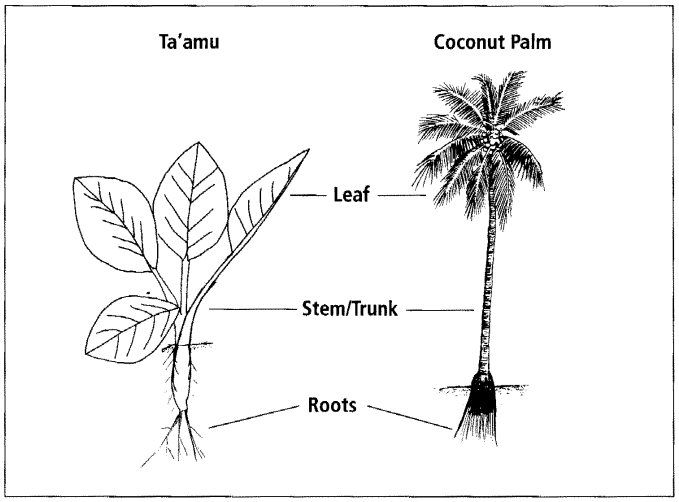
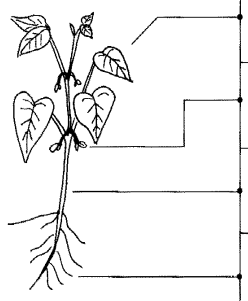


Diagram 1.2
The structure of the leaves, stems, branches and flowers of each type of plant are different.

Activity 1 Plant Parts

Aim: To record information about the main parts of plants.

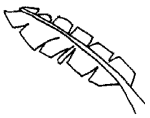
- Copy and complete the table below into your book.

Plant Parts	Name	Function
		

Activity 2 Plant Parts Field Work

Aim: To find out about differences in the main parts of plants.

1. In pairs, observe four different types of plants of your choice. Choose plants that look very different, *e.g. Grass, a tree, a bush or shrub.*
2. Use words, measurements and drawings to record your observations about the main parts of each plant. Record your observations in a table like the one below. An example has been done for you.

Plant Name	Leaves	Stem/Branches	Roots	Flowers
Banana	Large, 120 cm long and 30 cm wide. Light green. 	Light green, 25 cm thick. Made up of rolled up leaves.	Short and thin. They don't hold the plant up very well.	

Discussion Points

1. Describe the differences you saw in the stems and branches of the plants you observed.
2. Why do you think the parts of each type of plant are different?

Leaves

Leaves are very important to the plant because they carry out chemical reactions, using sunlight, to make sugars for the plant. Making sugars in this way is called **photosynthesis**. Leaves are usually flat and very thin, but each type of plant has a leaf size and shape that fits their way of life. For example, a coconut palm has long, thin, tough leaves. This allows the plant to live in windy places without getting its leaves broken by wind. The coconut palm leaves are all at the top of a long stem. This means the leaves are above the leaves of other plants and can get more sunlight.

The stems and branches of a plant help to spread the leaves out around the plant. The stems, branches and leaves are arranged on the plant in a way that lets as much light as possible shine on each leaf. The diagrams below show some of the ways leaves are placed around the stem.

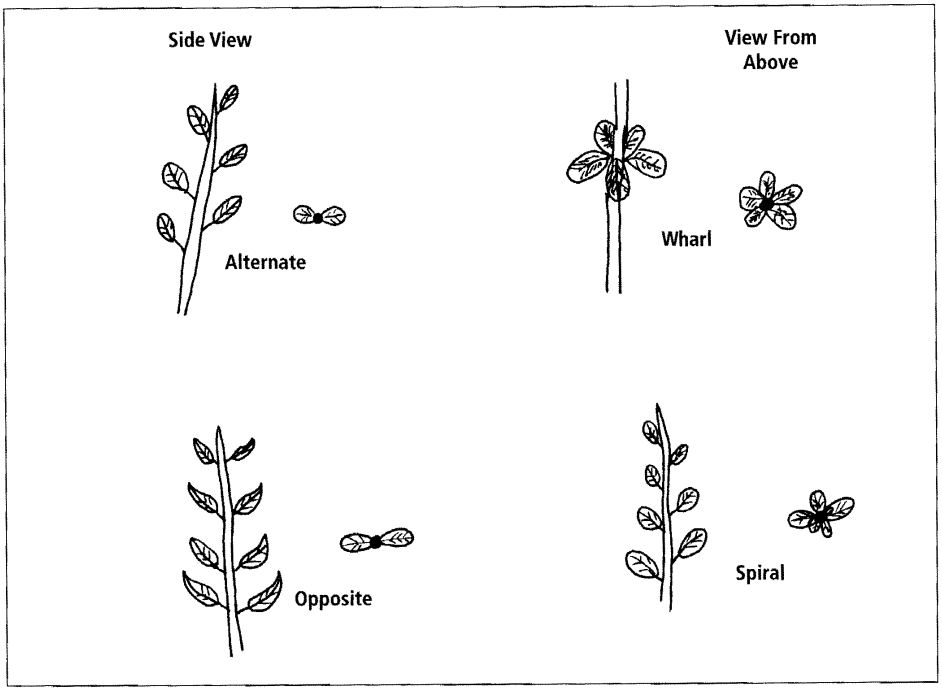


Diagram 1.3
Different plants have their leaves arranged in different ways.

Did you know?
Leaves are green because they have a green chemical called chlorophyll in them. Chlorophyll is important for photosynthesis. Plants with red or yellow areas on their leaves are more common in tropical countries, like Samoa.

Activity 3 Leaf Arrangements

Aim: To find out about the ways leaves are arranged on different plants.

- Choose three plants that have their leaves placed around the stem in different patterns.
- Use words and drawings to record the way the leaves are arranged on each plant.

Discussion Points

1. Use the results from the rest of the class to find out which were the most common ways leaves were placed around the stems of the plants studied.
2. Explain why leaves are placed so that they are spread out around the plant.

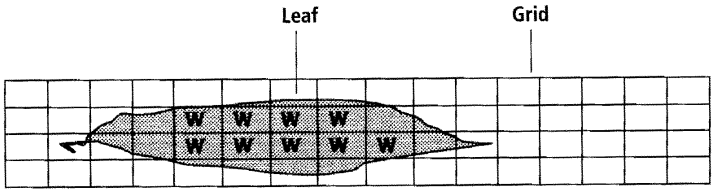
Activity 4

Surface Area Of A Leaf

Materials needed:
Three or four small leaves.

Aim: To find out the surface area of different shaped leaves.

1. Draw a grid of horizontal and vertical lines 1 cm apart, like the one below. The grid has to be big enough for all the leaves to fit on to it at the same time.
2. Place the leaves apart on the grid and draw around each one. See the example below.
3. Copy the data table at the bottom of the page.
4. Count the number of whole squares covered by a leaf. Record this information in your table.
5. Count the amount of area in partly covered squares. It is often easier to match two partly covered squares that add up to covering one whole square.
6. Add the amount of area covered by whole squares and partly covered squares together. This gives the surface area of the leaf.
7. Work out the surface area of all the leaves and record the results in the table.



This leaf covers nine squares completely. This is shown by the squares with 'W' in them. By adding up the partly covered squares it covers approximately another six squares. This gives a surface area of 9 + 6 = 15 squares. If the squares are 1 cm by 1 cm then the surface area is 15 cm^2.

Leaf	Number of whole squares covered	Area covered by adding partly covered squares	Surface area (cm^2)
1			
2			
3			
4			

Stems

The stems of some plants are woody (hard wood stems) and some are soft (herbaceous). **Herbaceous** stems are not as strong as hard wood stems so herbaceous plants are often smaller. These stems are often green and can make food by photosynthesis. They lose water during **transpiration** just as leaves do. Some woody stems are much thicker than others are. Many have branches but there are also others, like the coconut palm, which do not branch.

Plant stems are a network of tubes joining the roots and the leaves. Substances are transported inside these tubes. This system of tubes is called the **vascular system**. It has two types of **tissues**. The first type is called **xylem**. The cells in xylem tissue take water and minerals from the roots to the leaves. The second type of tissue is called **phloem**. The cells in phloem tissue transport sugar (food) throughout the plant.

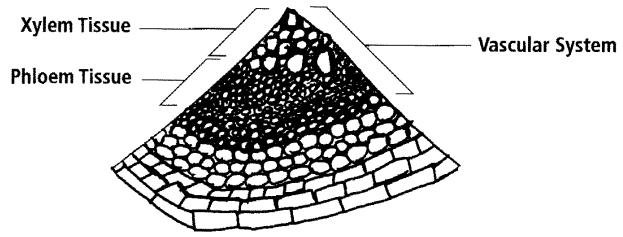


Diagram 1.4
The cross section of a stem, showing the parts inside it.

Activity 5

Plant Stems

Materials needed:
A sharp knife or blade; Hand lens or magnifying glass.

Aim: To find out about the variety of different plant stems.

1. In pairs, observe different plant stems around the school grounds. Record the name of each plant and draw its stem. Record whether the stem is woody or herbaceous.
2. Collect part of a stem from a small herbaceous plant. Cut the end of the stem so that it is a clean cut. Use a hand lens or magnifying glass to look at the cut end of the stem. Draw what you see.
3. With the help of your teacher, cut the stem into thin sections and make a slide using the thinnest section. View the slide under a microscope. Draw a diagram of what the stem looks like under the microscope. Information on how to make a slide and use a microscope can be found on page 20 and 21, in the unit on organisms and cells.

Roots

The roots of a plant are spread out in the soil to hold the plant firm and to get minerals and water from the ground around the plant. The roots also help transport substances to the stem and the other parts of the plant. The root systems of some plants, such as the yam and tapioca, are also used to store food.

The two main types of root systems in plants are the **tap root** system and the **fibrous root** system. Some plants have **adventitious** roots that grow from stems that lie along the top of the ground. Mangrove roots are often under water so the plant grows roots in the air. These roots are called **pneumatophores**.

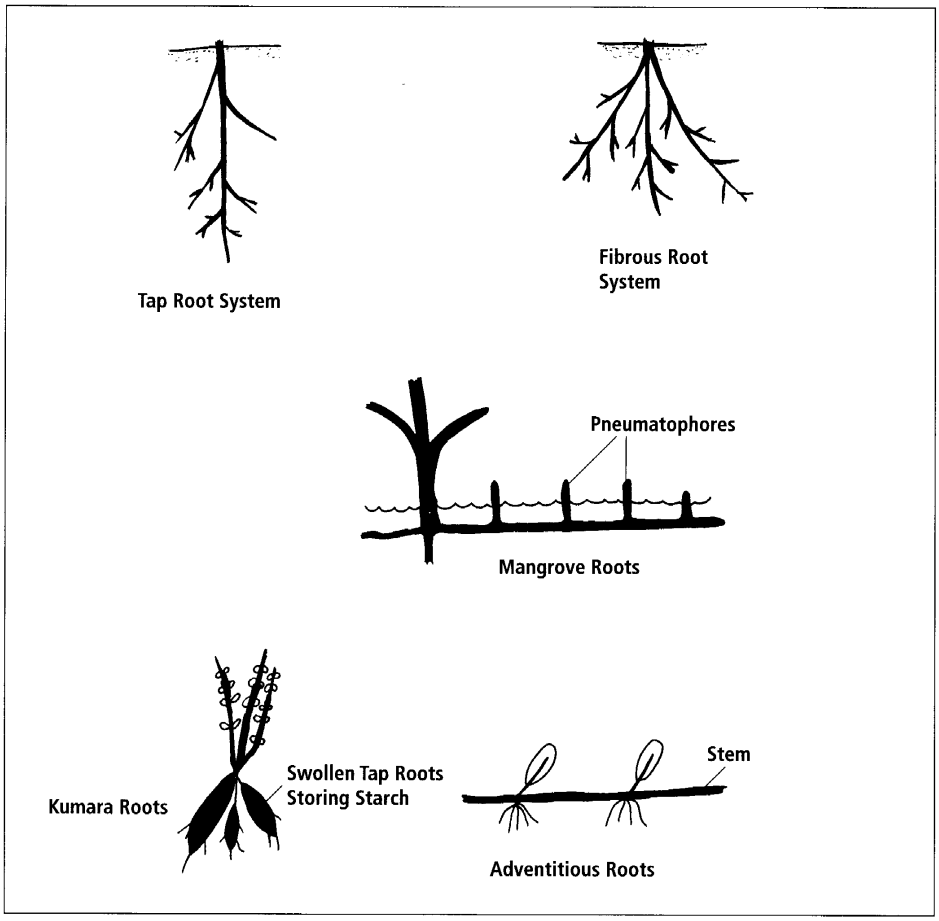
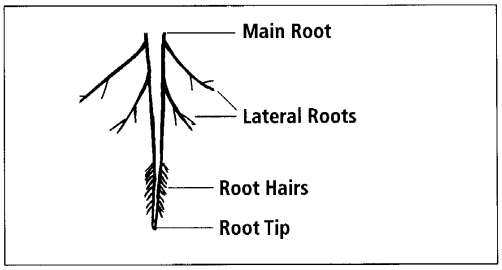


Diagram 1.5
Root types in different types of plants.



Most plants have a main root with smaller lateral roots. The end of each root is a growing point called the root tip. The area behind the root tip is covered with very thin root hairs. Root hairs grow through the soil and take in water and minerals.

Diagram 1.6
Root structure.

Activity 6 Plant Roots

Materials needed:
A collection of different types of roots;
A sharp blade.

Aim: To find out about the shapes and sizes of the roots of different plants.

1. In groups of 4 or 5, collect a variety of small herbaceous plants with different root systems.
2. Gently clean the dirt off the roots with water and then compare the appearance, colour and length of the roots.
3. Try to identify different parts of the root such as root hairs, root tip and the older parts of the roots. Copy and fill in the table below.

Plant	Root Type	Appearance	Colour	Length	Other Observations

Unit Summary

- Plants are able to respire, move, sense, grow, reproduce, use nutrients and get rid of wastes.
- The leaves, stem, roots and flowers of plants help them to carry out the life processes. Even though the leaves, stems and roots of different plants can look very different each part still carries out the same main function.
- Leaves are the main organ of plants. Most of the photosynthesis, used to make food, is carried out in the leaves. Leaves need light shining on them to carry out photosynthesis.
- The stems, branches and leaves are arranged so that each leaf gets as much light as possible.
- The stem holds the leaves up and has xylem and phloem tissue for the transport of sugars, water and minerals.
- The roots are arranged to hold the plant firm in the soil and to collect minerals and water. Xylem and phloem tissue in the roots transport food, water and minerals.

Unit 2: ORGANISMS AND CELLS

Introduction

In this unit, you will study the ways cells, tissues and organs work together in an organism. You will also study the parts of cells and learn how to use a microscope.

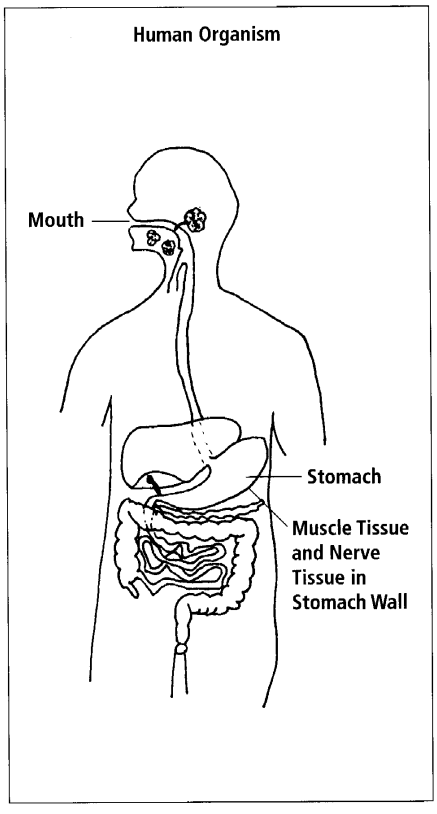


Diagram 2.1
Human digestive system.

Organisms

People study living things in different ways. They can study the whole **organism** or parts of the organism. The body of a whole organism, such as a person, is made up of different **organ systems** that work together to allow the person to move, respire, sense, grow, reproduce, excrete and feed.

The digestive system is an example of an organ system in which all the parts work together to digest the food.

Each organ system is made up of different **organs** that carry out a job. In the digestive system the mouth and stomach both mix food and break it down.

Organs are made up of **tissues**. The stomach is made up of muscle tissue and nerve tissue. Another example of tissues can be found in the heart. The heart is made up of muscle tissue, connective tissue and nerve tissue. All these tissues work together to pump the blood around the body.

Tissues are made up of **cells**. Muscle tissue is made up of lots of muscle cells. Nerve cells cause the muscle cells to change shape, which causes the stomach wall to move and mix the food.

The leaf is one of the main organs of a plant. The leaf is made up of different tissues that work together to make sugars for the plant. Xylem and phloem are examples of tissues found in leaves. Phloem is made up of two types of special cells that work together to transport sugars around the plant.

Activity 1 Organisms To Cells

Aim: To sort examples of organisms, organ systems, organs, tissues and cells.

- Copy the terms listed A to E into your book in order of largest to smallest, i.e. in order, starting from organism and ending at cell.

	List 1	List 2
A.	Muscle tissue.	Lung.
B.	Digestive system.	Cow.
C.	Stomach.	Nerve tissue.
D.	Human.	Nerve cell.
E.	Muscle cell.	Respiration system.

Activity 2 Identifying Organisms To Cells

Aim: To identify and sort further examples of organisms, organ systems, organs, tissues and cells

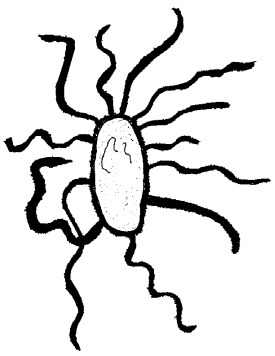
Cell	Tissue	Organ	Organ System	Organism

1. Copy the table above.
2. Write each of the following under the correct column.

cheek cell	heart	xylem tissue
pig	excretion system	blood cell
cat	liver	muscle tissue
skin cell	leaf	nervous system
stem	ulu tree	connective tissue
dolphin	reproductive system	

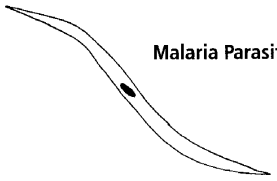
3. Think of some more examples of cells, tissues, organs, organ systems and organisms. Then add them to the correct column in your table.

Did you know?
Some organisms are made up of only one cell. These organisms are very small. Examples are bacteria, some algae and organisms such as paramecium and amoeba. The disease malaria is caused by an organism made up of only one cell.

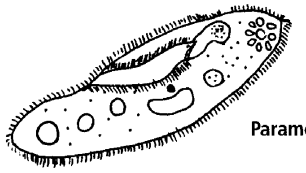


Salmonella Bacterium

This bacterium causes food poisoning.



Malaria Parasite



Paramecium

Diagram 2.2
Some single cell organisms.

Cells

Cells are so tiny that they are only able to be viewed under a microscope. There are lots of different types of microscopes. The microscopes that you will be using are called **light microscopes**.

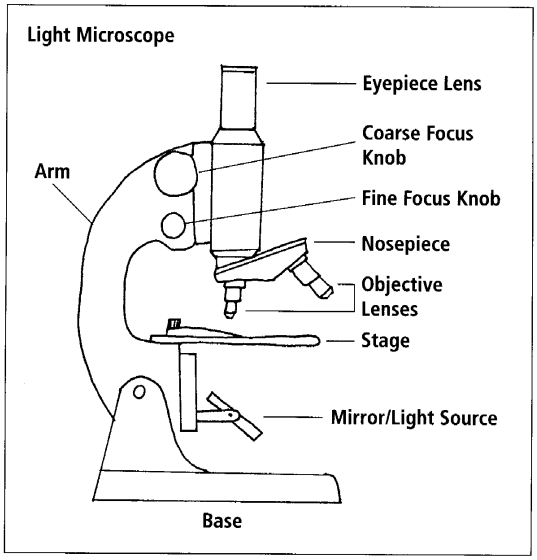


Diagram 2.3
A light microscope.

Functions of the parts of a microscope

Eyepiece Lens: the person using the microscope looks down the eyepiece lens to see the object on the stage.

Nosepiece: when the nosepiece is turned around another objective lens comes into use. This changes the magnification.

Objective Lens: used to view the slide. The longer the objective lens, the higher the magnification.

Stage: the microscope slide is placed on the stage. The slide is moved so that the part to be looked at is under the objective lens.

Mirror/Light Source: light is directed up through the slide and lenses so the object can be seen.

Arm: hold onto this and the base when carrying the microscope.

Coarse Focus Knob: used to focus the microscope when using the low power objective lens.

Fine Focus Knob: used to precisely focus the microscope when using the medium or high power objective lens. Also used after the coarse focus on low power.

Some objects are too thick to view under a microscope so they have to be cut or torn. When viewing something under the microscope, it must be thin enough to allow light to pass through it. The object to be viewed must be placed on a piece of glass. This glass is called a **microscope slide**. Sometimes a chemical called a **stain** is used to make the cells easier to see. Activity 8 explains how to prepare a piece of plant material so that it can be viewed using a microscope.

Activity 3 Parts Of A Microscope

Aim: To learn the functions of the parts of a microscope.

1. Draw a diagram of a light microscope in your exercise book.
2. Label the parts.
3. Copy the following table into your exercise book. Then use the information on the opposite page to list the main function of each part of the microscope.

Microscope Part	Function
Eyepiece Lens	
Coarse Focus Knob	
Fine Focus Knob	
Nosepiece	
Objective Lens	
Stage	
Mirror/Light Source	
Arm	

Activity 4 — Making A Wet Mount

Materials needed:
Newspaper;
Microscope slide;
Water;
Cover slip (if available).

Aim: To make a wet mount microscope slide.

1. Cut or tear a 1 cm by 1 cm square of newspaper with printing on it.
2. Place the square in the centre of the slide and cover with a drop of water.
3. Hold the cover slip at an angle. Touch one edge in the water drop and carefully lower the cover slip. Use this slide for Activity 5.

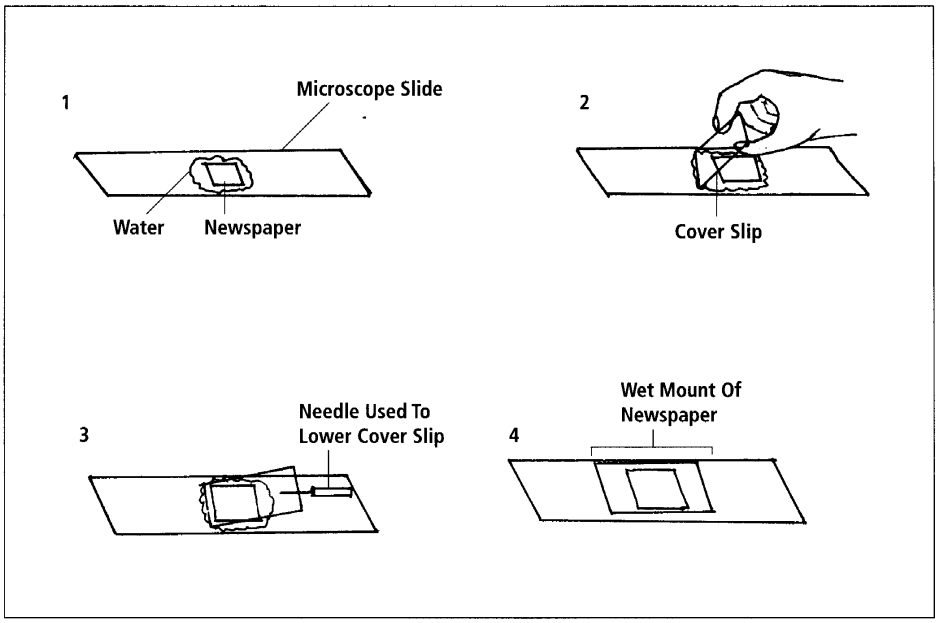


Diagram 2.4
The steps involved in making a slide.

Activity 5 Using The Microscope

Materials needed:
Wet mount of newspaper made in activity 4;
Light microscope.

Aim: To use a microscope to view a slide.

1. Turn the objective lens to low power.
2. Place the newspaper slide on the stage and move it until the printing on the newspaper is under the objective lens.
3. Look from the side of the microscope and turn the coarse focus to move the objective lens down until it stops or almost touches the cover slip or paper.
4. Now look through the eyepiece lens while turning the coarse focus up. Stop when the letters on the paper can be seen clearly. Move the slide over to clearly see a letter 'a'. If there is no 'a' on your slide, pick another letter to replace it in the following questions. Do not use letters like 'o' and 'l' as they will not clearly show the difference you will be looking for.
   a. Is the letter 'a' upside down or the right way up?
   b. Is the letter 'a' larger, smaller or the same size?
   c. Is the letter 'a' turned around back to front?
5. Draw what you see.
6. Turn the nosepiece so that the medium power lens is over the slide.
7. Look down the eyepiece lens while focusing the microscope using *only* the fine focus knob.
8. Remove the newspaper slide.
9. Use the low power objective lens to look at a coloured picture from a magazine or book.
10. Describe what you see.

Magnification

The nosepiece of most light microscopes can be turned so that a different objective lens can be used. Each lens has a different magnification. The higher the magnification, the larger the object will look and the finer the detail you can see.

A microscope with three objective lenses usually has low, medium and high power magnification. The shortest lens gives the lowest power. The magnification is written on the side of the lens. For example:

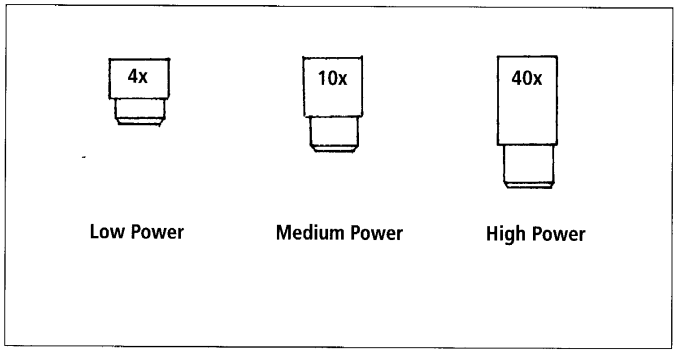


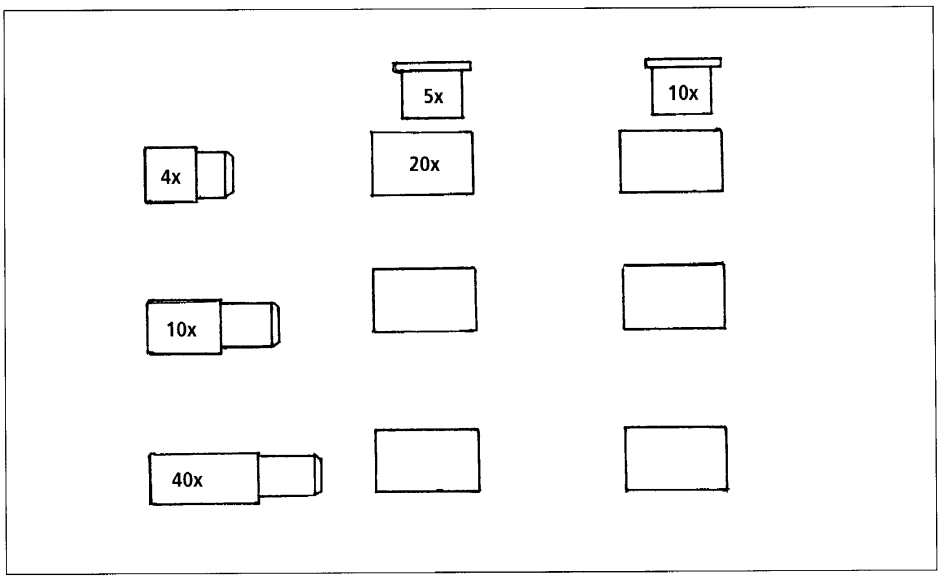
Diagram 2.5
Objective lenses (the 'x' indicates 'times', or magnification).

The total magnification being used is worked out by multiplying the power of the eyepiece lens by the power of the objective lens. For example, if the eyepiece lens is 5x and the objective lens is 10x, then the total magnification is 50x.

Activity 6 Working Out Magnification

Aim: To work out the magnification possible with different eyepiece and objective lenses.

- Copy the diagram below.
- Complete it by working out the magnification for each of the different combinations of lenses used. The first one has been done for you.



Making biological drawings

People do biological drawings of what they can see under the microscope. The following are examples of biological drawings of common cells.

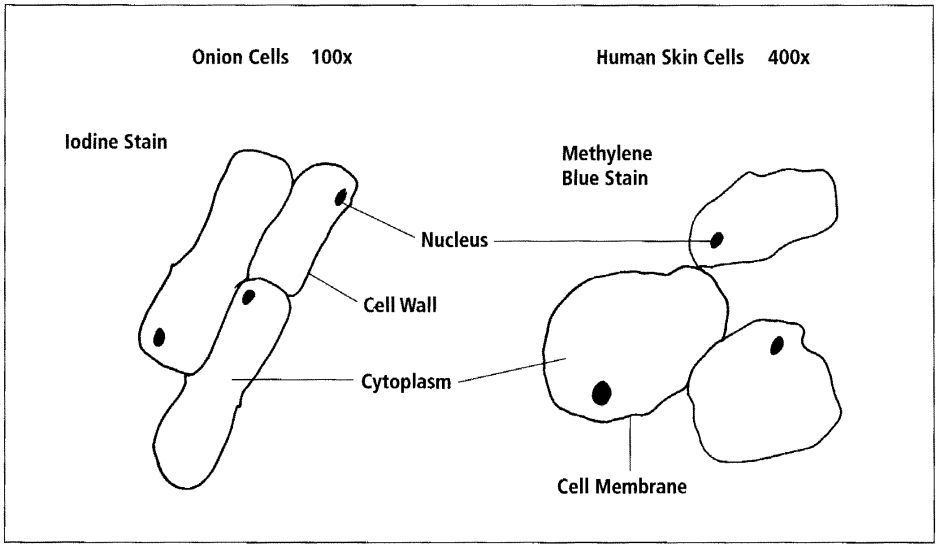


Diagram 2.6
Biological drawing of onion and human skin cells.

The following are rules that are used to make good quality drawings.

- Use pencil if possible.
- Draw large diagrams.
- Draw only 3 or 4 cells. Draw the cells as complete shapes.
- Use smooth, clear lines.
- Add a heading and labels.
- Record the magnification used.

Activity 7 Biological Drawings

Copy the above rules for making biological drawings into your book.

Activity 8

Making A Slide

Materials needed:
Paper tissues or clean cloth;
Slides;
Cover slips;
Iodine stain or water;
Onion or a leaf;
Microscope.

Aim: To make and view a microscope slide of plant cells.

1. Clean a slide with a paper tissue or clean cloth.
2. Peel off a small piece of onion and tear it to get a layer of clear skin or tear a leaf to get a thin piece of clear leaf.
3. Place the onion skin or leaf skin on the clean slide.
4. Place a drop of iodine stain on the onion or a drop of water on the leaf.
5. Carefully lower a clean cover slip over the onion or leaf.
6. Look at the cells on the slide under low power and make a drawing.
7. Look at the cells on the slide under high power and make a drawing.

Plant cells

The cells of the onion skin are tiny oblong shapes. The cells in the leaf are box shaped. No matter what kind of plant you are looking at, their cells will have similar features.

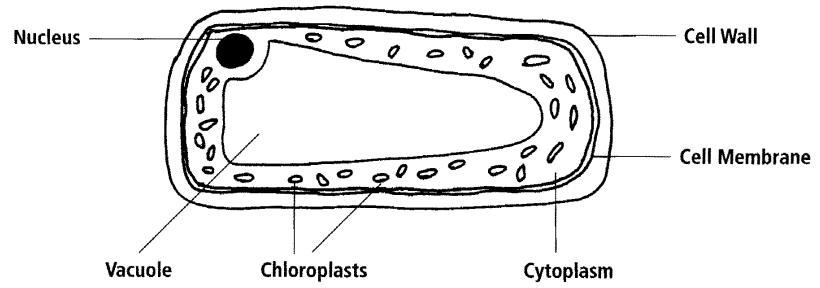


Diagram 2.7
Parts of a plant cell.

Plant cells usually have a fixed shape. The shape they have depends upon the job they do. Only the cells that carry out photosynthesis have chloroplasts in them. Chloroplasts are coloured green, which makes them easier to see with a microscope compared to other parts.

Part of Cell	Function
Cell wall	Gives the cell a fixed shape. Found only in plant cells.
Cell membrane	Holds everything together inside the cell and controls what enters or leaves the cell.
Cytoplasm	Jelly-like substance that holds all the parts of the cell. Some chemical reactions occur in the cytoplasm.
Nucleus	Controls the functioning of the cell and is sometimes called the control centre of the cell.
Vacuole	Stores water, minerals and other nutrients needed by the plant. It looks like a large water droplet.
Chloroplast	This is where the food of the plant is made. Chloroplasts are found in the cells in the green parts of the plant.

Animal Cells

Animal cells do not have all the parts that plant cells have. They do not have a cell wall and do not contain chloroplasts. Some animal cells have several very small vacuoles but many have none at all. The parts that are present in animal cells have the same function as they do in plant cells. The shape of animal cells also depends on the job they do but because they don't have a cell wall some cells can have lots of very different shapes.

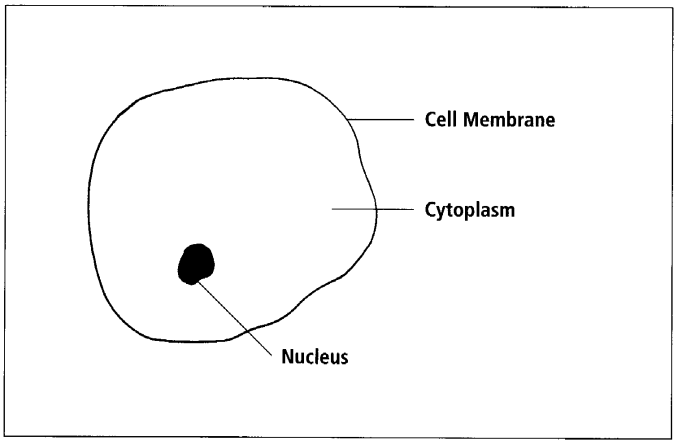


Diagram 2.8
Animal cell.

Activity 9 Differences Between Plant And Animal Cells

Aim: To record the differences between plant and animal cells.

- Copy the following table into your exercise book.
- Use the information about animal and plant cells to describe the important differences between plant and animal cells.

Cell Part	Plant Cell	Animal Cell
Shape		
Cell wall		
Vacuole		
Chloroplast		

Activity 10 Skin Cells

Materials needed:
Sticky tape;
Microscope slide;
Cover slip;
Water, methylene blue or iodine stain;
Microscope.

Aim: To look at human skin cells under a microscope.

1. Place the sticky side of a small piece of sticky tape onto the flat side of your wrist and push down on it. This will collect some skin cells.
2. Place the sticky side of the sticky tape on to a microscope slide and rub over it. This will get the skin cells onto the slide.
3. Add a drop of water or stain.
4. Cover with a cover slip.
5. View under low, then medium, then high power magnification.
6. Draw what you see.

Activity 11 — Water Organisms

Material needed:
Pond, river or puddle water, or slime;
Eyedropper;
Microscope slide;
Cover slip;
Microscope.

Aim: To look at water organisms under a microscope.

1. Collect some water or slime from a river, pond or puddle. Take care to use water that is not likely to be polluted by human waste material.
2. Use an eyedropper to suck up a little water or slime.
3. Place one small drop of the water on a slide.
4. Carefully lower the cover slip.
5. View under low power. Try to focus on any small object that is moving. Often these organisms move too quickly to be viewed easily.
6. Examine under medium and high power. Pick one cell and draw a diagram of it.

Activity 12 — Making A Model Plant Cell

Materials needed:
Clear plastic jar with a lid, or a bottle with the neck cut off;
Water or jelly;
Plastic bag;
Small objects that look like the cell parts, e.g. stone, green leaf;
Rubber bands or string.

Aim: To use everyday objects to make a model of the parts of a cell.

- Collect the materials needed and use them to make a cell.
- Draw your model cell and label the following parts:

Cell wall	Cell membrane
Nucleus	Chloroplast
Cytoplasm	Vacuole

Nucleus

The nucleus controls all the activities of the cell. The nucleus is a very small dark sphere when seen under a light microscope. The parts inside the nucleus cannot be seen with the light microscopes used in science classrooms.

The nucleus is made up of three main parts. These are the nuclear membrane, nucleolus and chromosomes.

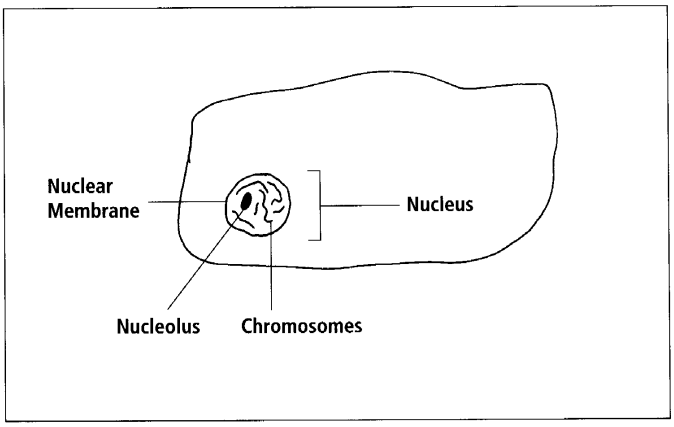


Diagram 2.9
The parts of the nucleus.

The nuclear membrane looks like a thin circle. It keeps all the parts of the nucleus together and lets chemicals move in and out of the nucleus.

The nucleolus is a small dark area in the nucleus. The nucleolus makes some chemicals needed by the cell.

Sometimes the chromosomes can be seen with a light microscope. They appear as long, thin threads. Chromosomes are made up of a chemical called deoxyribonucleic acid, which is often called **DNA**. The DNA is a chemical code that has all the instructions needed for the cell to function. These instructions are called the genetic code. In animals and plants the genetic code controls the features of the organism, such as brown eye colour, leaf shape, etc.

Different types of organisms have different numbers of chromosomes. For example, humans have 46 chromosomes, cattle have 60, starfish 36 and corn 20.

Activity 13 Nucleus Parts

Aim: To record information about the parts of the nucleus.

- Copy the labelled diagram of a cell, showing the parts of the nucleus.
- Copy and complete the following table.

Parts of the Nucleus	What the Part Looks Like	What the Part Does
1.		
2.		
3.		

Activity 14 Famous People Research

Aim: To find out about a famous scientist.

- Find out what one of these people was famous for:

  Mathias Schleiden
  Theodor Schwann
  Robert Hooke

- Present your information to the class.

Unit Summary

- Organisms are made up of organ systems that work together to carry out the life processes. Organ systems are made up of organs. Organs are made up of tissues and tissues are made up of cells.
- Light microscopes are used to look at cells and tissues.
- Objects to be viewed using a microscope are often prepared by cutting or tearing to get a thin piece. The piece is then placed on a glass microscope slide and water or stain is added. They are then covered with a cover slip.
- Magnification is the number of times larger the object is when it is being looked at with the microscope. Magnification is worked out by multiplying the magnification of the eyepiece lens by the magnification of the objective lens.
- Biological drawings are made to record the detail of an object being looked at with the eyes or a microscope.
- Plant and animal cells have a cell membrane, cytoplasm and a nucleus.
- Plant and animal cells have some different organelles. Plant cells have a cell wall and a large vacuole. Some have green chloroplasts.
- The nucleus contains chromosomes, made up of DNA, which carry the genetic information that give the cell instructions for growth and many other cell activities.

Unit 3: FOOD

Introduction
In this unit, you will learn about the different groups of food and how each food group helps to keep your body healthy. You will also test common foods to find out some of the food groups they contain.

Activity 1 Foods On Sale

Aim: To find out which foods sold locally are the most popular.

1. With a partner, list down all the types of foods sold at your school or local market.
2. Share your ideas with the rest of the class.
3. Find out which of the foods listed are the most popular with students. Record the class results in a table.
4. Why are these foods the most popular?

Food and its functions
Food is made up of a variety of substances called **nutrients**. Nutrients include **protein**, **carbohydrates**, **fats**, **vitamins**, **minerals** and **water**. All of these nutrients are needed for growth, repair of damaged tissue and control of body functions. Some nutrients are used for **energy**. For your body to be healthy, each of these nutrients must be present in the food you eat every day. Some vitamins and minerals are only needed in very small amounts.

Energy Foods	Fats and oil, carbohydrates.
Body Building/Repair Foods	Proteins.
Protective Foods	Vitamins, minerals, water.

Energy Foods
These foods provide the body with energy for life activities such as movement, keeping the body warm and pumping blood. There are carbohydrates in starchy foods like taro and banana and fat and oil in foods, like butter, vegetable oil and the fat in animal meats.

Body Building/Repair Foods
These foods provide the body with the materials for growth and repair of damaged body tissues. There are proteins in eggs and animal meats, including fish, seafood, pigs and chicken and plants like laupele, beans, peas and other dark-green leafy vegetables.

Protective Foods
These foods provide the body with the materials needed to keep the body functioning and free from diseases. There are vitamins, minerals and water in foods like fruits, animal meats and vegetables.

Activity 2 Food And Its Functions

Aim: To record information about the functions of different food groups.

- Copy and complete the table below using information found under the heading 'Food and its functions'.

Function of Food	Food Groups Include	Description of Function
Energy Foods		
Body Building/Repair Foods		
Protective Foods		

Nutrients

The main nutrients in food are carbohydrates, fats and oils, proteins, vitamins, minerals and water.

Carbohydrates

Carbohydrates are the most abundant nutrient in nature. They are produced by plants during the process of photosynthesis. There are three types of carbohydrates.

Sugars

Single sugars are made up of a sugar by itself. These include glucose which is used by cells for energy and fructose from fruits. Double sugars are made up of two single sugars linked together. These include sucrose known as table sugar.

Starch

Starch is made up of many single sugars linked together. Plants store starches in their roots, underground stems and seeds.

Fibre (Cellulose)

Cellulose fibre is the material that provides support to a plant. Fibre is found in raw vegetables, fruits, whole-grain breads and cereals. Fibre helps foods move through the digestive system more easily. People who eat too little fibre are likely to have problems such as constipation.

The following table shows the amounts of different carbohydrates in some common foods.

Food Type	Total Carbohydrates (g)	Sugar (g)	Starch And Fibre (g)
Bread, 1 slice	12	1	11
Carrots, 1 cup	12	6	6
Potatoes, 1 cup	30	6	24
Rice, 1 1/2 cup cooked	20	0	20
Beans, 1 cup cooked	40	0	40
Cornflakes, 1 oz	24	2	22

Activity 3 Testing For Carbohydrates

Materials needed:
At least five food items;
Aluminium foil;
Cornstarch;
Eyedropper;
Water;
Iodine solution;
Seven test tubes;
Glucose solution;
Safety glasses;
Benedict's solution;
Beaker;
Hot plate, burner or hot water;
Test tube holder.

Aim: To use chemical tests to see which foods contain starch and glucose.

Part A
Predicting

1. Work with a partner.
2. Collect at least five food samples for testing and record these foods on a data table like the one below.
3. Predict if your food samples contain starch or sugar. Put a tick (✓) if you think the food contains starch or sugar, or a cross (✗) if you think it does not.

Carbohydrate Test				
Food	**Starch Prediction**	**Results**	**Sugar (Glucose) Prediction**	**Results**
Water				
Starch				
Glucose Solution				
1				
2				
3				
4				
5				

1. Describe the colour change of iodine on starch. Brown iodine turns _____ with starch.

2. Describe the colour change of Benedict's solution on corn. Blue Benedict's solution turns _____ with glucose.

Part B
Testing for starch

1. Put three drops of water on the aluminium foil. Put the same amount of starch solution on a different place on the foil.
2. Add two or three drops of iodine solution to the water and two or three drops to the starch solution. Note the colour change when starch solution is mixed with iodine. Any food that contains starch will give the same colour change. Complete sentence 1 on the data table.

CAUTION: Iodine can stain clothes. Use it carefully!

3. Now test a small amount of each of your foods collected by adding two or three drops of iodine solution. Record your results on the data table.

Part C
Testing for sugar (glucose)

1. Put nine or ten drops of water in one test tube. Put the same amount of glucose solution in another test tube.
2. Add ten drops of Benedict's solution to each of the two test tubes.
3. Place both test tubes in a beaker of hot water for about three minutes. Note what happens when glucose solution is heated with Benedict's solution. The more glucose that is present, the darker the colour will go. Pale green means little glucose, yellow means more, and orange means lots of glucose. Complete sentence 2 on the data table.

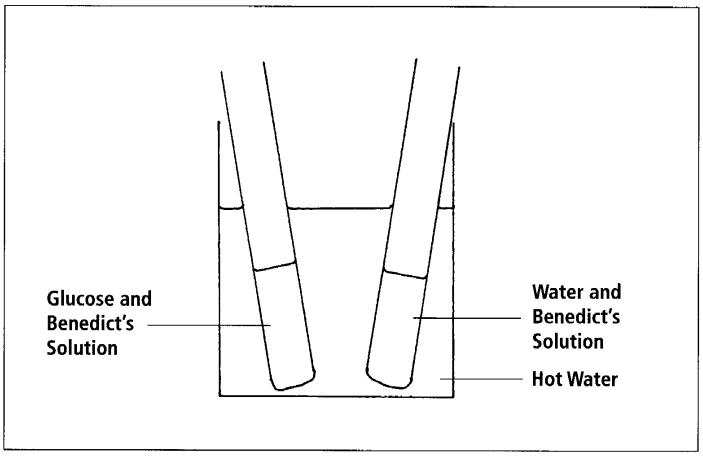


Diagram 3.2
Using a water bath to heat solutions.

4. Label each test tube with the name of the food.
5. Put a small amount of each food into the named test tube.
6. Add nine or ten drops of water to each test tube.
7. Add ten drops of Benedict's solution to each test tube and gently swirl to mix.
8. Heat each test tube in a water bath for ten minutes. Record your results on the data table.

Part D
Analysing and concluding

Answer the following questions and summarise what you have learnt from doing these tests.

1. Which foods did you predict would contain starch? For which foods were your predictions correct?
2. Did water contain sugar or starch? Why did you test water for sugar and starch?
3. What foods did you predict would contain sugar? For which foods were your predictions correct?
4. Which foods did not contain starch or sugar? If they are not sugar or starch, what could they be made of?
5. Sione and Naomi both tested ice-cream for sugar. Sione got a yellow colour change. Naomi got a red-orange colour change. Give a possible explanation for their different results.
6. Where do foods that contain carbohydrates come from? Plants, animals, both or neither? Explain your answer.

Fats and oils

Fats and oils supply energy. When the body stores fats, it is storing energy to use later. Fat also provides insulation. It keeps the body warm. Fat acts as padding that surrounds the body organs. This helps hold the body organs in place and protects them from knocks. Fats also transport some vitamins through the body and are used in the production of several hormones.

There are several kinds of fats. Some of them seem to cause more health problems than others.

Saturated fats are found in animal fats and in hardened vegetable oils. Coconut oil and palm oil are also high in saturated fat.

Polyunsaturated fats are found in vegetable or natural plant oils. Plant or vegetable fats are usually liquids at room temperature so they are called oils.

Cholesterol is one fat that may cause heart disease. It is found only in animal products. Red meats and egg yolks are high in cholesterol.

Activity 4 Testing For Fats And Oils

Materials needed:
Brown paper;
Fat or oil;
Samples of ten different foods;
Eyedropper;
Water.

Aim: To find out which foods contain fats or oils.

Part A
Predicting

1. Work with a partner.
2. Copy the data table on the opposite page.
3. Collect samples of ten foods and record their names on your data table.
4. Predict if your foods contain fat. If you think a food contains fat put a tick (✓), or a cross (✗) if you think it does not.

Part B
Testing for fat

1. Divide your brown paper into twelve squares as shown below. Label the first square 'fat' and the second 'water'. Write the name of one of your ten foods on each of the other squares.

Fat		
Water		

2. Cover the first square with the fat and the second with one drop of water. Then take each food sample and cover each square as labelled. Make sure you clean your hands between foods to avoid mixing the foods.
3. Leave the paper covered with food until the next day to dry.
4. Look at the square of your dried paper that is labelled 'fat'. Hold the paper up to the light. Look at the square from both front and back. This shows you a positive test for fat. Record this result on the results table.
5. Look at the water section. Does water contain fat?
6. Check the rest of the sections against the ones with fat and water. Record your results. Try to identify which squares are covered with foods that are more fatty than others.

Fat And Oil Test		
Food	**Fat Prediction**	**Results**
Fat		
Water		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Part C
Analysing and concluding

Answer the following questions and summarise what you have learnt from doing these tests.

1. Compare your predictions and test results. How many of your predictions were correct?
2. In making your predictions, how did you decide whether or not something contained fat?
3. Which foods contained fats or oils?

Protein

Protein is an important part of cell structure. Every cell in your body contains protein. Protein makes up other structures such as bones, hair and fingernails. Proteins help to fight disease and infections. Protein can be used for energy if a body is low on fats and carbohydrates. Animals need to eat a continuous supply of proteins so they can continue to produce new cells for growth and repair.

Proteins are found in both animals and plants. Meats of all types are good sources of protein and so are eggs, milk, cheese and other dairy products. Peas, beans, grains, cereals, rice, oats, nuts and seeds are also good protein sources. Fruits are poor protein sources.

Proteins are made up of smaller chemicals called **amino acids** that are linked together in long chains.

Activity 5 Testing For Protein

Materials needed:
Nitric acid;
Seven test tubes;
Test tube rack;
Egg white;
Eyedropper;
Water;
Samples of five different food types;
Safety glasses.

Aim: To find out which foods are good sources of protein.

Part A
Predicting

1. Work with a partner.
2. Copy the data table opposite.
3. Record your five food samples on a data table.
4. Predict which of your food samples contains protein. Put a tick (✓) if you think the food contains protein or a cross (✗) if you think it does not.

Part B
Testing for protein

CAUTION: Nitric acid can be dangerous. If you spill any acid on your skin, wash it off immediately with cold water. Wear safety glasses when adding acid.

1. Put nine or ten drops of water in one test tube. Put a small amount of egg white in another tube.
2. Add ten drops of nitric acid into both test tubes. Gently swirl the test tubes to mix. Wait for five minutes then note what happens when nitric acid is added to both water and egg white. Record this information on the table. Most foods that contain protein will react the same way.
3. Label each of the remaining test tubes with the name of your food samples. Put small amounts of each food into the named test tube. You may need to crush or crumble the foods first.
4. Add ten drops of nitric acid to each test tube and swirl to mix. Wait for five minutes.
5. Record the results for each food on the data table and answer the question below.

Protein Test		
Food	**Protein Predictions**	**Results**
Fat		
Water		
1		
2		
3		
4		
5		

Part C
Analysing and concluding

Answer the following questions and summarise what you have learnt from doing these tests.

1. Compare your predictions and test results. How many of your predictions were correct?
2. In making your predictions, how did you decide whether or not something contained protein?
3. Which foods did contain proteins?

Other nutrients

Vitamins and minerals are also nutrients found in foods. They are needed in very small amounts. Each has its own role in the body, but they all make it possible for the body to use other nutrients in our foods. As such, they help protect the body from disease.

A lack of certain vitamins in the body can cause some health problems. Calcium and vitamin D are used for building strong bones and teeth. Calcium and vitamin D can be found in milk. Vitamin D is found in fish, and sunlight changes a chemical found in the skin to vitamin D.

One other extremely important nutrient is water. All body tissues contain large amounts of water. Water makes up more than half of our body weight. It is recommended by nutritionists, that people should drink eight glasses of water a day.

Staying healthy

The body needs all these essential nutrients in order to remain healthy. However, it is also recommended that people should eat a variety of food, and eat some nutrients in small amounts and lots of other nutrients. Avoid too much fat and too much sugar. Eat lots of fresh fruit, vegetables, breads and cereals.

Activity 6 Follow-up Exercise

Aim: To use your knowledge to evaluate the range of foods sold at your school.

- Now that you have learnt about nutrients, answer these questions about your findings from Activity 1.

1. Are your fellow students eating healthy foods?
2. Is your school or local market selling foods with all the necessary nutrients?
3. What could be done to improve the quality and variety of foods sold at your school or local market?

Did you know?
Because the humming-bird is so small and flies by beating its wings very fast, it has to eat an amount of food equal to its own body weight daily in order to survive.

Unit Summary

- The three groups of foods are energy foods, body building foods and protective foods.
- There are six main nutrients found in foods. These are proteins, carbohydrates, fats, vitamins, minerals and water.
- Carbohydrates and fats provide a body with energy. Proteins provide the materials for growth and repair of a body. Vitamins and minerals help to protect a body from diseases by making it possible for other nutrients in foods to be used by the body.
- Water is an important nutrient for a body and it must be taken each day.
- A healthy body is a result of eating healthy meals with balanced amounts of all the nutrients.

Unit 4: HUMAN CIRCULATION

Introduction

In this unit, you will learn about why many animals have a circulation system. You will investigate the main parts of the human circulation system to find out what they are like and how they work.

Animals that are made up of lots and lots of cells need to have a circulation system to carry **oxygen** and food chemicals to each of the cells in their body. The circulation system also carries **carbon dioxide** and other wastes away from the cells. Very small animals do not need to have a circulation system because oxygen can easily get to all the cells in the animal's body.

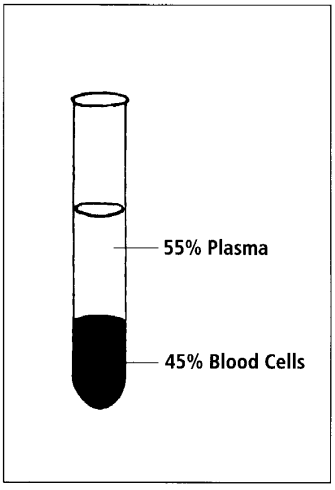


Diagram 4.1
Blood composition.

Human circulation

The circulation system is made up of three parts: **blood**, **blood vessels** and the **heart**. The blood is a liquid made up of 55% **plasma** and 45% cells. Plasma is mostly water. The rest of plasma is made up of the substances that are being carried to and from the cells of the body. These include digested food, mineral salts, carbon dioxide and wastes.

The cells in blood that are important in circulation are called **red blood cells**. These cells have a special shape and are full of a red coloured chemical called **haemoglobin**.

Oxygen joins on to the haemoglobin and is transported around the body inside the red blood cells. Blood that is carrying lots of oxygen is called **oxygenated blood**. Blood that lacks oxygen and is full of carbon dioxide is called **deoxygenated blood**.

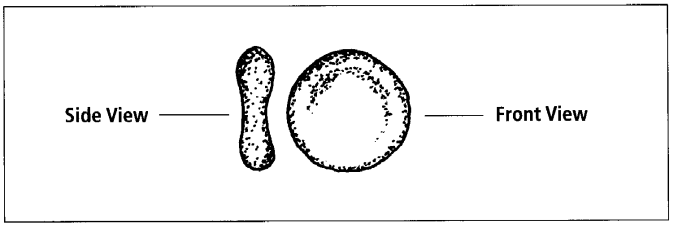


Diagram 4.2
Red blood cells.

Blood vessels

The blood vessels form long branching tubes that carry blood. They take the blood from the heart to the lungs and then back to the heart. The blood vessels then carry the blood to the rest of the body and back to the heart to start the cycle again.

The blood vessels that carry blood away from the heart are called **arteries**. Arteries are large and have strong, thick walls. The arteries divide and get smaller and smaller.

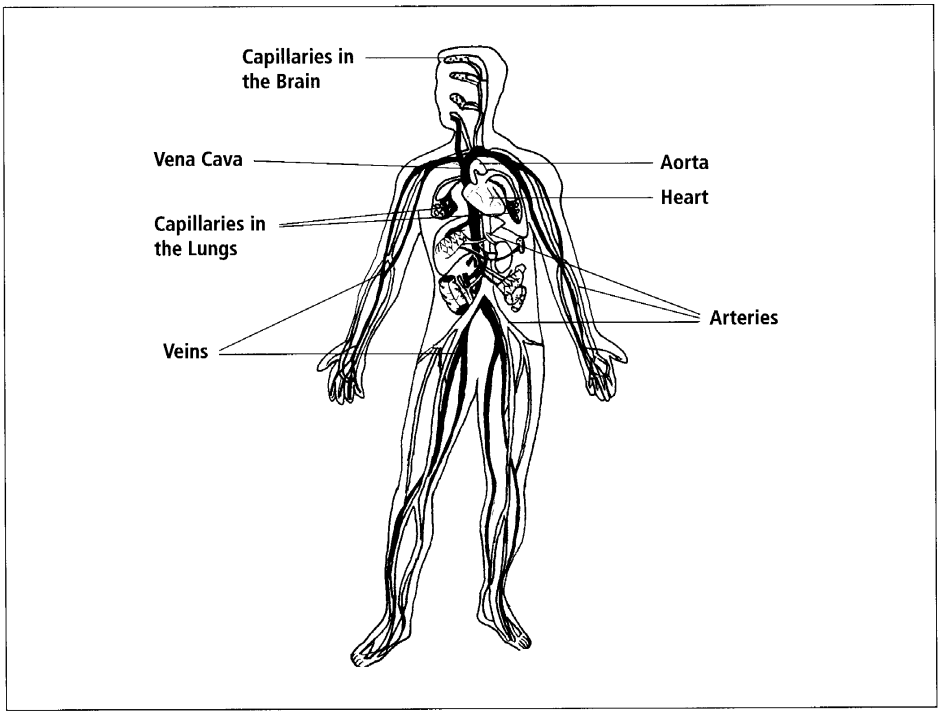


Diagram 4.3
Human circulation system.

The blood then goes into very small vessels called **capillaries**. Every cell in your body has a capillary close to it. This is how cells get the oxygen and food they need to live and have their wastes removed. Capillaries have very thin walls so that the oxygen and food can easily move from the blood to the body cells and the wastes can easily move from the body cells to the blood.

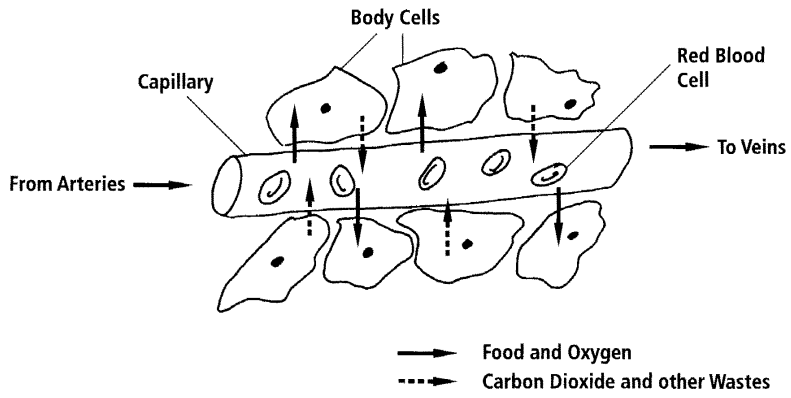


Diagram 4.4
Gas exchange in capillaries.

After the blood has gone through the capillaries, and the food, oxygen and wastes have been exchanged, the capillaries join together to form larger blood vessels. These large vessels that carry blood back to the heart are called **veins**.

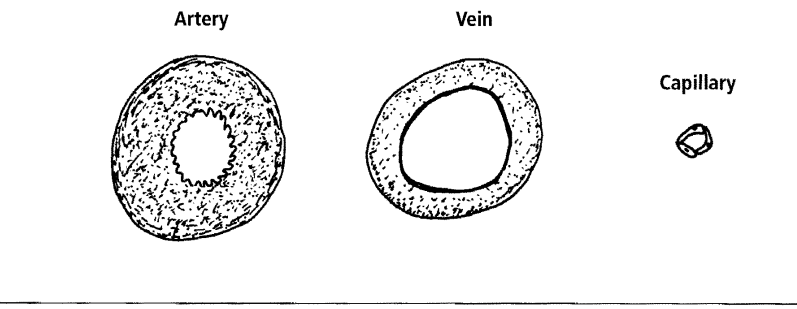
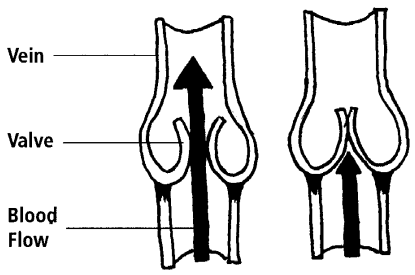


Diagram 4.5
Arteries, capillaries and veins.

Veins have thin walls and they have to have **valves** to stop the blood from flowing back towards the capillaries. These valves are very important in the long veins that bring blood back up the legs. The valves and muscles in the legs are needed to keep the blood moving towards the heart.



Valves keep the blood flowing towards the heart

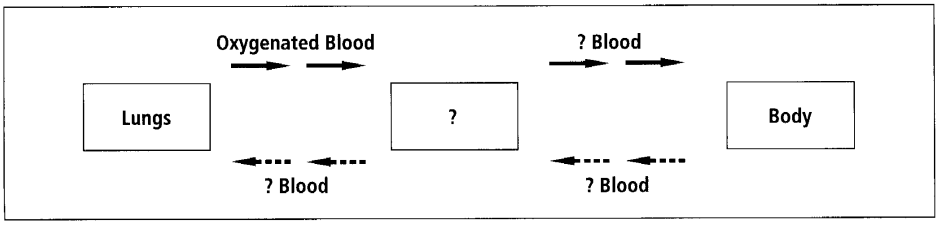
Diagram 4.6
Valves in veins.

Activity 1 Human Circulation

Aim: To record information about the human circulation system.

- Write out the following and then give an answer for each.

1. Why do large animals, such as humans, need a circulation system?
2. Describe what the circulation system does.
3. What percentage of blood is cells and what percentage is plasma?
4. List three things that are transported in the plasma part of the blood.
5. Explain how oxygen is transported in the blood.
6. What does the term 'oxygenated blood' mean?
7. Copy and complete the following diagram to describe the path blood follows.



8. Copy and complete the following table to show the differences between the different types of blood vessels.

Vessel	Arteries	Capillaries	Veins
Function			
Features/Structure			

9. Why are valves needed in the veins of your legs?

Activity 2

Blood Circulation In A Fish Tail

Materials needed:
Live Mosquito fish (ia vai);
Petri dish or another small dish;
Soft wet sterile material;
Microscope slide or small piece of glass;
Microscope or magnifying glass.

Aim: To find out about the blood circulation in a fish tail.

1. Remove a live fish from water and wrap the body of the fish in a piece of soft, wet, sterile material. Leave the tail unwrapped. Work quickly so that the fish may be returned to the water as soon as possible.
2. Carefully place the fish in a dish of water and gently spread the tail out. Carefully place a microscope slide or piece of glass over the tail to keep it flat.
3. Place the dish on the stage of the microscope and focus the tail under low power or place it on a desk and use the magnifying glass.

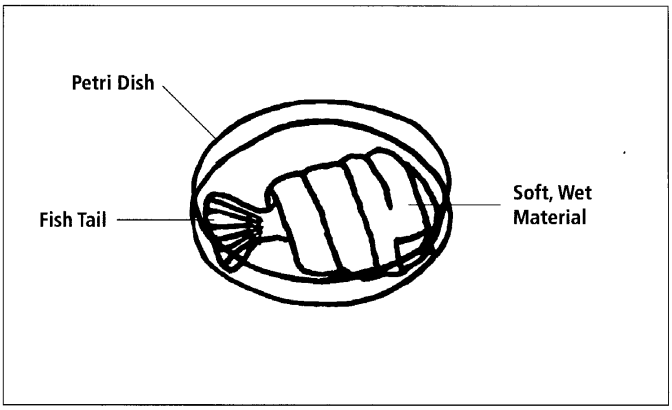


Diagram 4.7
Fish tail for observation.

4. Look for small arteries, veins and capillaries and watch the blood moving through them. Return fish to water. Draw what you saw, using arrows to show the flow of blood in the fish tail.
5. Describe the different speed of the blood flowing in the small and large blood vessels. Notice that the blood flows slowly in the capillaries and the red blood cells have to squeeze through the small capillaries one at a time.

The heart

The heart pumps the blood to keep it moving through the blood vessels. The human heart is divided into two sides by a thick muscle wall called the **septum**. The right side of the heart is smaller and has thinner walls because it pumps the blood the short distance to the lungs. The left side is larger and has thicker walls because it pumps blood to the rest of the body.

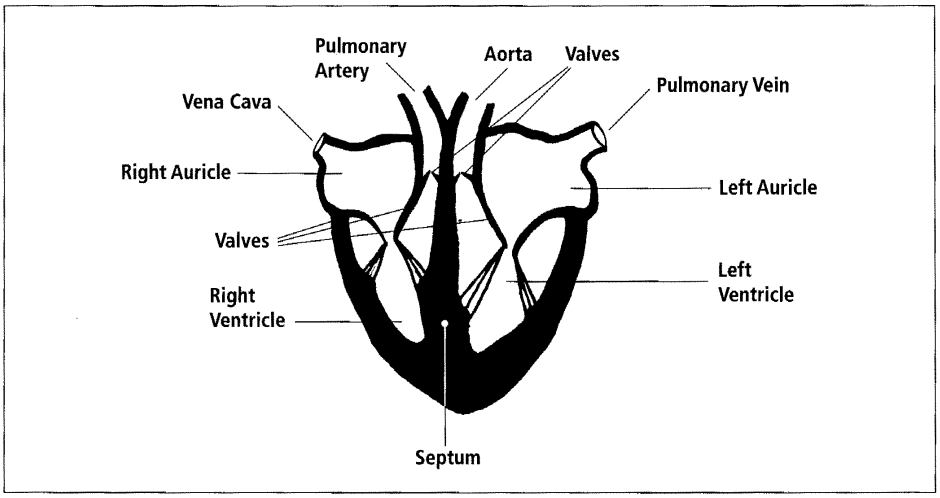


Diagram 4.8
Human heart structure.

Blood in veins all over the body is collected into the largest vein, called the **vena cava**. The blood goes from the vena cava into the top part of the heart, called the **right auricle**. The blood flows through a valve into the **right ventricle**. The valve prevents the blood from flowing back to the right auricle when the ventricle contracts. The muscles in the thick ventricle wall contract and force the blood along the **pulmonary artery**, which takes the blood to each lung.

Language note: the word 'pulmonary' means to do with the lungs.

In the capillaries of the lungs the blood gets rid of the carbon dioxide and gains oxygen to become oxygenated. It then flows in the pulmonary vein, through the **left auricle** and into the **left ventricle** of the heart. When the left ventricle contracts the valve between the auricle and ventricle shuts quickly causing a noise that a doctor can listen to with a stethoscope. The contraction of the ventricle pushes blood out into a large artery called the **aorta** and a second noise is made when the valve at the beginning of the aorta closes. Blood then flows into smaller arteries that take the oxygenated blood around the body.

The contractions of the muscles in the ventricle are called heart beats. Normally the heart beats 70 to 80 times in one minute. Each beat causes pressure in the arteries — this is called a **pulse**. The pulse can be felt in the arteries in the neck, wrist and thumb.

Activity 3 The Heart

Materials needed:
Heart of a pig or cow;
Knife or scissors;
Pen and paper.

Aim: To draw a diagram showing the path blood takes through the heart.

1. Draw a diagram of the heart in your exercise book. Show the path blood takes from the vena cava to the pulmonary artery and from the pulmonary vein to the aorta.
2. Label the following parts on your diagram: aorta, pulmonary artery, left auricle, left ventricle, right auricle, right ventricle, septum, vena cava.
3. Look at the heart of a pig or cow. Feel the muscle walls of the ventricles. Find the left side which has thicker muscle than the right side.
4. Carefully cut the heart open to find the auricles, ventricles and valves.

Activity 4 Pulse Rate

Materials needed:
Stop watch or wristwatch.

Aim: To find out what your resting pulse rate is.

1. Work in pairs. Locate your own pulse by pressing the first and second fingers of one hand against the wrist of your other hand or on to your neck just below the lower jaw.

Taking Your Pulse

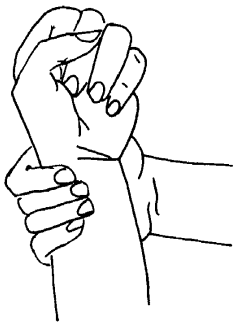


Diagram 4.9
How to take your pulse.

2. Copy the table below in to your book. Record your results in the table.
3. Sit down and rest for three minutes, then one person times 15 seconds while the other person counts their pulse or heart beats. Record this number. It is your resting pulse rate.

Name	Resting Pulse Rate (Beats Per Minute)			
	First Trial	Second Trial	Third Trial	Average

4. Repeat two more times and then measure and record the pulse of the other person.
5. Multiply the number of beats by four to get your pulse rate in beats per minute, and then work out your average pulse rate.
6. Record the pulse rate of each class member on the board or a sheet of paper. Copy the following table and use tally marks to record the pulse rate of all members of the class. When using tally marks:

/	means 1
//	means 2
///	means 3
////	means 4
~~////~~	means 5
~~//// ////~~ //	means 12

Pulse Rate (Per Minute)	Class Tally	Number of People
Less Than 60		
60–64		
65–69		
70–74		
75–79		
80–84		
Greater Than 84		

7. Graph the number of people against the resting pulse rate.

Activity 5 Pulse Rate When Standing And Lying Down

Materials needed:
Stop watch or wristwatch.

Aim: To find out what your pulse rate is when you are standing or lying down.

1. Work in pairs. Stand up for three minutes and then measure and record the pulse rate of each person, for 15 seconds, while they are standing. Remember to multiply the number of beats by four to get pulse rate in beats per minute. Repeat another two times and work out your average pulse rate. Working out an average gives you more accurate results.
2. Repeat for each person in the pair lying down.
3. Draw up a table like the one for Activity 4 and record your pulse rates when sitting (use your results from Activity 4), standing and lying down.

Activity 6 Pulse Rate When Exercising

Materials needed:
Stop watch or wristwatch.

Aim: To find out what your pulse rate is after you exercise.

1. Work in a group of four. Plan an investigation to find out what effect exercise has on the pulse rate of the members of the group. The pulse should be taken immediately after exercise and then after every 30 seconds. Keep on recording, for 15 seconds every 30 seconds, until the pulse returns to your normal resting value found in Activity 4.
2. Copy and complete the investigation plan sheet opposite.
3. Hand your plan to your teacher for checking.
4. Record the step-by-step instructions for carrying out your investigation. Write them clearly, so that someone else could follow the instructions to carry out the same investigation.
5. Carry out your planned investigation.
6. Record your results in a table like the one opposite.
7. Write a conclusion about the effect of exercise on your pulse rate.

What is the investigation called? (*e.g. Exercising.*)

What is the aim or purpose of this investigation? (*e.g. To find out changes to pulse rate caused by exercise.*)

What variable will be changed? (*e.g. The exercise done* **or** *the amount of exercise done.*)

How will the variable be changed? (*e.g. I will run on the spot for different amounts of time* **or** *I will do different exercises for 10 times each.*)

Which variables will be kept the same? (*e.g. The type of exercise done* **or** *the length of time that the exercise is done for.*)

What will be measured? (*e.g. The pulse rate will be measured for 15 seconds every 30 seconds until the pulse rate returns to resting pulse rate.*)

How will you make sure the results are accurate and reliable? (*e.g. Repeat each test three times.*)

Exercise Done	**Pulse Rate (Beats In 15 Seconds)**			
	Immediately After	**30 Seconds**	**60 Seconds**	**90 Seconds**

Heart sounds

The sounds made by the valves in the heart closing can be heard using a stethoscope. Normally the valves make a sound like 'lubb dub' as they close. If the valves are not working properly then the sounds made are different.

Activity 7

Making A Model Stethoscope

Materials needed:
Y glass tubing;
2x 30cm tubing;
1x 10cm tubing;
Filter funnel.

Aim: To make a model stethoscope and listen to the sound made by the heart and aorta valves closing.

- Use the diagram to make up a model stethoscope.
- Place the funnel against a persons' chest and listen to the sounds made by the valves closing.

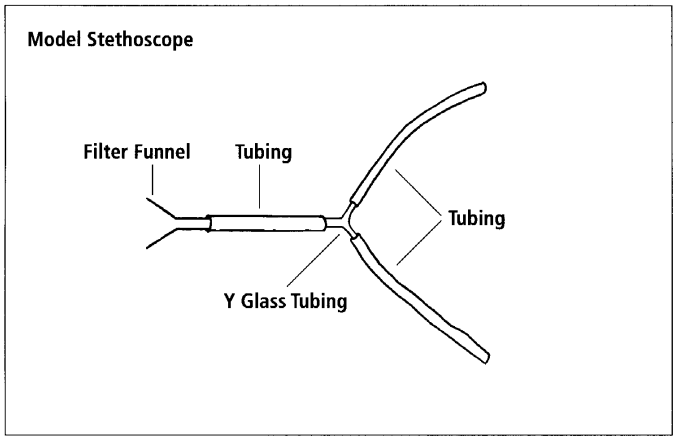


Diagram 4.10
Model stethoscope.

Blood pressure

Blood in the blood vessels is under pressure. This pressure is needed to pump blood around the body. The pressure is caused by the force of the heart when it contracts. When blood pressure is taken there are two readings. A common reading is 120/80 mmHg. The first, higher pressure, is when the heart is contracting, and the second, lower pressure, is when the heart is resting.

Activity 8 Measuring Blood Pressure

Materials needed:
A sphygmomanometer.

Aim: To find out what your blood pressure is.

- Your teacher will measure the blood pressure of each person in the class.
- Record your own blood pressure.

Unit Summary

- The circulation system is needed to transport a range of materials around the body.
- The blood carries materials such as digested food, mineral salts, carbon dioxide, wastes and oxygen. The haemoglobin in the red blood cells carries the oxygen.
- Blood vessels called arteries carry blood away from the heart. Veins carry the blood back to the heart. Between the arteries and veins are the capillaries.
- Exchange of gases and food occurs in the capillaries. Each body cell has a capillary close to it. Oxygen and food in the blood move into the cell and carbon dioxide and wastes move from the cell into the blood.
- The heart is made up of two pumps side by side. The right side receives blood from the body and pumps the blood to the lungs and the left side receives blood from the lungs and pumps blood to the body.
- The pumping of the heart causes pressure in the arteries and this can be felt as a pulse. The pulse rate changes with different activities. The pulse rate increases when the activity the body is doing requires more oxygen.

Unit 5: HUMAN RESPIRATION SYSTEM

Introduction

In this unit, you will learn about the parts of the respiratory system and how they work together to carry out the processes of breathing and exchange of gases.

Respiration

The body cells carry out a process called **respiration**, which takes the energy from food chemicals and changes it into a form that can be used by the cells. For example, muscle cells use the energy for movement. The process of respiration uses oxygen and makes carbon dioxide. It is the job of the respiratory system to supply oxygen to the body and to remove the carbon dioxide.

Breathing

Moving air in and out of the lungs is called **breathing**. The parts of the body involved in the process of breathing are the diaphragm and the rib-cage.

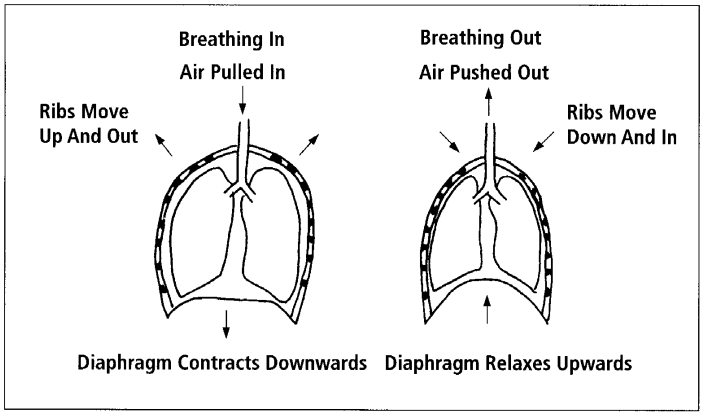


Diagram 5.1
Breathing.

The **rib-cage** forms an airtight cage that protects the lungs and heart. When we breathe in, called inhaling, the ribs move upwards and outwards. This, and the **diaphragm** moving down, makes the pressure inside the ribcage lower so that air moves into the lungs. During breathing, the air going into the lungs is cleaned, warmed and becomes moist.

When we breathe out, called exhaling, the ribs move in again which increases the pressure inside the lungs and forces air out.

Air moves in and out of the lungs through the nose. Small hairs inside the nose stop dirt and other unwanted substances entering the lungs. Air moves from the nose into the windpipe called the **trachea**. The trachea is a pipe that has rings of hard material called **cartilage** to hold it open as the air moves in and out through it. Mucous on the walls of the trachea traps small bits of dirt to stop it from getting into the lungs. The cells in the wall of the trachea are covered in thin hairs called **cilia**. The cilia are able to move the mucous and trapped dirt up and out of the trachea.

The trachea splits into two branches called **bronchi**. These take the clean, warm, moist air into the right and left lungs.

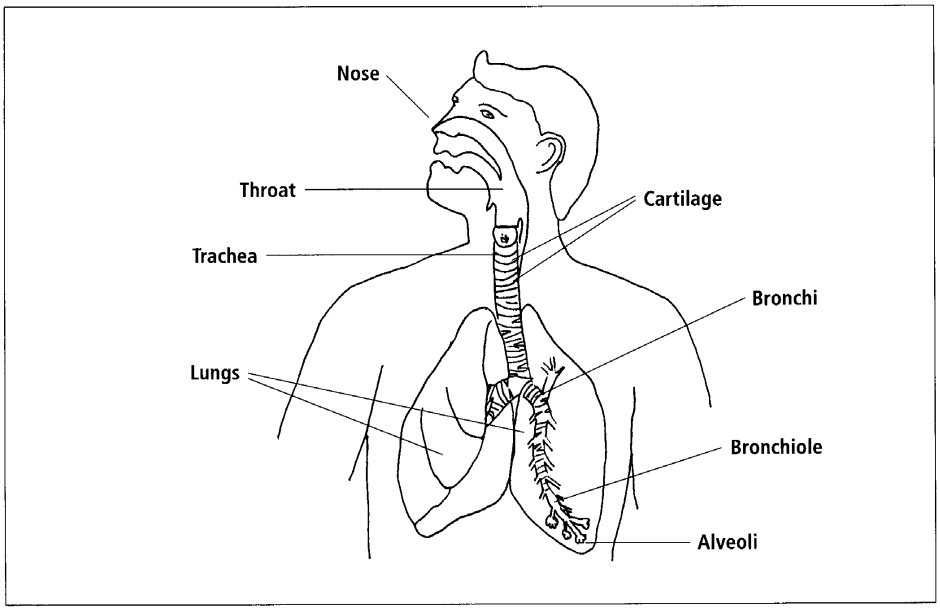


Diagram 5.2
Human respiratory system.

Gas exchange

The bronchi divide to form smaller tubes called **bronchiole**. The bronchiole divide again and again to form very small tubes that end in a large air space called an alveoli. The walls of the alveoli are very thin and each alveoli has a blood capillary next to it. The oxygen in the air in the alveoli dissolves in a thin layer of water inside the alveoli and moves into the blood capillary. At the same time, carbon dioxide in the blood moves into the alveoli. This exchange of places of the oxygen and carbon dioxide is called **gas exchange**.

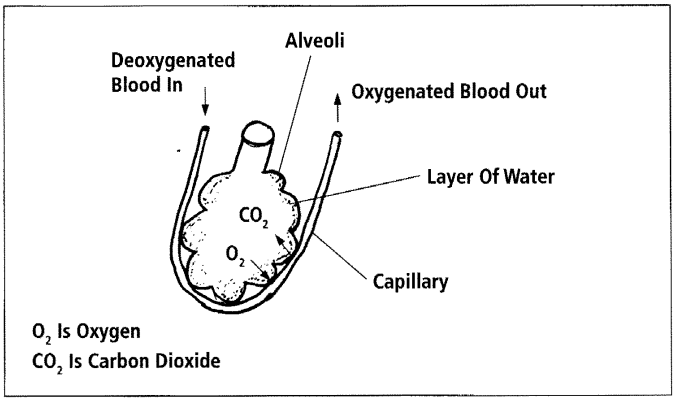


Diagram 5.3
Gas exchange in an alveoli.

Activity 1 Breathing

Aim: To record information on the parts of the respiratory system that are involved in breathing.

Part	Function
Rib-cage	It stretches downward to provide more room for the lungs to expand.
Diaphragm	This is where oxygen and carbon dioxide are exchanged.
Bronchi	Join the two lungs with the trachea and give a passage for the air to move in and out.
Alveoli	This is where air comes into the respiratory system.
Nose	Protects the lungs and also helps to suck air into the lungs by expanding outward.

- Match the parts of the respiratory system with their functions and record the information in a table. The table on the previous page is out of order. Rearrange it so each part matches the correct function.

Did you know?
If all the alveoli in the lungs were opened up and spread, it would cover an area about the size of a football field.

Activity 2 Breathing Rate Investigation

Materials needed:
Stop watch or wristwatch.

Aim: To plan and carry out an investigation to find out the effect of different activities on breathing rate.

1. Measure your resting breathing rate by sitting still for five minutes then counting the number of times you breathe in 20 seconds. Multiply this number by three to get the number of breaths per minute.
2. Copy and complete the investigation plan sheet below for an investigation into the effect of different activities on breathing rate.
3. Hand your plan to your teacher for checking.
4. Record the step-by-step instructions for carrying out your investigation. Write them in a way so that someone else could follow the instructions to carry out the same investigation.
5. Carry out your planned investigation.
6. Record your results in a table.
7. Present your information in a graph if appropriate.
8. Write a conclusion to your investigation.
9. Discuss the findings of your investigation and any difficulties that occurred.

What is the aim or purpose of this investigation?

What different activities will be done?

How long will each activity be done for?

What will be measured?

How will you make sure the results are accurate and reliable? (*e.g. Repeat each test three times.*)

Activity 3

Model Of The Respiration System

Materials needed:

Bell-jar or 3-litre juice bottle with the bottom cut off;

Two Balloons;

Y glass tubing;

Rubber sheet or similar material;

Tape or strong elastic bands;

Small stone;

String.

Aim: To make a model that shows some of the things that happen during breathing.

1. In groups, or as a class, set up the apparatus as shown below. Make sure there is an air tight seal at the top and bottom of the bell jar.

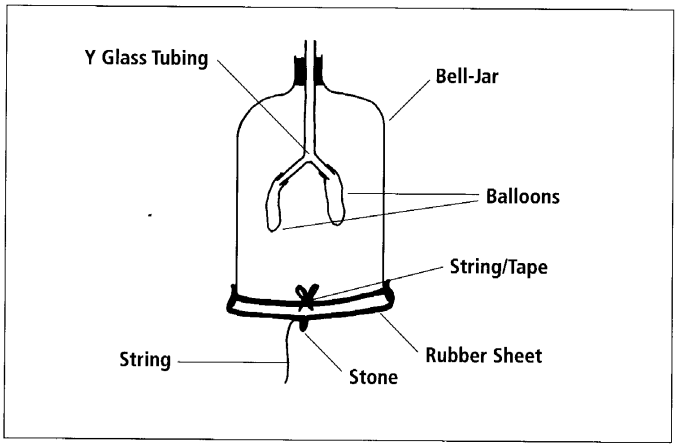


Diagram 5.4
Model of the respiratory system.

2. Pull the string attached to the rubber sheet.
3. Observe what happens.
4. Answer the following questions.
   a. What happened to the balloons when the string was pulled down?
   b. Where did the air that filled the balloons come from?
   c. What happened to the balloons when the string was released?

- Copy the table below. Then add the following terms to match the parts of the model with the part of the respiratory system it shows: *Diaphragm, Y-glass tubing, Rib-cage, Lungs.*

Model	Respiratory system
Balloons	
	Wind-pipe
Rubber sheet	
Bell-jar	
Y-glass tubing	Bronchi

Activity 4 Breathing Out Carbon Dioxide

Materials needed:
Limewater solution;
Large test tubes or small plastic bottle;
Clean drinking straw, hose or glass tubing.

Aim: To show that the air we breathe out contains carbon dioxide.

1. Add limewater to the test tube. Limewater is a chemical that is used to show that carbon dioxide is present.
2. Gently blow through the straw into the limewater solution for one minute.
3. Observe any changes in the limewater solution and record these results.
4. Write a conclusion for the activity.
5. Explain what happened to the limewater solution.
6. Draw a diagram of how gas exchange occurs in the alveoli to explain where the carbon dioxide we breathe out comes from.

Activity 5 Lungs Of A Pig Or Gills Of A Fish

Materials needed:
Stop watch or wristwatch.

Aim: To identify structures of the respiration system.

1. Look at the lungs or gills and note how light in weight each is.
2. Notice the colour which is due to the high level of blood in the lungs and gills.
3. Draw biological drawings of the outside of the lungs and gills. Label any parts.
4. Cut open the lungs or gills, and draw and label the parts inside.

Activity 6 Research

Aim: To find out the connection between the respiratory and circulatory systems.

- With the help of your notes and other sources of information, describe how the respiration and circulation systems work together to keep us alive.

Unit Summary

- Respiration is the process of using food to get energy. Respiration occurs in almost all cells. The cells need oxygen to carry out respiration.
- Breathing is used to get air into and out of the body. The rib cage and diaphragm work together to pull air into the lungs. Mucous, hairs and cilia help to clean the air as it goes into the lungs.
- Air travels through the trachea, bronchi and bronchiole to get to alveoli where gas exchange takes place.
- During gas exchange the oxygen in the air moves into the blood capillary and carbon dioxide moves from the blood capillary into the alveoli. The blood leaving the lungs is high in oxygen and is called oxygenated blood.

Unit 6: MICRO-ORGANISMS

Introduction

In this unit, you will learn about the structure of some micro-organisms. Micro-organisms are very small living things. Some can only be seen with a microscope. The most common types of micro-organisms are bacteria, fungi and viruses.

Language note: The word 'bacteria' means many bacteria, and the word 'bacterium' means one.

Bacteria

Bacteria can live almost anywhere. They are in water, air, soil, plants and animals, and on every surface around us. Each bacterium is made up of a single cell which is too small to see without a microscope. Different types of bacteria have different shapes. Sometimes the bacteria cells join together in groups or chains.

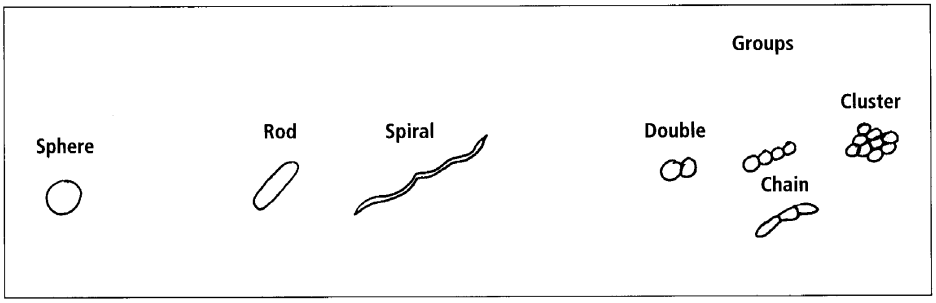


Diagram 6.1
Shapes of bacteria.

The following diagram shows the parts of a bacteria.

A sticky **capsule** covers some bacteria. The capsule protects the bacteria and is used to help groups of bacteria stick together. **Flagella** are used to move the cell from place to place.

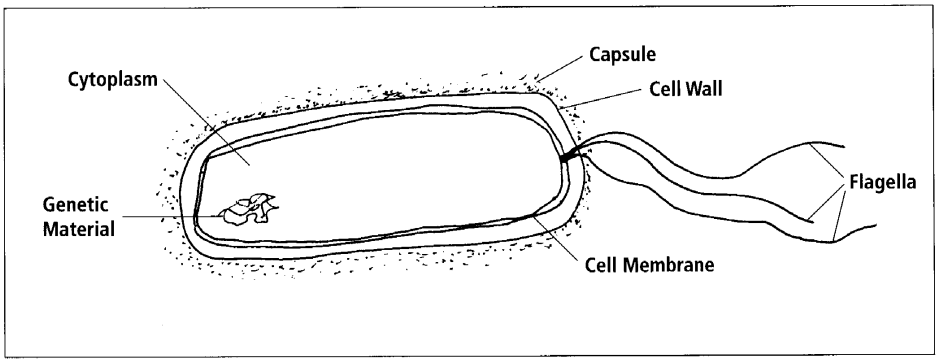


Diagram 6.2
Parts of a bacterium.

The **cell wall** is strong so that the cell parts are held together. The **cell membrane** controls what chemicals can enter and leave the bacterium. The **genetic material** is usually DNA and it contains the instructions for the way the bacterium will live. The **cytoplasm** is where chemical reactions occur. These chemical reactions are needed for growth and reproduction of the bacterium.

Growth and reproduction

Bacteria grow by getting bigger and they reproduce by splitting in two, using a process called **binary fission**.

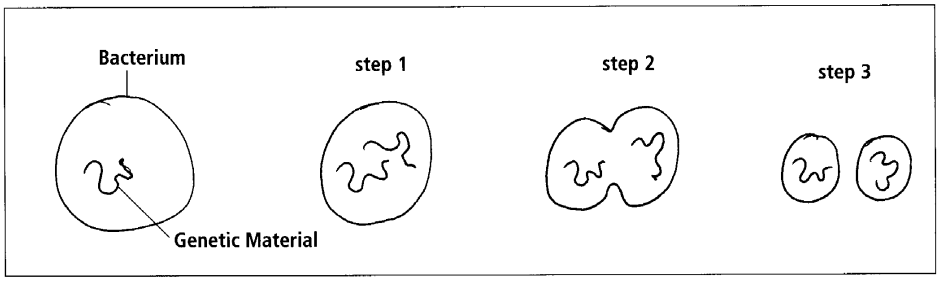


Diagram 6.3
Bacteria reproduction by binary fission.

Steps in binary fission

Step 1: During Step 1 of binary fission the genetic material is copied.

Step 2: In Step 2 the cell wall and membrane grow across the cell. This splits the cytoplasm in half. One copy of the genetic material goes into each half.

Step 3: Reproduction is finished and two cells that are exactly the same have been produced.

Binary fission can happen very often. If the bacteria are at a good temperature and have lots of food they can carry out binary fission once every 20 minutes. This means that the number of bacteria can increase very, very quickly. This fast rate of reproduction is usually stopped when the bacteria run out of space or food, or there is too much of their own **toxic** waste. The rate of reproduction is slower when the temperature is too hot or too cold.

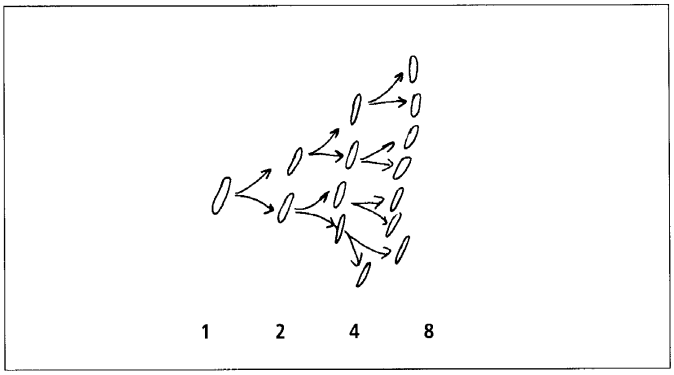


Diagram 6.4
Increase in numbers of bacteria.

In some conditions when bacteria reproduce quickly they form groups, called **colonies**. Colonies of bacteria can be seen as shiny or greasy spots coloured white, pink, orange, or yellow.

Feeding

Different types of bacteria have different ways of life. Some are **saprophytes**. This means that they feed on dead plant and animal materials. Other bacteria are **parasites**. This means that they cause diseases by feeding on plants and animals while they are still living.

Saprophytes and parasites both feed by **extra-cellular digestion**. This means that the digestion of food occurs outside the cell of the bacterium. The first thing that happens in extra-cellular digestion is the cell releases enzymes onto the food. These enzymes then digest the food. Next the bacterium absorbs the digested food chemicals and uses them for growth and respiration.

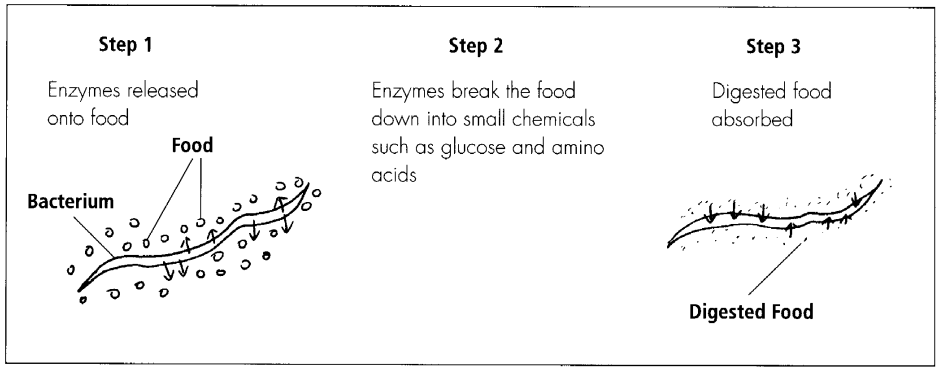


Diagram 6.5
The steps in extra-cellular digestion.

Respiration
Respiration is a series of chemical reactions that releases the energy in food chemicals for cells to use. Some types of bacteria use **aerobic respiration**. This means they need oxygen to carry out respiration. Other types of bacteria carry out respiration without oxygen. This type of respiration is called **anaerobic respiration**.

Activity 1 Structure And Life Processes Of Bacteria

Aim: To record information about the structure and life processes of bacteria.

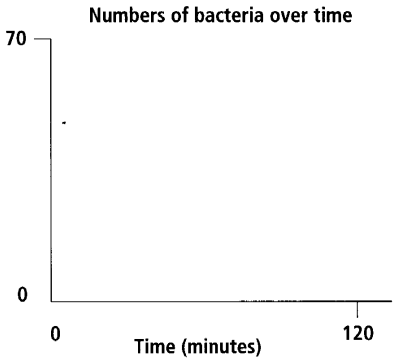
- Draw a labelled diagram showing the parts of a bacterium.
- Copy and complete the following table.

Part	Function
Cytoplasm	
Genetic material	
Capsule	
Cell wall	
Flagella	
Cell membrane	

◧ Answer the following questions.

1. What is the purpose of binary fission?
2. Use the following information to draw a graph showing the reproduction rate of bacteria.

Time (min)	0	20	40	60	80	100	120
Number of Bacteria	1	2	4	8	16	32	64



3. What is a 'saprophyte'?
4. Copy the following diagram showing extra-cellular digestion. Explain what is happening at the points labeled 1, 2 and 3 on the diagram.

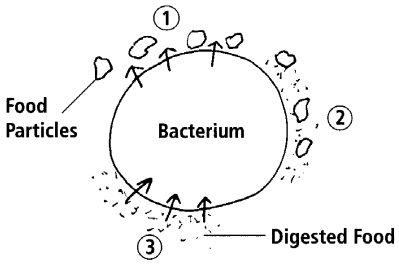


Diagram 6.6
Extra-cellular digestion.

5. Explain the difference between aerobic and anaerobic respiration.

Activity 2

Growing Bacteria

Materials needed:

Water that has been boiled then covered, to stop bacteria from getting in it, and cooled;

Vegemite or Marmite;

Agar, gelatin or animal bones;

Petri dishes or jam-jars with lids.

Aim: To grow colonies of bacteria.

1. Dissolve agar or gelatin and a very small amount of Vegemite or Marmite in cooled boiled water then boil to kill any bacteria. Cover and allow to cool slightly.

   Alternatively: boil up some fresh animal bones in water for two to three hours to collect the gelatin.

2. Before the agar or gelatin becomes too thick, pour a 0.5 cm-thick layer in Petri dishes or jam-jars. Cover and allow to cool and become solid.

3. Leave the lid on one agar or gelatin dish or jar and label it 'control'. Tape it shut and turn it upside down.

4. Use a different way to get some bacteria on each of the other dishes or jars. For example:

   a. Mix a small amount of soil with a small amount of boiled water. Then pour a small amount of the water on to the agar or gelatin in the dish or jar. Swirl it to get the water over all the agar or gelatin surface and then pour off any extra water. Tape the dish or jar shut and turn it upside down.

   b. Use a comb on a person's hair and then touch the comb surface to the agar or gelatin for a few seconds. Remove the comb. Tape the dish or jar shut and turn it upside down.

   c. Place objects such as leaves, soap, fingertips, keys, etc., onto the agar or gelatin. Remove them, then tape the dish or jar shut and turn it upside down.

   d. Leave a dish or jar open to the air for 20 minutes. Tape the dish or jar shut and turn it upside down. Do **not** spit on the agar or put anything that may be carrying disease-causing bacteria onto it.

   e. Leave the dishes or jars in a warm place for four to eight days. Check each day. Do **not** remove the lids in case there are some disease-causing bacteria growing on the agar or gelatin. Any small round shiny spots growing on the agar or gelatin are bacteria. Fungi could also grow. Fungi will look furry. Record your results using drawings.

5. When finished burn the plastic dishes and jars unopened. Leave the glass jars unopened and get rid of them through the rubbish system.

Note: The dishes and jars are turned upside down to stop water from falling on the bacteria.

Fungi

Moulds, yeasts, mushrooms and toadstools are common types of fungi. The part of the micro-organism that people usually call a 'mushroom' or 'toadstool' is only the reproductive part of the fungi. The body of the fungus is in the food supply it is growing on. The bodies of most fungi are made up of thin threads called **hyphae**. The hyphae grow through the food supply and feed on it. Yeast is a type of fungi that lives as single cells.

Language note: *Fungus* means *one fungi*.

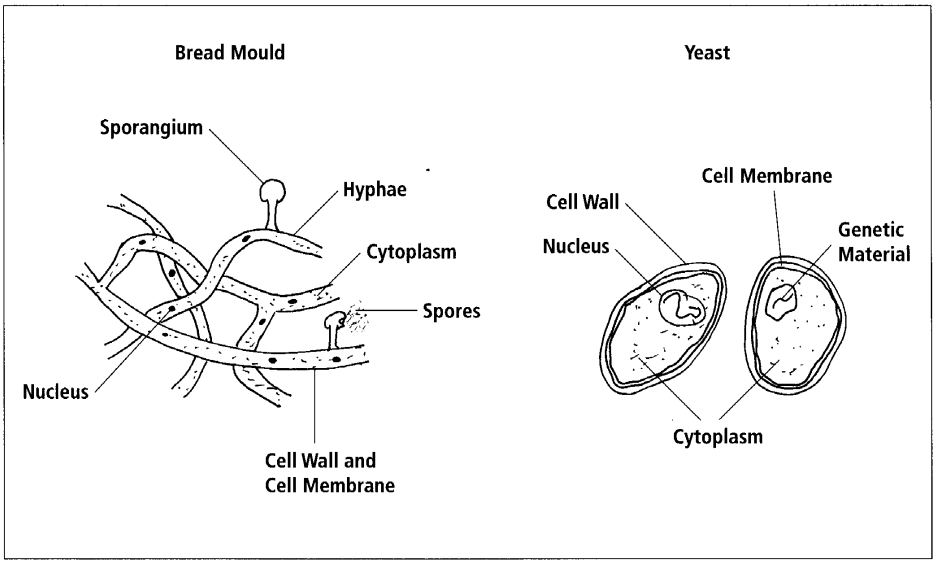


Diagram 6.7
Structure of bread mould and yeast.

Growth and reproduction

To grow well fungi need warm, moist conditions with a good supply of food.

Fungi reproduce using **spores**. A **sporangium** grows up from the hyphae and spores grow inside it. The sporangium lets large numbers of spores into the air. Spores are small and light so that they can float in the air until they fall on a suitable food source and grow into new hyphae.

Language note: *Sporangia* for *more than one sporangium*.

Bread mould is a common fungi. The hyphae of bread mould can be seen as fine white threads on the surface of the food source. Bread mould turns to a blue green colour as the sporangia grow and ripen.

Feeding

Some fungi are saprophytes and feed on dead plant and animal material. These fungi are important in recycling nutrients in forests and grasslands. Other fungi are called parasites because they cause diseases.

Fungi can be grown on food sources such as bread and fruit. These food sources must be kept moist to give good conditions for growth.

Controlling the growth of micro-organisms

Lots of different chemicals are used to try to control the growth and reproduction of fungi and bacteria. Disinfectants and antiseptics are examples. **Disinfectants** are used to control the growth of bacteria and fungi on surfaces and in toilets. **Antiseptics** are chemicals that are used on our skin and in wounds. Many of these chemicals are made by plants and people use the plant material as natural disinfectants and antiseptics. Wooden cutting-boards are more healthy than plastic because the wood contains chemicals with disinfectant properties.

Antibiotics are another group of chemicals that are made by micro-organisms to stop the growth of other micro-organisms. People have learnt to make and use these chemicals to make medicines that slow down the growth and reproduction of fungi and bacteria. Antibiotics work by stopping the cell wall of the micro-organism from forming properly.

Different disinfectants, antiseptics and antibiotics are often more effective against some types of bacteria than others. Agar plates can be used to test which chemical is most effective against a type of bacteria. The size of the cleared area around the disinfectant shows how effective it is at stopping bacteria growth. The larger the cleared area is the more effective the disinfectant is.

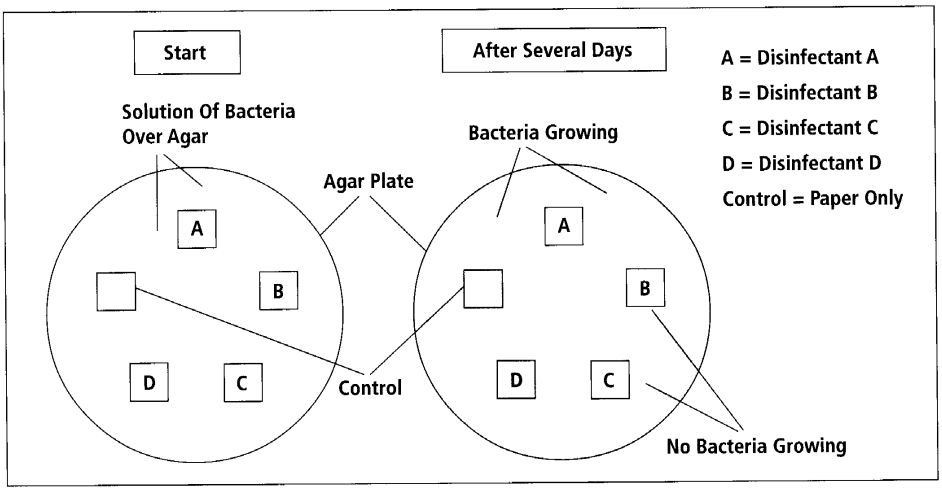


Diagram 6.8
Effectiveness of disinfectants.

Activity 3 Fungi

Aim: To record information about fungi.

1. Draw a labelled diagram showing the parts of fungi.
2. Copy and complete the following table.

Part	**Function**
Hyphae	
Nucleus	
Genetic Material	
Sporangium	
Spore	

3. List three things fungi need to grow.
4. Explain how fungi, such as bread mould, reproduce.
5. Copy and complete the following table.

Chemical	**Where Chemical is used to control Bacteria and Fungi**
Disinfectant	
Antiseptic	
Antibiotic	

- Answer the following questions using the information given in the diagram below.

1. Which antibiotic is the most effective against this bacteria?
2. Which antibiotic is least effective against this bacteria?
3. Why is the paper with no antibiotic on it used in this investigation?

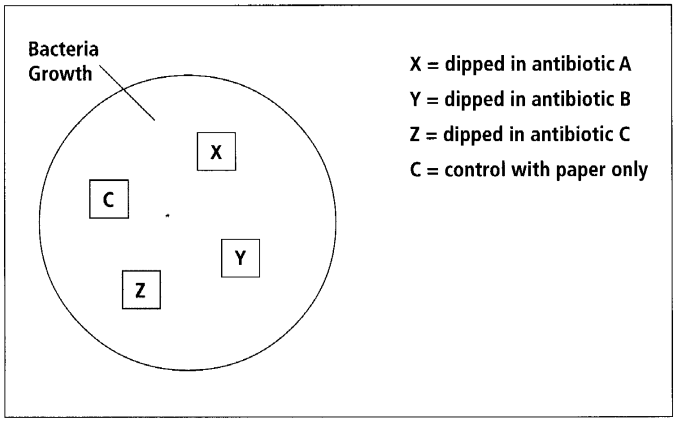


Diagram 6.9

Activity 4

Looking At Fungi

Materials needed:
Bread and fruit with mould growth;
Hand lens.

Aim: To identify fungi growing on food.

1. Use a hand lens to look at pieces of bread that have been kept in a plastic bag for five or six days. Can you see white or blue-green spots on the bread? These spots are bread mould fungi. If the spots are white they are made up of very thin threads which are the hyphae of the fungus. If the spots are a blue-green colour then you are looking at ripe sporangia.
2. Use a hand lens to look at pieces of mould on fruit. A brown-coloured mould will be a type of penicillin mould.
3. Draw labelled diagrams of the moulds.

Viruses

Viruses are so small that they can only be seen with special types of microscopes. Each type of virus has a different shape. They are made up of only a protein coat and **genetic material**. All viruses cause diseases in animals and plants. The flu, common cold, hepatitis B, HIV, polio, measles, mumps and chicken-pox are all diseases caused by viruses.

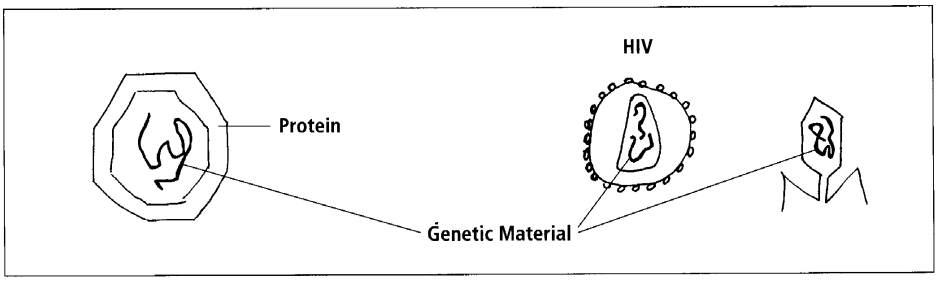


Diagram 6.10
Viruses.

The only life process a virus is able to carry out is reproduction. This is why viruses always cause diseases. Viruses reproduce by joining onto a living cell and then using their genetic material to make the cell produce new viruses. After the new viruses are made the cell that the virus used dies.

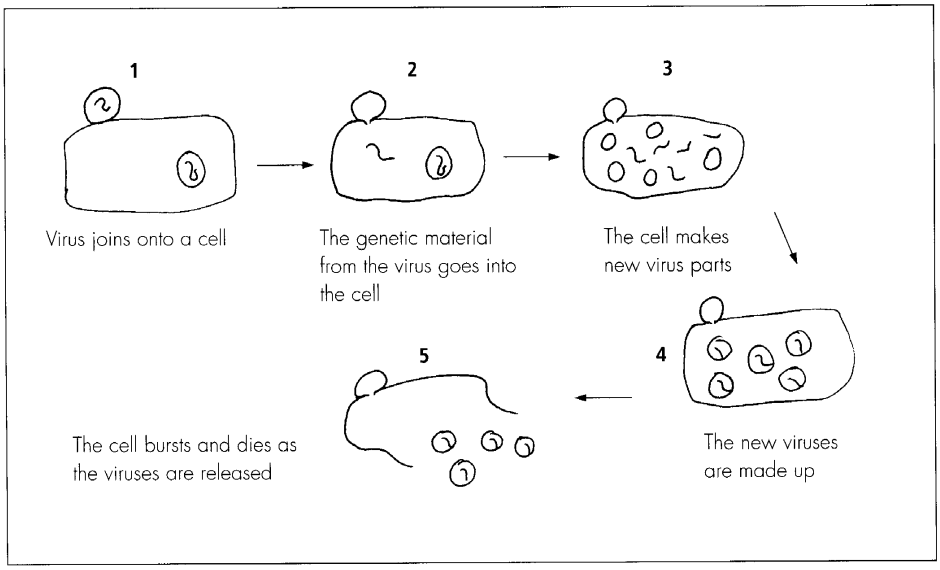


Diagram 6.11
How viruses reproduce.

The human immunodeficiency virus (HIV) reproduces itself in cells that the human body uses to fight disease. This means that the person will not be able to fight other micro-organisms that cause disease and the person affected could develop AIDS.

Activity 5 Viruses

Aim: To record information about viruses.

1. Describe the structure of a virus and name the two parts.
2. Copy and complete this sentence:
   The only life process that viruses are able to carry out is . . .
3. Copy the diagram showing how viruses reproduce.
4. Explain why viruses always cause diseases in plants and animals.

Unit Summary

- Bacteria are organisms made up of a single cell with a cell wall, cell membrane, cytoplasm and genetic material. Some types of bacteria also have capsules and flagella.
- Bacteria reproduce by binary fission. Reproduction can be as quick as once every 20 minutes. Lack of space or food, too much toxic waste and too high or too low temperature all slow reproduction down.
- Bacteria and fungi feed by extra-cellular digestion. Saprophytes feed on dead material and parasites feed on living host cells.
- Some bacteria carry out aerobic respiration which means they need oxygen. Other types of bacteria use anaerobic respiration.
- Agar plates can be used to grow and reproduce a single bacterium into a colony of so many bacteria that they can be seen as a shiny spot on the agar. Fungi also grow on agar. They appear as lumps of threads.
- Fungi are made up of hyphae that grow through their food supply.
- Fungi grow in warm, moist places and reproduce using spores.
- Disinfectants, antiseptics and antibiotics are chemicals used to stop the growth of micro-organisms.
- Viruses are made up of a protein coat and genetic material.
- Viruses are always parasites. They reproduce by joining onto a host cell and using the cell to make copies of themselves.

YEAR 9 GLOSSARY

Word/Phrase	Meaning
Adventitious	Roots that grow from a stem.
Aerobic respiration	Respiration that uses oxygen.
Alveoli	Parts of the lungs where oxygen and carbon dioxide are exchanged.
Amino acids	Chemicals that make up protein.
Anaerobic respiration	Respiration that occurs without oxygen.
Antibiotics	Chemicals used in medicines.
Antiseptics	Chemicals used to kill bacteria on living tissue.
Aorta	Largest artery in the body.
Artery	Blood vessel that carries blood away from the heart.
Binary fission	Reproduction where the cell splits into two new cells.
Blood	Red liquid pumped around the body. It carries oxygen and food to the cells and removes wastes.
Blood capillaries	The smallest type of blood vessel. Gas exchange occurs in the capillaries.
Blood pressure	Pressure in the arteries caused by the force of the heart pumping.
Blood vessels	Arteries, veins and capillaries, which are the tubes that carry blood around the body.
Breathing	Taking air in and out of the body.
Bronchi	Large tube that takes air to and from each lung.
Bronchiole	Thin tube that takes air between the bronchi and alveoli.
Capillaries	see *Blood capillaries*.
Capsule	Layer of sticky material around the outside of some bacterial cells.
Carbohydrates	A group of nutrients needed in the diet. Sugars, starch and fibre.
Carbon dioxide	This gas is exhaled when we breathe out.
Cartilage	Tough material that forms parts of the body.
Cell	Basic living unit of plants and animals.
Cell membrane	Thin layer that controls what chemicals go in and out of cells.
Cell wall	Strong wall around the outside of plant, bacteria and fungi cells.
Cholesterol	Type of fat.
Chromosomes	Structures with DNA coiled up inside.
Cilia	Tiny hairs on the outside of the cell that move to cause movement.
Circulation	Blood flow around the body.
Colonies	Groups of so many bacteria that they can be seen as a small spot.

YEAR 9 GLOSSARY

Word/Phrase	Meaning
Cytoplasm	Jelly-like material on the inside of cells.
Deoxygenated blood	Blood that has little or no oxygen in it.
Diaphragm	A dome-shaped organ that separates the chest and the abdomen. It changes shape during breathing.
Diffusion	Evenly spreading through another substance.
Disinfectants	Chemicals used to kill bacteria on surfaces.
DNA	The chemical in chromosomes that has the instructions for cell growth and function.
Exhale	Breathe out air.
Extra-cellular digestion	Digestion of food that happens outside the cells.
Fat	A chemical needed in the diet.
Fibre	Material in food.
Flagella	Long tail-like part that is used to move the cell.
Food	Nutrients produced by plants and eaten by animals.
Function	What something does.
Gas exchange	The exchange of carbon dioxide and oxygen between cells and the blood and between the air in the lungs and the blood.
Genetic material	Material that has the instructions for cell growth and function.
Glucose	Single sugar.
Haemoglobin	Chemical in red blood cells that carries oxygen.
Heart	An organ that pumps blood around the body.
Herbaceous	A plant with a soft stem.
Hyphae	Feeding threads forming the body of the fungus.
Inhale	Breathe in air.
Lateral roots	Roots that grow off the side of a main root.
Left auricle	Top, left part of the heart.
Left ventricle	Bottom, left part of the heart.
Light microscope	Microscope that uses light to show the object.
Magnification	How much larger the object is when viewed with the microscope.
Minerals	Nutrients needed to carry out life processes.
Nuclear membrane	Membrane around the nucleus.
Nucleus	Part of a cell that controls how it functions.
Nutrients	Chemicals taken into the body as food.

YEAR 9 GLOSSARY

Word/Phrase	Meaning
Organ systems	A group of organs in the body that work together.
Organism	A living thing. It can be made up of one or many cells.
Organs	Structures made up of different types of cells and tissue working together.
Oxygen	The gas that is in air, and used in respiration.
Oxygenated blood	Blood that has lots of oxygen in it.
Parasites	Organisms that cause disease.
Phloem	This tube takes sugar throughout the plant.
Photosynthesis	A chemical process used by plants to make sugars.
Plasma	A watery liquid, found in blood.
Pneumatophores	Roots of a mangrove that grow into the air.
Polyunsaturated fats	A fat that has chains of carbon atoms with double bonds between them.
Protein	Large molecules, made up of amino acid units joined together.
Pulmonary artery	Vessel that takes blood from the heart to the lungs.
Pulse	Pressure of the heartbeat felt in the arteries.
Red blood cells	Cells that carry oxygen in haemoglobin.
Respiration	Chemical reactions that give energy in the cells.
Rib-cage	Bones that protect the lungs and heart from knocks.
Right auricle	Top, right part of the heart.
Right ventricle	Bottom, right part of the heart.
Saprophytes	Organisms that feed on dead plant or animal material.
Saturated fats	A fat that has chains of carbon atoms with no double bonds between them.
Semilunar valve	Valve in the aorta that stops blood flowing back into the heart.
Septum	Muscle tissue between the left and right side of the heart.
Sporangium	Reproductive part of a fungus inside which the spores develop.
Spores	Small, light, reproductive cells of fungi.
Starch	A carbohydrate chemical made up of lots of glucose units joined together.
Sugar	A carbohydrate such as glucose or sucrose.
Tissues	A group of cells that work together to carry out a function.
Toxic	Poisonous.

YEAR 9 GLOSSARY

Word/Phrase	Meaning
Trachea	Large tube or windpipe that takes air in and out of the body.
Transpiration	Water loss from the leaves and stem of the plant.
Valves	Flaps of tissue that stop blood flowing backwards along a vein, or in the heart.
Vascular system	The system of cells used to move water and sugar around the plant.
Vein	A tube that takes blood from the body back to the heart.
Vena cava	The main vein in the body. It takes blood into the heart.
Viruses	Small organisms made up of protein and genetic material.
Vitamins	Nutrients needed in the diet.
Water	A substance made up of one oxygen and two hydrogen atoms, which is necessary for all living organisms to survive.
Xylem	Tubes that take water and minerals from the roots to the leaves.