TEACHING GUIDE

FOR SECONDARY CLASSES

SCIENCE FACT FILE

GRADE 6

THIRD EDITION

David Coppock

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Illustration: p. 26: © Tom Oliveira / Shutterstock

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Introduction

As science teachers in the 21st century, we stand on the shoulders of many hundreds, if not thousands, of scientific giants who have gone before us. Never in human history has so much been understood about the scientific world. Yet, there still remains a lot that is unknown.

We should open up to students the many wonderful discoveries that have already been made, and stir in them a desire to continue to investigate and explore those areas of science that are still not fully understood.

When Newton, Faraday, or Pasteur, were looking at the world and seeking explanations, they did not have a book that contained all the answers; they used the knowledge they had to ask questions, to investigate, to try to discover what they did not know. They were active and life-long learners.

Far too often we permit our students to be passive learners by providing them with information and asking them to learn it. Education must be active! We must encourage our students to be inquisitive and searching, particularly in the field of science education, and empower them to be our partners in the process of acquiring knowledge.

Our hope is that this series of books and teaching guides will help in that endeavour.

Organization of the book

The *Science Fact file* series provides a well-balanced and organized course in science, emphasizing the acquisition of knowledge to be used as a guide for intelligent behaviour in daily life. It is not only a collection of facts about the world around us; the content is focused on the acquisition and understanding of general concepts which are developed using problem-solving methods.

About the Teaching Guide

Science Fact file Teaching Guides 1, 2, and 3 have been written to promote and support effective science teaching. Suggestions for teaching procedures are provided for each unit, and answers for questions and solutions for exercises and problems are supplied.

Background information

This section will prove very helpful as it explains the scientific knowledge necessary to teach a particular unit.

Unit introduction

Below are some of the ways in which a unit can be introduced. Most of them can also be used to tackle new problems within the unit.

1. **Ask questions about the students' experiences in relation to the unit.**

   At the start of a new unit, it is vital to find out what knowledge (and misconceptions!) students may already have. This can give rise to questions which will be answered during the unit. Ask questions such as: *Have you ever seen…..? What did it look like? Have you ever made a …? Have you heard about…? Have you ever watched someone …?* The purpose of these questions is to obtain some facts from the students' past experiences.

   While questioning, the teacher should bear in mind that the purpose is not to obtain correct answers; it is to find out what the students know and how they think. Another purpose is to get the students to ask their own questions. As the discussion progresses, the main points of the answers can be recorded on the board. Any questions that cannot be answered should be written on the board under the heading 'Questions we cannot answer'. The students can then read the text to check their responses and also find answers to their questions.

2. **Using pictures**

   Pictures make it possible for the students to learn indirectly from other people's experiences. Students should be encouraged to study the pictures on the opening pages of a unit. To provide help to develop the concept, several thought-provoking questions should be asked about the pictures.

3. **Reading and discussion**

   Reading is a necessary and desirable activity for learning science, but too often it is the only activity. This is probably because reading is the method most familiar to teachers, who feel more at ease when using it.

   Groups can be formed in different ways, but this will affect how an activity is planned. If each group has a strong scientist, this person can take the lead and support the other group members. Alternatively, differentiated assignments and scaffolding can help strong and weaker groups to get the most out of the activity. Both approaches can and should be used, but both require the teacher to assign the groups. If students choose their groups, the teacher will not know in advance what the groups will be like, so he/she will not be able to design the activity accordingly.

4. **Experiments and observations**

   Though science concepts are best developed through first-hand experiences, sometimes, it is impossible to provide experiments that are simple enough for secondary level students, or they require laboratory facilities far beyond the resources of the average school. It is equally impossible to organize actual observations of all living things in their natural habitats. However with careful preparation, it should be possible to provide students with some opportunities to carry out relevant and meaningful practical work.

   These can be the experiments given in the book and/or those provided by the teacher. The purpose is to explore phenomena that require explanation. There are various ways in which the teacher can use the experiments and observations, depending on the time and materials available, and the size of the class. Ideally each student should do his/her own work; but this is not possible in all schools. Satisfactory results may be obtained by having different groups perform the experiments and make observations. However, the teacher should make sure that each student has an opportunity to work within a group. If an activity takes several days to prepare or carry out, the group should be selected in advance by the teacher.

   Before any experiment or observation is performed, ask questions such as: *What is the purpose of this experiment? What are we trying to find out? Why?* This is effective as the teacher can discover from the answers whether the students understand what is going to be done.

   When the results have been observed and recorded, ask what was done in the experiment and what happened. Do the results answer the questions posed at the start of the experiment? How do they explain what happened?

5. Field trips

Another means to provide opportunities for first-hand observation is through field studies. To decide what to observe and what questions to ask, the teacher should first study the unit thoroughly, then find out what first-hand information is available to help solve problems raised in the unit. Make a list of the things that can be seen and the questions that can be asked. Then take the students on the trip and have them make their observations. When they return to class, ask questions that bring out the observation, and call for explanation of those observations.

How to use this Teaching guide

Please do not see this guide as the definitive or only way in which to present the material in the book. You, as a teacher, know your students best, so use this guide to help you plan lessons that they will find interesting and exciting.

Also remember that the text book contains only some of the information on a given topic. Do not be afraid to extend your students' learning experience by supplementing the work with other resources that you might have access to.

Each chapter of the guide corresponds to a chapter in the textbook.

Lesson Plans – For each unit there is a series of suggested lesson plans based on a 45 minute lesson. These can be used as a basis for planning your lessons based on the resources and time allocation in your school; the timings mentioned are purely as a suggestion. Do take the time to make the plans according to your requirements.

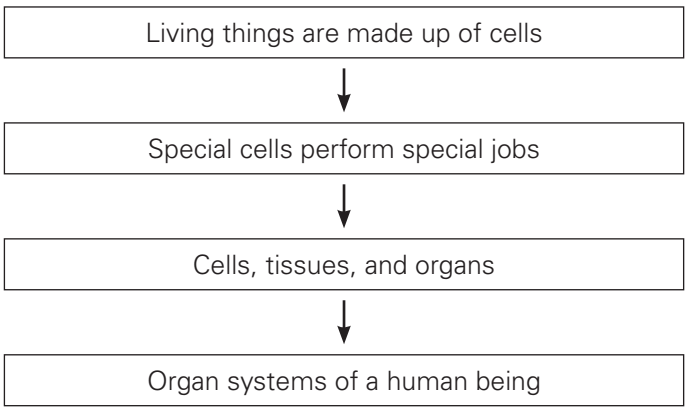
Worksheets – Photocopiable masters are referred to in the lesson plans; use these to supplement and extend the work presented in the textbook. Conduct experiments that can be carried out throughout the unit, there are also suggestions for investigations that can be conducted. The idea of the investigations is not to 'give' the students the experimental procedure but to encourage them to use their existing knowledge and understanding to draw up a plan and then carry out and evaluate their own experimental procedure.

Finally, a word about what we would like to achieve through this course. Our aim is to give students information about themselves and the world they live in, upon which they can base opinions, derive judgments, and determine courses of action in later life. We certainly do not see our suggestions as mandatory. We hope they will supplement and support the teacher's own professional practice. After all, no book can replace a good teacher!

Chapter

1 Cellular Life

UNIT FLOW CHART



INTRODUCTION

Living organisms perform different vital functions. They take in food and excrete waste materials. They respire and move. Similarly, in plants, leaves make food while roots absorb water. These all functions are carried out by different organs. These organs are made up of specialized cells.

This chapter is about cellular life. Students will be able to sort most things into 'living' and'non-living' quite easily, but it might be harder to work out what is at the basis of their decisions. This could be an interesting discussion to start off the chapter.

There is no substitute for the hands-on work students do in the lab. They enjoy doing experiments and it will increase their interest in science, which usually makes them easier to teach. We teach the scientific method and this makes a lot more sense if students actually carry out experiments. Some of you will teach in schools with limited resources where you have no choice but to find alternatives to experiments, but many of the experiments or activities in this book can be done in classrooms or outside with very simple equipment.

Lesson 1

Pages 9

OBJECTIVES

- to explain how organisms are constructed from cells, tissues, and organ systems
- to differentiate unicellular and multicellular organisms

LEARNING OUTCOMES

After this lesson, students should be able to:

- Recognise cells as the basic unit of life that are organized into tissues, organs, systems and organisms.

START (10 min)

- Display a picture of a cell or refer to the pictures on page 9 of the Student Book.
- Ask a student to write on the board: All living things are made of cells.
- Ask another student to write on the board: Cells are microscopic.

MAIN (30 min)

Read page 9

- Take the students to the laboratory and show them a microscope and hand lens. Show them slides of different kinds of cells.
- Explain about the term microscopic organisms and show slides of amoeba and paramecium.
- Help the students to practice and acquire skill in using a microscope.
- If microscopes are not available, use the internet as an alternate option. Search for 'animal cells under a microscope' and show the students the differences between animal and plant cells.
- Discuss about the term unicellular and multicellular. Make two columns on the board and ask students to write names of unicellular and multicellular rganisms.

PLENARY (5 min)

Ask students what is used to make a wall.

HOMEWORK

- Make a list of unicellular and multicellular organisms on colour paper.

Student Book.

- unicellular and multicellular organisms in note book.

Lesson 2

Pages 10

OBJECTIVE

- To differentiate between plant and animal cell.

LEARNING OUTCOMES

After this lesson, students should be able to:

- Identify the structures present in an animal cell and plant cell as seen under a simple microscope and relate them to their functions (only include cell membrane, cytoplasm, nucleus, cell wall, chloroplast, mitochondria and sap vacuole).
- Animal and plant cells and label key organelles in each. and contrast an animal cell and plant cell by preparing slides using onion peels and cheek cells.
- Describe the similarities and differences between the structures of plant and animal cells.

START (10 min)

Remind students that all living things are made of cells.

Remind students that we need a microscope to see cells.

MAIN (30 min)

Read page 10

- Take students to the Biology lab and show one or two prepared slides of plant and animal cells under the microscope.
- If microscopes are not available, use a chart paper as an alternate option. Show pictures of plant and animal cell and show the students the differences between animal and plant cells.
- Discuss the functions of each structure present in the cell one by one.
- Ask them to draw what they see in their note books.
- Complete worksheet 1-1.

PLENARY (5 min)

Discuss the different structures found in plant and animal cells and the functions of each structure. This

can be done in a plenary discussion or by asking students to answer questions on slips of paper/card.

HOMEWORK

- Write answers of questions test your self on page 11 in note books.

Student Book.

- Draw and colour a plant cell and an animal cell in note book.

Lesson 3

Pages 10

OBJECTIVE

- To explain how organisms are constructed from cells, tissues, and organ systems

LEARNING OUTCOMES

After this lesson, students should be able to:

- arrange and rank different levels of cellular organisations – cells to tissues, organs and organisms.
- relate the structures of some common cells (nerve, muscle, epithelilal and blood cells) to their functions.

START (10 min)

Revision

Play the link below.

https://www.youtube.com/watch?v=-zafJKbMPA8

Discuss the information that is given and relate it to what was learnt in the previous lesson.

MAIN (25 min)

STRUCTURE AND FUNCTION

- Read Student Book page 12 and 13.
- Have a number of objects ready, for example, a fork, a spoon, a knife, a cup, and a plate. Ask students which item they would choose if they wished to drink tea. What about cutting a piece of bread? Obviously, students will drink tea from a cup and slice bread with a knife. Ask them why they made their choices. There will be different answers, but they will have in common a relationship between the structure of the item and the function for which they need it. Students are unlikely to actually say this, so the teacher may have to provide some guidance.
- Then ask students to give other examples where shape relates to function, and extend it to include the structure of the material. For example, we do not wear Styrofoam (a great insulator) to keep warm because it is not flexible. (It could be used to insulate houses but it is dangerous in case of fire.)
- Now ask students to write and/or draw a part of a living organism where the structure supports the function. Examples could include the gills of a fish (large surface for getting oxygen from the water), the splayed feet of camels (large surface area so they do not sink into the sand too far), the long snout and tongue of an ant eater (which allows them to get ants from deep inside their nests), etc.
- Explain the term levels of organization.
- Discuss how different organs work together in an organ system.
- If desired, connections between the systems be considered. For example, the respiratory system gets oxygen into the organism but the circulatory system takes it to where it is needed, e.g. muscles.
- Complete worksheet 3-1.

PLENARY (10 min)

Check if students have understood the relationship between structure and function by referring to their writing/drawing. Ask students to explain where appropriate.

HOMEWORK

- Test yourself questions on page 12 in the note book.
- Answer exercise questions 5 and 6 in note book.

Student Book.

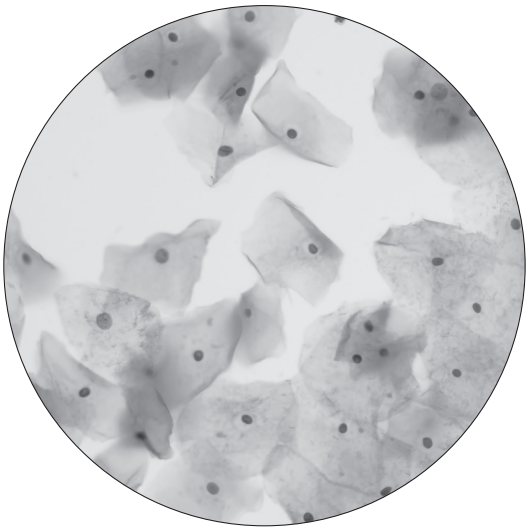
- Complete tasks from Workbook pages 9 and 10.

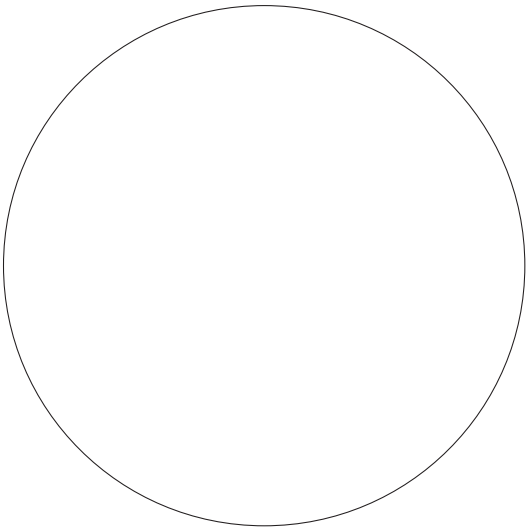
All living things are made up of cells. We need a microscope to see cells.

1. Looking at cells. Plant and animal cells carry out similar tasks but each type of cell also has unique functions. Therefore, some of the structures of plant and animal cells are the same, but others are different. Using your microscope, look at the slides of some animal cells.

a. Describe what you see.

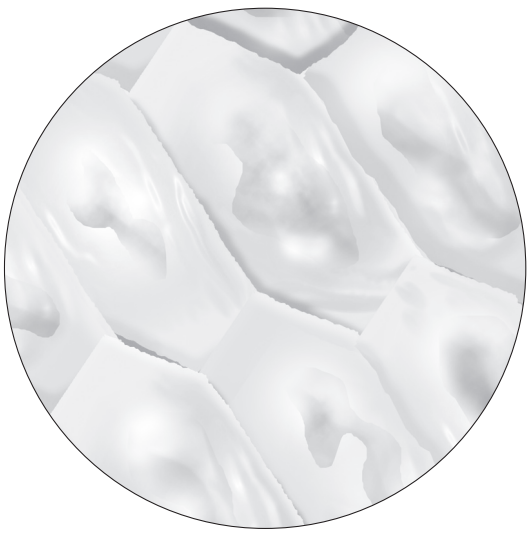
b. It is possible that your animal cells look something like the picture below. Draw what you see under your microscope.

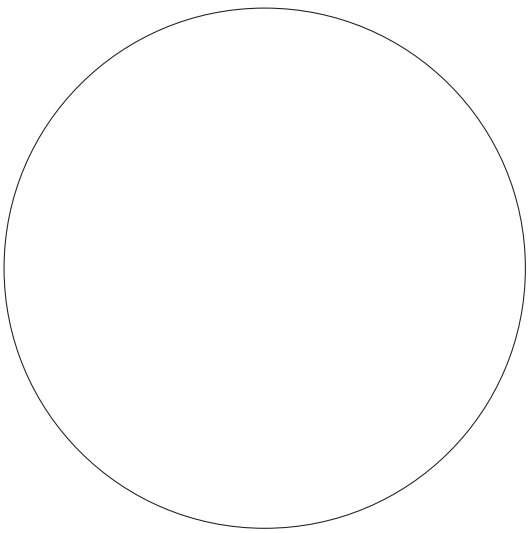




Name of the slide: _____

Now look at your plant cell. Does it look something like the micrograph below? Draw your plant cells.

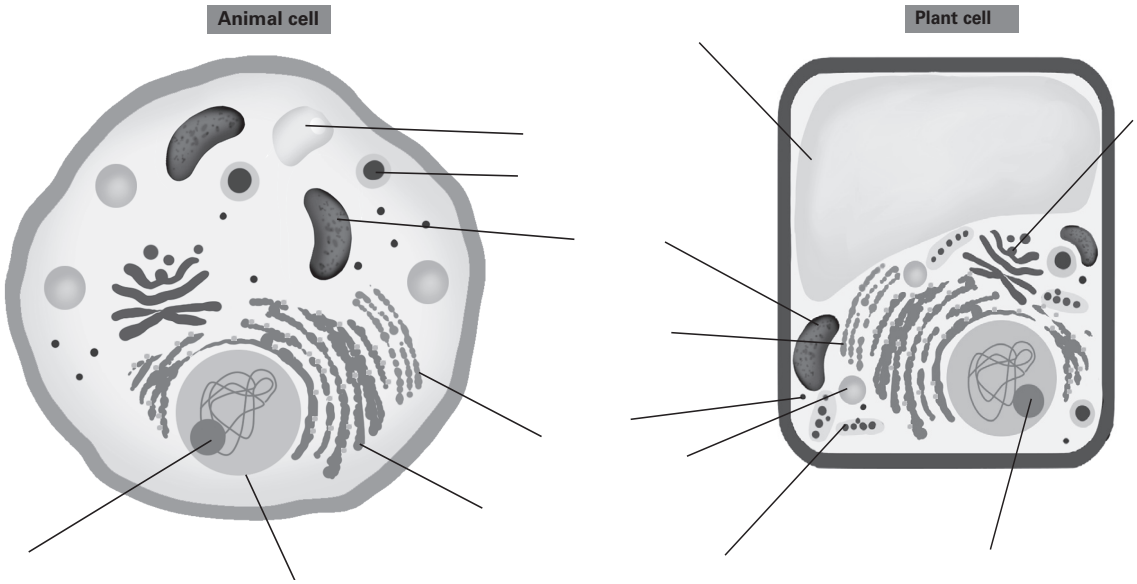




Name of the slide:_____

c. What colour are the little round structures you see in the plant cell? Use page 20 of your Student Book to label the structures you drew in your animal and plant cells.

2. Comparing plant and animal cells. Looking at page 10 of your Student Book, which structures do you see in the diagram of the animal cell and also in that of the plant cell?



_____

_____

_____

There are some structures which are found only in plant cells. Which are they?

_____

_____

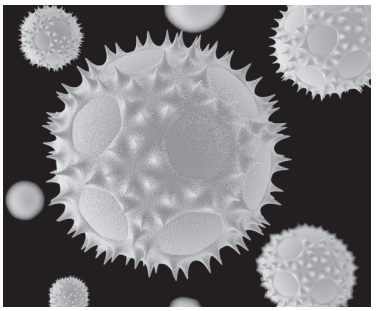
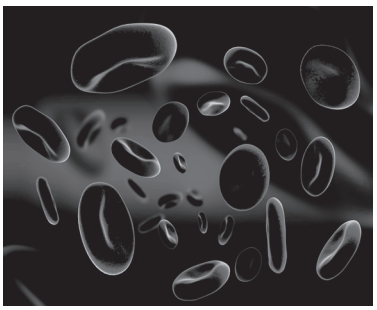
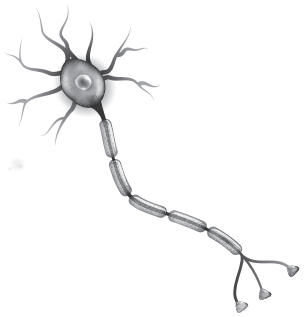
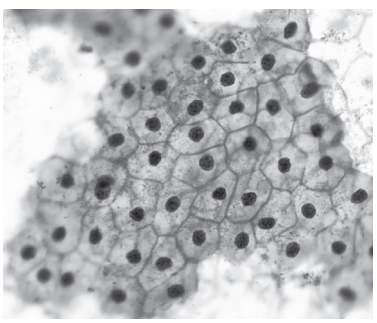
_____

Complete the table below. Use the information from page 10 of your Student Book.

	name of the structure	**what it looks like?**	**what it does?**
All cells		Dense, round structure	It is the control centre of the cell
		fluid substance	Everything floats in this.
		thin layer around the skin	It controls what enters and leaves the cell.
Plant cells		thicker layer around the cell	It helps the plant cell keep its shape.
		green sphere, most plant cells have many of them	This is where the plant uses light energy to make its food.
		Very large structure in the middle, filled with sap	Together with the cell wall, the vacuole helps the plant cell to keep its shape

All living things are made of cells but organisms are not just a lot of cells sticking together. Organisms have many different types of cells, doing different jobs, and they are highly organized.

Specialised cells If cells have a special function, they may need to have a special shape in order to do their work well. This relationship between structure and function is a key concept in biology that you will see often. Below are pictures of four types of cells: nerve cells, epithelial cells, pollen grains, and red blood cells. Fill in the empty sections of the table.

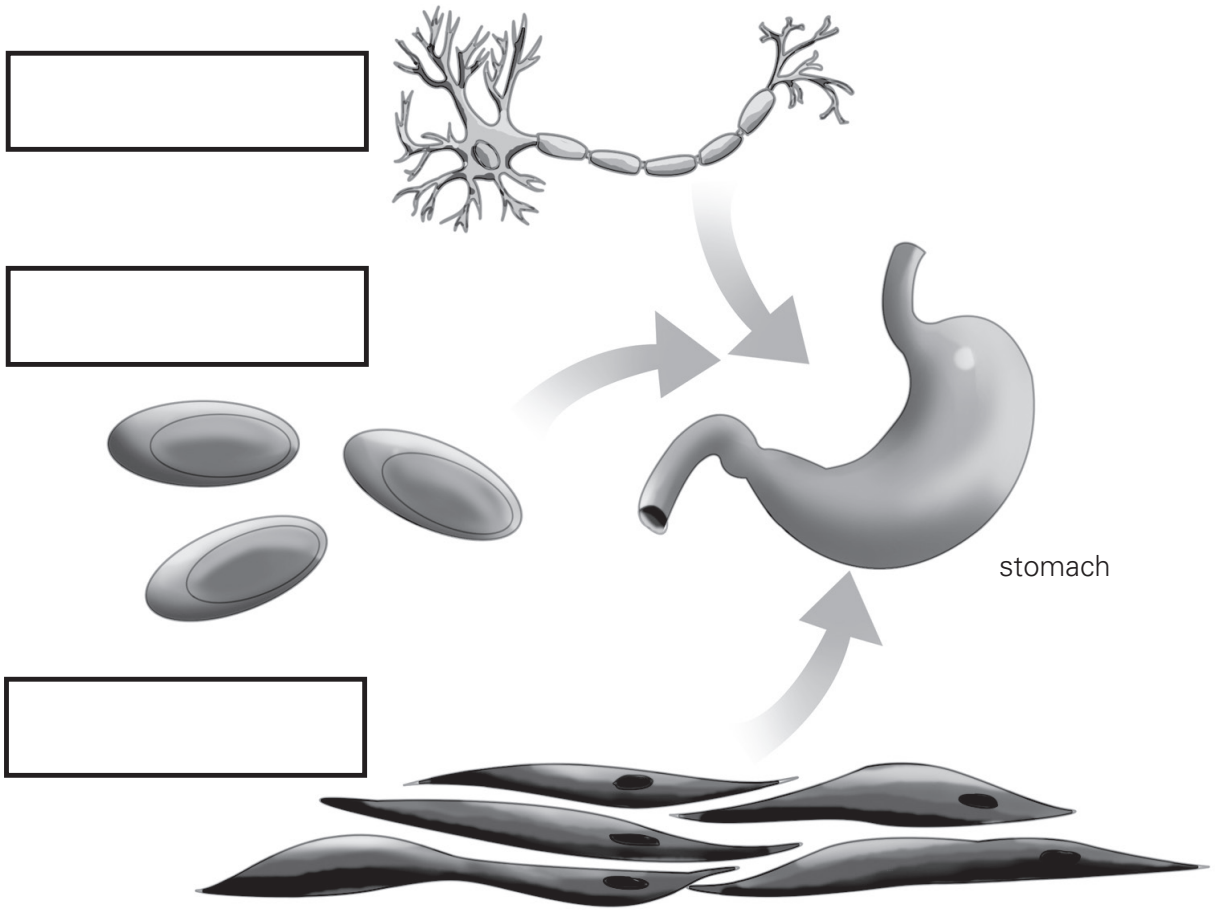
picture	name of cell	function	structural adaptations
		reproductive cells	
			round with a dent in the middle so that it has a large surface area which makes it faster to absorb or give off oxygen
			
		cover surfaces	packed close together without any spaces between the cells so that everything entering or leaving the body is controlled by having to go through the cells

Levels of organisation.

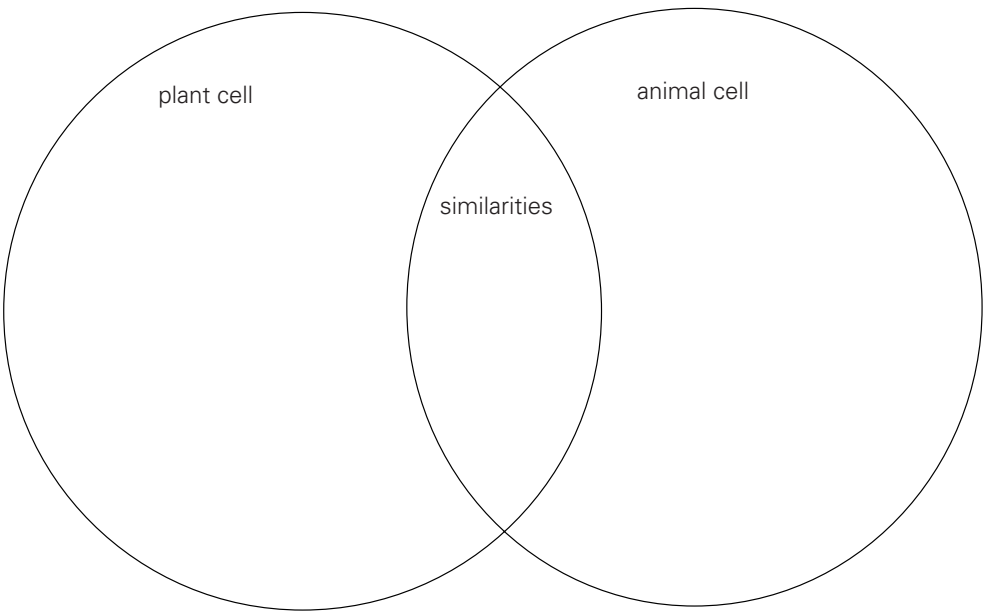
Fill in the empty sections in the table.

name of the structure	description	examples found in plants	examples found in animal
	basic unit of life	root cell	skin cell
Tissue		vascular tissue	
Organ		leaf	
Organ system		branch	
Organism		palm tree	

Different tissues combine together to make an organ. Lable the tissues which make up the stomach.



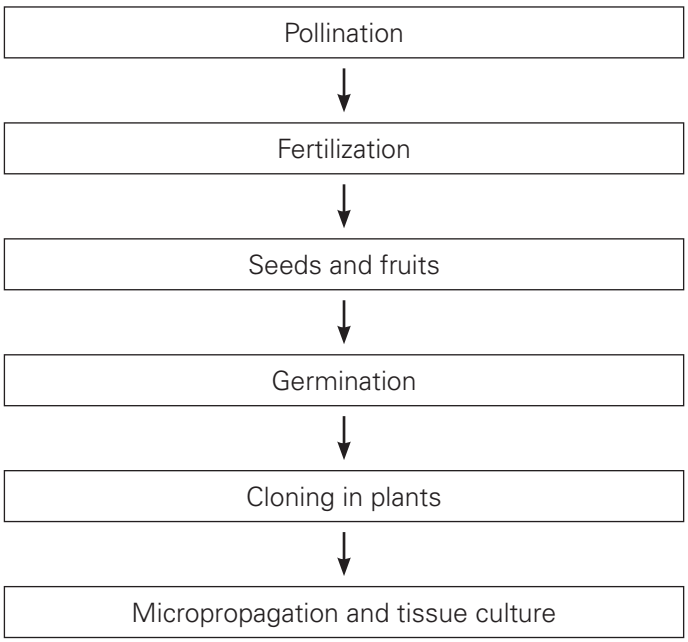
Write similarities and differences between plant and animal cell.



Chapter

2 Reproduction in Plants

UNIT FLOW CHART



INTRODUCTION

Plants are the organisms which capture the Sun's energy and use it to create large organic molecules. In other words, they make their own food; but they are also food for all herbivores, which, in turn, may be eaten by carnivores. So all organisms depend on photosynthesis, directly or indirectly. Like all other organisms, plants die. This may be after one season, a year, or several years, but the oldest tree we know is 5000 years old. It is called Methuselah and found in California.

Although we are aware of a few other trees which are over 2000 years old, they are the exceptions. And even these trees will die. Just like for any other organism, it is important that plants reproduce so new individuals can take the place of those that die. In this chapter, we will discuss pollination, fertilization, and seed dispersal. Please ensure that your students are clear on the difference between pollination and seed dispersal since these processes have some similarities which could confuse them.

A practical component of plant reproduction which is suitable for the lab or a classroom is the germination of seeds. Any teacher should be able to do this as it requires no equipment other than some seeds and wet tissue or cotton wool. If you place some seeds, e.g. beans, in different conditions (dry, wet, dark, light) at the start of this unit, then students can deduce what is needed for seeds to germinate.

Lesson 1

page 19-21

OBJECTIVE

- To extend knowledge about reproduction in plants.

LEARNING OUTCOMES

The students should be able to:

- describe the different types of reproduction of plants.
- compare and contrast types of reproduction (sexual and asexual) in plants.

START (15 minutes)

Give students some pictures of flowering plants and ask them to draw and label the plant. Make sure the pictures include the following parts: roots, stem, leaves, flower, fruit/seeds.

MAIN (20 minutes)

read page 19

- Discuss that there are two types of reproduction, sexual reproduction and asexual reproduction.
- that sexual reproduction involves the fusion of male and female sex cells.
- Discuss the importance of Sexual reproduction that enables genetic information from two parents to mix together. The offspring produced are genetically different from each other and from their parents.
- Asexual reproduction does not involve sex cells or fertilisation. Only one parent is involved in this type of reproduction, so there is no fusion of gametes and no mixing of genetic information.
- Draw two columns on the board and ask students to write advantages and disadvantages of sexual reproduction and asexual reproduction.
- Discuss and solve worksheet 2-1

PLENARY (10 minutes)

Divide the students into 5 groups. Give one complete flower to each group. Ask them to study its various parts. Open the flower, take out the ovary and ovules, and look at them under a magnifying glass and microscope.

HOMEWORK

- Answer test yourself questions page no. 20 in notebook.

Note book

- Answer exercise question 4 in note book.

Lesson 2

Page21

OBJECTIVE

- To explain the processes of fertilisation.

LEARNING OUTCOMES

The students should be able to:

- explain pollination and its types.
- compare and contrast types of pollination.

START (10 minutes)

Ask students to name the parts of a plant (revision). Then ask about the function of each part. Follow it by discussing the parts of the flower. Then consider the following: the only function the flower has is reproduction. It uses up a fair amount of the plant's resources and does not contribute anything to the plant's survival (but it is important for the species' survival).

Although it is a little sidetrack, you could spend a few minutes considering reproductive strategies among animal species. An example is a salmon which returns from the sea to the river where it was born to reproduce. But its body is no longer fit for living in fresh water and it dies after depositing or fertilizing the eggs.

Some plants grow rapidly from seeds, produce flowers and seeds, and die.

MAIN (25 minutes)

- The purpose of flowers is reproduction. What is needed for (sexual) reproduction is the fusion of male and female gametes. In the case of plants, this means the pollen needs to be carried to the stigma so that the male nucleus inside the pollen can fuse with the female nucleus inside the ovary.
- Go over insect pollination and wind pollination (pages 21 and 22 of the Student Book).
- Discuss pollination is followed by fertilisation. The nucleus of the male reproductive cell must join

up with the nucleus of the female reproductive cell before a new plant can be formed.

- Show the students a diagram of flowers' pollen transferred from anther to stigma of the same and different plants.
- Hand out Worksheet 2-2 to students.

PLENARY (10 minutes)

Discuss in class:

- What are the different agents of pollination?
- What are the characteristics of plants pollinated by insects, wind, and animals?

HOMEWORK

- Questions of test yourself page 22 in notebook.

Lesson 3

Page 22

OBJECTIVE

- To explain the processes of pollination.

LEARNING OUTCOMES

The students should be able to:

- describe the process of pollination.
- explain different types of pollination.

START (10 minutes)

Ask students to name some seeds that they eat. You could divide them into groups and ask each group to write their answers down. Share their answers and see if they include rice, wheat (flour), sweet corn, peanuts, beans, pine seeds, etc. What needs to happen for these seeds to be formed? (fertilisation)

MAIN (25 minutes)

Read page 22 with the students.

- It might be useful to clarify that only pollen of the same species is capable of fertilising the plant's egg cell. Insect-pollinated plants have flowers with a certain shape, colour, and scent. The idea is that an insect which found tasty nectar in a certain flower will look for more of the same; i.e. will continue to visit flowers of the same species. In this way, the pollen reaches other plants of the same species and fertilization occurs. If a bee takes pollen from a daisy to a buttercup, it will pollinate the buttercup but no fertilisation will occur.
- The transfer of pollen from anther to stigma is called pollination. After pollination, the pollen tube elongates, carrying with it the male nucleus which enters the ovum or egg cell and fuses with its nucleus. This is called fertilisation. The ovary develops into fruit and the ovule develops into seeds.
- Hand out Worksheet 2-3 to students.
- Ask them to distinguish from the pictures the difference between self pollination and cross-pollination. Which one is better and why?
- Discuss the characteristics of wind-pollinated, insect-pollinated and animal-pollinated plants.
- Work sheet 2-3

PLENARY (10 minutes)

Discuss the 'Test yourself' questions from page 19 of the Student Book. Ask the students to draw a flowchart of the fertilisation process.

HOMEWORK

- Questions of test yourself page 23 in notebook.

Lesson 4

OBJECTIVE

- To explain the structure of seeds and their functions.

LEARNING OUTCOMES

The students should be able to:

- describe the structure of a seed.
- explain the process of germination.

START (10 minutes)

Ask the students if they have ever seen a bean seed soaked in water? (Show them the bean soaked in water for a day).

MAIN (20 minutes)

- Show the students the chart of germination.
- Explain the term germination and discuss if seed is given the right conditions, it will start to germinate. Seeds need water, oxygen, and a suitable temperature before they will begin to

grow. A new plant begins to grow when suitable conditions are available.

- Discuss the steps of germination in detail.
- Show a video of germination of bean seed and ask questions about different stages.
- Investigations given on page 31 of Student Book can be conducted.
- Ask students to answer Question 6 from page 30 of the Student Book.

PLENARY (15 minutes)

Discuss the Test yourself questions from page 21 of the Student Book by showing students seeds and their germination.

HOMEWORK

- Draw and colour the structure of seeds and their functions.

Lesson 5

OBJECTIVES

- To extend knowledge about different parts of a plant and their functions.
- To explain the processes of pollination and fertilisation.
- To explain the structure of seeds and their functions.

LEARNING OUTCOMES

The students should be able to:

- explain how cloning in plants takes place.
- inquire how artificial propagation can lead to better quality yield in agriculture.

START (10 minutes)

Before starting the lesson discuss following questions:

- What are the reproductive parts of the flower? What is this type of reproduction called?
- Some plants are reproduced by growing some of the parts in soil. What is this type of reproduction called?

MAIN (25 minutes)

- Explain about artificial asexual reproduction like, cloning,cuttings, budding, layering.
- **Discuss** Many plants are produced by growing some parts of the plant, e.g., from a stem-cutting or leaf-cutting. When strawberry plants grow, their stems touch the ground and grow into new plants. These new plants are called clones. Sometimes new plants are formed from very small pieces of a plant. This is called micro-propagation. In tissue culture new plants are grown from only a few cells instead of a bud.
- Explain the term micro-propagation. Micro-propagation means growing new plants from microscopic pieces of a plant .
- Some plants can be grown from a tiny piece of plant containing only one bud. Give example of potato.

Hand out:

worksheet 2-5 to students

PLENARY (10 minutes)

Invite two students to speak, one on the advantages of cloning and the other on the disadvantages of cloning. Read about micro-propagation and tissue culture on page 28 of the Student Book and discuss the 'Test yourself' questions.

HOMEWORK

- Ask students to grow different plants by asexual methods in different pots, for example, cut onion, garlic, and potato, and grow them in soil. Take care of them daily and watch them growing.

Note book

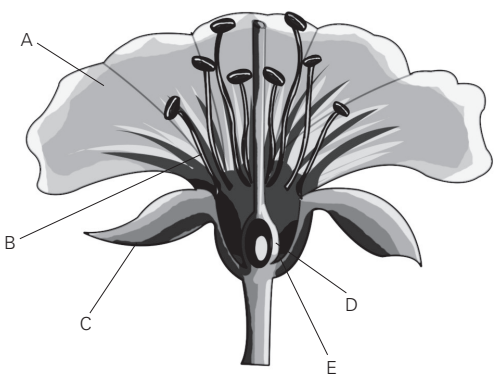
- Test Yourself questions page 26 in note book

1. Your teacher gave you a picture of a plant. Use the space below to draw this plant and label the parts.

Either your teacher will give you some flowers or you can use the pictures of different flowers e.g., lily, buttercup, fuchsia, tulip etc. Carefully study your flowers or their pictures. If you study real flowers, make a quick sketch of each.

2. Label the following structures in the given flower:

petal , stamen , carpel ,sepal, nectary



What difference can you see between the flowers? Note the shape of each of the structures and their position relative to the rest of the flower.

3. Answer the following questions:

   i. Why are the petals colourful and why does the flower smell nice?

ii. What is the male reproductive organ of the flower called?

_____

iii. What is the female reproductive organ of a flower called?

_____

4. Complete the following table:

Sexual reproduction	**Asexual reproduction**
Advantages	Advantages

Sexual reproduction	**Asexual reproduction**
Disadvantages	Disadvantages

1. Two different male and female flowers that are colourful and scented are present on the same plant.

i. What method of pollination will take place in this plant?

_____

ii. Is this an example of wind-pollinated or insect-pollinated flowers? Give two reasons.

_____

2. State whether the following adaptations are for insect-, wind-, or animal-pollinated flowers.

   i Pollen grains inside anther are small and light

   ii Petals are colourful

   iii Short stamens and protected stigma

   iv Pollen grains have wings

   v Seeds are hard

   vi Petals have scent and nectar

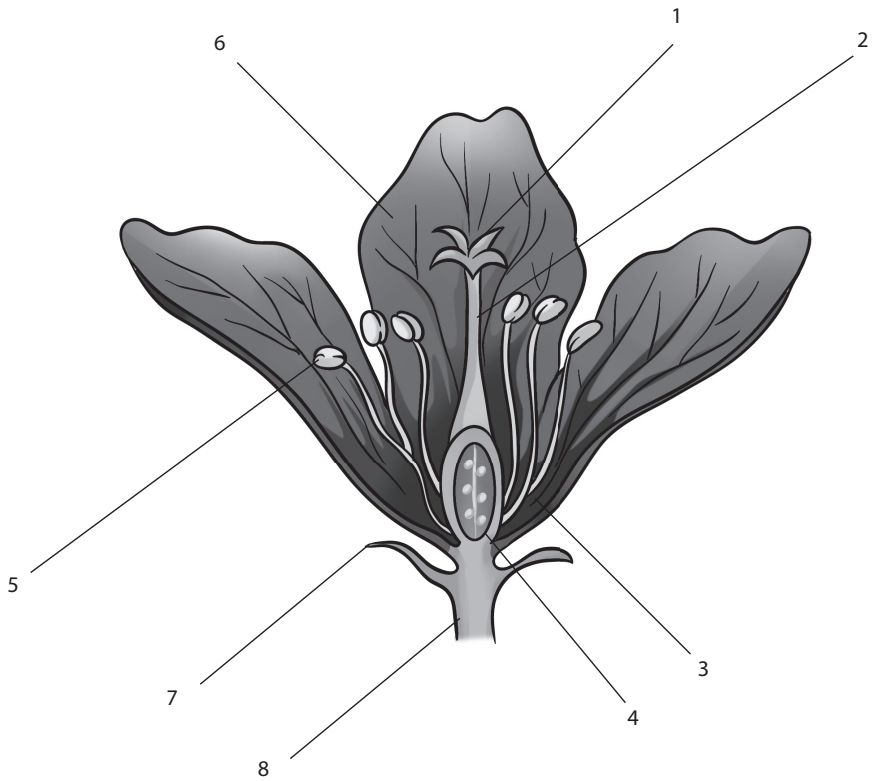
   vii Seeds have hooks

   vii Long filament with anther hangs out of flower

   viii Pollen grains are numerous

   ix Pollen grains are sticky

1. Label the parts of the flower numbered on the diagram below.



i. Explain the functions of sepals and petals in flowers.

_____

ii. a) What is the male part of a flower called?

_____

b) What is it made up of?

_____

iii. a) What is the female part of a flower called?

_____

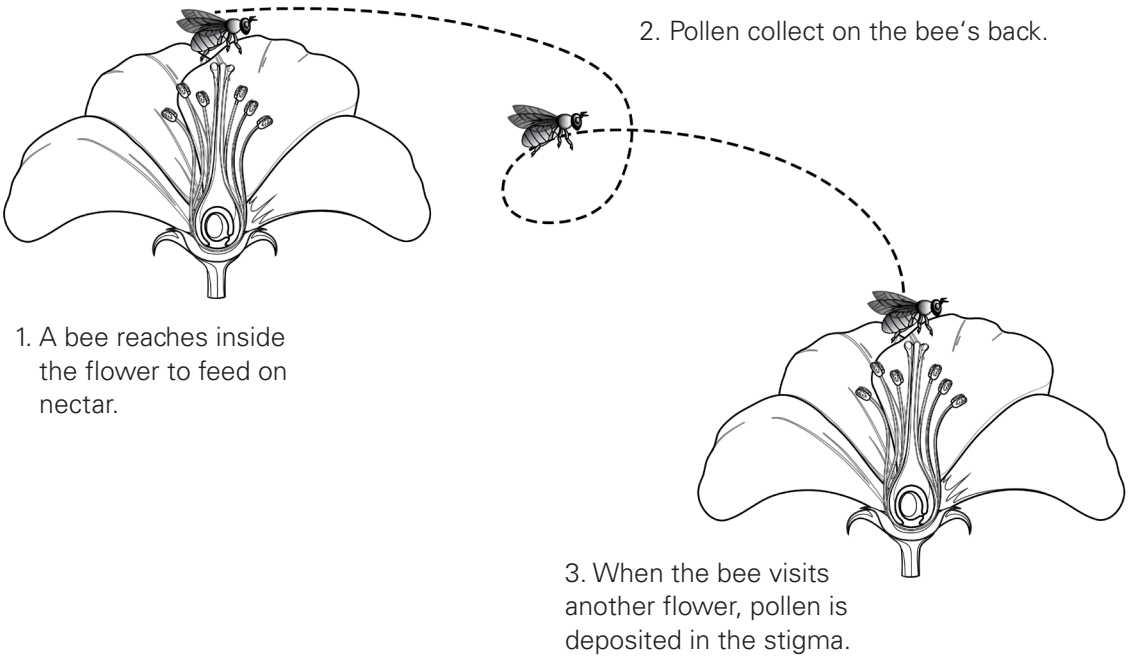
b) What does it consist of?

_____

iv. Define pollination.

_____

2. Flowers are reproductive parts of a plant. In the diagram given below colour the female reproductive parts pink and male reproductive parts blue.



3. Complete the table given below:

Name of reproductive parts	**Function**
Sepals	
Petals	
Anther	
Stamens	
Stigma	
Carpel	
Ovary	
Nectary	

Take some peanuts and answer the following questions:

You can see a peanut can be divided into two parts. Are they the same? Explain your answer.

_____

Compare your peanut with the diagram on page 23 of your Student Book. Can you now further explain your answer above?

_____

Compare your peanut with a kernel of sweet corn. List the similarities and the differences.

_____

1. Use your Student Book to find the following definitions. They can be found in the chapter and/or in the glossary at the back of the book.

   seed dispersal

   _____

   germination

   _____

   Pollination happens when pollen grains are carried from an anther to a stigma.

Which two different types of pollination do you know? Briefly describe each of them.

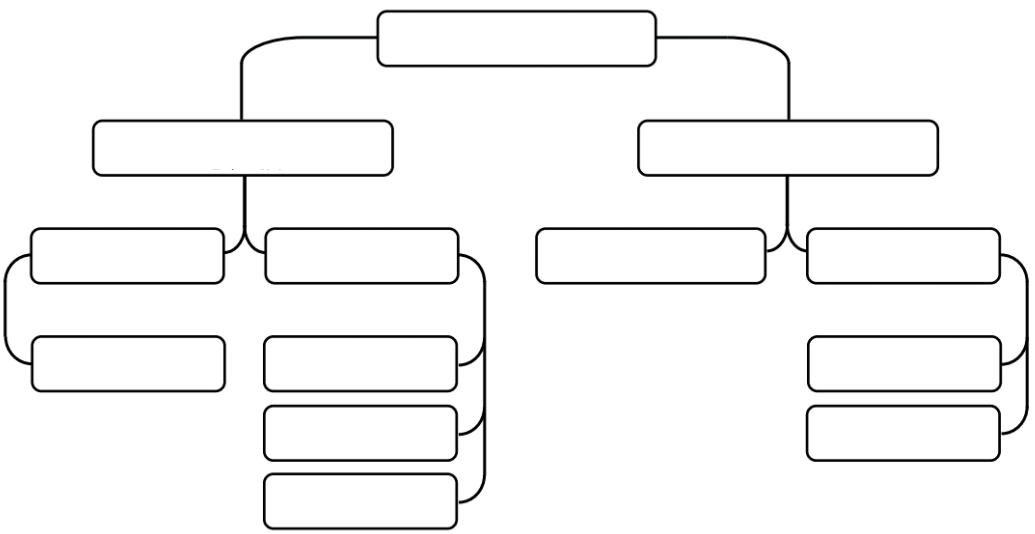
_____

What are the differences between the pollen used in each of the above methods?

_____

2. Summarise all different types of plant reproduction in the table below. Use the words from the word bank below.

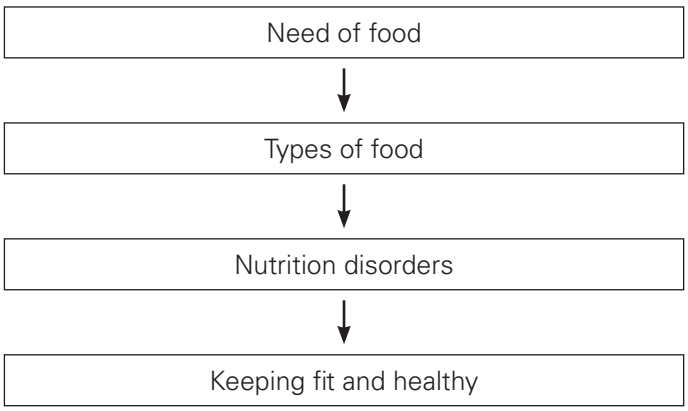
Asexual reproduction (cloning)	insect-pollination	self-pollination
	Micro-propagation	Sexual reproduction
cross-pollination	Natural	Tissue culture
cuttings	Plant reproduction	Wind pollination
Done by human	Runner, tubers, bulbs	



Chapter

3 Balanced Diet

UNIT FLOW CHART



INTRODUCTION

The food we eat contain different types of nutrients. The body needs these in the right quantities in order to stay fit. Deficiency as well as excess of nutrients can lead to problems. It is therefore important to eat a balanced diet.

Achieving the correct balance is not always easy. Many of us just leave it to chance and eat what we like. However, we often eat far too much fat, sugar, and salt. In addition, we often do not eat enough fibre. Fats and sugars are energy foods. If we do not use up the available energy, the body stores the excess food as fat and one becomes overweight.

Most people get more than enough proteins, vitamins, and minerals in their normal diet. The body cannot store proteins, so eating more will not make you stronger or healthier than you already are. Strength and fitness will only come by carefully balancing healthy eating with exercise.

Fibre or roughage is made up of the cell walls of plants which pass through the digestive system without being digested or absorbed. It adds bulk to the food, giving the muscles in the walls of the digestive system something to push on. Food containing a lot of fibre helps prevent constipation and other disorders of the digestive tract. We should eat around 30g of fibre each day.

Food additives should be listed and their function clearly explained on food packaging.

Lesson 1

OBJECTIVE

- To extend knowledge about food and nutrition.

LEARNING OUTCOMES

The students should be able to:

- identify the constituents of a balanced diet for humans as one which includes protein, carbohydrates, fats and oils, water, minerals (limited to calcium and iron) and vitamins (limited to a, c and d), and describe the functions of these nutrients.
- name the components of a balanced diet.
- describe the roles of the main nutrients in the body.

START (15 min)

- Give students four post-it notes or coloured paper sheets of two different colours (e.g 2 yellow and 2 green). Ask them to write one favourite food on each of the yellow pages and one of the foods they don't like much on each of the green notes. Display the notes on a sheet of poster paper.
- Ask students to sort these foods into 'healthy' on one side and 'unhealthy' on the other. Label the sides. Put the poster on the wall for future reference.

MAIN (15 min)

Read page 32 and 33 of the student book.

- Give information on the food tests. Information on food rich in any one (or more) of the listed nutrients can be found on the internet and/or by studying food labels.
- Write name of nutrient on the board and ask students to discuss about the importance of that nutrient.

PLENARY (15 min)

Give a colour paper to every student and ask to draw a menu they like to eat. Display drawings on the class soft board.

Using the information from this lesson, go back to the poster and consider whether any of the foods should be moved.

Worksheet 1-3.

HOMEWORK

- Answer Test yourself questions on page 34 of the student book.

Lesson 2

OBJECTIVE

- To extend knowledge about food and nutrition.

LEARNING OUTCOMES

The students should be able to:

- identify essential nutrients, their chemical composition, and their food sources.
- give examples of foods in which these components are found.

START (10 min)

- Remind students of what they learned in the last lesson about the elements of a balanced diet and the different food groups. Ask them to write down what they had for breakfast and discuss how far this is a balanced meal. Not all meals need to be completely balanced, but over a day all components of a balanced diet should be met in reasonable proportions.

MAIN (20 min)

Read page 34 of the student book.

- Ask students to create a menu for three days, including all meals and snacks. They can start by putting in all the food they like, but then they should ensure that the food eaten in a day is balanced. It is possible that their initial menu is lacking, for example, fruit and/or vegetables. These can be added, but it should be considered that pizza with a side dish of vegetables may not be realistic.

PLENARY(15 min)

Write names of nutrient on the board and ask

Ask students to share their solutions. For example, a student may need to add fruit to create balance but s/he does not like fruit. A smoothie, possibly with low fat yoghurt, may solve this issue. Students can finish the menu at home using these ideas from classmates.

Work sheet 2-3

HOMEWORK

- Complete the menu. Bring in 2-5 empty food containers or wrappers which contain a food label. These will be used in next lesson.

Lesson 3

OBJECTIVE

- To extend knowledge about food and nutrition.

LEARNING OUTCOMES

The students should be able to:

- Recognise that a healthy diet contains a balance of foodstuffs.
- Identify and describe deficiency disorders caused by lack of essential nutrients.

START (15 min)

- Go over the menus which students developed. Let students discuss their menus in groups of four where the focus is on the reasons for choosing specific dishes ('I needed something with protein like fish.').

MAIN (15 min)

Read page 35, 36 of the student book.

- Ask each group to develop their three-day menu and from there create a menu for the entire class. It could be published in a school newspaper, posted on a notice board, and/or given to the cafeteria to see if they can provide some of these dishes. Bring in some food for students to test for glucose, starch, protein, and fat.
- If a demonstration is not possible, search the internet for a video. Try searching using terms such as 'food test starch glucose fat protein', and choosing the option 'video'. Always preview the videos to ensure they are suitable and provide the information you want (enough but not too much).
- Ask students to consider if everyone needs the same amount and the same type of food. If they compared the balanced diet of an elderly person with limited physical activity with that of a young student who plays basketball, what would the differences be? (The elderly person would need less food; the student would need a lot of energy from carbohydrates and protein for building muscles).

PLENARY (15 min)

A person recovering from a serious illness might need more vitamins and minerals. So we all need the same nutrients but not in the same amounts. It will depend on our age and activity level as well as our health.

Now go back to the poster with 'healthy' and 'unhealthy' foods. Suppose you made this poster for the elderly person, would it look the same as the poster for the student or the recovering patient? So are there really 'healthy' and 'unhealthy' foods? Most people consider oranges healthy, but would a diet of only oranges be healthy?

Test yourself page 36 of the student book.

Overall conclusion

We need to eat a range of foods for a balanced diet, which is different for different people. Variation and moderation are key concepts in every diet.

Home work

- Exercise question 5 page 40 of the student book.

Lesson 3

OBJECTIVE

- To know about the disorders caused by the deficiency of nutrients.

LEARNING OUTCOMES

The students should be able to:

- identify and describe deficiency disorders caused by lack of essential nutrition.
- correlate diet and fitness.

START (15 min)

- write on the board and ask students to discuss;

"An apple a day keeps the doctor away"

"Early to bed and early to rise makes a man healthy, wealthy, and wise."

MAIN (15 min)

Read page 37 of the student book.

- Check the height and weight of the students and discuss what should be the actual height and weight of their age.

- Show a poster about the healthy and unhealthy people. Ask from the students about the health issues they see in the poster.
- Discuss that most people get more than enough proteins in their normal diet. The body cannot digest more proteins so eating more will not make you stronger or healthier than you already are.
- Explain that deficiency as well as excess of any nutrient can lead to fitness problem. It is therefore important to take a balanced diet.
- Ask a student to deliver a speech about health is wealth and collect views from the students.
- Discuss some ways to keep the body fit and healthy and make a list on the board.
- Ask about bad habits which make us unhealthy, for e.g. smoking.

PLENARY (15 min)

Exercise question 3 page 39 of the student book.

Ask students about the importance of exercise for fitness. Discuss that strength and fitness will only come by carefully balancing healthy eating with exercise.

Test yourself page 37 of the student book.

HOMEWORK

- Exercise question 6 page 40 of the student book.

1. A balanced diet you know that eating only one or two kinds of food is not healthy and that you need a balanced diet. When you talk about 'a diet', most likely you mean a selection of foods or a programme, often aimed at losing weight or related to a food intolerance (e.g., a gluten free diet). In science, 'diet' simply means everything you actually eat—good or bad.

   So, to eat a balanced diet means to obtain all the necessary nutrients from a range of different foods in the right balance; i.e., a diet with all the food types. But what does a balanced diet contain?

Find the components of a balanced diet and complete the questions below.

i. What are the elements of a balanced diet?

_____

ii. Which one of the above is not easily digested?

_____

iii. What do we also need quite a lot of, although it has no nutritional value?

_____

iv. Why do we need it?

_____

2. The table below has all the information about a balanced diet but it is not complete. You may have to use the internet to check which foods are particularly rich in a certain nutrient.

Nutrients	Mainly used for	Sources	Test
glucose	for energy		
		rice, wheat (bread, pasta), corn, potatoes, beans	
	for energy for insulation		ethanol test
	for building muscles for enzymes	beans, meat, cheese	
minerals			
calcium			
iron			
vitamins			
vitamin C	for growth and repair		
vitamin D	to absorb calcium		
roughage/fibre		whole wheat products, bran, lentils, broccoli	
water	(important but has no nutritional value)		

1. Using the information from previous lessons, create a menu for three days where every day has all the food types more than once. Please make sure your menu is both healthy and tasty and all meals are different. Since we all like different foods, your menu should not be the same as those of the others in your class.

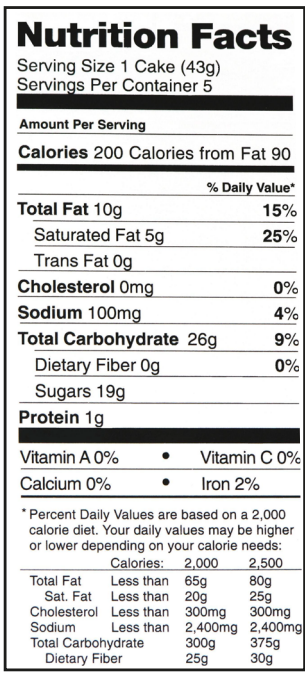
   Please make notes of the reasons you chose your foods, so you can explain it in class.

Day 1				
Breakfast	Snack	Lunch	Snack	Dinner
Day 2				
Breakfast	Snack	Lunch	Snack	Dinner
Day 3				
Breakfast	Snack	Lunch	Snack	Dinner

1. Food labels explain how to test foods for the different food types. This will help you determine if, for example, orange juice contains proteins or bread contains glucose, but you need a lab and the right chemicals.

   Most of us buy our foods in the supermarket and some of it is likely to be processed. We may bake our own biscuits but buy breakfast cereal. In many countries, packaged foods must show what the food contains. This information is often shown on food labels and/or on the list of ingredients, but does not always look the same since the food may come from different countries.

Many countries have food labels which look like the one below



Nutrition Facts

Serving Size 1 Cake (43g)
Servings Per Container 5

Amount Per Serving

Calories 200 Calories from Fat 90

	% Daily Value*
Total Fat 10g	**15**%
Saturated Fat 5g	**25**%
Trans Fat 0g	
Cholesterol 0mg	**0**%
Sodium 100mg	**4**%
Total Carbohydrate 26g	**9**%
Dietary Fiber 0g	**0**%
Sugars 19g	
Protein 1g	

Vitamin A 0% • Vitamin C 0%
Calcium 0% • Iron 2%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Use the information on the food label to answer the following questions.

a. If you were to eat the entire container of this product, how many servings would you have had?

_____

b. How much sugar does one serving contain?

_____

c. Suppose, one day, you only ate this product (and nothing else). How many containers would you have to eat to get enough carbohydrates?

_____

d. What percentage of the daily required amount of sodium (a mineral) would you have had?

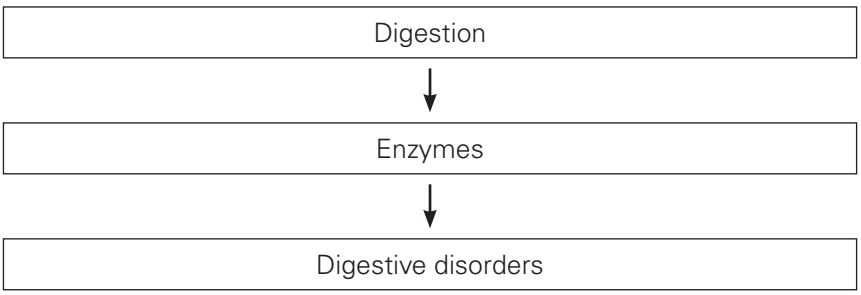
_____

e. Would you consider eating only this food to be a balanced diet? Explain your answer.

_____

Chapter 4 Human Digestive system

UNIT FLOW CHART



INTRODUCTION

The human Physical digestion is one of the complex and major organ systems in the human body. It is where complex food is broken down, or digested, into very small and simpler molecules which can be easily absorbed and passed into the bloodstream.

Physical digestion and chemical digestion are the two main steps of the Physical digestion. Food is passed through the alimentary canal for digestion where enzymes work at particular food type in favourable conditions. There are different disorders of the digestive system. Some are common disorders while others are serious disorders.

Lesson 1

Page 43 and 46

OBJECTIVE

- To understand about the digestion in the human body.

LEARNING OUTCOMES

The students should be able to:

- state the importance of digestion in the human body and describe physical and chemical digestion.
- sequence the main regions of the Alimentary Canal, its associated organs and describe the functions of different parts of the Alimentary Canal.

START (15 min)

- Ask students to consider the entire process of digestion. Each student should think about their favourite food—in silence.
- Ask students to think of the name of the food. Ask them to visualize what it looks like, what it smells like, how often they eat it, and what the best thing about this food is.
- Encourage them to really think about this food—maybe with closed eyes. Watch them closely and hopefully you will see some of them swallowing—thinking of this food made their mouths water.
- Now engage in a group discussion.

  Qa. What does it mean when thinking of certain food makes your mouth water?

  Qb. What does saliva do?

- You can give them a piece of white bread to chew for a few minutes. Ask them what it tastes like after they have chewed it for a while. Someone will say it tastes sweet. Ask if it tasted sweet when they started chewing. If they say no, you can then draw their attention to the fact that something changed to make the bread taste sweet.

MAIN (25 min)

Read page 43 and 46 of the student book.

- Before the lesson show the video available at: https://www.stem.org.uk/resources/elibrary/resource/35396/digestive-system-experiment
- In class do the demonstration which you saw on the video. For once this is not recommended as a student activity as it may become a discipline problem.
- Do not provide all the comments they do on the video; for example, do not say, that the plastic bag represents the stomach. Instead, explain that you will carry out a process which models the entire process of digestion. Ask them to write down the steps.
- Ask students to read page 43 and 46 of the student book and use the information to discuss which part of the demonstration mimics which part of the digestive system.
- Pay special attention to the reasons that the objects/processes were chosen to mimic certain parts of the digestive system.

PLENARY (15 min)

Discuss where the model shown in the video of digestion is a good representation of digestion and where it is lacking. For example, the wall of the stomach absorbs some small molecules but the plastic bag does not. Ask students if it matters that the model is not perfect. (Not really, it can even be helpful to consider the aspects in which the model does NOT resemble the original.) Make sure this point is understood.

Work sheet 1-4.

Test yourself questions on page 43 of Student Book.

HOMEWORK

- Draw and colour a labeled diagram of the human digestive system.
- Test yourself questions on page 45 of the student Book.

Lesson 2

Pages 47

OBJECTIVE

- To understand the role of enzyme in digestive system.

LEARNING OUTCOMES

The students should be able to:

- briefly describe the role of enzymes in digestion.
- describe the human digestive system.

- describe how large molecules are broken down during digestion.

START (15 min)

Review the parts of the digestive system and go over homework questions.

MAIN (15 min)

Read page 47 of the student book.

- Ask student to play role of different organs of the elementary canal and explain the job of that organ.
- Discuss about the role of different enzymes on different food components.
- Explain the concept of complex molecules and simple molecules.

PLENARY (15 min)

Our digestive system (and that of most animals, even insects) has different sections. Can you think of how this would be helpful? (It allows different enzymes to work in different conditions, which helps to complete digestion).

Work sheet 2-4

HOMEWORK

- Exercise question 3 page 51 of the student book.

Lesson 3

OBJECTIVE

- To extend knowledge about enzymes and digestion.

LEARNING OUTCOME

The students should be able to:

- explain how temperature and pH can affect the way enzymes work.

START (15 min)

Conduct following demonstration:

You will need to have ready:

- an apple (or ¾ of an apple)
- a cup of boiling water
- lemon juice
- a fork

Take a fresh, intact apple and cut it into four quarters. Immediately carry out the next steps. Three of these quarters will receive different treatments.

1. Put one quarter on a saucer on the desk.
2. Put one quarter on the fork and dip it in boiling water for 30 seconds. Put it on its own saucer on the desk.
3. Put one quarter on a saucer and pour lemon juice over it. Pour off the juice and put the saucer on the desk

Leave the pieces of apple for 20–30 minutes.

MAIN (15 min)

- You can bring in a raw egg and a boiled egg if you wish, so they can see the real objects.
- It would be great if you could bring some raw fish and some fish marinated in lemon juice overnight. We often associate raw fish with a somewhat translucent appearance and cooked fish with a white colour. Raw fish, especially when sliced thinly and marinated in lemon juice, also goes white because the proteins have been denatured like they are during cooking.
- Explain that the enzymes in apple will turn the apple brown as soon as they come into contact with oxygen. The enzymes can be denatured by exposing them to a high temperature or to acid. When the enzymes no longer work, the apple does not turn brown.

PLENARY (15 min)

Dishes should be washed in very hot water to denature the proteins of the bacteria on the plates and forks, which kills the bacteria. Some household cleaning products contain lemon juice. This smells nice but also helps kill bacteria. Milk is often pasteurised. This means it is brought to 70°C to kill most of the bacteria. Boiling milk would be even safer, but this changes the taste in a way that many people do not like.

Work sheet 3-4

HOMEWORK

- Test yourself page 47 of the student book.

Lesson 4

OBJECTIVE

- To know the digested food is absorbed into the body.

LEARNING OUTCOMES

The students should be able to:

- conclude that blood transports the products of digestion to other parts of the body and the undigested products get egested /defecated.
- explain how digested food is absorbed into the body.

START (15 min)

- Show a poster of alimentary canal and ask about the function of each organ.
- Discuss why we need to eat. (Food is needed for energy, growth, and repair.)

MAIN (15 min)

- Ask for which parts of the body food is needed. (For energy: muscles, e.g., legs, arms, etc.
  A. For growth: anywhere, but obvious areas would be bones and muscles.
  B. For repair: anywhere).
- Now connect the two points made above. When we eat food, it enters our bodies (mouth) and passes through the digestive tract.
- Explain that how do these nutrients get from our gut to where they are needed.

PLENARY (15 min)

Ask students what they remember most about this section and the reasons for this. This can help you shape your next lessons so it will be easier for students to learn.

HOMEWORK

- Exercise question 4 page 51 of the student book.

Lesson 5

Pages 48

OBJECTIVE

- To know about some major digestive disorders.

LEARNING OUTCOME

The students should be able to:

- briefly describe some major digestive disorders.

START (15 min)

- Show a poster of alimentary canal and begin the lesson by reviewing the major organs of the digestive system and function of each organ.
- Ask students to name some of the problems of the digestive system.

MAIN (20 min)

Read page 48 of the student book.

- Discuss about the common digestive disorders such as diarrhoea, constipation, and indigestion. Explain that the common digestive disorders are usually the result of changes in diet, lifestyle, or stress. They usually last for only a short time and can be treated quite easily.
- Explain that healthy food and plenty of water can save us from the common disorders.
- Explain that the serious digestive problems such as appendicitis and bowel cancer are more serious and require more medical treatment.
- Write names of digestive disorders such as Diarrhoea, Indigestion, Constipation, Crohn's disease and Appendicitis on the board and discuss in detail about the mentioned disorders in detail.

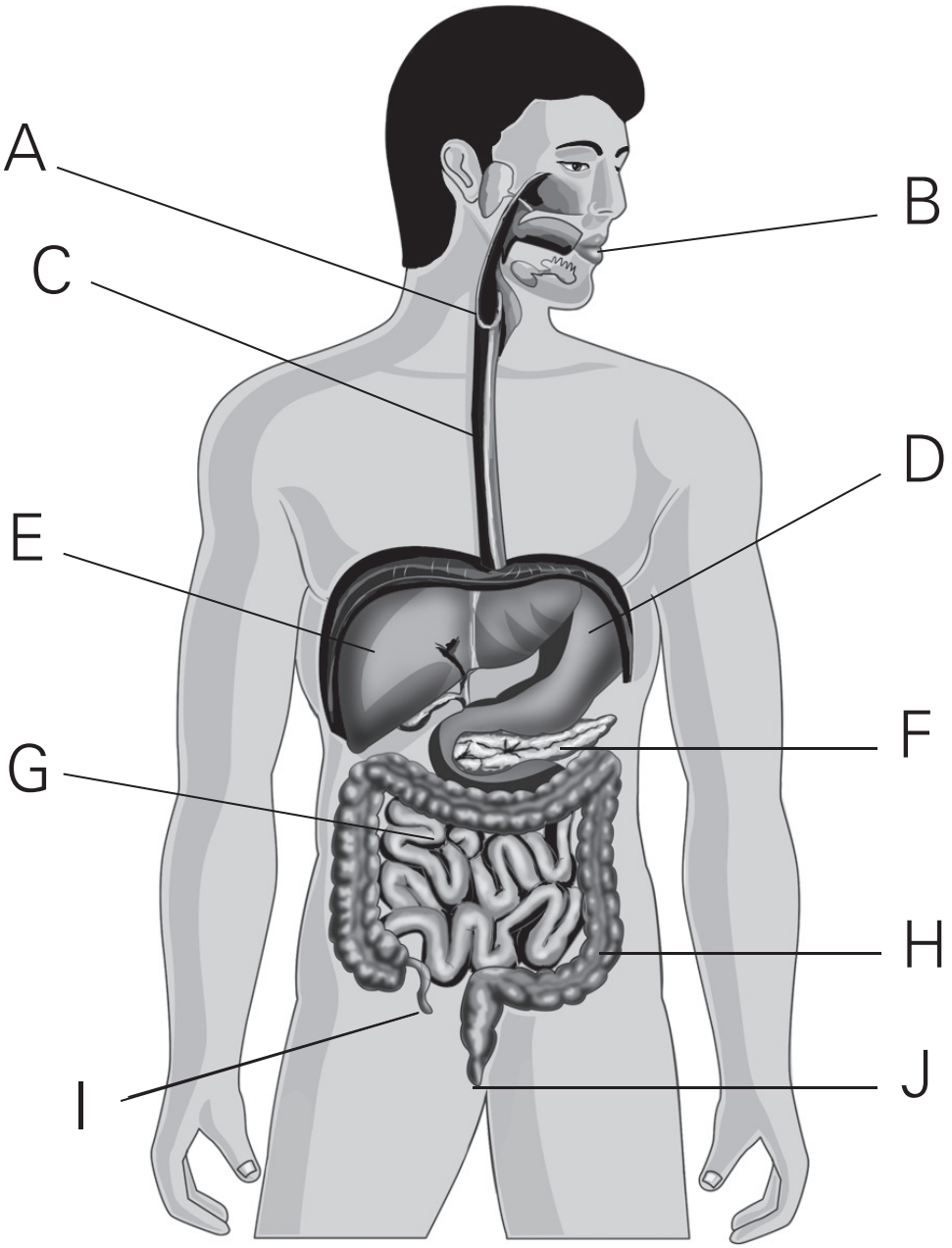
PLENARY (15 min)

Test yourself page 49 of the student book.

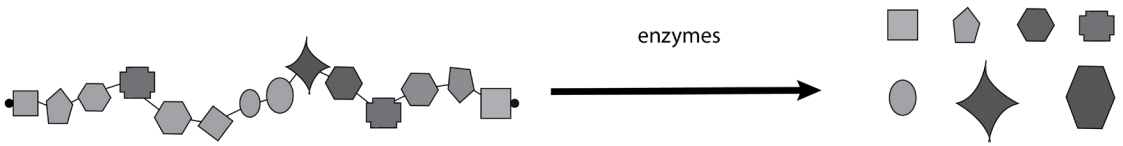
HOMEWORK

- Research about any one digestive disorder.

1. Identify names of the organs of the alimentary canal canal.



1. **Digestive enzymes** All matter is made of particles. So our food is also made of particles and they are often relatively big. Digestion is the process where large food particles are broken down into smaller particles which can be absorbed into your blood. An example would be protein.



A protein - a long chain of amino acids.

Amino acids

Enzymes help to break down the larger protein particles into smaller amino acid particles. Different enzymes break down starch particles into smaller maltose particles. Of course, enzymes themselves are also particles. Enzymes are specific. An enzyme for protein cannot break down starch. Enzymes turn substrates into products. We often write it this way:

$$\text{substrate} \xrightarrow{\text{enzyme}} \text{product}$$

Complete the table below

parts of the digestive system	digestive juice produced	substrate	enzyme	product
	Saliva	Starch		
	no digestion; moves food through peristalsis			
			Amino acid	amino acids
		produced by liver; stored in gall bladder emulsifies fats		
	_____ juice		Amylase	
	And _____	Protein		
	juice		Lipase	
		Carbohydrate		
	stores good bacteria			
	absorption of water storage and egestion of faeces			

Denaturing enzymes

1. Answer the questions below.
   a. Consider a raw egg and a boiled egg. What are the differences?

      _____

   b. If you cool down the boiled egg, does it go back to being a raw egg? Explain your answer.

      _____

   c. Eggs are rich in one nutrient or food type. Which one is it?

      _____

2 Your teacher has done a demonstration, putting parts of an apple under different conditions. Please observe what happens to the different parts and record your observations below.

Apple parts in different conditions:

Part	Condition	After 25 minutes
1	on table	
2	dipped in boiling water and then on the table	
3	covered in lemon juice and then on the table	

Enzymes in the apple will make the apple turn brown as soon as it is in contact with oxygen.

Enzymes are proteins.

a. What happened to the enzymes in the apple when exposed to high temperature?

   _____

b. What happened to the enzymes in the apple when covered in acidic lemon juice?

   _____

   _____

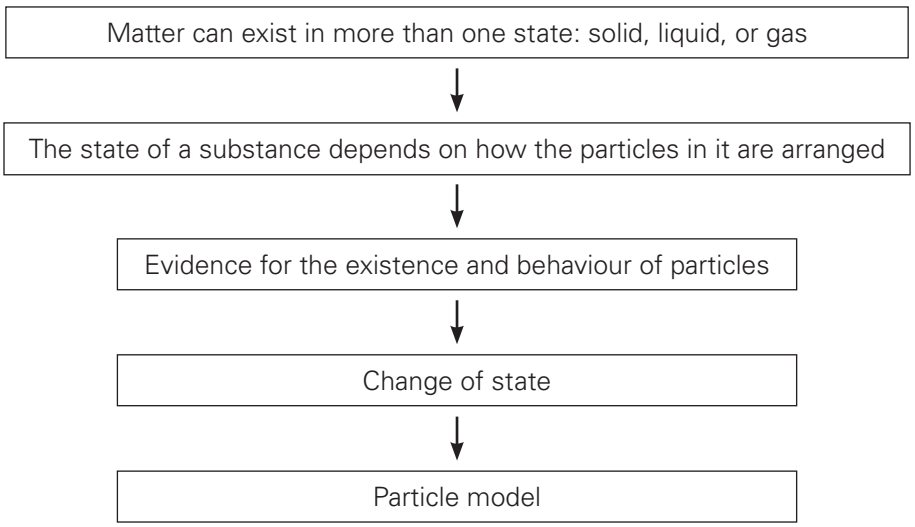
Conclusion

c. Enzymes are _____ and they are changed by _____ and _____ so that they no longer work.

Chapter 5

Matter and Particles

UNIT FLOW CHART



INTRODUCTION

This chapter deals with the nature of all the materials we see around us every day. They are so common and so much a part of our lives that we take them for granted. Of course ice melts into water and boils into steam. Of course we do not build bridges from orange juice (or other liquids). What we try to do in this chapter is to take the 'of course' knowledge and look at the reasons for it. Why is orange juice not the best building material?

As before, some experiments have been included in this chapter. It would be great if students could do them (hands-on) so that they learn the skills needed in the lab. At least as important is the fact that most students prefer doing an experiment to watching a demonstration or video. Our future generations need scientists, and it is our responsibility to create the interest among our students.

Too often, students perceive what they learn at school as being separate from 'real life', so this unit (as all others) aims to include as many examples from 'everyday life' as possible.

Lesson 1

pages 54 and 55

OBJECTIVE

- To show how the particle model can be used to explain the differences between solids, liquids, and gases.

LEARNING OUTCOMES

After this lesson, students should be able to:

- explain the particle theory of matter.
- classify materials as solid, liquid, or gas.
- describe materials as being made of particles.
- describe the movement and arrangement of particles in a solid, a liquid, and a gas.

START (15 min)

Show students an ice cube, a glass of water, and a boiling kettle with steam coming out. Ask them what the differences are between the ice cube, the water, and the steam. Students should recognize that they are all water, but in different states (solid, liquid, and gas).

MAIN (15 min)

Read pages 54 and 55 of the student book.

- Worksheet 1-5 students.
- As mentioned in the worksheet, give students a stone, different size cups or beakers, a way to measure 100 ml of water, and a balloon.
- Ensure each student records his/her answers.

PLENARY (15 min)

Discuss the answers and the reasons for the answers given by the students.

HOMEWORK

- Complete the second half of the worksheet (fill in the blanks).
- Collect and paste pictures of solid, liquid and gas in note book.

Lesson 2

OBJECTIVE

- To show how the particle model can be used to explain the differences between solids, liquids, and gases.

LEARNING OUTCOMES

After this lesson, students should be able to:

- use particle model of matter to investigate the movement and arrangement of particles in three states.
- explain why gases and liquids take the shape of their containers but solids do not, in terms of the particle theory of matter.
- discuss, using the particle theory of matter, why liquids and gases can flow easily but solids cannot.
- interpret the evidence for the existence of particles in matter by observing daily life (examples include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water and evaporating salt water).

START (10 min)

Activity: Take a deflated basketball and weigh on a weighing machine and note the initial mass of the ball. Now pump air in the ball and put it back on weighing machine. Note the weight of the ball and see the difference.

MAIN (15 min)

- Read pages 56 of the student book.
- Take a glass of water and one table spoon of sugar. Stir it well and explain when you add sugar to water and stir, the sugar dissolves in water. This is because tiny particles of sugar move in to empty spaces between water particles.
- Do the activity from Worksheet 2-5.

PLENARY (15 min)

Why the ball will weigh less before air is pumped into the ball? This is because air is made up of freely moving particles.

Go over the questions in worksheet 2-5 and relate the information to both the activity and their drawings of the particles in different states (gas, liquid, solid).

HOMEWORK

- Perform investigation 2 page 61

Lesson 3

pages 57 and 58

OBJECTIVE

- To show how the particle model can be used to explain the differences between solids, liquids, and gases.

LEARNING OUTCOMES

After this lesson, students should be able to:

- describe the movement and arrangement of particles in a solid, a liquid, and a gas.
- apply the particle theory of matter to explain diffusion.
- explain the changes in states of matter melting, freezing, evaporation, condensation and sublimation using the particle model of matter.

START (10 min)

Perform investigation 1 page 61

MAIN (25 min)

- Read pages 57 and 58 of the Student Book.
- Hand out worksheet 3-5. Carry out the experiment mentioned in the worksheet. As always, it is preferable if students do this experiment themselves.
- If this is not possible, the next best option is for a few students to demonstrate it at the teacher's desk while the others watch. (But please do not choose the same students every time you use this approach).
- Perform investigation 2 page 61of the student book.
- Introduce the idea that change in temperature will change the state of the matter. Like on heating ice will change into water. This happens because, as particles are heated, they get more energy, speed up and move further apart. As particles cool, the opposite happens.
- Explain the term sublimation is a process when some solids turn directly into a gas when they are heated without becoming a liquid first. When the gas is cooled, it turns straight back into its solid state.

PLENARY (5 min)

Hand out worksheet 4-5 and ask students to discuss and solve. Go over their answers.

HOMEWORK

- Test yourself questions on page 59 of the student book.

1. Experiment: The properties of different states of matter. Form groups with your class-fellows and perform the following three experiments. Follow the directions and record what you observe. Discuss your conclusions in your groups and then each of you record your conclusions below.

   a. A stone

Action	Observation	Concluding statement
Try to press and squeeze the stone. What happens to its shape and volume?	Shape	
	Volume	
Put the stone in different-shaped containers. Does the shape or the volume of the stone change?	Shape	
	Volume	

   b. Water

Action	Observation	Concluding statement
Measure 100 ml of water into different shaped containers. Observe what happens to the volume and shape of the water when you place the water in different-shaped containers.	Shape	
	Volume	

   c. A balloon

Action	Observation	Concluding statement
Blow up the balloon. Does its shape and volume change?	Shape	
	Volume	

   d. A sponge

Action	Observation	Concluding statement
Squeeze the sponge. Does its shape and volume change?	Shape	
	Volume	

2. Fill in the gaps in the sentences below, using words from the box. You may need to use some words more than once.

   Dense, fill, lower, squashed, density, fixed, properties, volume, easy, flow, rise

   a. All solids have some things in common. These are called the _____of solids.

   b. Solids have a _____volume.

   c. They cannot be _____.

d. They also have a _____shape which cannot be changed, making them ideal materials to use to build large structures such as bridges.

e. They do not _____and so they cannot be poured.

f. Solids also have a high _____, which means that their mass is higher than the same _____ of other materials.

g. Like solids, liquids cannot be_____ .

h. They have a _____which is fixed.

i. However, they are different from solids because they can _____quite easily and have no _____shape.

This means that they always take the shape of their container.

j. Although liquids are _____, they usually have a _____density than solids.

k. Gases are quite _____to squash and so they have no fixed _____.

l. They also have no _____shape.

m. They will spread out and _____any shaped container.

n. Gases are less _____than liquids (which is why bubbles_____ in a fizzy drink).

1. Activity: Ten students should line up and close their eyes. It would be best to be away from windows, fans, and/or air conditioners. The teacher will spray some perfume onto a tissue and place it at the end of the line. Each student should raise her/his hand when she/he smells the perfume. Students not in the line should record the time between spraying the perfume and each student raising her/his hand. Write down in the table below how long it took for each student to smell the perfume. Write the time in seconds.

Student	Time (in seconds)

   a. Which students smelled the perfume first?

   _____

   b. Were they close to the tissue or far away?

   _____

   c. How can all students smell the perfume after some time if they are not near the tissue?

   _____

2. Remember what you know about the particles in different states. Draw the arrangements of the particles in a solid, a liquid, and a gas in the boxes below.

Solid	Liquid	Gas

3. Answer the questions below.

Are there big spaces between the particles in a solid?	yes/no
Are there big spaces between the particles in a liquid?	yes/no
Are there big spaces between the particles in a gas?	yes/no
When you compress a substance, do the particles get smaller?	yes/no
When you compress a substance, do the spaces between the particles get smaller?	yes/no

1. Experiment:

Diffusion of food colourant in hot and cold water.

Method:

i. Collect two glasses.

   Fill one with hot water, and the other with cold water.

ii. Leave the water to stand for a minute or two so that it has stopped moving.

iii. CAREFULLY put one drop of food colourant in the water. Make sure you do NOT stir the water.

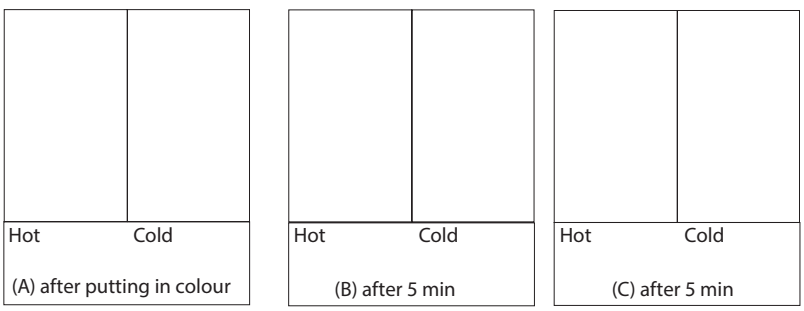
iv. Leave the glasses of water absolutely still.

v. Draw a diagram (A) of each glass to show what it was like just after you put the coloured substance in the glass.

vi. Look at the glasses again after 5 minutes. How far has the colour spread through the water?

vii. Draw another set of diagrams (B) to show what has happened.

viii. Draw a third set of diagrams (C) to show what has happened after 15 minutes.



Considering your results/conclusions

Complete these sentences.

a. The longer you leave the water, the more the colour _____.

b. The hotter the water, the _____the colour spreads out.

c. This is because in hot water the particles are moving _____than in cold water.

d. How long did it take before the last student smelled the scent? _____

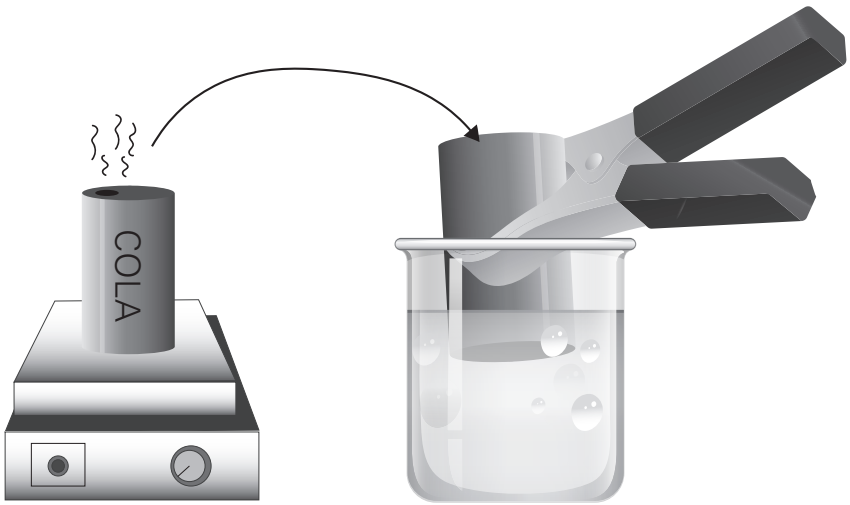
e. What was the distance between this student and the scented tissue? _____

f. If you compare this with the distance the colour diffused in water in 5 or 15 minutes, what can you conclude about the speed of diffusion in a gas compared to the speed of diffusion in a liquid?

_____

1. Demonstration - Gas pressure.

Your teacher will show you the following experiment. A large bowl of very cold water (containing ice cubes) has been prepared and is placed on a table. Nearby, your teacher will put a small amount of water into an empty can. The can is put on a hot plate until water vapour starts to come out. The teacher will take the can, using tongs, and put it in the large bowl of cold water.



a. What did you see?

_____

b. Some force was needed to make this happen. Which direction did this force come from?

_____

c. What was in the space that provided this force?

_____

d. What force was it?

_____

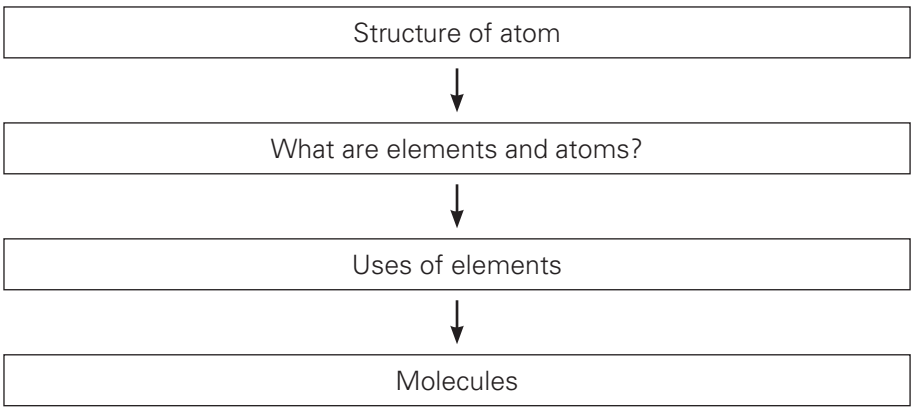
e. Why did the can collapse after being put in cold water and not before?

_____

When air pressure is the same on all sides, we do not notice it. But when the pressure is higher on one side than on the other (for example, more air pressure outside the can than inside), we suddenly realize that air pressure is a big force.

Chapter 6 Elements and Compounds

UNIT FLOW CHART



INTRODUCTION

This section looks at the building blocks of matter. As teachers, we know a fair bit about the world around us, but we should not hesitate to share our wonder about some of it with our students. We know (or can look up) the size of an electron but can still be amazed by it. We know that all matter is made from protons, neutrons, and electrons, but the diversity achieved from only three building blocks can still astonish us. Please make sure by the end of the chapter that students understand the building blocks of an atom. Atoms are the particles of an element. Alternatively, they can be combined into molecules which can build a compound. Atoms and/or molecules can be put together to make a mixture. The variation possible from all of this is really endless.

If you or your students do an internet search on 'new compounds made' you may find articles referring to a compound that could give you a 'sun tan, a new lining for pans in the kitchen, or an exceptionally hard compound containing carbon and/or something completely different. Some 'new' compounds are discovered, some are created in the lab for a specific purpose, and some are created and then found to have unexpected, sometimes useful, properties.

The processes involved in creating compounds and mixtures are different, and students should understand this. Once again, trying to connect to everyday life examples and comparisons with food preparation seem appropriate here.

Lesson 1

pages 62 and 63

OBJECTIVE

- To explain the structure of the atom.

LEARNING OUTCOMES

The students should be able to:

- describe the structure of matter in terms of particles (i.e. atoms and molecules).
- describe molecules as a combination of atoms (e.g. H_2, O_2, and CO_2).

START (15 min)

Revise the key information a in Chapter 5 and ask students to complete the first section of work sheet 1-6.

MAIN (25 min)

- Read pages 62 and 63 of Student Book.
- Explain that a molecule is made up of two or more atoms chemically joined together. A molecule of element is made up of two or more atoms of the same type, while a molecule of element is made up of atoms of the same type.
- Explain that all known matter on Earth and in space is made from only about 118 different chemical 'building bricks'. We call these building bricks elements.
- Discuss that about 90 elements have been found in nature, these are some of the natural elements. The others have been created by scientists. Each name of the element is followed by a chemical symbol.
- Give examples of symbols and explain symbol is a kind of chemical shorthand recognised all over the world.
- Hand out worksheet 1-6 and support students while they work through it. This task is best done individually.

PLENARY (5 min)

Ask students what is in between the electrons in an atom. It is likely that someone will suggest air, but this is not correct since air is also made of atoms. The answer is nothing, which is a concept that some students struggle with. Introducing it at this time will allow them to understand it gradually.

Test yourself questions on page 63 of the Student Book.

HOMEWORK

- Draw and colour the structure of an atom in the notebook.

Lesson 2

page 64 and 65

OBJECTIVE

- To distinguish between elements, mixtures, and compounds.

LEARNING OUTCOMES

The students should be able to:

- recognise the names and symbols for some common elements (first 10 elements of the Periodic Table) and recognise their physical properties.
- differentiate that some elements are made of atoms and some elements exist as molecules and have different properties compared to a single atom of the element.

START (15 min)

Go over the homework from last lesson to check for understanding.

Ensure the following points are clear to all students:

- All matter is made of particles.
- The state of a substance (solid, liquid, or gas) is decided by the speed of the particles, the type of movement of the particles, and the distance between the particles. The particles themselves remain the same.
- Substances made of only one chemical which cannot be broken down by chemical means are elements.
- The smallest particle in an element is an atom.
- Atoms have a nucleus (with protons and neutrons) surrounded by an electron cloud.
- Atoms of different elements have different numbers of protons, neutrons, and electrons.
- The number of protons in an atom is the same as the number of electrons.
- Neutrons have no charge and keep the nucleus together.

MAIN (20 min)

- Read page 64 and 65 to support students. Show a periodic table and ask symbols of different elements.
- Show pictures of uses of elements and discuss the uses of different elements in daily life. This may be suitable for group work. It seems unlikely, but the basic components of all matter are very few: protons, electrons, and neutrons.

PLENARY (10 min)

The number of protons in an atom is the same as the number of electrons and decides the properties of the chemical. It may help to draw a comparison with Lego blocks. Ask students to imagine what they could build if they had an unlimited supply of only three different types of Lego blocks.

Lesson 3

page 67-69

OBJECTIVES

- To distinguish between elements and Compounds.
- To show that a huge range of materials can be made from a relatively small number of elements.

LEARNING OUTCOMES

The students should be able to:

- explain that compounds are formed by different types of elements joining together chemically and forming a new substance e.g. burning magnesium or steel wool in air/oxygen.
- illustrate the formation of a compound with the help of a word equation.
- distinguish between elements and compounds.

START (10 min)

- Give some Lego blocks and ask students to make different arrangements from Lego blocks.
- Last lesson, you explained the structure of the atom. Revise this briefly and go on to discuss what can be made from these atoms.

MAIN (20 min)

Read page 67-69

- It is important that we, as teachers, make it obvious to our students that what they learn at school is linked to their lives at home. Even when we think we have shown how the work in class links to everyday life, not all students may have really understood this.
- Showing that science is part of 'real life' and not just some abstract information to be memorized for a test, will make students more interested and will make it easier for them to remember the information.
- They will also talk about it at home, which will make the parents more supportive of the school, which also has a positive influence on the students' academic success.
- Mixing flour, butter, milk, and eggs to make batter is a physical change (although one which would, in reality, be hard to undo), but baking the batter to make a cake is a chemical change. For those of you who love French and Italian dishes, tomatoes, onions, garlic, and paprika (bell peppers or capsicum) can be chopped and mixed into a salad (physical change) or cooked and pureed (blended) into a sauce for pasta (chemical change).
- Ask students to consider their usual meals and favourite dishes to identify what the 'elements' would be, and if other dishes or meals can be made with them. Where are the physical or chemical changes involved?

PLENARY (15 min)

- One of the ways of linking students' science learning to real life can be by using models. Cooking is an area which relates closely to science, as we saw when discussing the denaturation of proteins, and most students have some awareness of what is involved in preparing food. So this link with reality should be made explicit whenever possible.
- Hand out worksheet 3-6 and support students working through the questions. This may be suitable for group work.
- Home work

Questions of Test yourself page 68 of the student book.

Lesson 4

Page 66

OBJECTIVE

- To differentiate between metals and non-metals.

LEARNING OUTCOMES

The students should be able to:

- identify metals and non-metals.
- explore the common elements and compounds in our daily life-(carbon, nitrogen, hydrogen, aluminium, water, common salt, sugar).
- categorize elements into metals and non-metals (first 10 elements) based on their physical properties.

START (15 min)

Ask students to compare a few household items, pans, doors, shoes, string etc. Suggest reasons for the choice of materials.

Investigate activity 1 page 73 of the student book.

MAIN (20 min)

- Read page 66 and discuss the names of metals and non-metals. Discuss the uses of metals and non-metals. Discuss that carbon is used in printing ink, pencils and batteries. It is also present in coal, oil and gas.
- Explain that mercury in the thermometer is liquid at room temperature and expands evenly when heated.
- Introduce the lesson and explain to the students that metals are useful material.
- Explain general properties of metals and make students recognise brittle, flexible and.
- malleable materials by using easily obtained materials, e.g. brittle – dried pasta, "squash ability"-Synthetic foam, malleability.
- Demonstrate the difference between good and bad conductors of heat and electricity.
- Discuss the main differences between metals and non-metals.
- Explain to the students that Non-metals are also useful materials.
- Explain general properties of non-metals.
- Classify unfamiliar materials as metal or non-metal giving evidence to support each decision.
- Discuss examples from book and everyday life.
- Support students completing the worksheet 5-6.

PLENARY (10 min)

Go back to the question about whether air is matter and see if this lesson answered it. (Yes, it is matter; it is a mixture of gases). Ask students to check if what they wrote down about air at the start of the lesson is correct—they should work in pairs.

Work sheet 6-6 discuss and answer

HOMEWORK

- Investigate activity 2 page 73 of the student book.
- Exercise questions 4 and 6 page 72 of the Student Book.

1. Look at the statements about gases, liquids, and solids below. Put a tick (√) where statement is applicable or a cross (×) in the empty sections.

Statements	Solid	Liquid	Gas
keeps it shape			
takes shape of the container			
cannot be compressed			
volume becomes smaller under pressure			
particles move close together			
particles move far apart			
particles vibrate but remain in position			
particles move around a bit			
particles move around freely			

All matter is made of particles. Some substances are made of only one type of particle which only contain one kind of chemical. These are called elements and their particles are atoms. The periodic table is a way of organizing the elements. First, they are put into a line, based on increasing atomic mass. Then, this line is cut into sections, called periods, and placed under each other so that elements with similar properties are in vertical groups.

The chemical symbol is based on the (Latin) name of the element which may or may not be similar to what we call the element today.

2. Use the periodic table to find the name of the following elements.

Symbols	Elements
H	
O	
Na	
K	
Ca	

Consider the elements magnesium (number 12) and manganese (number 25). A logical symbol would be Ma, but both elements could have this symbol. So they had to come up with two different symbols.

3. Find them in the periodic table and write them below.

Symbols	Elements
	magnesium
	manganese

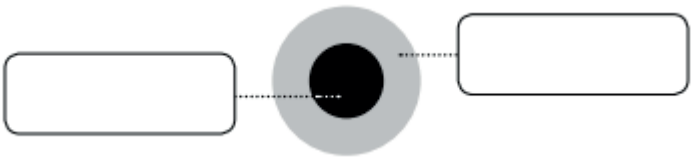
Recommended activity: This will take at least one lesson. Either ask students to bring in a white T-shirt or cut out T-shirt shaped chart papers as shown in diagram.

Each student should research one element (from the first 20) and put the information on the shirt. You will need to agree the format with the students so there is some uniformity between the shirts. If resources are available, shirts can be pre-printed so they will look somewhat similar.

Please use your imagination (and get students' input) to come up with your school's unique design. If desired, dress shirts, aprons, waist coats, lab coats, etc could be used instead. The back could also be used for more information.

An atom is the smallest part of an element. It cannot be seen, even with a very good microscope. Atoms of different elements are not the same. Scientists discovered that atoms are made of even smaller particles.

1. This is a simple diagram of an atom. Label the two areas:



The number of protons in the nucleus of an atom is also called the atomic number and usually written above the symbol of the element in the period table.

2. What are the names and the number of protons in an atom of each of the elements below?

symbol	name	number of protons
Li		
B		
N		
Ne		
Mg		

3. How many electrons does an atom of the following elements have?

symbol	name	number of electrons
Li		
C		
O		
F		
Na		

1. Answer the questions below.

   a. What particles are found in the nucleus of an atom? _____

   b. What is the name of the positively charged sub-atomic particle? _____

   c. Where in the atom are electrons found? _____

   d. Particles with the same charge repel each other. Particles with opposite charges attract each other.

      What is the charge of a neutron? _____

   e. Could you suggest a reason to have neutrons in the nucleus of an atom?

      _____

2. Complete the table.

   Atoms are too small to see, even with a microscope. Sub-atomic particles are even smaller—it is difficult to imagine how small they are. Their mass is too small to be conveniently expressed in grams so it can be expressed in 'atomic mass units (a.m.u.)'. Protons and electrons have a mass of around 1 a.m.u., and just under 2000 electrons together would also have a mass of 1 a.m.u.

name of the sub atomic particle	charge of the particle	mass (in a.m.u.)
proton (p)		
_____(n)		
_____(e)		

3. The very small electrons whiz around the nucleus in an electron cloud. If their movement was just random, they would collide from time to time and this does not happen. Instead, they spend most of their time circling around the nucleus in their specified area called a 'shell'.

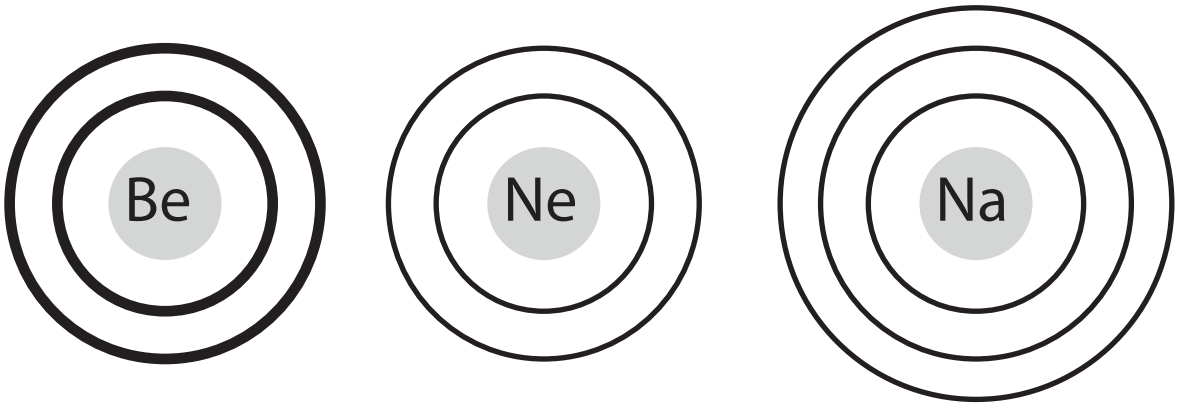
   Hydrogen and helium have one and two electrons respectively. The two electrons belonging to helium are in the same shell, relatively close to the nucleus. But have a look at lithium.

   a. How many electrons does lithium have? _____

   b. Are they all in the same shell? _____

4. It seems that the first shell, closest to the nucleus, has enough room for two electrons to buzz around. But if an atom has more electrons, the others are found in the next shell, a little further away from the nucleus. This second shell can hold eight electrons. Any electrons after that will have to occupy a third shell, again further away from the nucleus.

Draw the electrons of the elements below according to the periodic table.



1. Find the definitions of the following terms and write them below:

   a. element

   _____

   b. compound

   _____

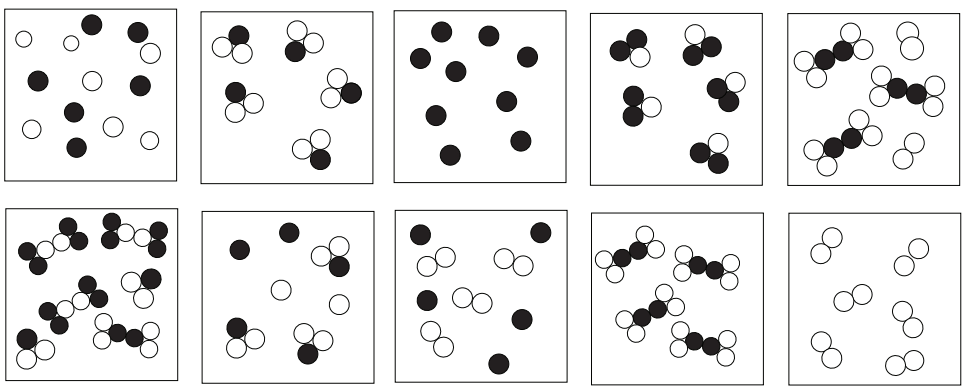
   c. atom

   _____

   d. molecule

   _____

2. Each of the ten squares below represents matter, using the particle model. Answer the questions below. Put a tick or a cross in each empty box in the table below.



	A	B	C	D	E	F	G	H	I	J
Which of the squares contain atoms?										
Which of the squares contain molecules?										
Which of the squares represent an element?										
Which of the squares represent a compound?										

Metals and non-metals

1. A few lessons ago, you learned about the periodic table. Use this information to answer the questions below.

   a. How are the elements in the periodic table initially arranged?

   _____

   b. How are elements with similar properties placed in the period table?

   _____

   c. Each element has a chemical symbol. What do you know about the chemical symbol?

   _____

   One of the first ways of organizing the elements was to divide them into metals and non-metals. This is still important today and can often be seen in the periodic table. If you look carefully, you can see a zig-zag line dividing all elements into two groups: metals and non-metals. One group is the 21 elements on the top-right, the other group is everything else.

   Read page 66 of your Student Book and take a good look at the two groups of elements. Read their names and consider what you may know about some of these metals.

   Which group are the metals and which the non-metals?

   d. The 21 elements found at the top-right of the periodic table are

   _____

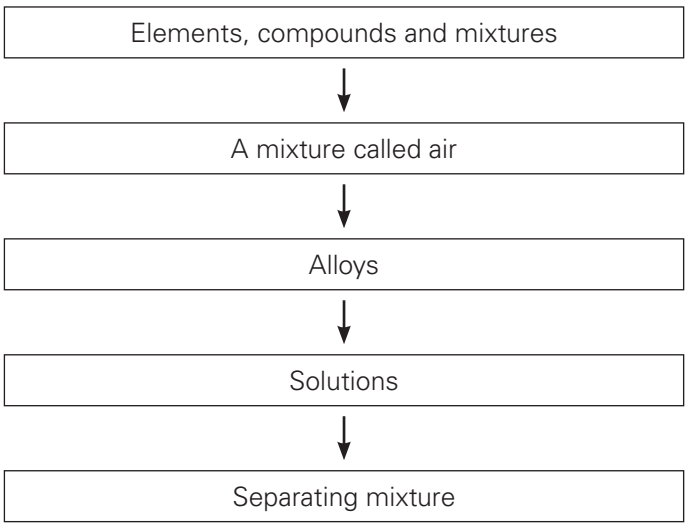
   e. All the other elements are

   _____

Chapter

7 Mixtures

UNIT FLOW CHART



INTRODUCTION

The mixtures comprise of two or more substances that are physically mixed together. These substances can be separated from the mixture because chemical reactions do not occurr when mixture is formed. Mixtures are not pure substances. Mixture can be Homogeneous or Heterogeneous. A mixture of salt with water is an example of a homogeneous mixture because it has uniform composition throughout. Salad is an example of heterogeneous mixture because it does not have uniform composition throughout. Mixture of metals is called alloys. Solder and brass are examples of alloys.

Solution is a type of mixture that is homogeneous in nature. Different techniques are used to separate soluble and insoluble substances from a mixture.

Lesson 1

Pages 74–75

OBJECTIVE

- To distinguish between elements, mixtures, and compounds.

LEARNING OUTCOMES

The students should be able to:

- demonstrate that mixtures are formed when two or more substances mix with each other without the formation of a new substance.
- identify different types of mixtures.
- describe the difference between elements, compounds, and mixtures.

START (10 min)

Put a mixture of sand and iron on a paper. Use a magnet to separate iron particles and notice the atoms are not joined chemically and so can be easily separated.

MAIN (25 min)

- Read page 74 and 75 and explain in detail about element, compound and mixtures.
- Give different examples of element, compound and mixtures.
- Like smoke is a mixture of sooty particles and air and blood also a mixture. It contains different kinds of blood cells and lots of other things.
- Salad is a mixture of different vegetables.
- Explain the illustrations on page 75 of the note book.

PLENARY (15 min)

Activity page 75 of the student book

HOMEWORK

- Write examples of elements, compounds, and mixtures in note book.

Lesson 2

Page 76

OBJECTIVE

- To understand about the composition of different types of mixtures.

LEARNING OUTCOMES

The students should be able to:

- demonstrate that mixtures are formed when two or more substances mix with each other without the formation of a new substance.
- differentiate between pure substances and mixtures on the basis of their formation and composition.
- justify why air is considered as a mixture of gases.

START (15 min)

In previous sections and chapters, we often talk about matter. Is air matter? How do you decide if something is matter? i.e. What is the criteria for matter? Avoid commenting on students' ideas, but keep a record of them since you may want to refer back to them later. Worksheet 1-7 and ask students to write down individually what they know about air. After a few minutes they can discuss their answers in small groups and add to what they wrote down. You may decide to open it up to a plenary session and collect the answers.

MAIN (20 min)

Read page 76 of the student book

- In the discussion on whether air is matter, students may have said something like, 'Matter has mass.' In our everyday perception, air does not have mass but our common sense ideas are not always scientifically correct. In order to check if air is matter, take an empty basketball. Weigh it, record the mass, and pump up the basketball before weighing it again. Most air-filled basketballs are about 1% heavier than empty ones, so use an accurate balance on a stable horizontal surface and take your measurements with care.
- If you can get a canister of compressed air, you could weigh it, empty it, and weigh it again. This should produce a good result, but not everyone may be able to get a canister of compressed air. Compressed carbon dioxide (in a fire extinguisher), or compressed oxygen (medical use) would strictly speaking not be air and not give the correct information. Although a filled balloon will be heavier than an empty one, the difference is likely to be too small to measure in your lab. A demo that adds a bit of fun but can start a discussion would be the following:

- Preparation before class: mix 2 tablespoons of baking soda with 2 table spoons of vinegar in a glass bottle. This will produce (invisible) carbon dioxide gas which is heavier than air. Cover the bottle with your hand to keep the carbon dioxide in.
- When the reaction is complete, 'pour' the CO_2 gas into an empty jar or bottle and close it. Prepare an identical jar/bottle containing only air. Light two small candles and place each inside a transparent glass. Pour the air from the bottle over one flame and see that it makes no difference. Repeat with the bottle filled with CO_2 and watch the flame go out. Please try this out beforehand to ensure it goes smoothly. Reference can be made to the website https://www.thoughtco.com/candle-science-magictrick-607494.
- Videos can be searched using the terms 'pour carbon dioxide candle flame'. Discuss with students that both bottles seemed empty but had a different effect on the flame. You could even put a candle under a glass and watch it go out (due to lack of oxygen). They can speculate on what was in each bottle and what caused the flame to go out. It can lead to the concept that air is a mixture of gases and if the composition changes (such as replacing most of it with CO_2) 'normal' things, like lighting a candle, are suddenly not possible. It shows again how much we take this vital mixture of gases for granted. If you wish, you can discuss how (and why) even a relatively small amount of carbon monoxide (from incomplete combustion, e.g., in a fire) can endanger human life.

PLENARY (10 min)

Go back to the question about whether air is matter and see if this lesson answered it. (Yes, it is matter; it is a mixture of gases). Ask students to check if what they wrote down about air at the start of the lesson is correct—they should work in pairs.

Test yourself questions on page 75 of Student Book

HOMEWORK

- Search on internet and draw a pie chart to show composition of air in note book.

Lesson 3

page 77 and 78

OBJECTIVE

- To know about different mixtures from daily life.

LEARNING OUTCOME

The students should be able to:

- describe alloys as mixtures of metals and some other elements.

START (15 min)

Show pictures of objects made up of alloys on page 78 of the student book.

MAIN (15 min)

- Read page 77 and 78 of the student book and explain the term alloy. Discuss that alloys are usually made by melting metals together then allowing the molten mixture to cool and harden.
- Draw the structure of alloy on the board and explain the larger atoms in the alloy prevent the smaller atoms sliding over each other.
- Explain the importance of making alloys that, many pure metals are too soft to be of any use. By adding another element, a soft metal becomes harder and more useful. This prevents the metal from changing shape and bending easily.
- Explain that mixing different metals together can produce alloys which have different properties to the metals from which they were made.

PLENARY (15 min)

Worksheet 2-7

HOMEWORK

- Test yourself questions page 79 of the student book. Collect pictures of objects made up of different alloys from magazines and newspapers and paste in note book.

Lesson 4

Page 79

OBJECTIVE

- To know about the examples of common mixtures from daily life.

LEARNING OUTCOMES

The students should be able to:

- identify and explain examples of common mixtures from daily life.
- demonstrate the process of solution formation (using water as a universal solvent).

START (15 min)

Dissolve salt in water and prepare a clear solution. Show that salt is mixed with water to make a salt solution. Put some sand in water and show small sand particles stay suspended in water.

Introduce the terms solute, solvent, soluble and insoluble.

MAIN (15 min)

- Read page 79 of the student book
- Activity 1: ideas for Investigation page 87 of the student book.
- Write the terms solute, solvent, soluble and insoluble on the board and explain in detail with the examples.
- Explain that the Salt is said to be soluble because it dissolves in water while sand is insoluble because that will not dissolve in water.
- Open a fizzy drink/ can in front of the class and explain Gases can also form solutions with liquids.
- Discuss that carbon dioxide is often mixed to make fizzy drinks.

PLENARY (15 min)

Discuss some examples of soluble and insoluble substances.

worksheet 3-7

HOMEWORK

- Test yourself page 80 of the student book.
- Exercise question 3 page 86 of the student book.

Lesson 5

Pages 80 and 84

OBJECTIVE

- To understand the ways of separating different mixtures.

LEARNING OUTCOME

The students should be able to:

- demonstrate ways of separating different mixtures.

START (15 min)

Activity 2 ideas for Investigation page 87 of the student book.

Arrange different stations of separating different mixtures in the lab and demonstrate different methods. Show videos of the ways of separating different substances from mixtures.

MAIN (15 min)

- Page 80 -84 (this lesson will take three classes).
- Explain that the insoluble solid can be removed from a mixture by filtration. When this mixture is passed through the filter paper the liquid is passed through the holes in the filter paper but the solid is not passed.
- Explain the Separation of dissolved solids from a liquid. An example of this method is obtaining salt from sea water.
- Demonstrate the procedure of obtaining pure water from ink. Explain that distillation involves two processes, boiling and condensing.
- Demonstrate that the coloured substances can be separated using a process called chromatography.
- Help student to solve worksheet 3-7.

PLENARY (15 min)

Draw diagrams to show

a. homogeneous and heterogeneous mixtures

b. pure substances and mixtures

Test yourself page 81, 82, 84 of the student book

HOMEWORK

- Exercise question 4, 5, 6 page 86 and 87 of the student book

Air: it is really there! Someone gives you a small box. You open it and look inside but cannot see anything. Your friend asks: 'What is in it?' You may answer: 'Nothing.' Your answer shows how much we take air for granted. Although we know we cannot survive without air for longer than a few minutes, and the news tells us about the damage air pollution causes, we still seem to ignore the presence of air most of the time.

a. So let us take a look at this vital but often forgotten matter. Write down what you already know about air.

_____

b. When you are somewhere in the mountains or a forest, you may enjoy the 'pure air'. From a scientific perspective, is this correct? Can air be a pure substance? Explain your answer.

_____

1. State with a reason, whether each of the following is a type of homogeneous or heterogeneous mixtures.

   Vegetable soup

_____

   Sugarcane juice

_____

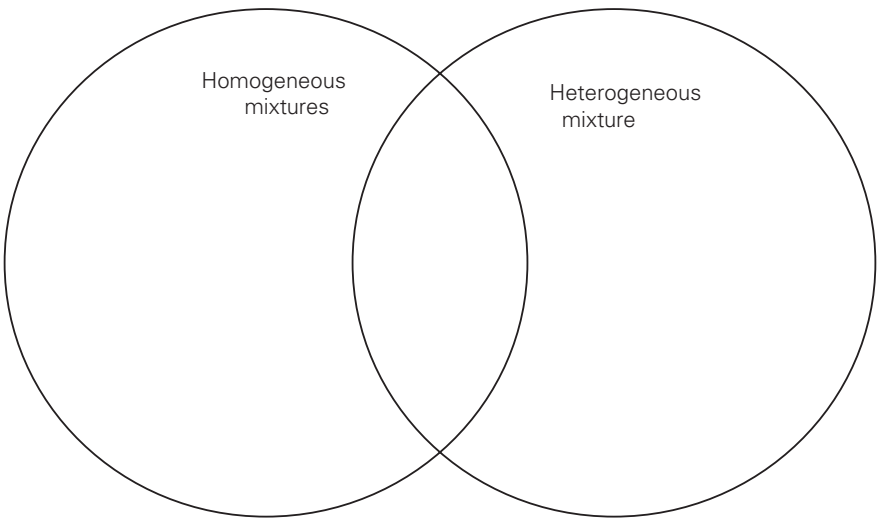
   Solder

_____

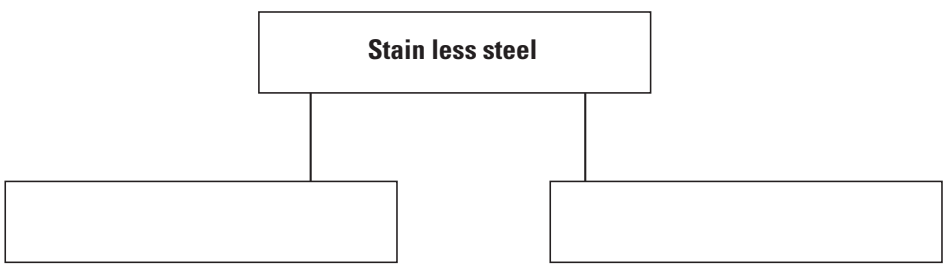
   Air

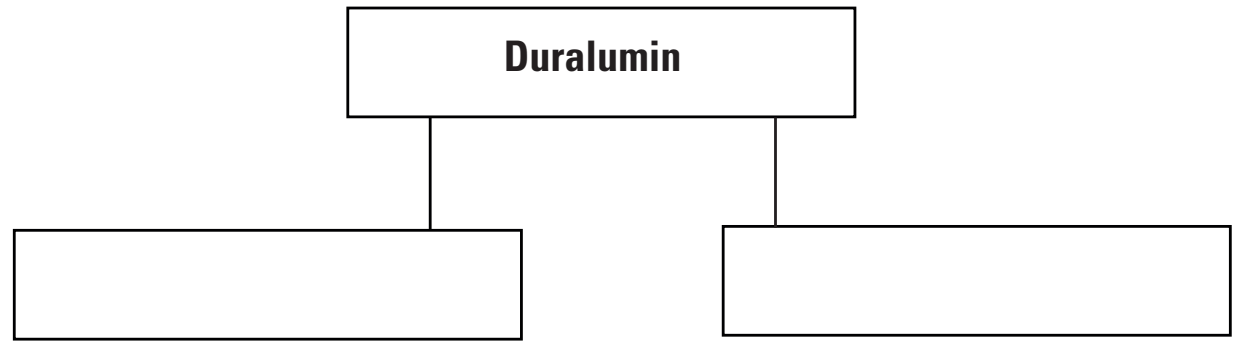
_____

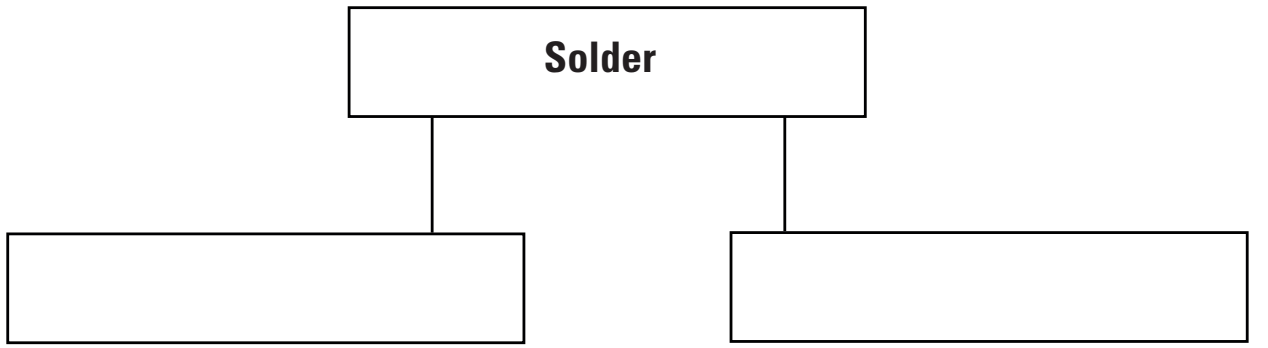
2. Differentiate between homogeneous and heterogeneous mixtures.

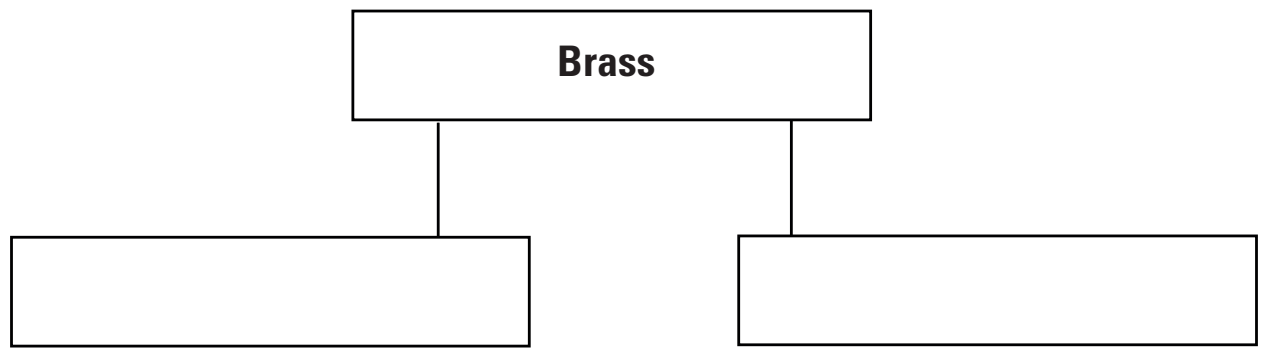


3. Show the composition of different metals in the following alloys.




Duralumin


Solder


Brass

1. Complete the following table:

Mixture	Solute	Solvent
Sugar+water		
Sand+ water		
Salt + water		
Nail paint+ nail paint remover		

2. Give two examples of each.

   i. Solution of gases

   _____

   ii. Solution of liquids

   _____

   iii. Solution of solid and liquids

   _____

Fill in the blanks with the given terms:

filtration , compounds , mixture, condenses , sublimation, elements, chromatography, insoluble

I. Coloured mixtures can be separated using a process called _____.

II. An alloy is a _____of two or more elements where at least one is a metal.

III. Some solids turn directly into a gas when they are heated, without becoming a liquid first. This is called_____.

IV. The steam _____ and is collected as pure water. The water is called the distillate.

V. The suspended solid can be removed by _____

VI. A substance that will not dissolve is called an _____substance.

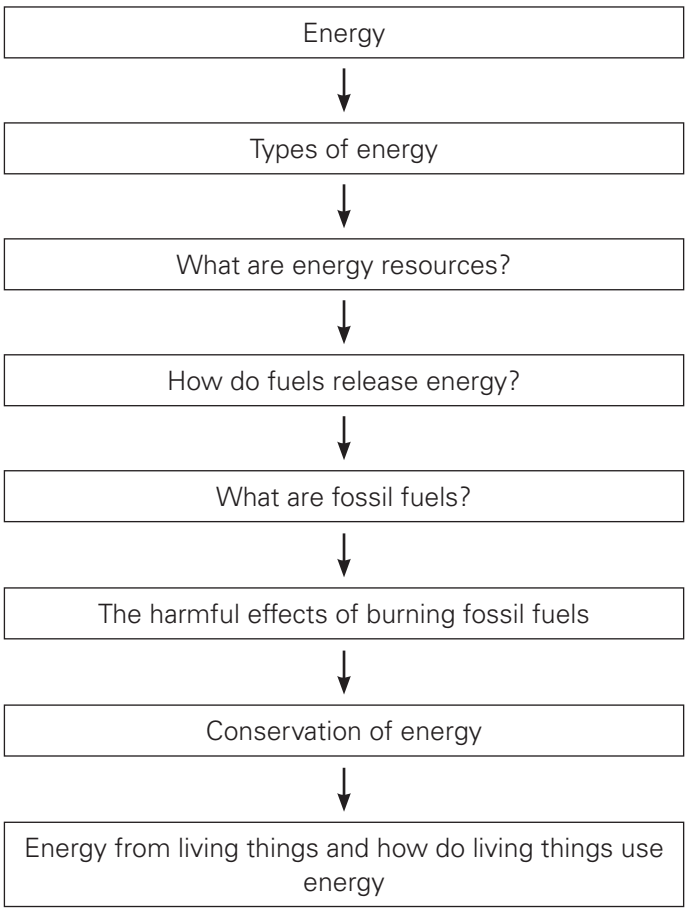
VII. A _____is an impure substance.

VIII. _____and _____have particles which are all the same so they can be described as pure

Chapter 8

Energy

UNIT FLOW CHART



INTRODUCTION

Every day, we use a lot of energy in many different ways. This includes the energy we use to walk up the stairs, energy used to move the car, and the energy needed to run the refrigerator. Coal, oil, and gas are fossil fuels that we get from the soil and use to produce electricity, drive cars, and cook our food. These fossil fuels were made over millions of years ago under special conditions, and there are only limited amounts of them left. They also pollute our environment. We need to find other sources of energy to stop the pollution, but also before the fossil fuels run out. Food contains the energy our bodies need to keep functioning. Some foods contain more energy than others. How can you test the amount of energy in different foods?

Lesson 1

page 88 and 89

OBJECTIVE

- To know about different forms of energy.

LEARNING OUTCOMES

The students should be able to:

- recognise energy as a physical quantity.
- relate potential energy and kinetic energy.
- demonstrate an energy transfer such as a bouncing ball by energy transfer diagram, e.g., gravitational potential energy ⟶ kinetic ⟶ elastic potential energy + thermal + sound ⟶ kinetic ⟶ gravitational potential energy etc.

START (15 min)

Ask students to list things that require energy. They can write them on post-it notes (one idea per post-it) and put them on the board or on a large poster on the wall. Expected answers could include: driving a car, playing soccer, and cooking food. The students could group similar ideas together, e.g., driving a car and flying an aeroplane could be put together, as could playing soccer and going upstairs. Groups could include: transport, activities of living things, appliances using electricity. Then, ask students for the source of energy in each group.

MAIN (20 min)

- Read page 88 and 89 and discuss energy is the ability to do work. You use energy whenever you write, type, walk to school, lift your school bag or go for swimming. We cannot see energy but we see the effect of energy in the world around us.
- Write the SI unit of energy on the board that is the joule (J). Explain that large amounts of energy are measured in kilojoules (kJ). 1 kJ = 1000 J.
- Explain that there are several different types of energy which can be used to do work. These can be divided into two main groups – potential, or stored energy and kinetic, or movement energy.
- Discuss about the main source of energy is the Sun which is absorbed by plants during photosynthesis and converted into chemical energy.
- Explain about the relationship between potential energy and kinetic energy. These are forms of energy that can be converted into each other. Potential energy can be converted into kinetic energy and vice versa.
- Put a book on the table and demonstrate book lying on the table has potential energy. The falling book has kinetic energy, the book fallen on the floor has potential energy.
- Explain that the energy can be converted from one form to another form. Discuss about the gravitational force pulls all objects towards the centre of the Earth.

PLENARY (15 min)

Activity: page 90 of the student book. Find the energy value in kilojoules (kJ) of a chocolate bar, baked beans, tinned fruit in syrup, breakfast cereal and a packet of biscuits. Calculate which one has the most energy per gram. Write down your results in order, starting with the food with the most energy.

HOMEWORK

- Collect food packets and find the nutritional information on food packaging.

Lesson 2

OBJECTIVE

- To extend knowledge about energy resources for living things.

LEARNING OUTCOMES

After this lesson, students should be able to:

- name some common fuels.
- explain that fuels release energy when they burn.
- describe how fossil fuels are formed.

START (15 min)

Using the examples from above, this could include: transport (using fossil fuel), activities of living things (muscle power with energy from food), electric power (cooking on electricity, running the air conditioning, or an electric heater). You may wish to leave these ideas on display so that you can refer to them in later lessons.

MAIN (15 min)

- Ask students to create a visual, e.g. a flow chart, which shows the sequence of events in the

formation of coal and oil/gas. Encourage them to draw as well as write.

- Discuss the similarities between these processes:

  They both started from living things.

  The living things died.

  Then they were covered by layers of mud which became rock.

  There was a lot of pressure and a high temperature.

  The formation took a long time.

PLENARY (15 min)

Going back to the beginning of the process, you can consider from where the living things (plants and animals) received their energy. Animals eat plants, and plants make their own food with the help of sunlight. So, ultimately, the energy in fossil fuels came from the Sun.

HOMEWORK

- Draw and colour sankey diagram in note book.

Lesson 3

pages 95 and 96

OBJECTIVE

- To extend knowledge about energy resources for living things.

LEARNING OUTCOMES

After this lesson, students should be able to:

- describe how renewable energy sources can be used to generate electricity and provide heating.

START (10 min)

- Reinforce the concept that ultimately, the energy in fossil fuels comes from the Sun.
- What about the energy of the other groups?

  The donkey pulling the cart, eats grass for energy. The grass gets energy from the Sun. All energy in muscle power initially comes from the Sun.

- What about electricity?

MAIN (20 min)

Read pages 95 and 96

- Electricity can be made in different ways. One of them is to run generators on fossil fuel. Read pages 95 and 96 and ask students to list the renewable ways to make electricity. Can they point out similarities between some of these ways?
- In principle, electricity can be made via movement: wind or water (or burning fossil fuel) can drive/rotate a generator, or the Sun's energy is used in solar panels (or heat collectors) and solar voltaic cells.
- Clearly, the energy in electricity from solar panels or solar voltaic cells comes from the Sun. We already saw that the energy in fossil fuels also comes from the Sun (although a long time ago).
- Moreover, the other sources of renewable energy also come (indirectly) from the Sun: When the Sun warms up the Earth, the air above the Earth becomes lighter and rises. This creates an area of low pressure. If this is not happening some distance away, the air there remains in place at a higher pressure. Air from the area of higher pressure will travel parallel to the surface of the Earth to the area of lower pressure, and we call this wind. So even wind energy comes from the Sun warming one place more than another.
- Since the Sun evaporates water which falls as rain on the mountains and runs down in a river, even the electric energy from a hydroelectricity plant comes from the Sun.
- Due to the gravitational forces of the Moon, the water in the seas and oceans is not always in the same place. This is called tidal movement and can be used to generate electricity. Details can be found on:

  http://www.alternative-energytutorials.com/tidal-energy/tidal-barrage.html

- Tidal power is mostly caused by the gravitational field of the Moon.
- Geothermal energy comes from the Earth.
- Ask students to read pages 95 and 96 to list sources of energy. Sources of energy include: fossil fuels (oil, gas, coal), wind, hydroelectric energy, solar energy, tidal and wave energy, geothermal energy, biomass.
- Discuss the concept of renewable vs nonrenewable energy and classify the sources of energy in either group.

PLENARY (10 min)

- 'When will fossil fuels run out?' Ask students to search the internet for this information for homework.

HOMEWORK

- Test yourself questions on page 43 of Student Book.

Lesson 4

Page 93-94

OBJECTIVE

- To the law of conservation of energy.

LEARNING OUTCOMES

After this lesson, students should be able to:

- state the law of conservation of energy and explain how the law applies to different situations.
- compare the renewable energy sources (wind, water, sun and plants) and non-renewable sources of energy (coal, natural gas, crude oil).

START (10 min)

Establish a range of answers from the earliest to the latest time the fuel is expected to run out. Let the students calculate how old they will be if the fuel runs out (soonest expected time), and how they will manage without these fuels.

MAIN (30 min)

Before the lesson

- Read page 93-94 and explain If we have a finite amount of fossil fuel, what can we do to make it last longer? Ask students to explore various ways of saving energy.
- They should also consider other ideas, especially those relevant to their area. For example, insulating houses will keep the heat inside in winter but outside in summer.
- They could also consider planting trees (which absorb carbon dioxide anyway) in such a way that their house is in the shade. Ask students what could they contribute? For example, walk short distances, take public transport, or car pool; switch off lights, heating, and air conditioning; recycle paper; avoid wasting food, etc. How and why do these things reduce energy use?
- Students can create a communication to parents which will list some of the ways in which the students can help to save energy. It could take many forms, however, a leaflet, newspaper, or letter could be taken home and parents may be requested to provide positive feedback when their child saves energy.

PLENARY (5 min)

In order to conserve energy, we will have to change our habits. This is not easy. Ask students to think about how they and their family could use less energy and write one action on a post-it. If they did this, would it really make a difference? (If we all do it, then yes, it will make a difference. Also, even a small difference is a difference.)

Do the Test yourself questions on page 95 of the Student Book.

HOMEWORK

- Worksheet 3-8

Lesson 5

Pages 98–99

OBJECTIVES

- To consider the impact on the environment of burning fossil fuels.
- To emphasize the importance of fuel conservation and the need to develop new sources of energy.

LEARNING OUTCOMES

After this lesson, students should be able to:

- describe and explain global warming and list some of its implications.
- identify the advantages of using renewable energy resources.

START (10 min)

Ask about renewable and non-renewable energy resources and discuss the advantages and disadvantages about them.

MAIN (25 min)

- Read page 98 and 99 of the student book.
- Worksheet 1-8
- Students should carry out the instructions. If you wish, you can have the timer and call out each

time they need to take a reading. This will reduce the students' independent inquiry, but increase classroom control.

PLENARY (15 min)

- Make sure students tidy up. Reflect on the results and how well the experiment went. Students can discuss the following: If I repeated this experiment, I would do the following differently: They will, of course, have to give reasons for why they would do something differently.

HOMEWORK

- Test yourself page 99 of the student book

Lesson 6

Pages 95–96

OBJECTIVES

- To consider the impact on the environment of burning fossil fuels.
- To emphasize the importance of fuel conservation and the need to develop new sources of energy.

LEARNING OUTCOME

After this lesson, students should be able to:

- describe and explain global warming and list some of its implications.

START (10 min)

Revise issues raised last lesson about fossil fuels running out and the need to conserve energy. Then bring up the fact that, even with very good conservation, fossil fuels will run out some day and we either change our lifestyle and do without a lot of things (like transport and refrigerators) or we need to find other ways of producing energy.

MAIN (30 min)

- Remind that burning fossil fuels will produce carbon dioxide. Carbon dioxide traps heat near the edge of the atmosphere of the Earth, making it a comfortable temperature for us. Carbon dioxide does this very effectively. Only 0.04 % of the gases in the atmosphere are particles of carbon dioxide, but they cause the Earth to be about 30 - 35°C warmer than it would be without any carbon dioxide.
- If possible, play the video 'Climate 101' on.

  http://video.nationalgeographic.com/video/101-videos/%20climate-101-causes-and-effect and discuss the information presented.
- Hand out the worksheet for lesson 2-8 and support the students working individually or in small groups.

Lesson 7

Pages 103–107

OBJECTIVE

- To extend knowledge about energy resources for living things.

LEARNING OUTCOMES

After this lesson, students should be able to:

- assemble and demonstrate a solar panel to operate a small fan. (steam).
- design and make a solar water heater. (steam).

START (10 min)

Collect different materials required to make the following:

a. solar panel to operate a small fan

   What you need: 6V 150mA, solar panel, DC motor, plastic propeller, small piece of wooden board, 2 x wooden blocks, solder, soldering iron, glue gun.

a. solar water heater

   cardboard box (approx. 40 cm x 20 cm x 5cm), aluminium kitchen foil, glue, scissors, approx. 2 metres of clear plastic tubing (8mm dia.), sticky tape, clear plastic film (clingfilm), tubing connector, container to collect water, thermometer, wooden block to support the heater.

MAIN (20 min)

- Perform activity 1 and 2 of Ideas for investigation page 103 of the student book.

PLENARY(15 min)

Ask following questions from the students given at the end of the investigation page 103, 104 and 105

Q. What happens if you move your model of solar panel back into the shade?

Q. What happens to the rotation of the fan if you reverse the electrical connections?

Q. What is the temperature of the water as it:

a. enters your water heater?

b. leaves the heater?

How do these result change if you:

a. speed up the flow of water through the heater?

b. slowdown the flow of water through the heater?

HOMEWORK

- Do the Test yourself questions on page 98 and 99 of the Student Book.

Experiment What does a greenhouse do? Greenhouses come in all shapes and sizes, but why do people use them? If you know someone who has a greenhouse, you can ask them, but you can also do an experiment.

Materials: You need the following:

- two thermometers
- a large glass jar (which can hold the thermometer)
- a stopwatch or timer

Method:

1. Find a place in the Sun where you can place the glass jar and a thermometer. You must be able to read the thermometer easily.

2. Place thermometer A on the table in direct sunlight. Place thermometer B in the jar, close the jar, and place it next to thermometer A. (Make sure it does not block the sunlight to thermometer A.)

3. Immediately read both thermometers, record your findings in the table, and start the stopwatch.

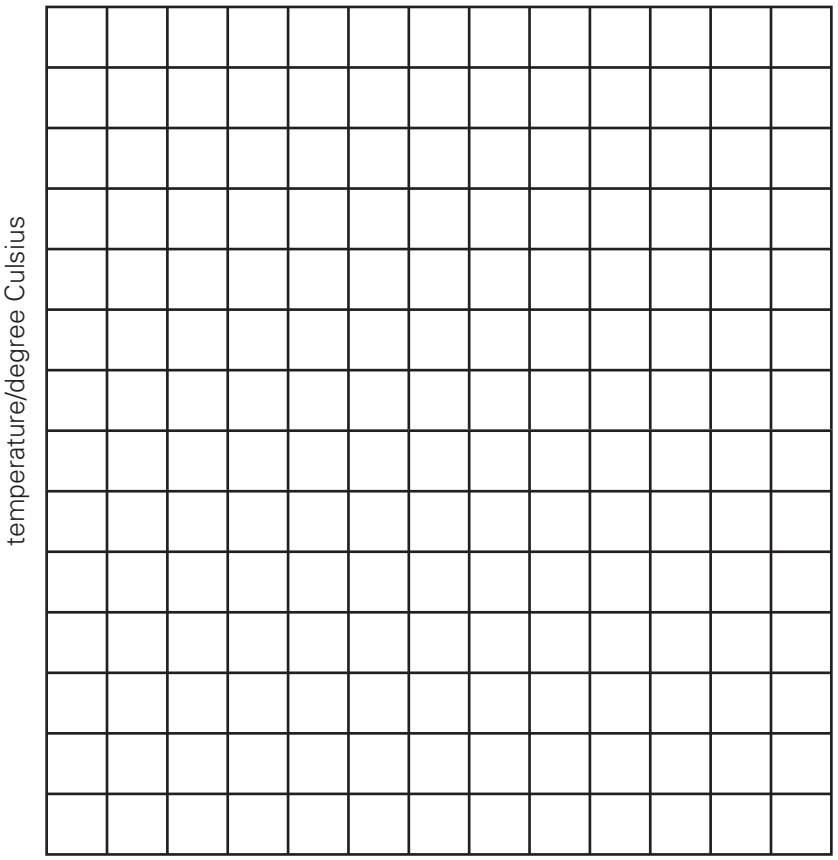
4. Every minute, read both thermometers and record your results in the table.

Results

Time	Thermometer A (degrees Celsius) on the table	Thermometer B (degrees Celsius) in the jar
0		
1 min		
2 min		
3 min		
4 min		
5 min		
6 min		
7 min		
8 min		
9 min		
10 min		

Use your results to draw a graph. The time (in minutes) goes on the X-axis and the temperature recorded goes on the Y-axis. Use two different colours for the two thermometers (or pen and pencil).

Tiltle: The effecta of a glass jar on temperature.



Conclusion:

i. Describe what happened to the temperature as measured by thermometer A.

_____

ii. Describe what happened to the temperature as measured by thermometer B.

_____

iii. Which changed faster?

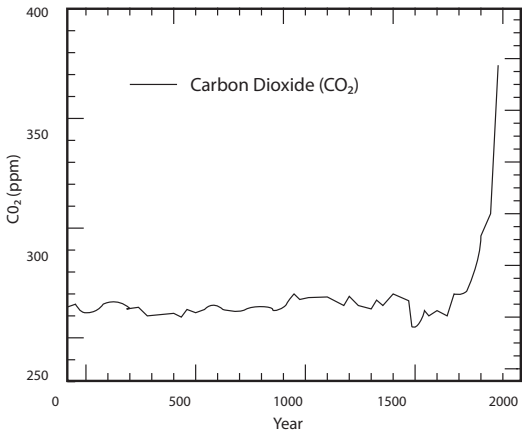
_____

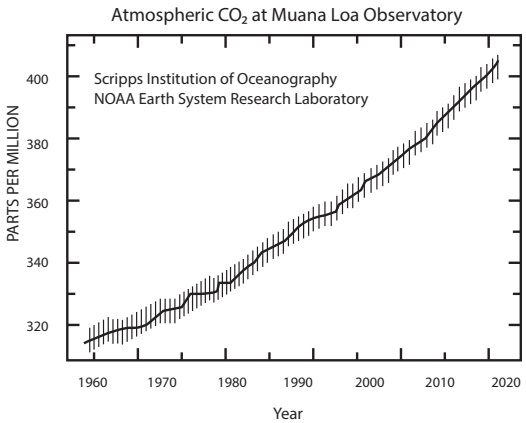
Conclusion.

iv. Describe how the glass jar affected the temperature change.

_____

Kindly add following new pictures from the net





a. What was the level of carbon dioxide in the atmosphere in the year 1000?

_____

b. What was the level of carbon dioxide in the atmosphere in the year 1900?

_____

c. How much did the level of carbon dioxide change between 1000 and 1900?

_____

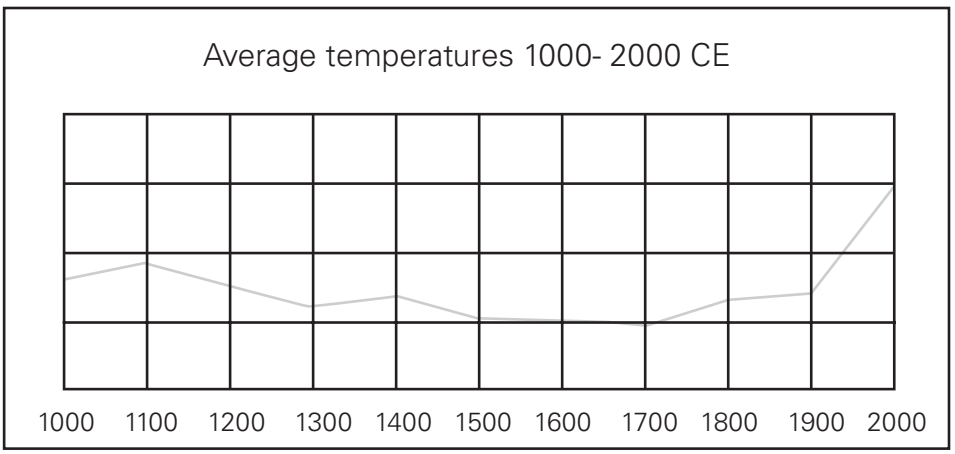
d. What was the level of carbon dioxide in the atmosphere in the year 2000?

_____

e. How much did the level of carbon dioxide change between 1900 and 2000?

_____

The graph below gives the average temperatures in the Northern Hemisphere.



a. Compare the changing pattern of the levels of carbon dioxide and the changing temperature between the year 1000 and now. What do you notice?

_____

b. Write one or two paragraphs about the relationship between carbon dioxide in the atmosphere and the temperature on Earth. Use information from previous lessons and/or the graphs to support your arguments.

_____

Watch the experiment done on

https://www.schooltube.com/media/Calorimetry-Measuring-Energy-in-a-Peanut/1_r8npx9ft

In an experiment, variables are the factors which change, or can change. In science experiments, we recognize three kinds of variables:

- independent variables
- dependent variables
- controlled variables

It is important to understand these variables very well because they will impact on your experiment.

Independent variables are factors which you decide to change. If you wanted to know how adding salt to water changes its boiling point, you would boil water with different amounts of salt, so the amount of salt is your independent variable.

Dependent variables are the factors you measure. They change, depending on your independent variable. So in your experiment on the effect of salt on the boiling point of water, the measured boiling point would be your dependent variable. If you change the independent variable (adding more or less salt), the dependent variable (the boiling point) will change.

Controlled variables are important to keep constant. For example, you want to know how adding salt changes the amount of time you need for your water to reach its boiling point. You can take 100 ml of water with a little salt, heat it and measure how long it takes to boil. Then you take 200 ml of water, add a lot of salt, heat it and measure the time until boiling. These times are likely to be different but what caused the difference? Was it the amount of salt or the amount of water? So you are only allowed to change one variable, you measure another variable, and everything else needs to remain the same. If you do this, you are conducting a fair test.

a. In this experiment, what are you measuring?

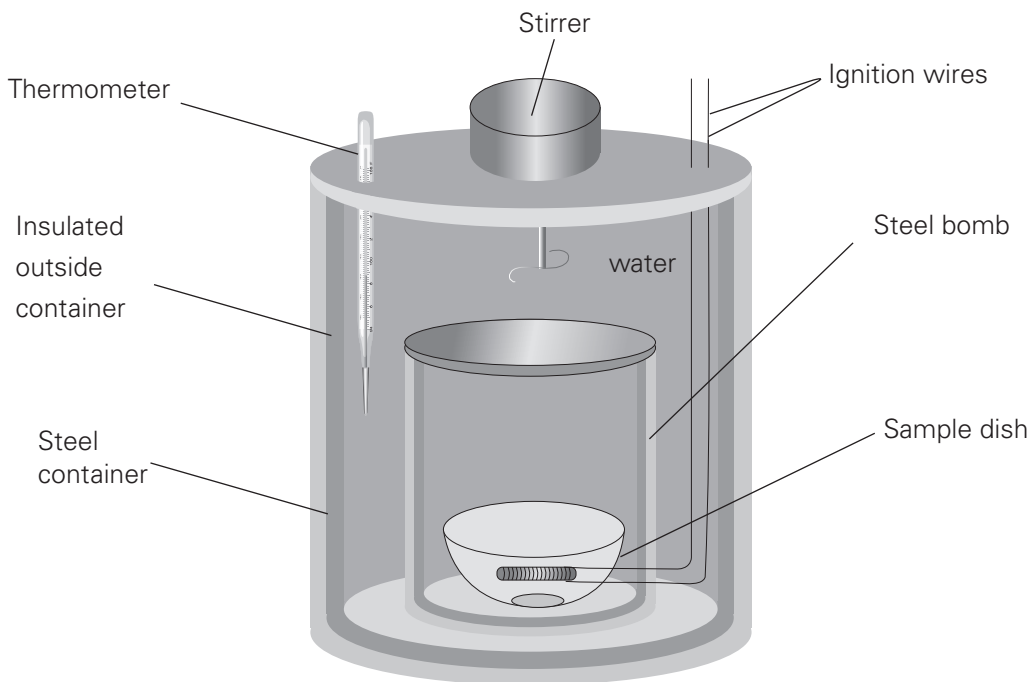
b. In this experiment, what are you changing?

c. In this experiment, what must stay the same?

d. So in this experiment, you have identified the following variables:

independent variable	
dependent variable	
controlled variables	

The principle of this experiment is that food is burnt, releasing energy as heat. This heat warms up the water and if we know how much the temperature of the water has increased, we can calculate the energy (heat) that was needed to cause this change. We then say that this energy was released by the food. When companies determine the energy in their food, they use a device called a calorimeter. The temperature of the water is recorded. A known mass of food is placed in the sample dish and ignited by running an electric current through the ignition wires. The food burns, giving off heat which warms up the water. To ensure it is warmed evenly, the water can be stirred. Once the food stops burning, the final temperature is recorded.



e. If you were to hold your hand near the burning food in the experiment as described on page 44, what would you feel?

_____

f. What would you expect to feel if you held your hand near the calorimeter?

_____

g. Which method do you think would give a more accurate result?

_____

h. If you wanted to do the experiment and had no calorimeter, how could you modify the set up as given on page 44 to get more accurate results?

_____

i. If you used 1 g of food and looked in the dish after the food stopped burning, you would see some of it left. Not all the food had completely burned (into carbon dioxide and water). This means that the energy you measured was given off by less than the 1 g of food that you started with. What could you do to get a more accurate result?

_____

1. Write two differences between the following:

Renewable energy	Non-renewable energy

Kinetic energy	Potential energy

2. Convert the following amounts of energy in joules.

   1000 MJ

   10.5 MJ

   10 kJ

3. Identify the type of energy:

   I. Heat from the hot rocks below the Earth's surface can be used to heat water.

   II. Waves of water could also be used to generate electricity.

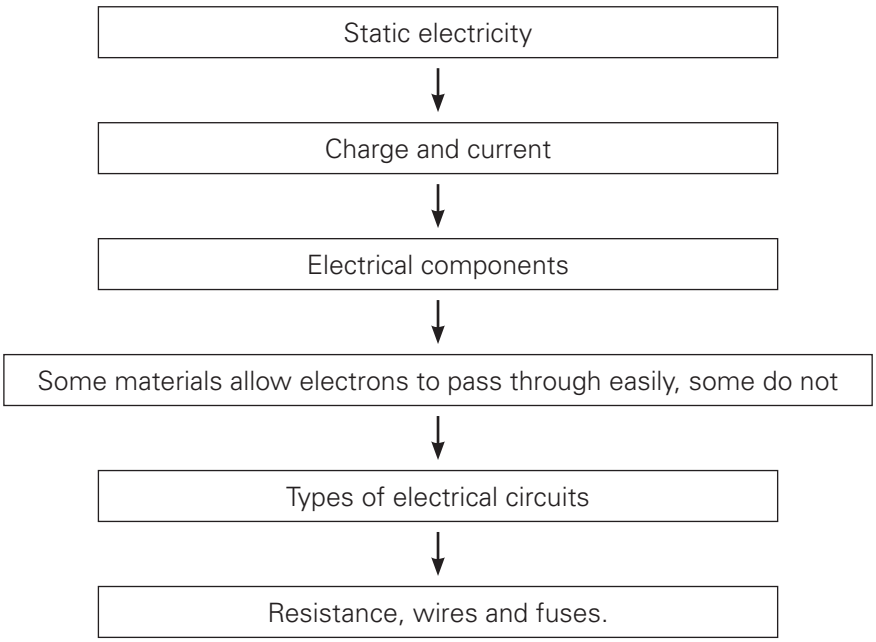
   III. Rotting plants releases heat and produces natural gas.

   IV. In electric circuits, a current is the flow of negatively charged electrons..

Chapter

9 Electricity

UNIT FLOW CHART



INTRODUCTION

In Chapter 8, students were introduced to electricity as one of the many types of energy. In our daily lives, electricity is very useful, mainly because it can easily be converted into other types of energy. Electricity has its own characteristics and, also like the other types of energy, it is potentially dangerous.

One of the most powerful examples of electricity is lightning which kills 20–40 people in the USA every year. And although the electricity from the mains at home carries a lot less energy than lightning, it is still dangerous if not used properly. In India, almost 10000 people died of electric shock in 2014. In the UK, on average, 4 people die per day as a result of a fire which started due to a problem with electricity (e.g. a short circuit).

This chapter will cover the basics of electricity from a science perspective. If possible, experiment building different types of circuits, including different numbers of light bulbs, resistors and other components, and measure the voltage and current in the various set-ups. Strongly recommended:

Please watch before starting to teach this unit. Many misconceptions students may have about electricity are indicated in the video found at https://www.stem.org.uk/elibrary/resource/30937. Some general principles of good science teaching are included. The teacher, can simulate the way electricity moves using a rope (from minute 6 of the video). Teachers may wish to watch this video with their students, but it might be more suitable to teach the concepts in a similar manner.

Lesson 1

page 107 and 108

OBJECTIVE

- To extend knowledge about electrical circuits and use the concepts of electric current and energy transfer to explain how electrical devices work.

LEARNING OUTCOMES

After this lesson, students should be able to:

- explain the phenomena of static electricity in everyday life.
- recognise electric current as a flow of charges.

START (10 min)

Demonstrate that the charged balloon attracts paper. Ask students to perform this activity.

BACKGROUND INFORMATION

We can run water and gas through pipes and transport coal in bags. In order to find out how to move electricity, we first need to know what it is. We established that electricity is a form of energy in previous chapter. All matter is made of atoms, and inside atoms are electrons. These tiny particles carry a negative charge. Normally, they stay with their atom and move back and forth a little. However, if there is a positive charge somewhere, electrons may move in that direction. This movement is flowing electricity.

Although electrons are attracted to a positive charge and will move in that direction, they maintain their position relative to each other, rather than all rushing to the positive charge.

If you were to model this with students, it will be like a proper dinner queue. Students remain in line and take a step towards the food (the positive charge).

What it is NOT is a rush of students (electrons), all trying to get to dessert (the positive charge)! So in order to move electrons (and have a current of electricity), we need a material which contains electrons that can move. Some materials have this and are called conductors; others do not, and are called insulators.

MAIN (25 min)

Read page 107 and 108

- Draw an atomic structure on the board and explain that all substances are made of atoms that consists of small particles called protons, electron and neutrons.
- Discuss that protons carry a positive charge (+ve). Electrons carry a negative charge (-ve), and neutrons carry no charge.
- Introduce the term static electricity.
- Rub a balloon against your hair and show that negatively charged balloon attracts positively charged hair.
- Explain that the balloon pulls electrons from the hair therefore, hair becomes positively charged and the balloon becomes negatively charged. This imbalance of electrical charges is called static electricity.

PLENARY (10 min)

Ask students to complete the following sentences:

Without electricity, I would have to ….

Without electricity, I would not be able to …

Example answer: Without electricity, we would have to cook using a fire, and would not be able to keep food fresh in the refrigerator or freezer. In winter, we would go to sleep early (without light and heat) and in summer we would have to live without fans.

HOMEWORK

- Test yourself questions on page 108 of Student Book.

Lesson 2

Pages 109 and 110

OBJECTIVE

- To extend knowledge about electrical circuits and use the concepts of electric current and energy transfer to explain how electrical devices work.

LEARNING OUTCOMES

After this lesson, students should be able to:

- describe a simple circuit as a path for flow of charges.
- differentiate between open and closed circuits.
- draw and interpret simple circuit diagrams (using symbols).

START (10 min)

- Please try to have students build circuits as shown in the experiment described in worksheet 1-9. If this is really not possible, use the online simulation available at http://coolsciencelab.com/conductors_and_insulators.htm
- Worksheet 1-9: Students carry out the experiment to classify materials as conductors or insulators. If the necessary resources are not available, have a look at this site to improvise: https://www.education.com/science-fair/article/parallel/

MAIN (20 min)

- Read pages 109 and 110 and discuss the concept of circuit diagrams.
- Show electrical components and explain how to connect them in the circuit.
- Give a concept of conductors and insulators.
- Provide support to students to draw circuit diagrams. If resources are available, the students can also build the circuits. Students can build simulated circuits on http://thefusebox.northernpowergrid.com/page/circuitbuilder.cfm. This could be an extension activity to be done at school or at home.

PLENARY (15 min)

Discuss high voltage cables transport electricity over long distances. The voltage involved can be 200 000 Volts or more. Birds sometimes sit on these cables and are not harmed. The reason is in the amount of electricity which actually goes through the body. The birds sit on the wire, holding the wire with their feet/claws. Their feet are close together, so the moving electrons, which are the electricity, have a 'choice': they can travel through a small length of highly conductive metal wire, or they can 'choose' to go all the way round through the bird's body (which is not as good a conductor as the metal wire).

As the resistance to go through the bird is much higher, (almost) all the electricity will flow through the wire, and the bird is safe—as long as it does not touch another wire or the supporting pole. If the bird puts its feet far apart, the resistance through its body will not change, but the length of wire (the alternative route for the electricity) will be longer, and hence the resistance higher. So a bird with its feet far apart will experience more electricity than a similar bird with its feet close together.

HOMEWORK

- Draw and colour the circuit diagram page 110 of Student Book.

Lesson 3

Pages 114 and 115

OBJECTIVE

- To extend knowledge about electrical circuits and use the concepts of electric current and energy transfer to explain how electrical devices work.

LEARNING OUTCOMES

After this lesson, students should be able to:

- describe the characteristics of series and parallel circuits.
- draw and construct a series and parallel circuits.
- identify the use of series and parallel electric circuits in daily life.

START (10 min)

Use https://www.ck12.org/book/ck-12-physicalscience-concepts-for-middle-school/section/5.72/ to watch a clip on different types of a circuit and share the explanation about series and parallel circuits.

MAIN (25 min)

Read pages 114 and 115

- Support students in building series and parallel circuits, comparing the brightness of the bulbs.
- Work sheet 3-9

PLENARY (10 min)

- It is great fun to have fairy lights for decoration when you are celebrating something. These days, fortunately, they are produced as parallel circuits, but many years ago, they were made as series circuits.
- Ask students why it is much better to have the bulbs connected in parallel.
- When they are connected in series, none of the lights will work if one bulb is loose or broken. You cannot tell which one is the problem, so you have to check them all.
- Work sheet 4-9
- Test yourself questions on page 117 of Student Book.

HOMEWORK

- Exercise questions 4 and 5 on page 122, 123 of Student Book.

Lesson 4

Pages 111 and 113

OBJECTIVES

- To demonstrate the use of an ammeter to measure the current flowing in an electrical circuit.
- To demonstrate the use of a voltmeter to measure voltage in an electrical circuit.

LEARNING OUTCOMES

After this lesson, students should be able to:

- draw circuit diagrams to represent simple electrical circuits, using appropriate symbols.
- measure the current and voltage in an electrical circuit.

START (10 min)

- Reinforce the concept that an ammeter measures current (how many electrons run through it), and a voltmeter measures voltage (how much "push", or energy, each electron has). The current is constant throughout the circuit (or you would have electrons collecting in one part of it) so it does not matter where in the circuit the ammeter is placed. The voltmeter is connected in parallel to a component (e.g. light bulb, resistor, or cell) and the voltage produced by the source (cell or battery) must be the same as the sum of the voltages measured for each component.
- As before, make sure every circuit has a switch (so it is not left 'on') and make sure that every circuit with an ammeter also has another component (in addition to the switch) such as a bulb or motor. Since the ammeter has very little resistance, a circuit without an additional component would essentially short circuit, which is both dangerous (fire) and/or damages the ammeter.

MAIN (20 min)

- Read Pages 112 and 113 and discuss. Ask questions to ensure students understand.
- Hand out worksheet 4-9. If possible, students should build the circuits and measure current and voltage at various points and in various set ups.
- If practical activity is not possible, complete worksheet 4-9 as a theoretical exercise.

PLENARY (10 min)

Ask students to apply their learning to how they understand appliances with batteries, e.g. a torch.

Test yourself questions on page 113 of the Student Book.

HOMEWORK

- Exercise questions 6 on page 123 of the Student Book.

Lesson 5

Page 114 and 115

OBJECTIVE

- To know about the factors that affect the brightness of bulbs or speed of motors.

LEARNING OUTCOMES

The students should be able to:

- investigate the factors that affect the brightness of bulbs or speed of motors
- number of batteries
- number of bulbs
- type of wire
- length of wire
- thickness of wire

START (15 min)

- Ask students to go through Page 114 and 115 and note down the factors.
- Ask students to make a simple circuit and investigate the factors that affect the brightness of bulbs or speed of motors by changing different components of the circuit.
- Activity page 120 of the student book.

MAIN (15 min)

- Read page 114 and 115 and explain the factors that affect the brightness of bulbs or speed of motors.

- Demonstrate that the larger the diameter of the wire, the more paths will be available for electrons to flow.
- Show that when more bulbs are added, brightness of the bulb in the circuit will become dimmer because it become difficult for current to flow.
- Demonstrate that a piece of thin wire has higher resistance than a piece of thicker wire with the same length.
- Discuss the factor that adding more cells in a series circuit will make the bulb in the circuit brighter because more current will be pushed around it.
- Explain that a long length of wire will have a high resistance.

PLENARY (15 min)

Test yourself questions on page 115 of the Student Book.

HOMEWORK

- Write the factors that affect the brightness of bulbs.

Lesson 6

Pages 118 and 119

OBJECTIVE

- To extend knowledge about electrical circuits and use the concepts of electric current and energy transfer to explain how electrical devices work.

LEARNING OUTCOMES

After this lesson, students should be able to:

- assemble and operate a trip wire security alarm system using simple items. (steam)
- explain electrical resistance and describe how a resistance wire can be used as a fuse.

START (10 min)

- Recall that in lesson 1, the bulb did not glow equally brightly with all conductors and remember that we mentioned 'resistance' when discussing the birds on the high voltage cable.
- Similar information can also be found at https://www.ck12.org/book/CK-12-Physical-ScienceConcepts-For-Middle-School/section/5.68/

MAIN (25 min)

Read Pages 118 and 119

- Explain that in homes, resistance in wires can be put to good use in electrical circuits.
- Show different fuses and their values.
- If possible, ask an electrician to show fuses are attached in circuits.
- Explain that an electrical device can be protected by a fuse in the plug.
- Discuss about the role of fuse in a circuit.

PLENARY (10 min)

Ask students to consider the advantages that electricity has brought us but also consider the dangers and write main points on the board.

Work sheet 5-9

HOMEWORK

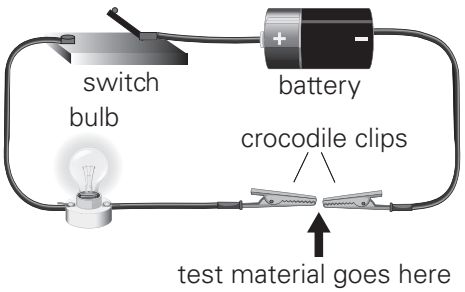
- Test yourself questions on page 120 of Student Book.

Experiment:

1. Which materials conduct electricity (conductors) and which do not (insulators)?

PLEASE NOTE – safety instructions

- Only use the equipment provided as directed by the teacher.
- When you have set up the equipment, ask the teacher to check it before starting the experiments.
- NEVER use power from the mains (unless you have a transformer provided by the teacher).
- Include a switch in every circuit so it is only completed when you push the switch.



Method

1. Set up a circuit as shown on page 110 of your student book.
2. Ask the teacher to check your circuit.
3. Place the first of the materials provided between the crocodile clips.
4. Push the switch.

If the light goes on, electricity is flowing through your circuit, so the material you tested is a conductor. If not, the material is an insulator.

Your materials could include some of the following:

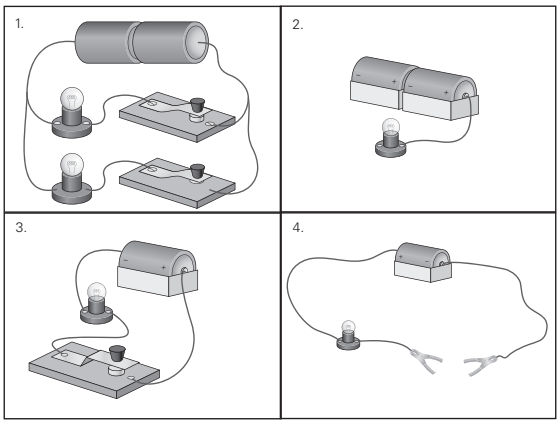
a piece of aluminium foil, a plastic bottle cap, an eraser, a drinking straw, a fresh twig from a bush or tree, a pencil lead, a metal bottle cap, a wooden cube, a paper clip (many others are also possible)

Results

In the table below, record your findings

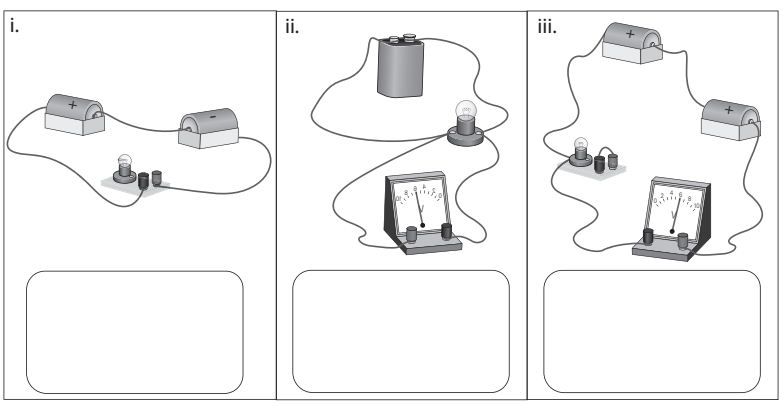
Material	conductor	insulator
a piece of aluminium foil		
a plastic bottle cap		
an eraser		
a drinking straw		
a fresh twig from a bush or tree		
a pencil lead		
a metal bottle cap		
a wooden cube		
a paper clip		

1. For each diagram given on the right side, put a red circle around every bulb which does not light and explain the reason below.



	Explain why the bulb(s) will not light.

2. Draw each of these electrical circuits as a circuit diagram.

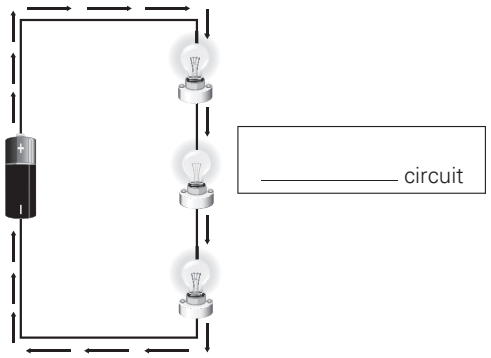


3. Draw circuit diagrams of the following situations. Please use a ruler so you draw straight lines.

a battery connected to a bulb	a battery connected to a motor and a switch	two batteries connected to a buzzer and a bell

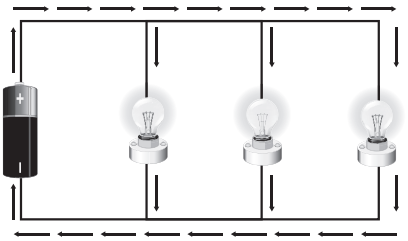
1. Label the drawings with "series circuit" or "parallel circuit".

a.



_____ circuit

b.



_____ circuit

2. Consider the following experiment:

Experiment:

Create a circuit with one cell or battery, a switch, and a lamp. Close the circuit and look at how bright the bulb is. Using the same circuit, add one lamp in series. The lamp must be the same as the one already used. Close the circuit.

a. Are the bulbs burning equally brightly?

_____

b. Are they as bright as when there was only one bulb?

_____

c. If you loosen one bulb, does the other still light up?

_____

Slightly change your circuit so that the bulbs are now in parallel.

d. Are the bulbs burning equally brightly?

_____

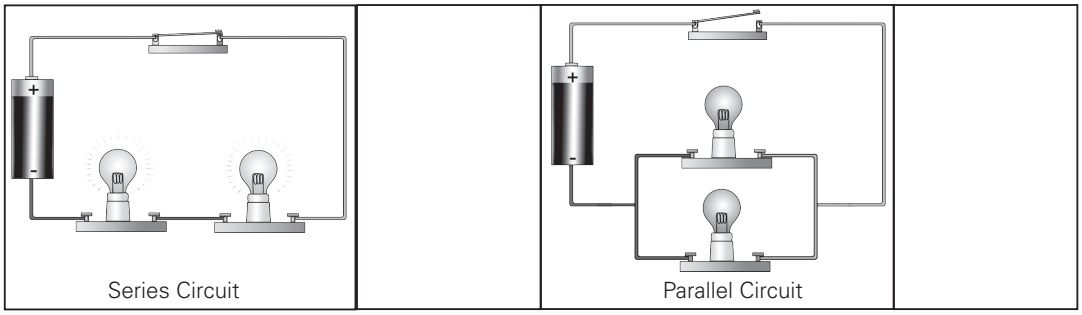
e. Are they as bright as when there was only one bulb?

_____

f. If you loosen one bulb, does the other still light up?

_____

3. Draw the following as circuit diagrams:



Series Circuit

Parallel Circuit

Assuming all bulbs are the same, will they all light equally bright? Explain your answer.

_____

_____

1. A mnemonic is a way to remember something in an easy way. This can be done by using the first letters and making a sentence (which is easier to remember).

   You need to remember that Voltmeters are connected in Parallel, Ammeters are connected in Series. If this is difficult, it may help to remember that "voltmeters and ammeters are **Very Particular About Some** things".

Complete the table below.

	Ammeter	Voltmeter
What does it measure?		
Which units does it use?		
How is it placed in the circuit?		
Does it matter where it is placed?		

2. In the previous worksheet, you saw that three bulbs in series do not burn as brightly as three similar bulbs connected in parallel.

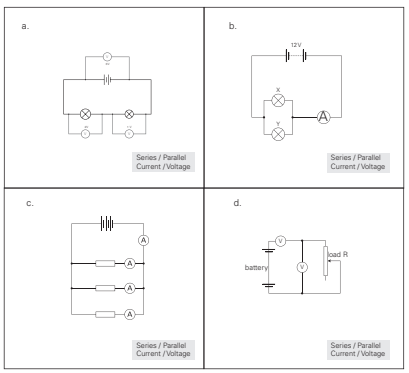
What happens to the current and the voltage in circuits with bulbs in series or in parallel?

Below you can see four circuit diagrams.

Write the correct answer by each circuit diagram:

How are the bulbs connected? Series / Parallel

What is being measured? Current / Voltage



3. Complete these sentences.

   a. When the bulbs are connected in series, the current will be

   _____

   b. When the bulbs are connected in series, the voltage will be

   _____

   c. When the bulbs are connected in parallel, the current will be

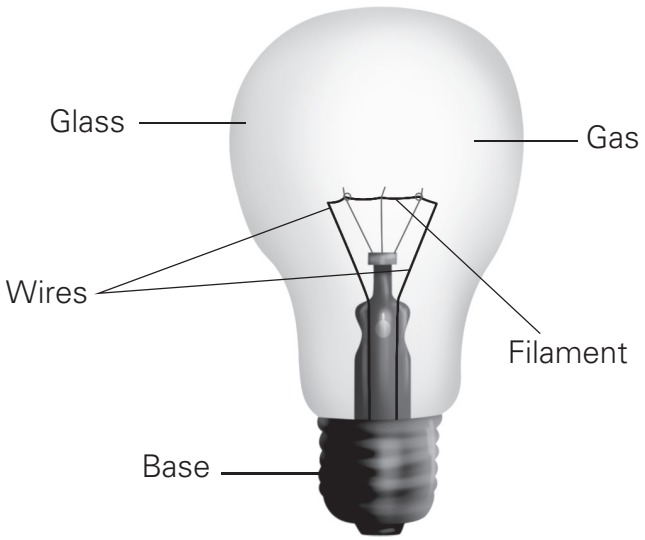
   _____

   d. When the bulbs are connected in parallel, the voltage will be

   _____

1. During the experiment in the first lesson of this unit, you may have noticed that not all conductors allowed the light bulb to light up equally brightly. This is because the division of conductors and insulators is not black and white.

   Many materials will conduct some electricity. How much they conduct depends on the amount of resistance they have. The higher the resistance to electricity, the less electricity will flow through it—remember the example of the birds on the high voltage wire. Even the best conductor has some resistance. This means that it will heat up when a current goes through it. Depending on how much the resistance is and how much the current is, this may or may not be a problem.



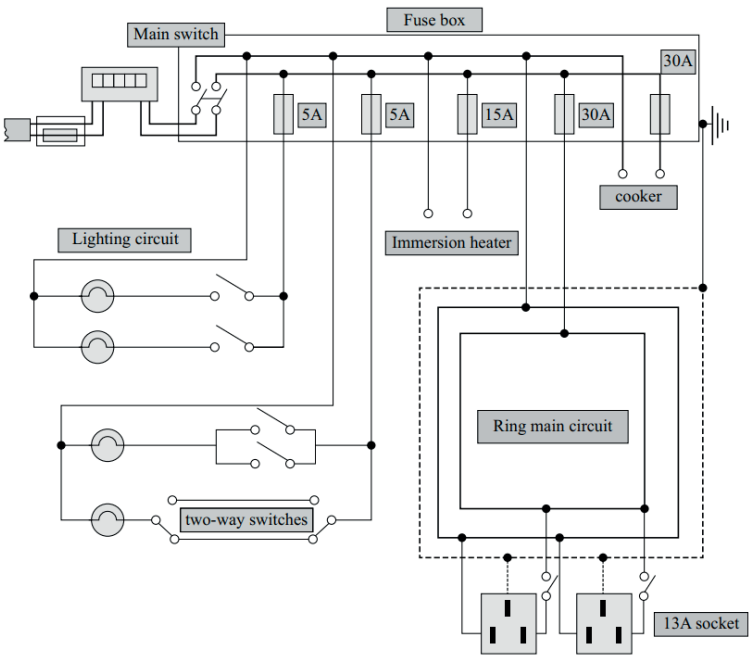
   In a light bulb, the filament has quite a high resistance. A current running through this filament will make it so hot that it will start to glow. A special gas in the light bulb will stop the filament from catching fire, but after some time, the filament will be destroyed and we need a new light bulb. Name some household appliances which also make use of the concept that high resistance causes a wire to become very hot.

   _____

   _____

   However, if an old appliance breaks, it may 'short circuit'. That means that the current will no longer go through the appliance, with its resistance, but, instead take a short cut. Without resistance, a lot more current will go through, and that could be dangerous. In order to prevent this large surge of current, we can use a fuse. A fuse is a piece of wire with a specific resistance. When too much current runs through this wire, it will melt and break the circuit. This means we have to replace the fuse but have avoided the large and dangerous surge of current. In some countries, each plug of an appliance will have its own fuse.

1. The cables used in a house are made in such a way that they do not heat up much when a normal current goes through them. However, an old appliance, for example, could break and cause a short circuit. The electricity would not flow through the appliance (with a certain amount of resistance) but would take a 'short-cut' without any resistance. This short circuit would lead to a lot of current going through the cables and could make them heat up so much they could start a fire. To prevent this type of situation, the cables in your house are connected to the electricity supply via a fuse. As there are several separate circuits in your house, each has its own fuse. All fuses are put together in the fuse box. A diagram of a possible design of the electric circuits in a house is shown below.



You can see that different parts of the house have their own circuit.

1. Give examples of anything in your house which uses electricity? Do not include anything on batteries.

_____

2. Consider that anything which heats up or cools down will take much more energy than e.g. lamps. Where in your house would you use fuses that allow a lot of current before they melt and where could you put fuses which do not allow so much electricity?

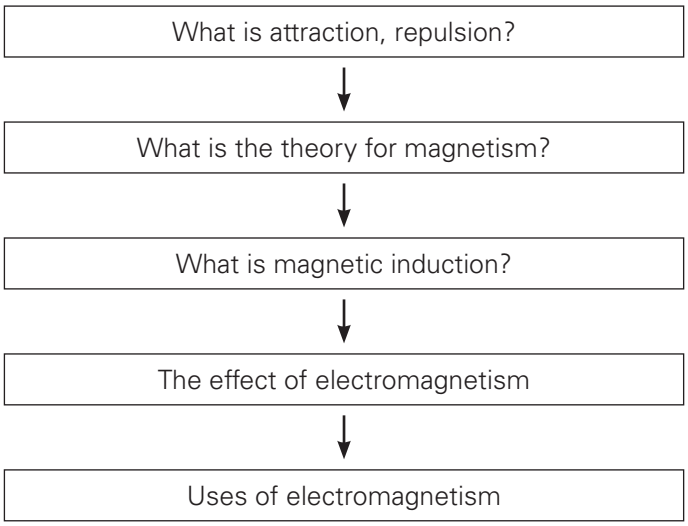
_____

When a fuse 'blows', i.e. too much current has gone through it and the special cable has melted, it needs to be replaced. As different areas have fuses allowing different amounts of current, this means that people have to have a range of spare fuses. So now, many places have devices called 'circuit breakers'. When too much current flows through them, a switch flips itself and the circuit is cut. When the faulty device which caused the overload is unplugged, the circuit breaker switch can simply be flipped back again.

Chapter

10 Magnetism

UNIT FLOW CHART



INTRODUCTION

Nearly everyone knows something about magnets. You have probably used a magnet to pick up pins, tacks, and other things made of iron or steel. We do not know when and how magnetism was discovered, but different stories are told about how a kind of rock was discovered which would attract pieces of iron towards itself and hold on to them.

For many years, people thought that magnetism was a quality unique to one kind of rock. It was interesting, but it was not really useful. At last, someone discovered that a piece of iron would act like a magnet if it was rubbed on the rock. This was followed by an even greater discovery.

If a magnet made of iron was set on a piece of wood floating in water, the magnet would turn until it pointed towards the north and south. This was the first compass. The rock used to make the iron magnet in the compass was called lodestone. Scientists have found that lodestone is made of a kind of iron ore called magnetite.

The compass is one of the most important inventions ever made, but for a long time no other uses for magnets were discovered. Magnets were so weak that they could move only small pieces of iron. Finally scientists discovered how to make much stronger magnets by using electric current. They also learned how to use electric current to make electromagnets, where the magnetic force could be turned on or off. From then on, many new uses for magnets were found.

Telephone receivers, loudspeakers and speedometers, all have magnets in them. So do electric bells and buzzers. Magnets are found in every electric motor or generator. Doctors often use magnets to get tiny bits of iron out of a person's eyes or throat. In these and many other ways, magnets are used every day.

The objective of this chapter is to explain the properties and function of magnets and electromagnets. They will be able to identify the different ways they are used.

Lesson 1

pages 126 and 127

OBJECTIVE

- To identify magnetic materials and magnetic field.

LEARNING OUTCOMES

The students should be able to:

- recognise that electric current has a magnetic field around it and that it can be verified using a magnetic compass.
- recognise that a freely moving magnet comes to rest pointing in a north-south direction.
- compare different types of magnets (permanent, temporary and electromagnets).
- recognise earth's magnetic field which attracts a freely-pivoted magnet to line up with it

Warning

Iron filings should be stored carefully. Do not dip your magnets in iron filings – it is difficult to get them clean again. Ensure there is no class room management issues, as inhalation of iron dust is unhygienic.

START (10 min)

Show students a magnet and elicit what they already know about magnetism. As usual, do not provide (much) feedback or response but let the students react to each other's comments so that you discover their knowledge and/or possible misconceptions.

MAIN (20 min)

- Read pages 126 and 127 and distribute worksheet 1-10.
- Hand out magnets and ask students to investigate whether objects are attracted or repelled by a magnet or if no force is evident. Students should record their findings in worksheet 1-10.
- Ask students to suspend their magnets as shown in the illustration. Place them around the room away from other magnets. The magnets should all orient themselves in the same direction – i.e. the Earth' magnetic field. Draw students' attention to this phenomenon.

  It would be useful to know which side of the room is north and which is south.
- Bring a magnet near to one of the suspended magnets and observe how it changes its

orientation. Ask students to write down their observations in worksheet 1-10.

PLENARY (15 min)

In this lesson, students saw that a magnet attracts objects made of iron or steel but also attracts the opposite pole of other magnets. So how could they prove if something is a magnet or if some material is attracted to a magnet? The proof of a magnet is in repulsion. If an object is attracted to the magnet, it may be a magnet or an object with induced magnetism. However, when the magnet is turned around to test the object with the other pole of the magnet—a real magnet would be repelled while an induced magnet would still be attracted. So the test for magnetism is in repulsion.

HOMEWORK

- 'Test yourself' questions page 127 of the student book.

EXTENSION

Visit https://www.exploratorium.edu/snacks/eddycurrents. This experiment shows that a magnet will fall through an aluminum, brass, or copper tube more slowly than through a non-metal pipe. Do not use an iron or steel pipe as the magnet simply attaches to the pipe and will not fall.

This can be done as a demonstration with the students timing the fall of the various objects through different pipes. If you do this, do several repeats of each combination (object and pipe) to obtain some statistical relevance.

Lesson 2

Pages 128-129

OBJECTIVE

- To identify magnetic materials.

LEARNING OUTCOMES

The students should be able to:

- identify the shape and direction, of the magnetic field around a bar magnet.
- recognise that electric current has a magnetic field around it and that it can be verified using a magnetic compass.
- recognise that a freely moving magnet comes to rest pointing in a north-south direction.
- recognise that there is a space around a magnet where the effect of magnetic force can be observed.
- draw the magnetic field of a bar magnet using iron filings.

START (10 min)

Forces cannot always be seen, but to understand them we can draw them. To show how a magnetic field works, we can use iron filings and a magnet. The small pieces of iron will be induced to behave like small magnets as long as they are near the real magnet. Discuss this concept with students.

Please remember to keep at least one sheet of paper between the magnet and the iron filings. Remind students that they also need to keep the iron filings separated from the magnet by a sheet of paper.

MAIN (25 min)

read pages 128-129

- Support students doing task 1 from the worksheet 2-10. Ensure that the iron filings do not come into direct contact with the magnet by keeping a sheet of paper or a transparency between them at all times.
- When investigating the strength of the magnetic field, students should consider that the iron filings represent the field lines and that a stronger field is indicated by the field lines being closer together.
- Test yourself page 129 of the student book

PLENARY (10 min)

Ask students the following questions:

- Where are magnetic forces stronger?
- In which direction do magnetic lines of force move?
- Do they ever cross each other? Explain by considering what happens if they do and if they do not cross.
- worksheet 2-10

HOMEWORK

- Exercise question 3 and 4 page 136 of the student book

Lesson 3

Pages 130–131

OBJECTIVE

- To explain the concepts of a magnetic field of a permanent magnet and an electromagnet.

LEARNING OUTCOMES

The students should be able to:

- understand how magnetism can be induced in a piece of iron or steel.
- describe how to magnetize a magnetic material.
- describe how to de-magnetize a magnetic material.
- construct an electromagnet and identify its application in everyday life.

START (15 min)

- Review 'Test yourself' questions from previous lessons.
- Show a small piece of a broken magnet to the class and ask if it is a complete magnet? Test the properties of this magnetic piece.

MAIN (15 min)

read page 130 -131

- Explain the domain theory with arrows drawn in the same direction on the board.
- Discuss if a piece of iron is kept near a magnet. What will happen to the domain?
- Ask students to magnetize a piece of iron by stroking it repeatedly with a magnet. Bring an iron nail near to the induced magnet. What happens? Then bring a steel nail near to it.

PLENARY (15 min)

Discuss the following in class:

- How can you make a temporary magnet? What happens to the domains before and after making a temporary magnet?
- What is induced magnetism?
- How can you make a permanent magnet?

HOMEWORK

- 'Test yourself' questions, page 130 -131 of Student Book.

Lesson 4

Page 132 and 133

OBJECTIVE

- To show how magnets and electromagnets can be used in a number of devices.

LEARNING OUTCOMES

The students should be able to:

- demonstrate how an electromagnet is made.
- describe some uses of magnets and electromagnets.

START (10 min)

Elicit responses from students on following questions:

- Have you seen an electromagnetic crane?
- Where is it used?
- Where else do we use electromagnets?

MAIN (25 min)

- Read Page 132 and 133 and explain about the use of electromagnets.
- The teacher should demonstrate making of an electromagnet and explain how to make it (as written in the worksheet 3-10). Students should be divided into four groups. Each group should be given an iron nail, copper wire, and batteries. They will be asked to make the electromagnet themselves.

PLENARY (10 min)

Perform investigation 2 on page 137 of the Student Book and discuss responses of the student.

HOMEWORK

- Students can do research on where electromagnets are used in modern technology.
- Project to construct a working model of an electromagnet can be assigned to the students.

EXTENSION

http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/electricityworld/mainselectricityrev3.shtml

This site allows students to set the circuit breaker and then to set the current flowing through it. If the

actual current exceeds the maximum set, the circuit breaker will cut the circuit.

Lesson 5

Page 134

OBJECTIVE

- To show how magnets and electromagnets can be used in a number of devices.

LEARNING OUTCOME

The students should be able to:

- describe some uses of magnets and electromagnets.

START (10 min)

Ask students if they can identify the uses of electromagnets.

MAIN (25 min)

- Read page 134 and briefly explain the uses of electromagnets.
- Explain that a relay is an electronically controlled switch. It uses a small current to turn on a separate circuit, which may carry a large current.
- Discuss that in electronic circuits, small relays are used. These have a very thin, flexible piece of metal inside a glass tube. The metal acts like a switch. When a magnet is nearby, the switch becomes magnetized and the contacts touch.
- Demonstrate that the relay can be activated by a small bar magnet or a small coil. Some reed relays have their contacts together under normal conditions. The switch then opens in a magnetic field.
- Work sheet 3-10

PLENARY (10 min)

Ask and discuss responses of 'Test yourself' questions given on page 134 of Student Book.

HOMEWORK

- Exercise Question 7 and 8 page 136 and 137.

Task 1

a. Use the magnet your teacher has provided to test if objects are attracted. Record your findings in the table below. You must record at least 5 objects.

Object	What is it made of?	Magnetic	Non-magnetic

b. What conclusion can you draw from your findings?

Task 2

With your class, suspend your magnets from a piece of string so that they can move freely. Place them around the room.

a. What do you notice about the orientation of the different magnets?

_____

b. If you bring another magnet near to one of the free moving magnets, what happens?

_____

c. Explain what happened in both of the above situations.

_____

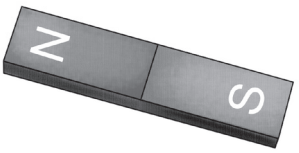
Make sure you have read pages 48 – 50 of your Student Book.

Task 1

Experiment:

a. Place a bar magnet flat on the table and place a thick sheet of paper on top of the magnet. If overhead transparencies are available, these are great too.

b. Gently shake a small amount of iron filings onto the paper or sheet.



c. Give the paper a few very gentle taps to allow the iron filings to settle.

d. Draw the field lines (=patterns you see) below.

e. Repeat using different shaped magnets.

f. Take a good look at the density of the iron filings at various points. There are more filings in some places than in others. You can also see this on page 48 of your Student Book. What could be the reason for this?

_____

g. We indicate a stronger magnetic field by drawing the field lines closer together. Check if you did this in your drawings and adjust them if necessary.

_____

Check with your teacher if you are allowed to place two magnets under a sheet to study the interactions on the position of the iron filings. Draw the field lines and compare them with those on page 50 of your Student Book.

Experiment:

1. Make an electromagnet. Take an iron nail. Wind 20 turns of copper wire around the iron nail.

   a. Is it behaving like a magnet?

   _____

   b. How many pins are attracted by this electromagnet?

   _____

   c. Now connect the ends of the wire to two batteries. What do you observe?

   _____

   d. How many pins can be attracted now? Record your observations.

   _____

2. Now take the same size of iron nail, but this time wind 40 turns of copper wire with one battery, and then with two batteries. Record your observations.

No. of turns of wire	No. of batteries	No. of pins attracted by electromagnet
20	1	
20	2	
40	1	
40	2	

   a. Which variables have you changed in this experiment?

   _____

   b. Which variable has been constant?

   _____

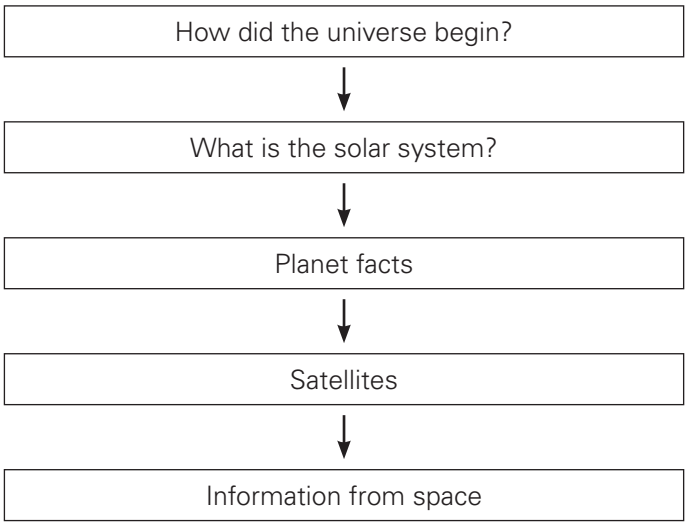
   c. How can you make an electromagnet stronger? List two ways.

   _____

Chapter

11 Solar System

UNIT FLOW CHART



INTRODUCTION

The universe contains everything that exists. We do not know how big the universe is. A galaxy is a star system. Our Earth is part of a galaxy called the Milky Way. There are thousands and thousands of stars in the Milky Way. These stars give a milky appearance to the sky, hence the name.

Galaxies are very far apart. The nearest galaxy to the Milky Way is called Andromeda. Andromeda is two million light years away. This means that the light we see from Andromeda has taken two million years to reach us. We are seeing it as it was two million years ago. Astronomers believe that there are many more galaxies further out in space that cannot be seen.

There are several theories regarding the origin and formation of the universe.

The big bang theory:

This theory suggests that the universe began 10,000 million years ago with an enormous explosion.

The pulsating universe theory:

Scientists assume the universe to be continually contracting and expanding. When the universe has expanded to a certain size it will begin to shrink. The galaxies will be pushed closer and closer together. Eventually they will explode causing the universe to expand again.

The expanding universe theory:

Scientists suggest that the universe will never collapse but keep on expanding. This theory implies that there has only ever been one big bang.

Lesson 1

pages 138-140

OBJECTIVE

- To extend knowledge about the planets of our solar system.

LEARNING OUTCOMES

Students should be able to:

- Differentiate between the characteristics of different planets.
- Name the planets of the solar system and recall some information about them.

START (15 min)

This sections starts with some calculations for two reasons. First, it is important that students have some idea of the size of Earth relative to our solar system. For this reason, they may hypothetically create a model of the solar system which is the size of the classroom. After doing the calculations, they will find that they cannot build this model to scale since Earth would be too small. The second reason is that students should see the use of working with numbers beyond what happens in mathematics. Many students struggle with numbers, but even those who can do the sums in mathematics do not always see how their skills can be applied in other situations. Please make sure you understand fully how the calculations work so you can help your students. The questions at the end of the worksheet 1-11.

Bingo game:

Another way of getting students to interact with this material would be for students to create a bingo game. Groups of four students prepare, e.g., 25 questions where the answers could be the name of a planet and/or facts about the solar system. It is important that answers are very brief. The group then prepares bingo cards with 15 correct answers. Each card should have correct answers to different questions. The game is played by the group reading out the questions in a random order. The other students in the class have each received a bingo card. When a question is asked by the group, the other students will individually and in silence think of the answer and if they find it on their card, cross it off. When a student has crossed off all answers on his/her card, he/she calls out 'Bingo' and a group member will check if they have crossed off the correct answers.

For example: a question could be 'Which planet is closest to the Sun?'

Student 1 will know the answer is Mercury and will cross it off his/her card.

Student 2 also knows the answer but his/her card does not have 'Mercury' as an answer so s/he cannot cross off anything.

Student 3 thinks the answer is Venus and crosses this off his/her card.

The next random question is then read out. If student 3 is the first to cross off all his/her answers, s/he will call out Bingo and a team member will check and see that s/he crossed off an incorrect answer. She/he will be disqualified and the game continues to the next question. So winning the game depends on knowing the correct answers, but also on luck as you may not have each answer on your card.

MAIN (10 min)

Read pages 138-140

- Steer the discussion towards the size of the solar system and the relative sizes of the planets and the distances between them. Then ask students to use the exercise where they calculate whether they can make a scale model of the universe in the classroom.
- Discuss what students know about the solar system. Often one or a few students will have been interested in this topic when younger and may remember some information. Invite (some of) these students to take turns to share their knowledge with the class and encourage the class to question these 'expert students'. Your role is only to monitor that the information provided is correct; try to avoid giving any answers.
- Tell about the next nearest star, Alpha Centauri, is much bigger but looks tiny because it is so far away.
- Discuss about the nuclear fusion and explain about the reaction of gases.

PLENARY (10 min)

Ensure students have understood the purpose of the exercise: that Earth is very small in the solar system. If you wish, you can take the discussion to the level of the Milky Way, the galaxy of our solar system,

and eventually the size of the universe, but do not be surprised if this becomes meaningless—most adults find it hard to really understand.

Test yourself page 140

HOMEWORK

- Draw and colour the labeled diagram of the solar system.

Lesson 2

Pages 141-145

OBJECTIVE

- To understand about the characteristics of asteroids, meteorites and comets.

LEARNING OUTCOMES

The students should be able to:

- describe the characteristics of asteroids, meteorites and comets.
- differentiate between planets and dwarf planets.
- inquire into the sighting of Halley's comet; describe what they would feel if they saw it.

START (10 min)

Show table on page 141 of the student book.

MAIN (15 min)

- Read page 142 and 143 of the student book and explain the characteristics of asteroids, meteorites and comets.
- Discuss about the five dwarf planets in our solar system. They are Ceres, Pluto, Haumea, Makemake, and Eris.
- Discuss about the facts about the Dwarf planet and show table on page 143.
- Explain that the Asteroids are pieces of rock that orbit the Sun. They were left over when the solar system was formed.
- Explain that the meteoroids are small pieces of Asteroids.
- Hoba meteorite in Namibia, the largest known meteorite on earth. It weighs about 60 tonnes
- Discuss about the Halley's Comet. This is a well-known comet in our solar system. This comet is named after the scientist Edmond Halley.

PLENARY (15 min)

Ask students about the differences between asteroids, meteorites and comets.

Exercise Question 3 page 150 of the student book

HOMEWORK

- Test yourself page 144

Lesson 3

Pages 146-149

OBJECTIVE

- To understand about the Global Positioning System (GPS).

LEARNING OUTCOMES

The students should be able to:

- describe the uses of various satellites in space i.e., geostationary, weather, communication and Global Positioning System (GPS).
- investigate how artificial satellites have improved our knowledge about space and are used for space research.

START (15 min)

MAIN (15 min)

Read Pages 146-149

- Explain why a satellite stays up?
- Draw a diagram on the board and show the following:
  a Show a path taken by a shell fired from the gun.
  b Show the path taken by the shell from the gun at a greater speed. It travels further before hitting the Earth.
  c Show the path of the shell fired from the gun at even greater speed. This shell is travelling so fast that the curve of its fall matches curve of the Earth.
- Explain that a polar orbit satellite 'sees' a slightly different part of the Earth because the planet is always turning.
- Discuss that the satellite can therefore build up a picture of the whole of the Earth's surface.
- Explain about the geostationary satellites which are very useful for communication.

- Discuss about the Global positioning system(GPS)
- Discuss that the Satellite navigation is made possible by the global positioning system.

PLENARY (15 min)

Worksheet 3-11

Ask different questions:

Q. Name three types of artificial satellites.

Q. What is the Hubble space telescope?

Q. Explain the difference between a polar orbit and a geostationary orbit.

Q. Why a satellite stays up in space?

Test yourself page 148 of the student book

HOMEWORK

- Test yourself page 149 of the student book.
- Assignment: students to make a traveller's guide booklet of solar system.

1. As it may be difficult to imagine all the planets circling the Sun, you could build a model of the planets of the solar system to scale in your classroom. Use the information on pages 134 and 135 to do your calculations.

   Suppose your classroom is 20 m long. If you put the Sun on one side, Neptune will be on the other side.

   a. What is the real distance between Neptune and the Sun? _____
   _____

   b. What would this be in metres? _____

   c. So if you are going to build a model of the solar system in your classroom, you will put the Sun on one side of the room and Neptune on the other. The scale of your model will be determined by the size of your classroom. Let us assume your classroom is 20 m long. This 20 m will represent the distance between the Sun and Neptune. Other distances and the sizes of the planets need to be calculated to the same scale. In order to work out the scale, you will need to do the calculation below.

$$\frac{\text{distance of Sun-Neptune (in m)}}{\text{Length of classroom}} \quad \frac{\qquad}{\qquad} \quad = \qquad$$

   The number in the grey box is your scale.

   So 1 m in the classroom model = _____ m in the scale system, or

   _____ m in the scale system is 1 m in the classroom

   Now you need to use the number in the grey box to work out how big Earth would be in your model.

   d. What is the real diameter of Earth? _____

   e. What would this be in metres? _____

   f. Now you need to divide the diameter of the Earth by the scale you calculated in the grey box to get the size of Earth in your classroom model.

$$\frac{\text{diameter of Earth (in m)}}{\text{Scale}} \quad \frac{\qquad}{\qquad} \quad = \qquad \text{m}$$

   g. This number in the grey box is in metres. What would be the size of the Earth in your classroom model in mm? _____

   So it may not be realistic to make a model of the solar system to scale in your classroom, but you now have an idea of the size of the solar system in relation to Earth. Just for comparison, the diameter of a pin (used by tailors) is 0.5–1 mm. Earth in your classroom model would be less than one tenth of the diameter of a pin when the distance of the Sun to Neptune is 20 m.

But what you can do is to model the distances between the Sun and the planets of the solar system inside your classroom. String a rope from one end of the room to the other. If the length of the rope is not 20 m, you will have to redo the previous calculations to find the scale for converting the distances in the solar system to the scale model inside your classroom.

h. Once you have calculated the scale, you need to calculate the relative distance of each planet to the Sun on the scale of your classroom.

$$\frac{\text{distance to the Sun (in metres)}}{\text{Scale factor}} = \quad \text{(relative distance on the scale of your classroom)}$$

Please also include Neptune in your calculations. If the relative distance to the Sun on the scale of your classroom is NOT the length of the string, you need to check your calculations. Use clothes pegs or paperclips to hang a piece of paper with the name of the planet (or Sun) at the correct spot on the string. You can also add more information about each planet and put the string up high so everyone can see it while going through this unit.

In order to remember the planets of the solar system, you can make a mnemonic of the first letters of their names. You can make a sentence using any words you like as long as their first letters are the same as the names of the planets in the solar system (in order). M(ercury), V(enus), E(arth), M(ars), J(upiter), S(aturn), U(ranus), N(eptune). Example: My Very Educated Mother Just Served Us Nuggets

a. Now write your own mnemonic: _____

_____

b. Answer the following questions.

Which planet is closest to the Sun?	
Which planet is the farthest from the Sun?	
On which planet would night be the longest?	
Which planet is the largest?	
Which planet is the smallest?	
On which planet would you have the most birthdays?	
On which planet would you be unlikely to live even one year?	
On which planet would you be able to wash?	
On which planets would you be able to breathe oxygen?	
Which planet is the warmest?	
Which planet is the average temperature of your freezer at home?	
Which planets have no moons?	
Which planet has the most moons?	

1. Write differences between the following:

Planet	Dwarf planet facts

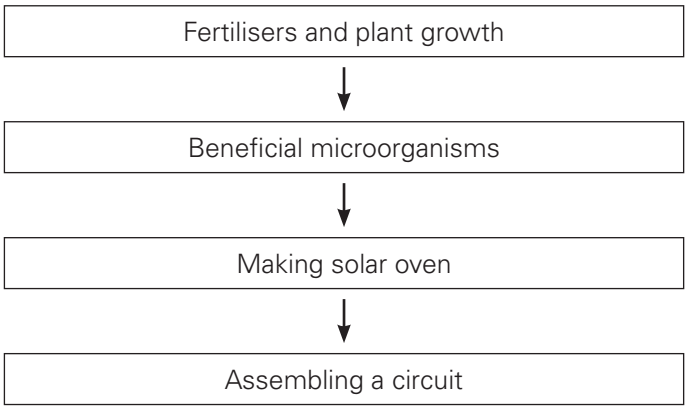
meteor	meteorite

Asteroids	Meteoroids

Chapter 12

Technology in everyday life

UNIT FLOW CHART



Lesson 1

Page 152-154

OBJECTIVE

- To encourage students for plantation.

LEARNING OUTCOMES

The students should be able to:

- grow seasonal plants and vegetables in earthen pots and demonstrate the effect of use of fertilisers on the growth of plants.

START (10 min)

Materials required : 12 small earthenware plant pots, labels, soil, liquid fertiliser, radish seeds, ruler.

MAIN (25 min)

Read Page 152-154

Explain that the fertiliser contains three elements essential for plant growth. These are

a. nitrogen (N)

b. phosphorous (P)

c. potassium (K)

Discuss that these elements are combined with glucose made in photosynthesis to make amino acids.

Explain that the Amino acids are the building blocks of protein.

PLENARY (10 min)

Ask the names and symbols of the elements required for the plants' growth.

HOMEWORK

- Assignment: collect biodegradable materials from the household trash and make fertiliser. Use that fertiliser in the potted plants at home and school.

Lesson 2

Pages 154-156

OBJECTIVE

- To understand the process of fermentation.

LEARNING OUTCOME

The students should be able to:

- prepare yoghurt and cheese from milk to demonstrate the beneficial microorganisms.

START (15 min)

Materials required:

Making yoghurt – method 1

Saucepan, 1 litre of fresh full fat milk, natural live yoghurt, thermometer, pH paper or pH meter, measuring cylinder or jug, stirrer, sterile glass jar and lid.

Making yoghurt – method 2

UHT (ultrahigh temperature treated) sterilized milk, natural live yoghurt, sterile boiling tubes, sterile glass stirrer, boiling tube rack, plastic film, thermometer, water bath or oven, pH paper or pH meter, measuring cylinder.

Safety notes:

1. Wear safety goggles. 2. Take care while boiling milk in the saucepan. 3. Do not taste this yoghurt without permission from your teacher.

MAIN (30 min)

Read Pages 154-156

- Discuss about the beneficial microorganisms.
- Explain that many microorganisms are of great benefit to us.
- Discuss that the good bacteria in yoghurt are called probiotics and are used to ferment milk.

PLENARY (15 min)

Ask students about different types of microorganisms.

HOMEWORK

- The good bacteria in yoghurt are called probiotics and are used to ferment milk.

Lesson 3

Pages 159-160

OBJECTIVE

- To know about the design of solar oven.

LEARNING OUTCOME

The students should be able to:

- design a solar oven to convert solar energy into heat energy.

START (15 min)

Materials required:

Cardboard box, scissors, black card, polystyrene sheets (3 cm thick), sharp knife, ruler, glue gun, sticky tape, aluminium foil, sheet of glass or clear plastic sheet (large enough to cover the box), beaker, thermometer.

MAIN (15 min)

Read pages 159-160

- Discuss that the Infrared waves from the Sun carry heat (thermal) energy to the box where it is reflected in to the box by the lid.
- Record results in a table.

PLENARY (15 min)

Discuss about the use and importance of renewable energy. Invite students to participate in the discussion.

HOMEWORK

- Collect information about solar energy and paste in the note book.

Lesson 4

Pages 161-162

OBJECTIVE

- To understand about the working of an electric bell.

LEARNING OUTCOME

The students should be able to:

- assemble a circuit to demonstrate the working of an electric bell.

START (15 min)

Materials required: door bell, push button switch, 3 x 1.5 V cells, connecting wires.

MAIN (15 min)

Pages 161-162

- Explain that the working of an electric bell is a mechanical bell that works by means of an electromagnet.
- If possible bring an electric bell and show the internal structure.
- Explain the concept of make or break circuit because when the circuit is 'made' (switched ON) the electromagnet attracts a lever with the hammer.

PLENARY (15 min)

Repeat the experiment again but this time use three cells and invite students to discuss the following questions:

a What is the voltage of this circuit?

b What difference does this make to the sound of the bell?

c What conclusion can you draw from your results?

HOMEWORK

- Ask students to draw a circuit diagram in the note book.