

Complimentary Copy—Not For Sale

For secondary classes

SCIENCE

Fact file

Teaching Guide

3



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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.

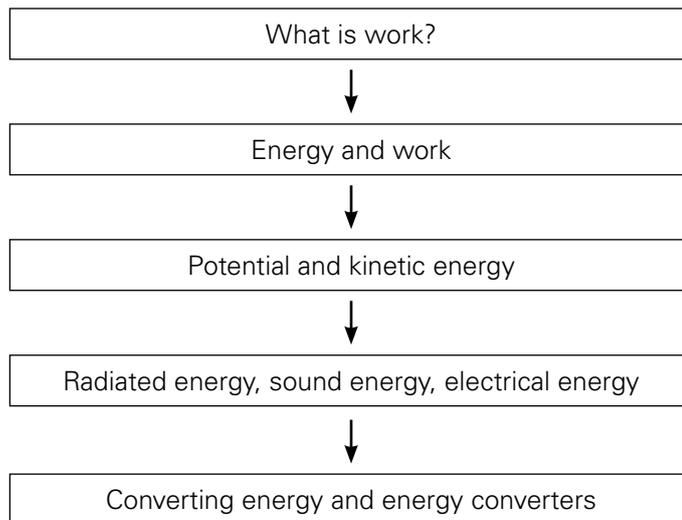
Worksheets – Photocopyable masters are referred to in the lesson plans; use these to supplement and extend the work presented in the textbook. Conduct experiments that can be carried out throughout the unit, there are also suggestions for investigations that can be conducted. The idea of the investigations 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.

Answers – These provide, where possible, the expected results of any activity and answers to any questions in the units, including the Test yourself section. They also contain answers to questions in the workbook.

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!

Work and energy

UNIT FLOW CHART



INTRODUCTION

When students think of 'work', they may have in mind the things they will do when they have a job, or they may even be considering 'homework'. It could be 'work' involving their minds (like homework) or physical work, such as a gardener does.

It is important that students realise that scientific use is sometimes different from the everyday use of the same term. 'Work' is a good example of this. To reinforce this concept, having students copy a definition can be a useful approach.

The scientific term 'work' relates to moving an object using a force. The more force needed, the more work is done. Similarly, the farther the object is moved, the more work is done. The amount of energy needed is the same as the amount of work done. Both are measured in joules or kilojoules.

Many different types of energy are discussed. Potential energy is 'not doing work yet'. It is the energy in petrol while it is in the car's fuel tank and the car is stationary. It is also the energy of a book on top of a cabinet before it falls. As energy is used to do work, the many kinds of potential energy become kinetic energy, such as moving car or falling book. One kind of energy can be converted into one or more others, although some energy is always released as heat.

Lesson 1-1

Pages 2-3

OBJECTIVES

- To explain what 'work' is.

LEARNING OUTCOMES

The students should be able to:

- explain how work is done.
- use correctly units for measuring work and calculate work done.

START (15 minutes)

Ask students to write down (on a post-it) how they would define 'work'. Put these post-it notes on a wall and try to work out a definition with the entire class. Now ask what they think 'work' means in terms of science. It is likely that students realise that 'homework', for example, is not 'work' when we use the term scientifically.

Ask: When you were doing your class work in the previous period, were you doing any work according to science? Push the huge class cupboard. Are you able to move it? If not, then are you doing any work? Now lift your bag from the ground to the table. Have you done any work?

MAIN (20 minutes)

- Tell the class that in science work is done only when:
 - o a force is applied.
 - o distance is moved in the direction of the force.
- Discuss what is the formula for work done? What are the units of work done?
- Hand out Worksheet 1-1 to students.

PLENARY (10 minutes)

1. Ask students to solve questions 3, 4, and 5 on page 13 of the Student Book.
2. Elicit responses from class whether work is being done or not in the following situations:
 - a boy pushing a wall
 - a car jack is turned to lift a car
 - a wind-surfer surfing in wind

- a student walking to school carrying his/her bag

HOMEWORK

Questions 3, and 4 on page 3 of the Workbook.

Lesson 1-2

Pages 4-9

OBJECTIVES

- To introduce different types of energy.
- To explain that gravitational pull between bodies depends on their masses and the distance between them.

LEARNING OUTCOMES

The students should be able to:

- identify different types of potential energy.
- explain kinetic energy.
- describe radiated energy, sound energy, thermal energy, and electrical energy.

START (10 minutes)

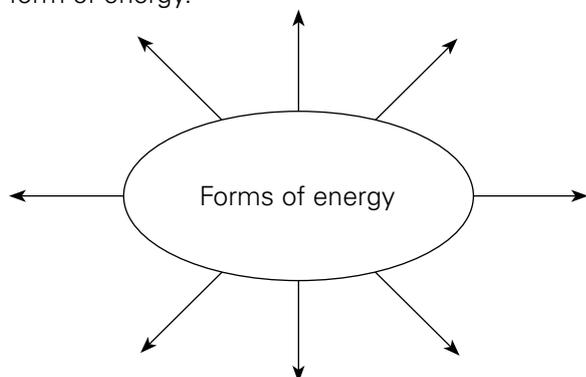
Remind students that they have learnt what 'work' is in terms of the scientific meaning of the word. In order to do work, one needs energy. Give each student two small post-it notes and ask them to write one type of energy on each note. Sort them on the board.

MAIN (20 minutes)

- Read pages 4 – 9 of the Student Book. You may choose to ask following questions while reading.
 - o What is the main source of energy?
 - o What is energy due to motion called?
 - o What is stored energy called?
 - o Can one form of energy be changed into another form? Give examples.
 - o What is the law of conservation of energy?
- Hand out Worksheet 1-2 to students.

PLENARY (15 minutes)

Ask the students to draw and complete the following energy chart. Ask them to give one example of each form of energy.

**HOMEWORK**

Workbook page 4, Question 5 and page 7 Question 8.

Lesson 1-3

Pages 10-11

OBJECTIVES

- To show a range of energy conversions.

LEARNING OUTCOMES

Students should be able to:

- describe how one form of energy is converted into another type of energy.

START (10 minutes)

Ask your students:

- to rub their hands together briskly for 10 seconds. What do they feel?
- if they have ever felt the bonnet and/or tyres of a car just after it came to a halt. Does anyone know what they feel like?
- if anyone of them has ever touched a light bulb just after it was switched off. What does it feel like?

MAIN (25 minutes)

- Discuss what the above situations have in common. (They all produce heat as a by-product of an energy conversion.)
- Read pages 10 and 11 of the Student Book.
- Hand out Worksheet 1-3.

- Make sure students understand the energy conversions in the car's engine. Maybe they all do not know that the fuel evaporates and therefore expands. This expansion moves a piston which in turn moves the wheels.

PLENARY (10 minutes)

Can your students come up with other chains of energy conversions? Ask them to plan how they would build something with as many energy conversions as possible. If you want, you could ask them to build it (see below) but this would require some planning relating to the necessary materials and the time allowed.

Discuss the efficiency of energy conversions. Every conversion produces some unintended other type of energy (often heat). Given that we need to reduce our use of energy, particularly fossil fuels, we need to reduce the energy 'lost' in these conversions. Discuss that energy is never 'lost', but this is a common way of describing the difference between the energy going in and the output of the type of energy we want. Ask students to come up with examples, such as the heat of the car tyres, which is a waste of energy.

If you want, you can compare various types of light bulbs and their efficiency. You may also wish to consider other environmental factors such as the toxicity of fluorescent bulbs on disposal.

EXTENSION IDEA

You could ask students to build something which will show many energy conversions. For example, use a rubber band to shoot a ping-pong ball into a tube angled down. The ball should drop onto a see-saw which will move and flip a switch to complete a circuit which will sound a bell. Of course, this can be extended quite a bit. The winner is the student with the most conversions. You will need to decide beforehand whether, for example, the kinetic energy from the ball to the kinetic energy of the see-saw is an energy conversion. Also, do you allow 'repeats'; e.g. from potential gravitational to kinetic, back to potential gravitational? There is no right and wrong in this but establish the rules clearly beforehand to avoid disgruntled students!

HOMEWORK

Read pages 10 and 11 of the Student Book and answer the questions on page 11.

**Task 1**

- a. Write the scientific definition of 'work'. Use page 2 of the Student Book.

Work is done when _____

- b. What is the unit of work?

- c. When is one unit of work done?

- d. A donkey pulls a cart with a force of 100 N over 2 km. How much work has the donkey done?

- e. A car with two men in it broke down. For 20 minutes they tried to push it to the nearest garage which was 500 m away. One man pushed with a force of 200 N, the other with a force of 250 N. However, the car was too heavy and did not move. How much work did they do?

Task 2

1. A boy pushes a box 2 metres along a smooth surface. He then pushes the same box 2 metres along a rough surface. In which situation will more work be required? Why?

2. Complete the following:

1 KJ = _____ J

1 MJ = _____ J

3. Calculate the work done in the following situations. Take 1 kgf = 10 N

- i. to lift a 10 kg school bag from the ground to the top of the bus 3m high

- ii. to carry a 30 kg suitcase up to the 4th floor if each floor is 2m high

iii. when a force of 5N pulls a book along a table for a distance of 40cm

iv. to carry a 2kg school bag from the classroom to the school gate 30m away

v. when a 20N fruit is falling freely from the top of a tree 300 cm high

vi. State the energy changes that takes place in question v.



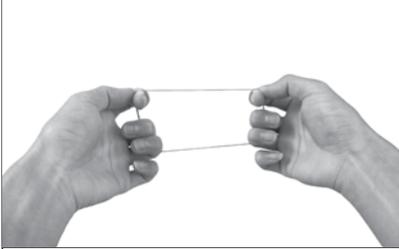
Task 1

1. a. Which types of potential and kinetic energy are listed in your Student Book? List them below.

Potential energy	Kinetic energy

b. Cut out the pictures and descriptions.

c. Sort them into types of energy.

		
releasing a rubber band	dolphin	playing a guitar
		
atomic bomb	extension cord	producing electricity
		
barbecue	hair dryer	skateboard

		
battery	lighted match	ski jumper about to start
		
bell	merry-go-round	Sun
		
coal	moon	tea
		
batsman playing cricket	petrol	tree

d. Discuss your sorting with other students. Do you all agree on every item? Explain why you may have some differences.

2. State the energy changes in the following examples

i. a burning candle

ii. a stretched string is released

iii. a car running on petrol

Task 2

Name the energy present in the following objects

Objects	Parts	Energy
i. power station	coal burning	
	steam turning turbine	
	generator	
ii. aeroplane	propeller	
	fuel	
	engine	
	whole plane	
iii. TV when switched on	wiring	
	speaker	
iv. pendulum swinging to and fro		



1. State the energy changes that take place in the following:

i. working of a drill machine

ii. nuclear bomb exploding

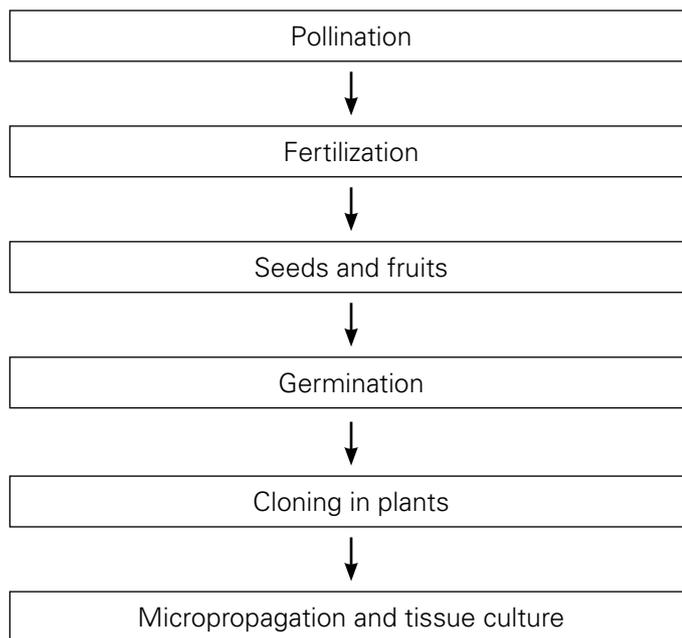
iii. escalator moving

iv. a moving train

v. a gun is fired

2. Why are LEDs about 99% efficient?

3. Write down five ways to save energy.

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 2-1

Page 16

OBJECTIVES

- To extend knowledge about different parts of a plant and their functions.

LEARNING OUTCOMES

The students should be able to:

- identify different parts of a plant and explain their functions.

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)

- Discuss the function of each of the parts. In the discussion, draw the students' attention to the relationship between structure and function. Examples are
 - the green colour of leaves due to chlorophyll for photosynthesis
 - the leaves' position so that they catch the most light
 - finely divided roots to maximise surface area for water uptake
 - a strong stem to hold the plant upright to keep leaves in the right position for photosynthesis
 - flowers on top of the stem or sticking out from the plant in order to be easily seen and reached by insects
 - brightly coloured flowers, scented flowers, nectar in flowers to attract insects so they will pollinate
 - hard seeds with a tough coat to withstand unfavourable conditions before germination
- Hand out Worksheet 2-1 to students.

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

Question no. 4 from page 27 of the Student Book

Lesson 2-2

Pages 17 - 19

OBJECTIVES

- To explain the processes of pollination and fertilization.

LEARNING OUTCOMES

The students should be able to:

- explain pollination and its types.
- describe the process of fertilization.

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. These 'ephemerals' have short lifespans and survive unfavourable conditions as seeds.

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 17 and 18 of the Student Book), keeping this in mind.
- Show the students a diagram of flowers' pollen transferred from anther to stigma of the same and different plants. 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.
- 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 4, 5, and 6 from pages 11, 12, and, 13 of the Workbook.

Lesson 2-3

Page 19

OBJECTIVES

- To explain the processes of pollination and fertilization.

LEARNING OUTCOMES

The students should be able to:

- describe the process of fertilization.

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? (fertilization)

MAIN (25 minutes)

- Read pages 19 and 20 with the students.
- It might be useful to clarify that only pollen of the same species is capable of fertilizing 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 fertilization 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 fertilization. The ovary develops into fruit and the ovule develops into seeds.
- Hand out Worksheet 2-3 to students.

PLENARY (10 minutes)

Discuss the 'Test yourself' questions from page 19 of the Student Book.

Ask the students to draw a flowchart of the fertilization process.

HOMEWORK

Question 4, page 11 of the Workbook

Lesson 2-4

Pages 20-21

OBJECTIVES

- 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. Ask questions on germination. Investigations given on page 29 of Student Book can be conducted.
- Ask students to answer Question 6 from page 28 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

Question 7, page 14 of the Workbook

Lesson 2-5**OBJECTIVES**

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

LEARNING OUTCOMES

The students should be able to:

- explain how cloning in plants takes place.

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)

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.

Hand out worksheet 2-4 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 24 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.

**Task 1**

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

2. What is the function of each of the parts? Record this information below.

Part of the plant	Function
roots	
stem	
leaves	
flower	
fruit	

Task 2

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.

- i. Use the diagram on page 16 to label the following structures in each flower:
 - petal
 - stamen
 - carpel
- ii. 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.

Task 3

Answer the following questions:

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

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

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



1. Two different male and female flowers that are colorful 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 colorful _____

iii. Short stamens and protected stigma _____

iv. Pollen grains have wings _____

v. Seeds are hard _____

vi. Petals have scent and nectar _____

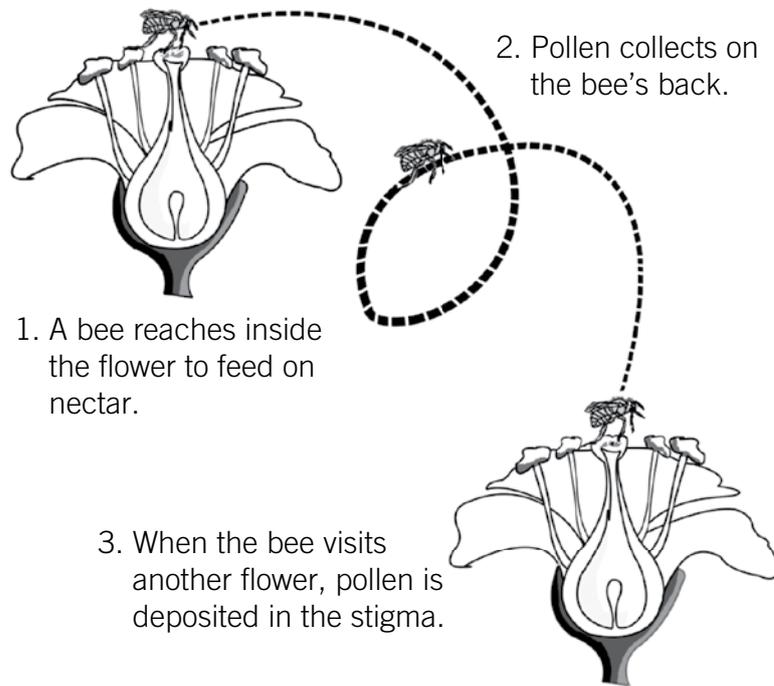
vii. Seeds have hooks _____

viii. Long filament with anther hangs out of flower _____

ix. Pollen grains are numerous _____

x. Pollen grains are sticky _____

- 1 Flowers are reproductive parts of a plant. In the diagram given below color the female reproductive parts pink and male reproductive parts blue.



Pollination is followed by Fertilization. Pollen is deposited onto the stigma. Pollen tube starts to grow down the style towards the ovary. When pollen tube reaches the ovary, the nucleus of male reproductive cell travels down the tube. The pollen nucleus fuses with the nucleus of the ovule. This is how fertilization takes place. The fertilized ovule divides and develops into an embryo. The embryo develops in a seed. The ovary swells and ripens into fruit.

2. 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:

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

- ii. Compare your peanut with the diagram on page 20 of your Student Book. Can you now further explain your answer above?

- iii. 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.

i. seed dispersal

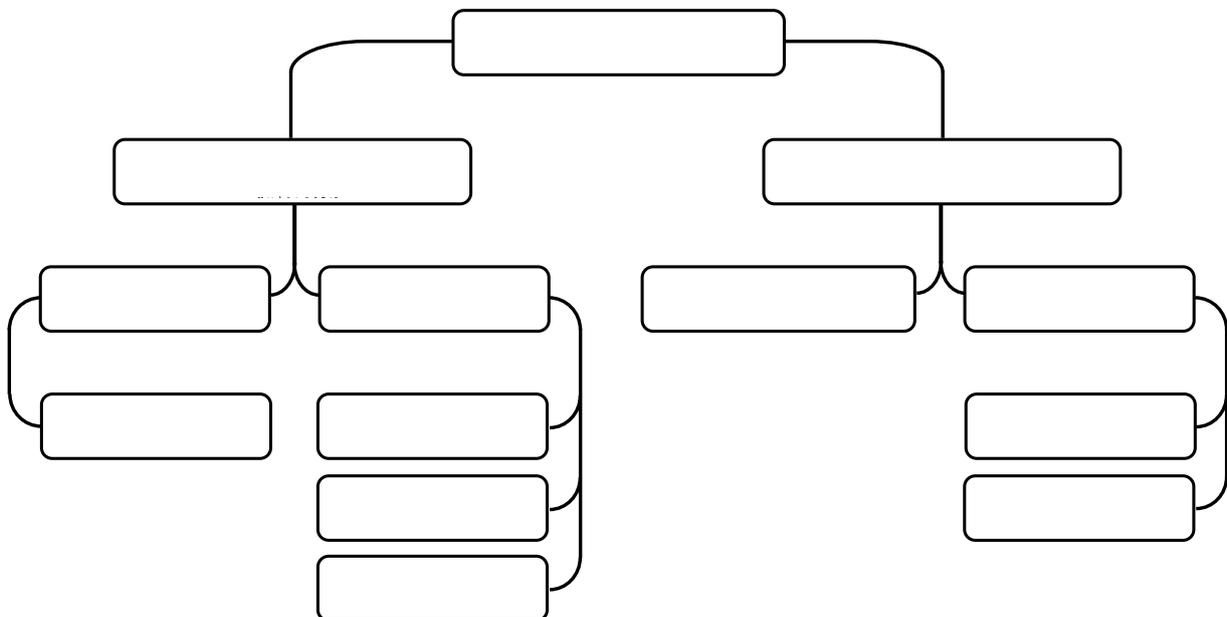
ii. germination

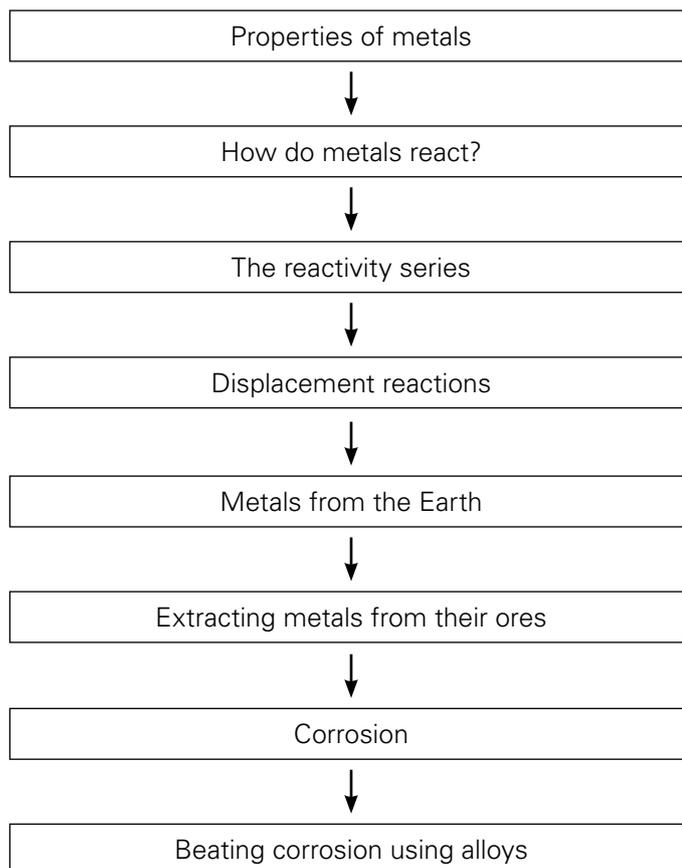
2. i. Which two different types of pollination do you know? Briefly describe each of them.

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

3. 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
cross-pollination	micro-propagation	sexual reproduction
cuttings	natural	tissue cultures
done by humans	plant reproduction	wind-pollination
	runners, tubers, bulbs	



UNIT FLOW CHART**INTRODUCTION**

It has been said that humans are the only species which uses metal tools. If people had not discovered how to use bronze for tools and weapons, civilisation would have developed in a very different way. It is very difficult to imagine how our lives would be without metal.

Although our knowledge of metals has developed continuously, our ability to create very thin layers of metal on plastic coating is recent and has provided us with bags to keep our snacks fresh for longer, but also has applications in insulation.

To demonstrate some of the less obvious uses of metal, show the students a 'space blanket'. These metal blankets were developed by NASA to protect Skylab (a space station) which was at risk of overheating. They are used to reduce heat loss in patients and marathon runners but are also used to prevent over-heating in high temperatures.

This website gives a chart with the reactions of metals and their extraction methods.

<http://www.compoundchem.com/2015/03/10/reactivity-series/>

Lesson 3-1

Pages 30 - 32

OBJECTIVES

- To explain the properties of metals.

LEARNING OUTCOMES:

The students should be able to:

- list the properties of metals.
- use the particle model to explain the properties of metals.

START (10 minutes)

Ask students about uses of metals in daily life. Write examples of their uses on the board (e.g. aluminum for aircraft, iron, steel, or copper for pans, copper for electric wires). Then ask students why these metals were chosen. (Because it is light, conducts heat, conducts electricity, etc.)

MAIN (20 minutes)

- Read pages 30-32 with the students.
- Go over tasks 1 and 2 of Worksheet 3-1. Use pages 30 to 32 of the Student Book for support.

PLENARY (10 minutes)

Show students a space blanket. Discuss what it does and why it is so effective. (The shiny side of the blanket reflects heat, either back at the person or away from them. Metals are shiny and shiny surfaces do not absorb or radiate heat well.) The layer of metal is very thin so it is light and not expensive.

What would happen if you simply used a layer of aluminum foil instead of a space blanket? Would it insulate as well? (It would re-radiate the heat but the metal is an excellent conductor so a lot of heat would pass through it. With the space blanket, the other material will stop heat conduction.)

HOMEWORK

List ten metals used in the home and write their uses.

Lesson 3-2

Pages 32 - 34

OBJECTIVES

- To explain that different acids react in similar ways with metals, metal carbonates, and metal oxides.

LEARNING OUTCOMES

The students should be able to:

- describe how metals react with acids and how acids react with metal carbonates, metal oxides, and alkalis.

START (10 minutes)

Show the students a rusted iron nail. Discuss following questions:

- What is the chemical name of rust?
- What happens when iron is exposed to oxygen and water?
- What is the reaction called?
- What new substance is formed?

MAIN (20 minutes)

- Investigation given on page 45 of Student Book can be conducted.
- Hand out Worksheet 3-2 to students.

PLENARY (15 minutes)

- Show a chart of the reactivity series of metals with oxygen, water, and acid.
- Ask 'Test yourself' questions given on page 35 of Student Book.

HOMEWORK

Questions 3, 4, and 5 on pages 15-16 of the Workbook

Lesson 3-3

Pages 35 – 36

OBJECTIVES

- To explain the use of word and symbol equations to describe chemical reactions.

LEARNING OUTCOMES

The students should be able to:

- identify patterns in these reactions and produce general equations.

START (10 minutes)

Go over pages 35 and 36 of the Student Book. Refer to the reactivity series on page 34. Please ensure that the concept of displacement is understood by students.

MAIN (20 minutes)

Demonstrate the experiment in Worksheet 3-3.

Safety: Please make sure you wear eye protection. If students are standing close by, please provide them with eye protection too. Lead and lead nitrate are toxic and harmful to the environment. Please use the smallest amounts needed. Please be aware that magnesium burns brightly and students might be tempted to 'play' with it, either in or outside the lab.

PLENARY (15 minutes)

Discuss findings and possible anomalies.

'Test yourself' questions given on page 36

HOMEWORK

Question 7, page 18 of the Workbook

Lesson 3-4

Pages 36 and 38

OBJECTIVES

- To explain that metals are extracted from the Earth as ores.

LEARNING OUTCOMES

The students should be able to:

- explain how the reactivity series has been helpful in extracting metals from these ores.

START (10 minutes)

Show the reactivity series to the students. Which are the unreactive metals in the reactivity series? Why was it easier to discover gold and silver than other, more reactive metals?

MAIN (25 minutes)

- Read pages 36-38 of Student Book.
- Discuss why carbon is placed between aluminium and zinc in the reactivity series? What does it indicate about the extraction of metals which are placed before carbon and metals which are placed after carbon?

PLENARY (10 minutes)

'Test yourself' questions given on page 39 of Student Book.

HOMEWORK

Question 6 and 7 page 44 of Student Book.

Lesson 3-5

Pages 39-41

OBJECTIVES

- To show why metals corrode and how corrosion of metals can be prevented.

LEARNING OUTCOMES

The students should be able to:

- define corrosion.
- identify ways to prevent corrosion.

START (10 minutes)

Ask the class why do people who live near the seaside find that objects made from iron corrode (rust) very quickly? Can this be prevented, and if so, how?

MAIN (10 minutes)

- Read pages 39-41 with the class.
- When a metal loses its shiny surface and is slowly eaten away and weakened, this is called corrosion. Reactive metals corrode very quickly as they combine with water and air easily. A protective coating called electroplating can prevent rusting. Corrosion is also prevented by using alloys.
- Questions 7 and 8 from pages 18 and 19 of the Workbook. (practical can be performed before answering the questions)

PLENARY (10 minutes)

Discuss questions from the 'Test yourself' section on page 41 of the Student Book.

HOMEWORK

Question 4 page 43 of Student Book.

Task 1

You may remember learning about metals and non-metals before so here is an exercise to refresh your memory. In the word bank below are terms which relate to metals and non-metals. Copy them into the correct places in the table which lists the properties of metals and non-metals.

<i>brittle</i>	<i>good conductors of electricity</i>	<i>malleable</i>
<i>brittle</i>	<i>good conductors of heat</i>	<i>poor conductors of electricity</i>
<i>brittle</i>	<i>high density</i>	<i>poor conductors of heat</i>
<i>ductile</i>	<i>high melting and boiling points</i>	<i>shiny when polished</i>
<i>dull looking</i>	<i>low density</i>	<i>sonorous</i>
<i>dull sound when hit with hammer</i>	<i>low melting and boiling points</i>	<i>strong</i>

Metals	Non-metals

If you have some trouble, use the following hint for the first letters of the properties of metals.

Dads **G**ive **G**reat **H**ugs when **H**aving **M**inty, **S**avoury, and **S**izzling Snacks

Task 2

- i. Read page 31 of the Student Book and explain in your own words why metals are ductile and malleable but are strong at the same time.

- ii. Read page 32 and explain in your own words why metals are good conductors of electricity and heat.

Task 3

1. Define the following terms:

i. malleable

ii. ductile

2. What are alloys?

3. Name the metals present in the following alloys.

i. monel

ii. bronze

iii. steel

4. How does graphite behave differently from other non-metals?

Task 1

- i. Write down the chemical names of the metals in the reactivity series. Which is the most reactive? Write the most reactive metal on the left and the least reactive on the right.

See page 34 of your Student Book if you need some help.

--	--	--	--	--	--	--	--	--	--	--	--

Task 2

1. Put following metals into dilute acid. Write your observations and results.

METAL	ACID	OBSERVATION	RESULT
magnesium			
copper			
zinc			
iron			

2. Put the above metals in the order of their reactivity with acid.

3. Aluminium is an active metal but sometimes gives odd results. Why?

4. What happens to iron when it is exposed to air or water?

5. What is the chemical name of rust?

6. Which metals are more reactive with oxygen?

Task 1

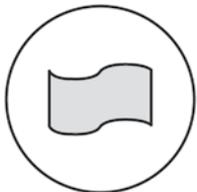
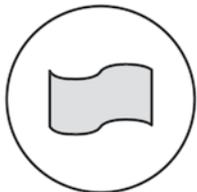
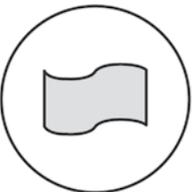
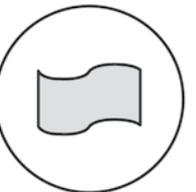
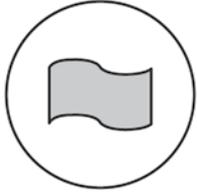
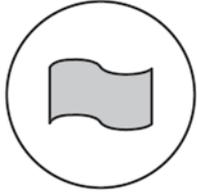
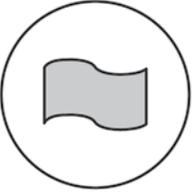
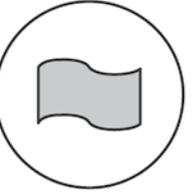
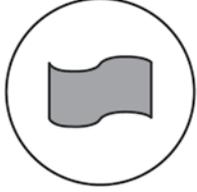
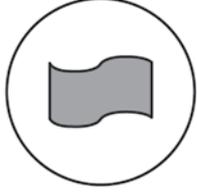
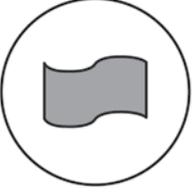
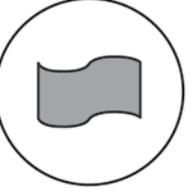
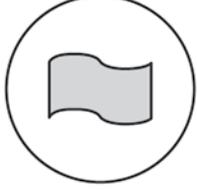
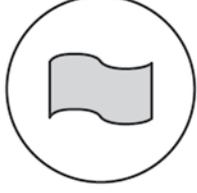
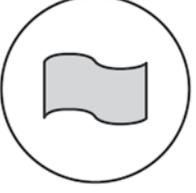
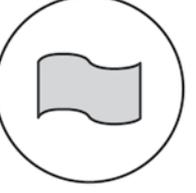
Read page 35 of your Student Book and answer these questions.

What happens when you put a metal in a solution of the salt of another metal?

Task 2

Your teacher will demonstrate the following experiment about displacement.

One or more spotting tiles will be set up so that you have 16 wells available. Each well will contain a solution of a metal nitrate to which a small piece of metal will be added. It should look like the diagram below.

	magnesium nitrate	zinc nitrate	lead nitrate	copper nitrate
magnesium				
zinc				
lead				
copper				

- i. Even without any knowledge of the reactivity series, there are four wells where you can already predict nothing will happen. Write a large S in these wells. Explain why you think nothing will happen here.

- ii. What will you observe when a reaction takes place?

- iii. When the metal in solution is less reactive than the pure metal, you expect a reaction. Use page 34 of your Student Book to predict where a reaction will take place. Write a Y in each of these boxes.

- iv. Now observe the demonstration and check if your predictions were correct. If not, discuss them with your group and the teacher.

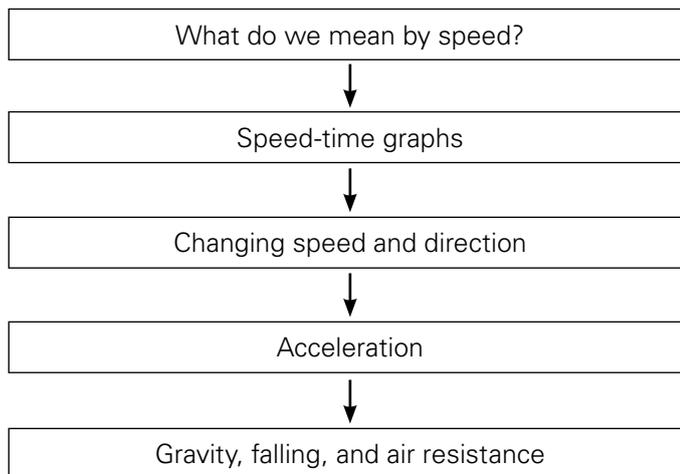
1. Look at the reactivity series and answer the questions.

K	}	Electrolysis
Na		
Li		
Ca		
Mg		
Al		
Carbon		
Zn	}	Heating ore mixed with carbon
Fe		
Cu		
Au		

i. How are the elements above carbon extracted from their ores?

ii. How are the elements placed after carbon extracted?

iii. Can we get aluminium by heating it with carbon?

UNIT FLOW CHART**INTRODUCTION**

Whenever we look at the universe we find things that are moving. By studying moving things, scientists can find laws or patterns which 'fit' the movement or motion. This means that they can predict how other things will move. Forces are thought of as 'pushes' or 'pulls'. The size of a force is measured in units called 'newtons'.

Show the students a picture of Sir Isaac Newton and tell them he was an English mathematician and scientist who, amongst other things, worked to find laws which would explain the movements of planets and things on Earth. He is remembered now for the 'laws of motion' which he set out.

When an object is pulled by two forces of equal size but in opposite directions, the forces will balance each other out. Newton realized that a thing will only change its speed or direction of travel when pulled by a force which is not balanced by other forces.

The best way to understand Newton's first law is to think of a spaceship moving in outer space so far from any star or planet that there is no gravity.

The spaceship has no engine to push it but there is no friction or other force to slow it down. It just travels on and on at the same speed and in the same direction.

The spaceship could be speeded up or slowed down by firing little rockets fixed to it. These would give a force to change the spaceship's speed or direction.

Things which are not moving have a speed of 0m/s. These stationary objects obey Newton's first law too. Quite simply, as long as there are no balanced forces acting on the object, they will not start to move.

Car designers use these laws to improve the performance of new models. Aerospace engineers use them to calculate how to put rockets into space and satellites into orbit. Astronomers can find out more about the universe by observing and measuring how stars move. Athletes can even improve their performances by studying the science of motion. There is no end to the use which we can make of the laws of motion.

Lesson 4-1

Pages 46 - 49

OBJECTIVES

- To use the concept of speed.

LEARNING OUTCOMES

The students should be able to:

- discuss the relationship between speed, distance, and time.
- use speed-time graphs.

START (10 minutes)

Start by discussing the speeds at which cars travel. What about bicycles, pedestrians, and aeroplanes? Allow students to answer without giving much feedback, but please note whether they use units and, if so, what these units are.

MAIN (20 minutes)

Handout worksheet 3-1 and help students find the answers. The idea is that they do the sums (most will know how to calculate these distances) and once they have done them, ask students to work out the equation they used. Ask following questions:

- In which unit will you measure speed over larger distances?
- What do you call the total distance travelled divided by the total time taken?

PLENARY (15 minutes)

Work out problems on speed and speed-time graphs from the 'Test Yourself' on page 49 and 50 of the Student Book.

HOMEWORK

Workbook page 21 and 22

Lesson 4-2

Page 51 - 52

OBJECTIVES

- To show the relationship between forces acting on an object and its movement.

LEARNING OUTCOMES

The students should be able to:

- explain the relationship between the forces acting on an object and its movement.

START (10 minutes)

Take a ball, a toy car, or any other object and give it a gentle nudge. The object will move a bit and then come to a halt. Repeat this and ask students to observe carefully without commenting.

Then introduce Newton's first law on page 51 of the Student Book.

Ask your students how Newton's first law can be correct when they just saw that you pushed an object to make it move but it came to a halt without anyone touching it.

MAIN (20 minutes)

- The forces which acted on the object are friction (from wheels, rolling, and/or air resistance). They all acted in the opposite direction to the movement and slowed the object down. As the object slowed down, the forces became less until the object was at rest and the forces were zero.
- Read pages 51-52
- Hand out Worksheet 4-2 to students.

PLENARY (15 minutes)

Discuss the 'Test yourself' questions on page 51 of the Student Book.

HOMEWORK

Page 23 of Workbook

Lesson 4-3

Pages 53 - 54

OBJECTIVES

- To show the relationship between balanced and unbalanced forces and how these affect the movement of falling objects.

LEARNING OUTCOMES

The students should be able to:

- apply the idea of balanced and unbalanced forces to falling objects.

START (10 minutes)

Write Newton's third law on the board as 'action is reaction'. Do not explain.

Arrange to have a strong rope. Take your students outside and divide them into two teams which are equally strong. Give them the rope and ask them to start pulling gently against each other.

Tell one team to pull slightly more and the other to continue with the same force. What happens? (the 'stronger' team will pull the rope towards them). Reverse the roles.

Tell both teams to slowly increase their pulling force a little but to keep the centre of the rope in the same place.

After this activity discuss Newton's third law.

MAIN (20 minutes)

- In the classroom, put the rope on the floor and ask the students why it is not moving. They will tell you there is no force acting on the rope. Remind them that this is part of Newton's first law.

Now remind students that the rope also did not move when they were pulling on either end with equal force. So there were forces acting on the rope but it did not move. It is likely that your students will say that these forces cancelled each other out and/or were equal in size but opposite in direction. Ask them if they think that forces can be 'added'?

If they agree, ask one student to push against a wall. The wall will not move. Why not? A force is acting on it. Allow students to speculate and then remind them what is written on the board. Essentially, the wall pushes back with a force equal in size but opposite in direction from that of the pushing student.

- Ask the students to complete Worksheet 4-3.
- Show them a diagram of a parachutist before opening and after opening the parachute and discuss the forces acting on it and what makes a safe landing possible
- Drop a crumpled sheet of paper and a flat sheet of paper to the ground. Ask students to analyse the forces working on both the papers. Consider gravity (the same because they are identical pieces of paper) and air resistance (different because they have different surface areas).

PLENARY (15 minutes)

Explain the concept of the egg drop (explained below) and ask students to start planning how they will build their project.

HOMEWORK

You could do an egg drop. Students will drop a raw egg from a height but they have to arrange for a way to prevent the egg from breaking. This can be done by extensive packing (cotton wool, bubble wrap etc) but even better by slowing down the drop by using a parachute.

They should prepare their egg at home. At school, you should weigh all wrapped eggs and start with the heaviest. The first egg dropped that does not break is the winner at that moment. If the next egg does not break, then that one becomes the winner because it was lighter.

Please check if the winner's egg is indeed raw.

**Task 1**

When you go to school or shopping, you have probably seen signs indicating a maximum speed limit. Depending on where you live in the world, they most likely look like one of the two signs below.



- i. What do these signs actually tell us?

- ii. If the maximum permitted speed is 50 km/h and you drive at this speed for one hour, what distance will you cover?

- iii. If you drive at the speed of 50 km/h for half an hour, what distance will you cover?

- iv. If you drive at 50 km for two hours, what distance will you cover?

- v. What calculation did you use to find the answers above? See page 48 of the Student Book if you need some help.

- vi. Complete the three equations about the relationship between speed, distance, and time.

speed = _____

distance = _____ × _____

time = _____

Please remember that you can use many different units but they have to be the same in one equation. For example, an object moves with the speed of 3 m/s for 2 minutes. How far does it move? You will have to change the speed into metres/minute (3 m/s is 3*60 metres in 60 seconds, which is 180 metres in 60 seconds, which is the same as 180 m/min. So the answer would be 2 min at 180 m/min = 360 m.

Task 2

1. A jogging track is 800 m long. If a boy jogs around 5 complete rounds of that track in 30 minutes, what is his average speed?

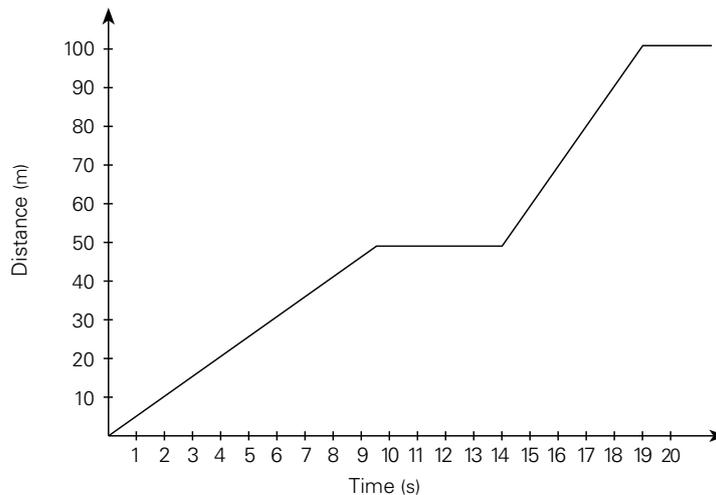
2. Ali lives 5 kilometres from school. It takes him 15 minutes to get to school. Sara lives 15 kilometres from school. It takes her 45 minutes to get to school. Who travels at a higher average speed?

3. Nasir cycles to school at an average speed of 8km/h. What is his speed in m/s? Show your working.

4. Draw three distance time graphs which represents
 i. constant speed ii. speeding up iii. slowing down

5. The graph below shows how far a cyclist travelled in 20 seconds.

Use the graph to answer the following questions.



- a. What was her average speed during her journey?

- b. Between which time interval was she travelling fastest?

6. When cyclists want to go fast, they often crouch down. Explain how this helps them.

Task 1

1. What happens to an object when no force acts on it?

2. Some 2014 models of the Porsche 918 Spyder accelerate from 0 km/h to 100 km/h in 2.5 seconds (according to the manufacturer). If the acceleration is uniform, how much does it accelerate in 1 second?

3. Some 2017 models of the McLaren 720S reach 148.2 mph in 9.9 seconds.

How does this acceleration compare to that of the Porsche?

(Actually, this comparison is unfair because the Porsche's speed was measured after only 2.5 seconds while the speed of the McLaren was measured after 9.9 seconds. The acceleration of all cars slows down as the speed increases, and this is not taken into account in these calculations.)

Task 2

Write the formula to calculate the following:

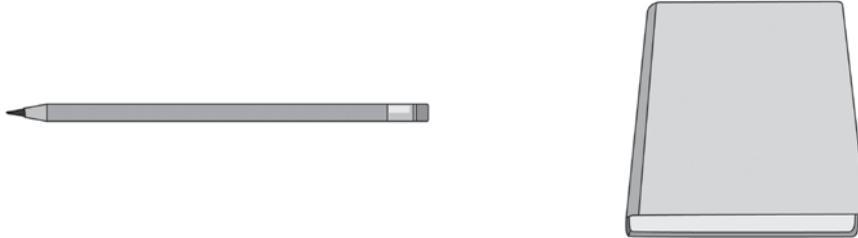
i. Speed

ii. Acceleration

**Task 1**

- i. Put a book on the table in front of you and gently push it with a pen or pencil. What happens?

- ii. If you were to draw or take a picture of the above situation, it could look like this. But that does not show the force used to move the book. How could you include this? Forces have a magnitude and a direction, like arrows. Draw the arrow to show the force used to move the book.



- iii. If you stop pushing, the book will stop moving. If no force was acting on the book, it would continue to move—Newton's first law. So what force is making it stop?

- iv. If you push very, very gently, the book will not move. Why not?

- v. What is the size and direction of this resistance? Draw it in the picture at ii.

If you push gently, the resistance pushes back with a force equal in size and opposite in direction from the force you used. The forces are balanced.

If you push harder, your force will increase in magnitude but the resistance remains the same so the book will move. These forces are no longer balanced.

Task 2

Read pages 53 and 54.

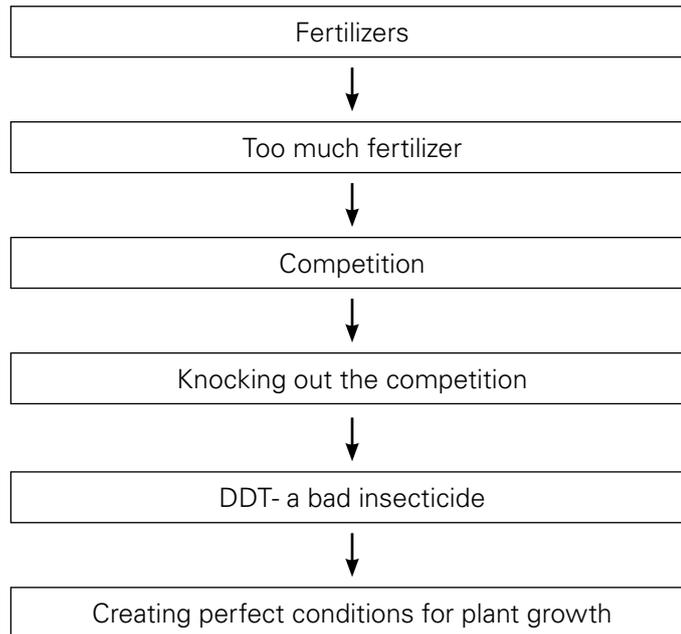
Your book is lying on the table. It does not move.

- a. Are there forces acting on your book? If so, which?

- b. Are these forces balanced? Explain your answer

Where does our food come from?

UNIT FLOW CHART



INTRODUCTION

Carbon, oxygen, nitrogen, and water circulate in the environment. Even though they continuously change from one form to another, these materials stay in roughly the same proportions within ecosystems.

Energy, however, does not cycle. Instead it flows through ecosystems in a straight line.

Producers convert the light energy from the Sun into chemical energy in sugar molecules. Some of this energy is used by plants in respiration, while the rest is stored as starch or used to build other chemicals like proteins and fat. When consumers feed on plants they release this stored energy by digestion and respiration. They can use it for activities such as movement. Some energy, however will be 'locked up' in the animal's body in fat and protein. This whole process is repeated at each link in a food chain. In the end all the energy is 'lost' usually as heat, to the environment. The trapping of energy from the Sun by producers maintains a continuous flow of energy through ecosystems.

The more people there are in the world, the more food is required to feed them. As the world population increases so does the demand for efficient farming methods. Farmers must get the highest yields they can.

Lesson 5-1

Pages 60 – 61

OBJECTIVES

- To show that humans are part of a complex food web.

LEARNING OUTCOMES

The students should be able to:

- construct a food web showing the feeding relationships of humans.
- explain why it is more efficient to eat plants than animals.

START (10 minutes)

Ask students to write down what they ate yesterday. Now ask about the plants or animals which provided the ingredients for their food. For example, a burger has bread (from wheat), a burger patty (from a cow), lettuce (a plant), possibly cheese (from cow's milk).

The students eat to get energy. How did the organisms that made their food get their energy? (Plants from the Sun, cows and goats from plants, chickens from seeds from plants, and maybe some insects or worms.)

Where did the insects and worms that fed the chicken get their energy? (From their food, most likely plants which got their energy from the Sun).

MAIN (15 minutes)

- Why does a food chain always start with a producer? Discuss the characteristics of a food chain. A diagram of a food web should be shown and questions asked about producers and primary, secondary, and tertiary consumers.
- Every animal uses most of the energy it eats to move, to digest its food, maybe to keep itself warm. Only a small part of the energy it eats becomes part of its body and could be eaten by the next animal in the food chain.
- Handout Worksheet 5-1 to students to complete Task 1.

PLENARY (20 minutes)

Question 3 from page 73 of the Student Book

HOMEWORK

Task 2 of Worksheet 5-1

Lesson 5-2

Pages 61 - 67

OBJECTIVES

- To identify the factors affecting plant growth.

LEARNING OUTCOMES

The students should be able to:

- identify a range of minerals that plants need for healthy growth.
- describe how the overuse of fertilisers can affect the environment.

START (10 minutes)

Show the students a packet of fertilizer and ask what nutrients it contains.

MAIN (20 minutes)

- Ask and discuss the following questions in class after reading pages 61-67.
 - Name the nutrients required by a plant and their importance.
 - Describe what happens due to lack of these nutrients.
 - How do plants compete for resources? What are pests and how are they controlled?
- Handout Worksheet 5-2 to students

PLENARY (15 minutes)

Make a leaflet advertising a pesticide.

Questions 4, 5, and 6 on pages 73 and 74 of the Student Book

HOMEWORK

Questions 4 and 5 from pages 27 and 28 of the Workbook.

Lesson 5-3

Pages 68 - 69

OBJECTIVES

- To identify the factors affecting plant growth.
- To explain how the production of food for humans can have a significant effect on other animal and plant populations.

LEARNING OUTCOMES

The students should be able to:

- explain what a greenhouse is.
- explain the advantages of growing plants in a greenhouse.
- Explain what is meant by 'biological control'.

START (10 minutes)

Ask the class what factors are necessary for the healthy growth of plants? In some cold countries there is little sunshine for many months of the year. How do plants grow there?

MAIN (20 minutes)

Divide the students into four groups. One group needs to present the advantages of growing plants in a greenhouse, one presents the disadvantages. A third group explains the advantages of using chemical pest controls while the last group talks about the disadvantages of chemical pesticides. Each group should prepare a poster showing their key findings. Encourage students to illustrate their posters with relevant diagrams.

If you want, you can encourage collaboration between groups. For example, the last group can argue in favour of biological control and show that this works well in greenhouses.

PLENARY (15 minutes)

- Discuss the 'Test yourself' questions from page 69 of the Student Book.
- Make a model of a greenhouse with plastic or glass. Put artificial plants in them and demonstrate the conditions required for the greenhouse.

HOMEWORK

Question 9 from pages 32 and 33 of the Workbook

Lesson 5-4

Pages 69 - 71

OBJECTIVES

- To explain how the production of food for humans can have a significant effect on other animal and plant populations.

LEARNING OUTCOMES

The students should be able to:

- define decomposers and saprophytes.
- explain the carbon and nitrogen cycles.

START (10 minutes)

Ask students about the difference in composition between the air they breathe in and the air they breathe out (decrease in oxygen, increase in carbon dioxide). Humans and animals have been breathing for millions of years. How come there is still only a small amount of carbon dioxide in the air? (leading to the carbon cycle)

MAIN (20 minutes)

- Read pages 69 to 71 of the Student Book and explain the cyclic nature of all matter. Except for a few meteorites, Earth only receives energy from the Sun. All matter is recycled by the systems on Earth.
- Ask the class to do questions 6 and 7 given on page 74 of the Student Book.

PLENARY (15 minutes)

Knowing that plants are so important to the environment (producing food and oxygen and absorbing carbon dioxide), consider the effects of deforestation. Include the impact on plants and animals living in the forests. You may wish to include 'extinction is forever', meaning that extinct species will never return, and be lost for good.

Explain how the nitrogen cycle helps in keeping the nitrogen levels balanced in our environment.

HOMEWORK

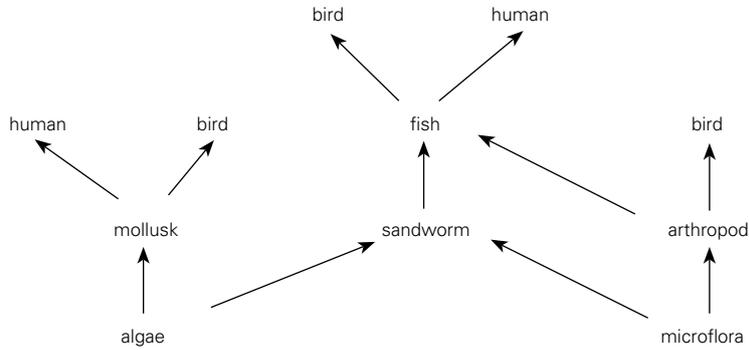
Worksheet 5-4



Task 1

Look at the diagram of a food web and answer the questions.

Food Web in a Shore Environment



i. Draw a food chain with three links.

ii. Draw a food chain with four links.

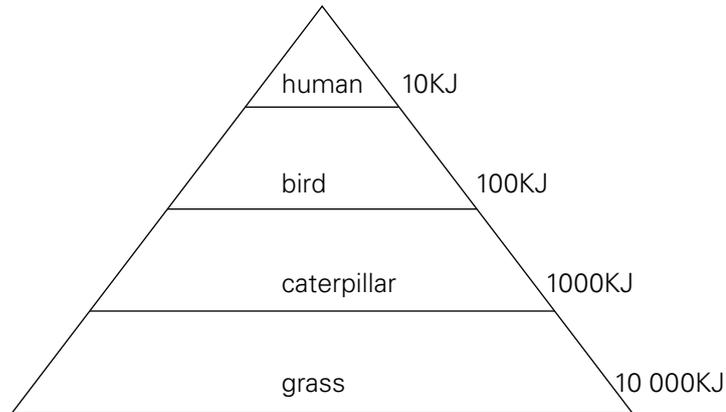
iii. What is the difference between a food chain and a food web?

iv. Name any three primary consumers from the food web above.

v. Name any secondary and any tertiary consumer.

Task 2

Below is a diagram of a pyramid of energy. Look at the diagram and answer the questions.



i. Why does the diagram have the shape of a pyramid?

ii. Define herbivore, carnivore, and omnivore. Place them on the pyramid.

iii. Why does the amount of energy keep on decreasing from one organism to another as you move up the pyramid?

iv. Create a food chain where you are the top consumer.

a. You ate some beef.

b. You ate some chicken, which fed on insects, which ate some worms.

c. To produce 1 kg of any organism, it needs to consume 10 kg of food. How many kg of plant material is needed to produce 1 kg of burger for you? How much to produce 1 kg of chicken?

d. What if you did not eat any meat for that meal and just ate vegetables? How much plant material would be needed?

e. What does the above tell you about the amount of plants needed for food?



1. Plants A and B were grown in different soils in pots for three months. All other conditions were the same and after three months the following information was obtained.

Feature	Plant A	Plant B
<i>height</i>	35 cm	20 cm
<i>number of leaves</i>	25	15
<i>appearance of new leaves</i>	large and dark green	small and yellow
<i>condition of root system</i>	well developed	poorly developed
<i>condition of flowers</i>	large number of flowers	very few flowers

- i. List three ways in which plant A differs from plant B.

- ii. Name two nutrients that were missing from the soil in plant B. Explain your answer.

- iii. Why were the leaves of plant B yellow?

- iv. Why were there fewer flowers on plant B than on plant A?

- v. Why was plant B's growth slower than that of plant A?



1. Why are greenhouses built?

2. List the advantages and disadvantages of building a greenhouse.

3. What are polytunnels?

4. What are pesticides?

5. Explain how pesticides are useful and how they are harmful?

6. What are the harmful effects of DDT?

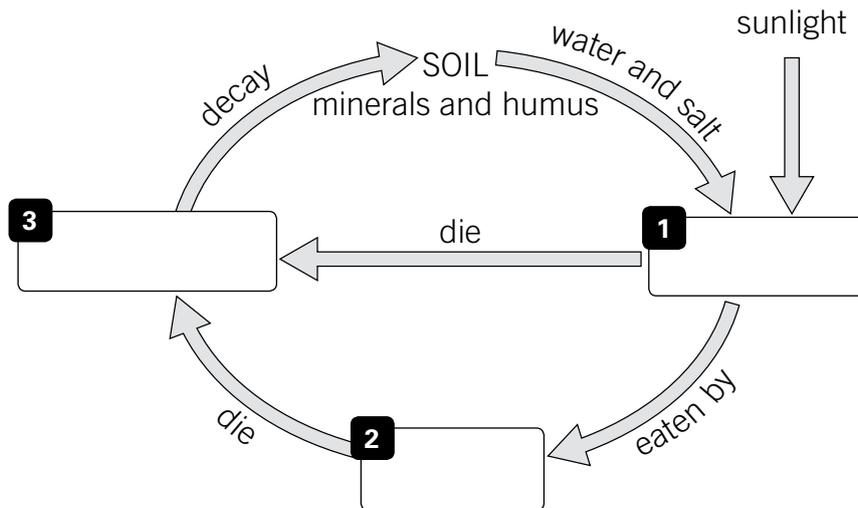
Task 1

Choose the correct answer.

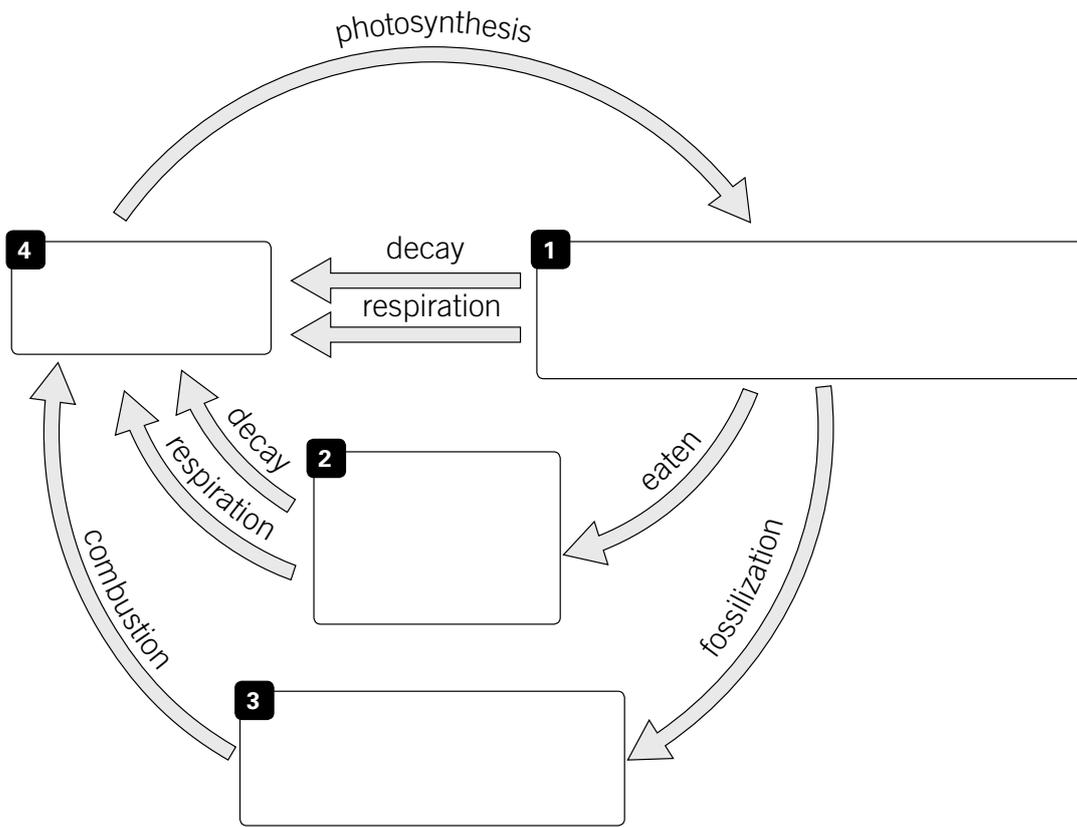
1. Plants are called producers because
 - a. they produce food.
 - b. they produce energy.
 - c. they produce oxygen.
 - d. they produce carbon dioxide.
2. Nitrogen is recycled in an eco-system. In what way is nitrogen present in animals?
 - a. as nitrogen gas
 - b. in ammonia
 - c. in proteins
 - d. in urea
3. Which organism always gets its energy from dead matter?
 - a. producer
 - b. consumer
 - c. decomposer
 - d. prey
4. What eventually happens to all the energy in an eco-system?
 - a. It is lost as heat.
 - b. It is recycled by decomposers.
 - c. It is used by producers.
 - d. It is used by carnivores.
5. Nitrates can be removed from the soil by the action of
 - a. nitrogen-fixing bacteria in decaying plants.
 - b. bacteria in the root nodules of legumes.
 - c. nitrogen-fixing bacteria in ammonium compounds.
 - d. denitrifying bacteria in poor air conditions.

Task 2

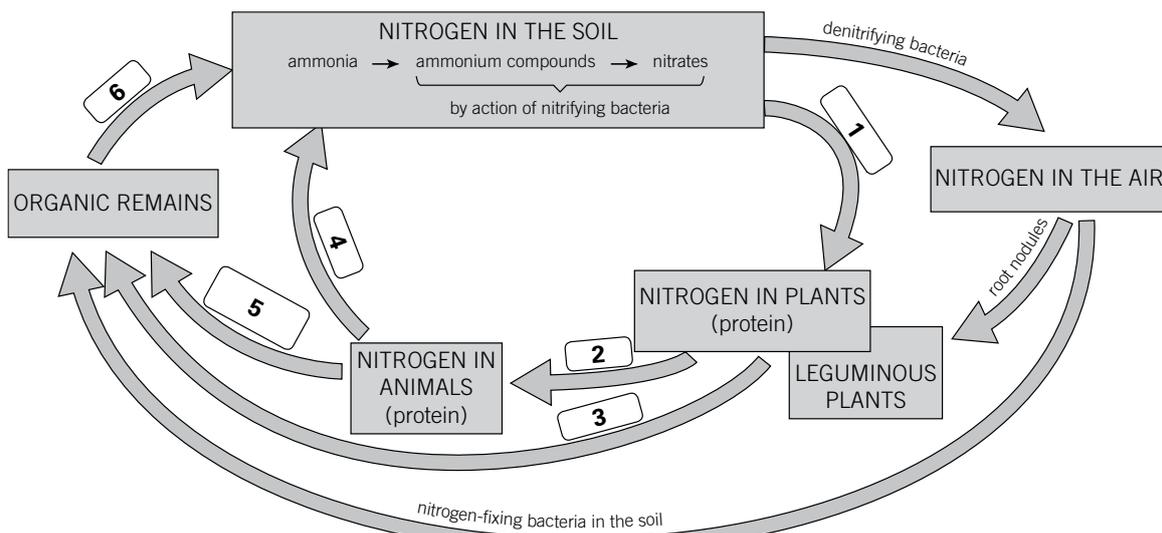
Label the diagrams given below:



Recycling in an ecosystem



The carbon cycle



The nitrogen cycle

1. _____

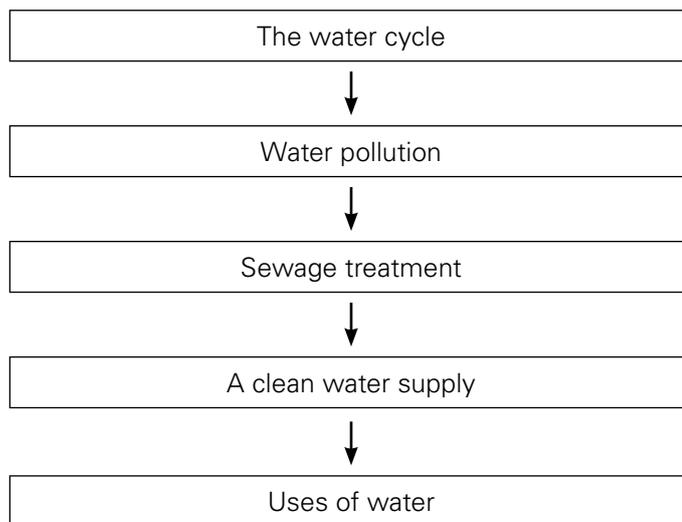
4. _____

2. _____

5. _____

3. _____

6. _____

UNIT FLOW CHART**INTRODUCTION**

Your body is about 60% water (children 75%, elderly people 50%) and 70% of the Earth's surface is water. Is that enough to encourage us to study water? If not, consider its unique chemical properties. It is a liquid at room temperature, made from two gases, one of which is flammable and the other makes combustion possible (and is used by firemen to put out fires!). It is less dense as a solid than as a liquid.

In this chapter, we look at the water cycle and at how we use water. Of course, we want the water we use to be clean. There are some places where water pumped from the ground is clean enough to use, but in most places the drinking water is treated. Our waste water usually goes into a sewage system and should also be treated so it is safe to put it back into the environment.

Lesson 6-1

Pages 76 – 77 and pages 81 – 83

OBJECTIVES

- To explain the importance of water.
- To describe the water cycle.

LEARNING OUTCOMES

Students should be able to:

- identify the percentage of water available in different parts of the world.
- describe how the water cycle works.

START (10 minutes)

Adults generally seem to be able to survive without food for about a month, but without water their life expectancy is a few hours (in extremely hot and dry conditions) to about a week (in optimal conditions). Discuss the reasons for this difference. (We have stored 'food' in the form of fat under our skins and if there is no other option, our bodies will break down some muscle tissue for food. However, we have no way to store water.)

MAIN (20 minutes)

- Hand out Worksheet 6-1 and ask students to complete Tasks 1 and 2. Refer to pages 76 and 77 of the Student Book for guidance.
- Read pages 81 to 83 with the students. As they are reading, complete Task 3.

PLENARY (15 minutes)

According to the Student Book, we use 2 litres of water a day for washing the car. Use two bottles to show students how much (or how little!) 2 litres are. When they see people washing a car, do they only use 2 litres? In many parts of the world, cars are not washed daily so the number is an average per day when the car is washed maybe weekly.

Discuss whether cars need washing every day. In your discussion, consider if you live in a part of the world where there is enough clean water for everyone. Is it safe to drink tap water? Where does the tap water come from? How is it treated? Some countries make drinking water out of sea water by using waste heat from power plants which produce electricity. Morocco has built a large solar energy plant and uses this energy to desalinate water.

HOMEWORK

Question 3, Workbook page no 35

Lesson 6-2

Pages 78 and 80

OBJECTIVES

- To explain how water is treated to make it clean.

LEARNING OUTCOMES

Students should be able to:

- explain how water is treated to make it clean.
- explain how water gets polluted.

START (10 minutes)

Discuss whether students would like to drink water straight from a river or stream. Why not? In water cycle diagrams, the water intake from the river is always upstream from the sewage discharge. However, one river often has more than one village or city near it so the sewage of one town will be discharged in the river downstream from that town, but upstream from the next town or village.

This shows two things. First, the water which we are going to use has to be treated properly to make it safe. Second, we also need to treat waste water to avoid causing too much pollution.

MAIN (20 minutes)

- Read page 80 of the Student Book with your students.

Go over Worksheet 6-2 Task 1

- If the water in rivers is not clean enough to drink, which factors are involved in polluting it?

Read page 78 of the Student Book.

Go over worksheet 6-2 Task 2

PLENARY (15 minutes)

Consider the role of ordinary people in producing pollution, either directly or by factories on their behalf. When students have discussed this (in abstract terms, i.e. about other people) bring the discussion to their individual responsibility.

HOMEWORK

'Test yourself questions' page 78 of Student Book.

Question 4 page 36 of Workbook

Lesson 6-3

Page 79

OBJECTIVES

- To explain how water is treated to make it clean.

LEARNING OUTCOMES

Students should be able to:

- explain the process of sewage treatment.

START (10 minutes)

So far, you have discussed why water is important, how it is used, the water cycle, how our drinking water is cleaned, and how water becomes polluted. Now you need to discuss how to treat sewage so it can be released into rivers without causing environmental problems.

MAIN (20 minutes)

Ask students to read page 79 of the Student Book and do Task 1 of worksheet 6-3.

Briefly discuss the process of sewage treatment to ensure that students understand it. Now compare the two processes. Compare and contrast the diagrams on pages 79 and 80. After the initial discussion, ask students to complete task 2 of worksheet 6-3.

Once students are aware of the differences, discuss the reasons for them. You can consider whether it would be desirable to chlorinate sewage (no, it would kill the decomposers) and if digestion of drinking water would be needed. (No, the amount of organic matter should be so low that it would not really help.)

PLENARY (15 minutes)

Summarise the chapter and discuss how they could contribute to maintaining a system where people have access to clean drinking water. You could ask, 'If not YOU, then WHO? If not now, then WHEN?'

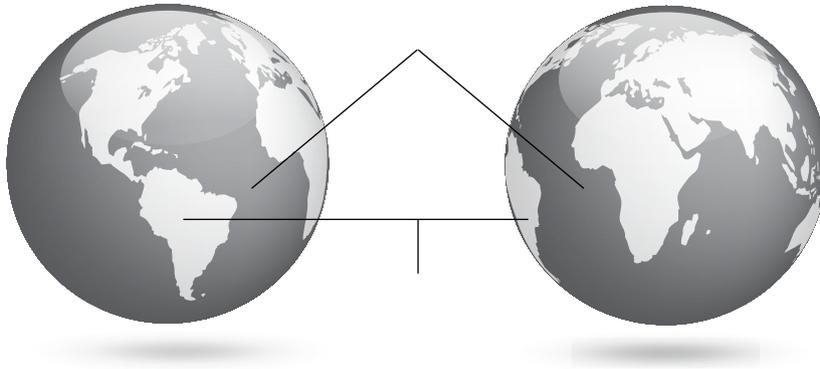
HOMEWORK

Pages 36-37, Question 5 and 6 of Workbook



Task 1

Read pages 76 and 77 of the Student Book and consider the diagram below of the eastern and western hemispheres of the Earth.



- i. Label which part is land and which is water in the above diagram.
- ii. Can you estimate which percentage of the Earth's surface is land and how much is covered with water?

- iii. Mars is called the red planet. What is Earth called? Explain your answer.

Task 2

- i. Which processes in the water cycle require energy?

- ii. Where does this energy come from?

- iii. Which has more run off: a steep slope or a gentle slope? Explain your answer.

Task 3

Read pages 81 – 83 of the Student Book.

- i. List the uses of water described in the book.

- ii. Which of these uses does not pollute the water. Explain your answer.

Task 4

1. Why is water important for plants and animals?

Importance for animals	Importance for plants

2. Answer the following questions:

i. What is the chemical formula for water?

ii. Is water an element or a compound? Give two reasons.

b. Give examples of physical changes that involve water.

**Task 1**

- i. List the steps in water treatment at the drinking water plant as described on page 80 of your Student book.

- ii. Water comes to your house through pipes. In some countries, the water in these pipes is put under pressure so that it easily reaches the first or second floor of the house. In others, there is less pressure and the houses have water tanks on the roof to store water. In this case, people usually do not drink the water from the taps. Can you think of a reason for this?

Task 2

Use the diagram on page 78 of the Student Book to answer the questions below.

- i. Which two main distinctions are made in areas contributing to the pollution of the river?

- ii. Which types of pollutants come from both areas?

- iii. Which types of pollution are unique to each of these areas?

Task 3**Answer the following questions;**

- i. Why are fertilizers and pesticides harmful if dumped in the sea?

- ii. What diseases are caused by untreated sewage?

- iii. How is litter harmful to marine animals?

**Task 1**

Use page 79 of your Student Book to help you answer the questions below.

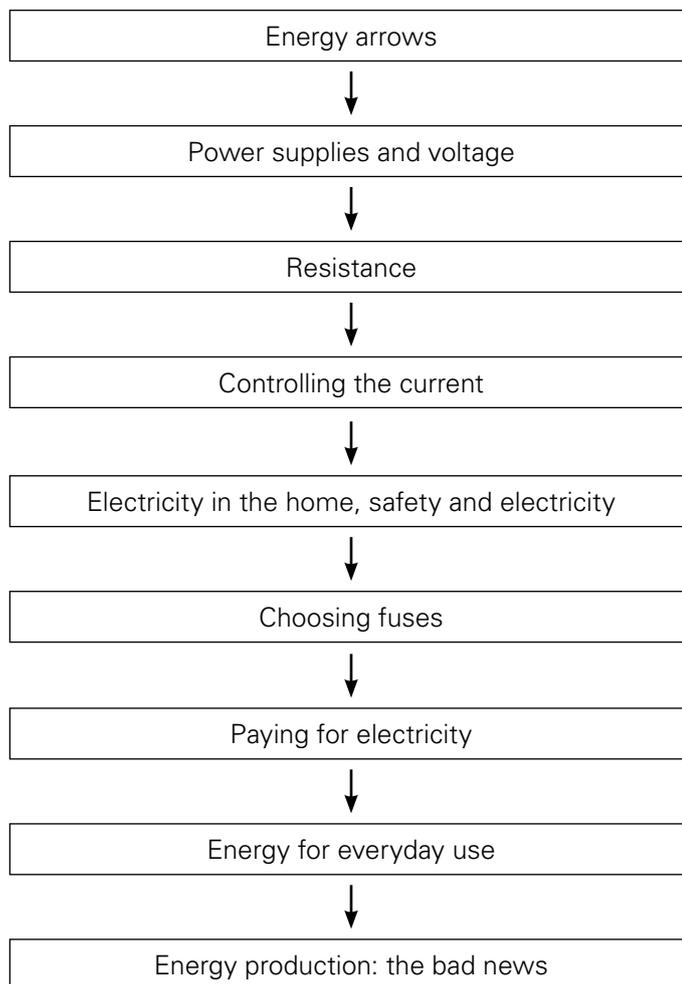
- i. List the four stages in the process of treating sewage.

- ii. Two stages have the same name. Explain how they are similar and how they are different.

- iii. What would happen if you were to flush disposable cleaning cloths or other inappropriate items down the toilet? What would happen to these items?

Task 2

Compare the stages of water treatment for drinking water with those for the treatment of sewage. What are the similarities and the differences?

UNIT FLOW CHART**INTRODUCTION**

In our modern society we depend on electrical devices to do work for us. On page 88 we can see some of the electrical appliances which we use in our daily life. Each one converts electrical energy into another form.

Energy is always lost in some form or another, usually in the form of heat.

All materials contain atoms. Atoms in turn contain small, electrically charged particles called electrons and ions.

Lesson 7-1

Pages 88 - 89

OBJECTIVES

- To explain a range of useful energy transfers.

LEARNING OUTCOMES

The students should be able to:

- describe some useful energy transfer devices.
- draw a Sankey diagram to show energy changes.

START (10 minutes)

Hand out 3 post-it notes per student. Ask them to write the name of one device that runs on electricity (mains or batteries) on each post-it note. Ask them to try to list devices which no one else will write down.

On the board or on poster paper, list the types of energy that these devices are meant to produce. Include thermal (heat or cold), sound, radiated energy (including light), and mechanical kinetic energy (movement). (Electric energy is not included because we are discussing devices which USE electrical energy.)

Put the post-it notes on the board under the headings of the type of energy they produce.

Discuss how these devices can, for example, heat something up. They should come to the conclusion that all devices transfer energy from electrical energy to another form of energy.

MAIN (25 minutes)

- Ask students if these devices also produce unintended forms of energy? For example, a microwave oven also produces sound, and a lamp also produces heat. Where does this energy come from?
- Read pages 88 and 89 of the Student Book and discuss the concept of a Sankey diagram.

PLENARY (10 minutes)

Discuss the 'Test yourself' questions on page 89 of the Student Book.

HOMEWORK

Questions 4 and 5 page 41-42 of Workbook

Lesson 7-2

Pages 90 – 92

OBJECTIVES

- To introduce the concepts of voltage and resistance.

LEARNING OUTCOMES

The students should be able to:

- recognise that any working electrical circuit needs a power supply to provide a voltage and that high voltages are dangerous.
- explain that all materials show resistance against the flow of electricity through them and that a resistor can be used to control the current in a circuit.

START (10 minutes)

- If you look at the charger of a mobile telephone or laptop, it will usually tell you what the input should be in volts and amps. What are these volts and amps?
- Read page 90 of the Student Book.

MAIN (20 minutes)

- A circuit diagram should be drawn with the help of students' input and ask 'What does each component represent?'
- Show them models of a series and a parallel circuit with ammeter and voltmeter. Ask:
 - o What is the opposition to the flow of current called? Why is it necessary to use a resistor?
- Hand out Worksheet 7-2 for students to solve.

PLENARY (15 minutes)

Discuss 'Test yourself' questions given on page 91-92

HOMEWORK

Questions 6, 7, and 8 from Workbook

Lesson 7-3 and 7-4

Pages 95 – 97

Objectives

- To show that some electrical appliances transfer more energy than others and this must be paid for.
- To explain how electricity is generated, with reference to environmental impacts.

LEARNING OUTCOMES

The students should be able to:

- explain safety devices used in homes.
- explain the importance of fuses and circuit breakers in mains electricity circuits.
- recognize that electricity must be paid for.
- describe how electricity is generated by energy from fuels and recognise possible environmental effects of this.

START (10 minutes)

Ask your students to imagine the following situation: A person is cold and wants to take a warm bath. However, the bathroom is very cold too, so he puts a small electric heater on the edge of the bath tub. He fills the bath and steps in. Unfortunately, he knocks over the heater which drops into the water. What will happen? (There will be a short circuit and a lot of current will run through the water.) Will the current stop or continue to run? (The current will stop because the fuse will blow or the circuit breaker will cut out.)

In this example, the person is probably seriously injured but the current may have been enough to stop his/her heart. In smaller accidents at home, by having circuit breakers or fuses, the amount of may be limited so people do not get (seriously) hurt.

MAIN (15 minutes)

- Explain how fuses help to protect house circuits from damage due to too much current. If the current gets too great, the fuse wire melts and breaks the circuit. A circuit breaker is an automatic switch which also turns off current when it gets too high, but it can be reset.
- Explain the formula for power by solving problem.

- Show charts of thermal power stations and a hydroelectric power station. Discuss the energy changes that take place in these power stations.
- Hand out Worksheet 7-3 for students to solve.

PLENARY (20 minutes)

Discuss the 'Test yourself' question on page 97 of the Student Book.

HOMEWORK

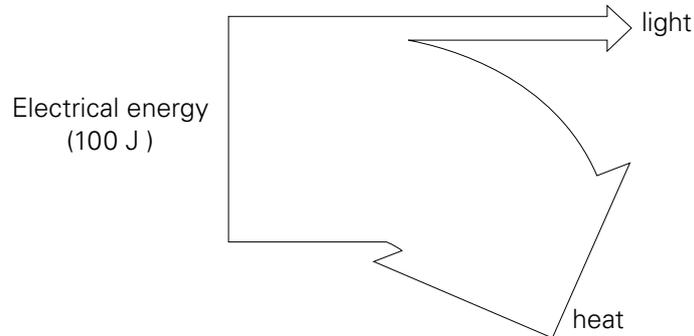
Questions 8 and 9 from pages 45 and 46 of the Workbook.

**Task 1**

1. Consider the type of information needed for a Sankey diagram.

Would you draw a Sankey diagram of your report card grades? If not, what type of diagram would be suitable?

2. Look at the Sankey diagram for the traditional incandescent bulb and answer the questions.



- i. How much energy is wasted as heat energy from 100 joules?

- ii. How much energy is made use of as useful light energy?

- iii. Why do we prefer to use energy savers over traditional bulbs?

- iv. Represent the energy input and output of an LED lamp by a Sankey diagram. LED lamps waste only 50% of the energy.

When you run a current through a circuit, you can measure two things:

- how many electrons are moving through the circuit—this is the current and is measured with an ammeter.
- how 'strong' these electrons are, i.e. how much energy or power or push each electron has – this is the potential difference or voltage and is measured with a voltmeter.

Task 1

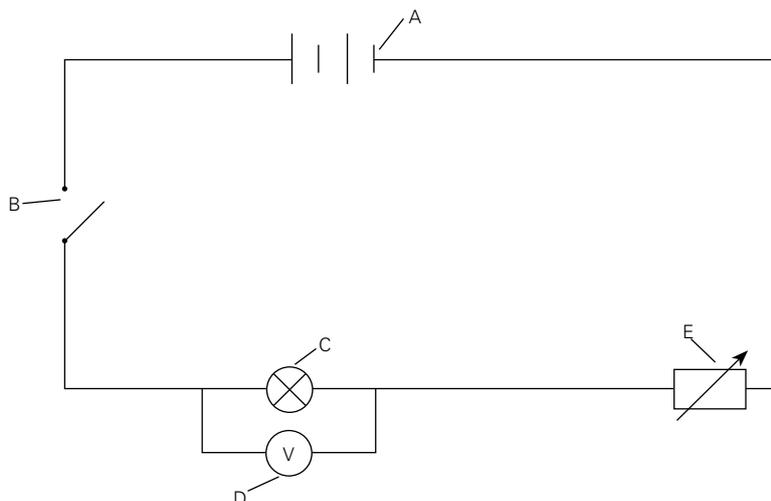
How should voltmeters and ammeters be connected? In series or in parallel? Page 90 of your Student Book may provide some help.

Task 2

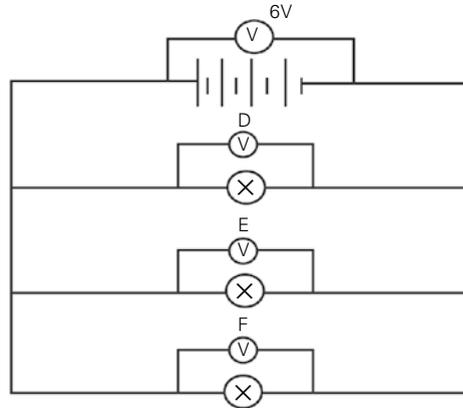
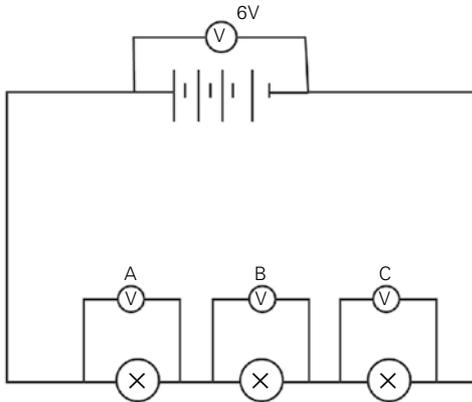
1. Complete the table.

Components	Symbols	Definitions	Formulas
1. voltage			
2. current			
3. resistance			
4. variable resistors			
5. power			
6. energy			

2. Below is a diagram of an electric circuit. Name the components marked A to E.



3. All the bulbs in these circuits are the same. As learnt in Book 1 that voltage produced by the battery is shared equally between the bulbs in the circuit, answer the following:



Write down the reading on each voltmeter in diagrams 1 and 2.

- A _____ B _____ C _____
 D _____ E _____ F _____

4. Write down two differences between series and parallel circuits.

5. Draw a circuit diagram of the following set up:

A 6 V power source is connected in series with an ammeter and a 6 ohm resistor.

- a. What is the reading on the ammeter?



Task 1

Look at the pictures of a circuit breaker and a fuse below.



(RED)



(BLACK)



(BROWN)

i. How can you tell if the circuit breaker was overloaded and cut out?

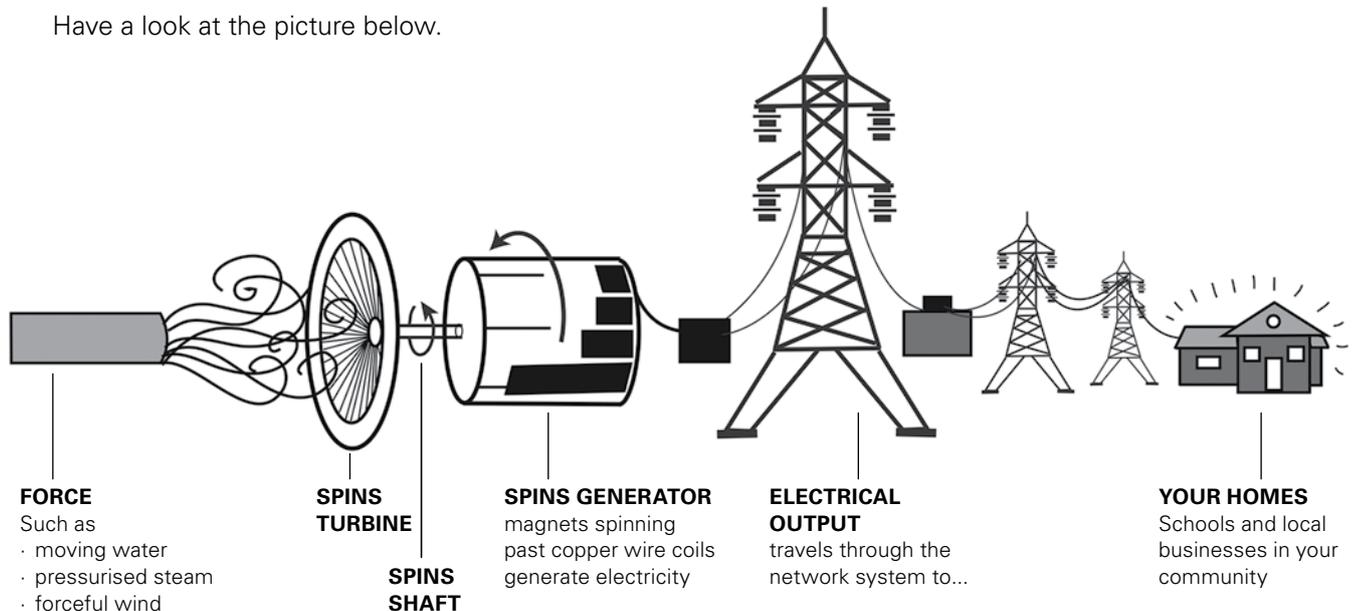
ii. How can you see that the fuse has 'blown'?

iii. Describe what might cause a circuit breaker to cut out or a fuse to blow.

Task 2

1. Electricity can be produced in different ways, but they also have common elements.

Have a look at the picture below.



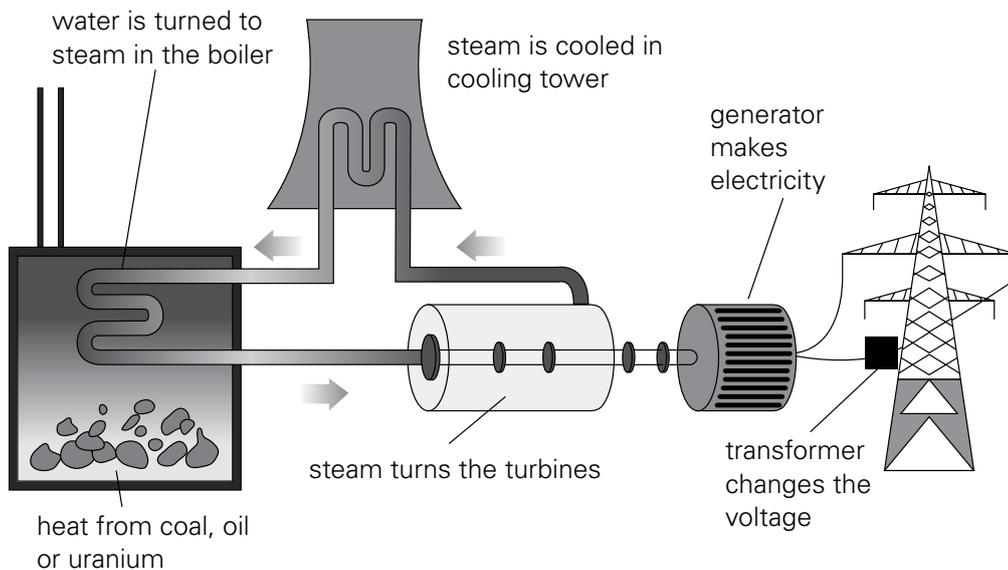
Basically, the power is generated by magnets spinning past coils of metal wire in all systems (except photovoltaic cells—solar panels). The difference is in the way the magnets are made to spin.

- i. What ways can you think of to make the generator spin?

Some of these ways are 'renewable', i.e. whatever made the generator spin will not run out.

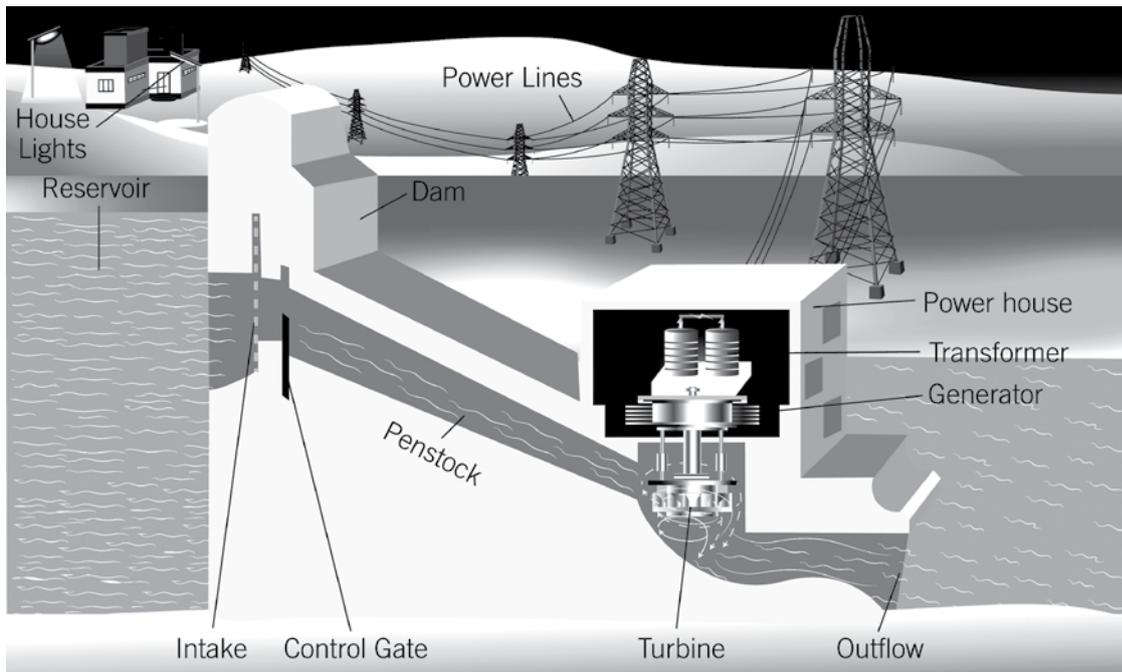
- ii. Which of the ways you identified are renewable?

2. Look at the diagram of a thermal power station and complete the sentences below.



- i. The energy present in the coal is _____.
- ii. When steam turns the turbine, _____ energy is changed to _____ energy.
- iii. The generator producing electricity has _____ energy.
- iv. Energy is wasted in the form of _____ and _____.

3. Look at the following diagram of a hydropower station and complete the sentences.



Water at the top has _____ energy which is converted into _____ energy when the wheel is turned by the generator to produce _____ energy.

4. State the laws of conservation of energy

5. If the following appliances are used over a period of one month in a house, calculate the electricity bill in rupees if each unit costs Rs 6. A unit is 1 kWh (1 kilowatt for 1 hour).

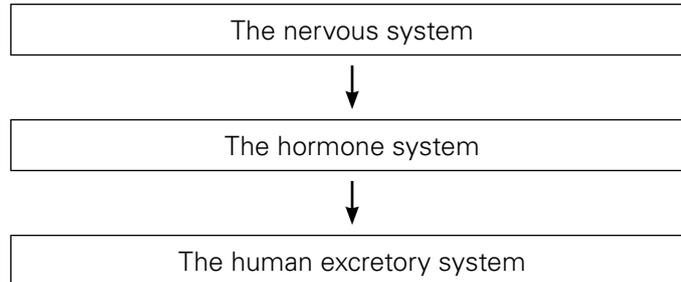
Which appliance used the most energy?

- i. a 1000 watt AC for two hours daily
- ii. a 1000 watt hair dryer for ten minutes daily
- iii. a 800 watt micro-wave oven for 45 minutes daily
- iv. a 1500 watt washing machine for 1.5 hours daily



More organ systems

UNIT FLOW CHART



INTRODUCTION

Fortunately, we can get up in the morning without having to think about keeping our body temperature constant, keeping our heart beating, or coordinating our muscles so we do not fall over on our way to the shower. Although we can decide to breathe more slowly or faster, most of the time this also seems to run on 'autopilot'. All of this is only possible by having organ systems which operate effectively, and a communication system which keeps it all working together.

Lesson 8-1

Pages 108 - 113

OBJECTIVES

- To increase knowledge of other organ systems.
- To explain in detail the nervous system, endocrine system, and the excretory system.

LEARNING OUTCOMES

The students should be able to:

- list the different organ systems.
- explain how the nervous system works and the roles of neurons and nerves.
- explain how voluntary and reflex actions take place.

START (15 minutes)

- Discuss the following with your students. You may have seen a doctor tap a patient's knee gently. The patient's lower leg will then kick out slightly. If necessary, explain that this is a reflex action.
- Ask students to read Task 1 of Worksheet 8-1, and answer the questions.

MAIN (20 minutes)

- For a reflex action to happen, several different parts of the body need to communicate. Read pages 108 – 111 of the Student Book.
- Display a chart of the nervous system showing the sensory and motor nerves and neurons. Ask questions about different parts of the nervous system and their function for instance:
 - o What happens when you touch a hot object? Why do you remove your hand at once? What is this type of action called?
- Consider coughing and talking; which action is voluntary? Explain your answer.
- Ask students to complete Task 2 of Worksheet 8-1.

PLENARY (10 minutes)

Discuss the 'Test yourself' questions from page 113 of the Student Book.

HOMEWORK

Questions 4 -6 of the Workbook

Lesson 8-2

Pages 113 - 115

OBJECTIVES

- To increase knowledge of other organ systems.
- To explain in detail the nervous system, endocrine system, and the excretory system.

LEARNING OUTCOMES

The students should be able to

- explain how hormones work and the functions of the different glands and hormones.

START (10 minutes)

Ask students to find a relaxed position. Tell them to close their eyes. Tell them slowly, with a soft voice, to relax their feet, their calves, their knees, etc., going up all the way to their face/head. Then take them on an imaginary journey through the woods or across a lake or anywhere you like. Keep speaking in a soothing voice, asking them to imagine feeling grass under their feet or trailing their fingers through water. When you think they are relaxed, suddenly scream.

Once the class has calmed down again, you can ask your students what they felt. Answers are likely to include a racing heart, increased breathing (depth and frequency), being alert, etc.

Could all of these responses be coordinated by the nervous system? How would that work? How many nerves would be involved?

MAIN (20 minutes)

Of course, the reactions the students experienced were caused by the hormone adrenalin.

- Read pages 113 to 115 of the Student Book.
- Show a picture of the different glands and ask the students to name them and discuss their functions.
- Explain the importance of hormones, especially the function of the pancreas to produce insulin to control blood sugar.
- Hand out Worksheet 8-2

PLENARY (15 minutes)

- State the functions of glands, hormones, and the pancreas.
- Discuss the 'Test yourself' questions on page 115 of the Student Book.

HOMEWORK

Question 5 and 6 of Student book

Lesson 8-3

Pages 116 - 118

OBJECTIVES

- To explain in detail the nervous system, endocrine system, and the excretory system.

LEARNING OUTCOMES

The students should be able to:

- describe the excretory system in detail.
- explain how the kidneys work.

START (10 minutes)

Discuss what happens when someone drinks very little water. Students should come up with the idea that the person then produces less urine and that it tends to be a darker colour. If you can, try to elicit the words 'more concentrated urine'.

Some people find that drinking tea will cause them to have to make more frequent trips to the bathroom. The 'extra' water in the tea will have to leave the body again, but tea also contains some compounds which make the kidneys produce more urine (which is then more dilute).

MAIN (25 minutes)

- Read pages 116 – 118 of the Student Book. Show either a plastic model or some real kidneys (from the butcher). The nephrons are usually too small to see but you should be able to see the cortex on the outside and the medulla towards the middle. You may be able to see the lines which are Henle's loop and the collecting ducts. All through any discussion, continue to emphasize the relationship between structure and function.
- Show the chart of the excretory system with the structure of the kidneys and ask students about the structure and functions.
- Hand out Worksheet 8-3 to students.

PLENARY (10 minutes)

Discuss the 'Test yourself' questions from page 118 of Student Book.

HOMEWORK

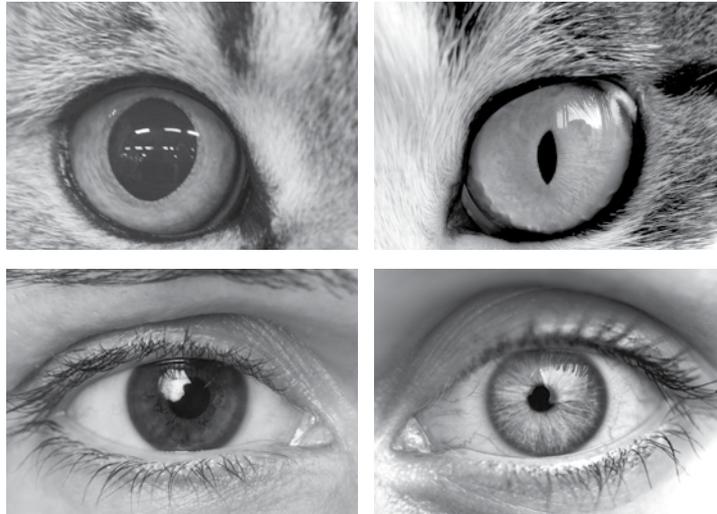
Question 7 from page 51 of Workbook



Task 1

'Cats can see in the dark'. Have you ever heard this statement? It is not actually true. In the total absence of light, cats cannot see anything. So why do people say this?

Look at the pictures below.



- On the left, you see pictures of a cat's eye and a human eye with dilated pupils. On the right, the same species are shown, but with constricted pupils. Where is the difference bigger, in cats or humans? How do you think this affects their ability to see under conditions of low light intensity?

- Is the size of the pupil under voluntary control or is it a reflex action? Explain your reasons.

Task 2

- Complete the following sentences.

- The central nervous system is made up of _____ and _____.
- The nervous system contains nerve cells called _____.
- Messages travel along nerve cell as tiny electrical signals or _____.
- _____ nerve cells carry impulses from sense receptors to control the nervous system.
- _____ nerve cells carry impulses from the central nervous system to the muscles.
- The longest nerve in the human body is the _____.
- _____ are chemicals made in special glands called the endocrine glands.
- The endocrine glands produce a number of different _____ which affect the body in different ways.
- The hormone system is also called the _____ system.
- _____ organs are those parts of the body that respond to a particular hormone.

Task 1**1. Answer the following:**

- i. What are hormones?

- ii. b. How do hormones reach different parts of the body?

Task 2

- i. What are the similarities between the nervous system and the endocrine system?

- ii. Below is a table comparing the nervous system and the endocrine system. Use pages 109 – 115 of the Student Book to complete the table.

	nervous system	endocrine system
Which cells are involved?		
What is the nature of the message?		
How are the messages carried?		
Where do the messages reach?		
What responds to the messages?		
How fast is the system?		
How widespread is the effect of the message?		
How long is the effect of the message?		
Voluntary or involuntary?		

1. State the function of these glands.

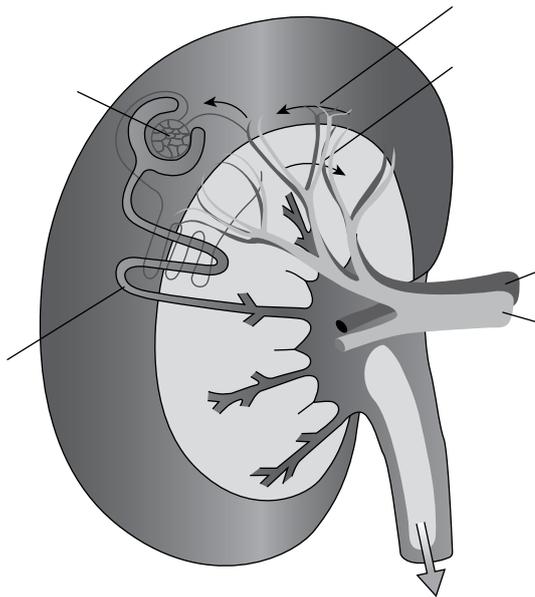
i. adrenal

ii. pituitary

iii. thyroid

iv. pancreas

2. Label the diagram of the kidney.



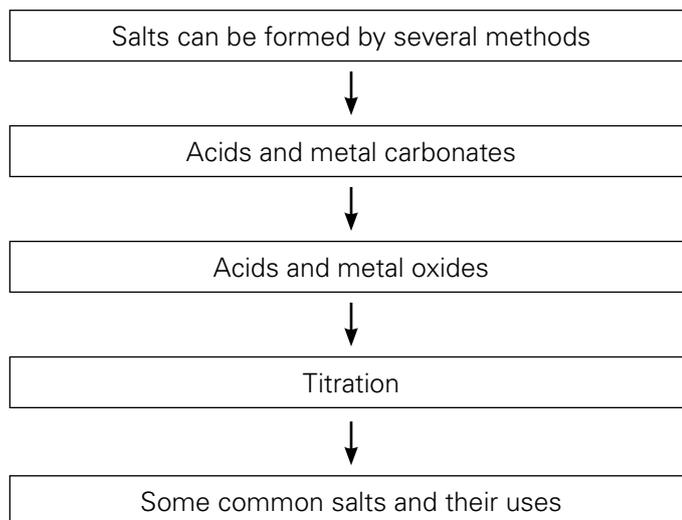
3. What is excretion?

4. State the functions of

i. the renal artery

ii. the renal vein

iii. the kidneys

UNIT FLOW CHART**INTRODUCTION**

Salt is an important element in our life. It is in fact almost necessary for our survival. The most common salt we know is table salt, however, there are some chemicals which are also called salts in chemistry. In this chapter you will learn how salts are formed.

According to science a salt is made whenever an acid is neutralized either by an alkali.

The experiment with lead carbonate and nitric acid on page 126 is an excellent theoretical example of the reaction between a metal carbonate and an acid. However, lead is poisonous and very harmful to the environment, so please do NOT carry out this experiment. If you wish to show the reaction, you can use potassium carbonate and nitric acid. If you wish to relate this to 'real life', then descale a kettle. (Remove the calcium carbonate with an acid such as vinegar, lime juice, or a descaling agent; it will form a soluble salt and carbon dioxide.)

Lesson 9-1

Pages 122 – 123 and Pages 130 - 131

OBJECTIVES

- To extend knowledge about different types of salts.
- To demonstrate how a salt is formed.
- To introduce some common salts and their uses.

LEARNING OUTCOMES

The students should be able to:

- explain how a salt is made and identify different types of salts.
- explain how salts are named.
- identify uses of salts in different fields of life.

START (10 minutes)

If you want to relate this chapter to the previous chapter: most of us eat too much salt. Salt increases your blood pressure and excess salt is excreted via the kidneys.

Ask students what they know about salt. Initially, they will think of kitchen salt (NaCl) but you can extend the discussion by considering bath salts (sodium chloride (sea salt) + magnesium sulphate (Epsom salts) + sodium bicarbonate (baking soda)). Fertilizers contain salt (e.g. ammonium chloride) as does one brand of toothpaste (sodium carbonate). Calcium sulphate is a component of plaster of Paris, and sodium hypochlorite is the main component of 'bleach'.

MAIN (20 minutes)

- Read pages 122 and 123.
- Divide the students into three lines representing three groups: acids, alkalis, and salts. Group A will name acids, group B will name alkalis, metals, carbonates, and metal oxides, and group C will say which salt is formed from the acids. In this way write ten acids, ten alkalis, metal carbonates, and metal oxides, and ten salts.
- Handout Worksheet 9-1 to the students.

PLENARY (15 minutes)

'Test yourself questions' from page 123 and 131

HOMEWORK

Q.3, Q.4, and Q.5 of Workbook page 53

Lesson 9-2

Pages 123 - 128

OBJECTIVES

- To demonstrate how a salt is formed.

LEARNING OUTCOMES

The students should be able to:

- describe how salts can be made by neutralizing an acid with an alkali.
- explain salt formation when a metal is added to an acid.
- explain the role of carbonates in baking cakes.
- explain how metal salts are formed through reactions between acids and metal oxides.

START (10 minutes)

Last lesson, your students learnt there are many different salts, not just the compound they put on food. They also learnt how to name some of these salts and about the different reactions to make salts was introduced. This lesson is about making salts in different ways.

MAIN (25 minutes)

- Ask students to have a quick look through pages 124 and 128 (maybe 20 or 30 seconds) and elicit information provided on these pages from them. This teaches them to skim some pages to get an impression of the type of information they contain. If students do not know how to do this, have a discussion on what should, and should not, be read when skimming. (Focus on headings and diagrams; any question sections should be skipped.)
- At this point, students should already be able to answer question 1 i. of Task 1 of Worksheet 9-2.
- They can look at question ii. and then see if they can find the relevant sections. Read the sections and answer the questions.
- If they then read questions iii and iv, they may realize that the entire section now needs to be read (although you can skip the tests for hydrogen and carbon dioxide as you just read them). They may be able to connect the reactions in iii and iv with the generalized reactions they wrote under i.

PLENARY (10 minutes)

Discuss with students which method they preferred: reading the entire section, or first checking what the questions are and then targeting the relevant sections. Ask them to explain their choices by giving examples of what they learnt. Stress the overview, i.e. the four ways of making salts.

Homework

Read pages 124 to 128 and do 'Test yourself' questions on Student book pages 125, 127, and 128.

Lesson 9-3

Pages 129 - 130

OBJECTIVES

- To demonstrate how a salt is formed.

LEARNING OUTCOMES

The students should be able to:

- describe the titration process.

If you can demonstrate titration in the lab, that would be great. This is not an experiment suitable for students of this age, but it is nice to see, especially if you can use a spectacular indicator such as phenolphthalein. Remember to put the acid in the burette because it is easier to rinse out than a hydroxide.

START (10 minutes)

Elicit responses to the following questions from students:

- What do you take when you have stomach acidity?
- Why is an alkali used?
- What happens when an acid reacts with an alkali?

MAIN (25 minutes)

- Read pages 129 - 130 of Student Book.
- Conduct experiment given in worksheet 9-3 and ask students to answer questions given in the worksheet.

PLENARY (10 minutes)

'Test yourself questions' given on page 130 of Student Book.

HOMEWORK

Question 9 of Workbook

i. What is the definition of a salt?

ii. Name some ways in which salts are made.

iii. Write "true" or "false" next to the following statements about salts.

Salts may have different colours.	
Most salts (but not all) are soluble in water.	
Not all salts have a salty taste. (But NEVER taste anything in the lab.)	
Most salts have a high melting point.	
Some salt crystals have water in them.	
Most salts are solids at room temperature.	
Solid salts do not conduct electricity, but liquid salts and salt solutions are good conductors.	

iv. What are the names of the salts resulting from the following reactions?

- a. copper oxide reacting with hydrochloric acid _____
- b. sulphuric acid reacting with potassium hydroxide _____
- c. calcium carbonate reacting with nitric acid _____
- d. magnesium reacting with hydrochloric acid _____

Task 1

- i. Write an equation for each of the following methods:

acid + alkali _____

acid + metal _____

acid + metal carbonate _____

acid + metal oxide _____

- ii. You do an experiment which releases a colourless, odourless gas. It is either carbon dioxide or hydrogen. Describe the tests you would carry out to identify the gas and what the results would tell you.

- iii. Complete the word equations:

+ hydrochloric acid → zinc chloride + water

sodium carbonate + → sodium chloride + carbon dioxide + water

magnesium + sulphuric acid → +

+ potassium hydroxide → potassium bromide + water

Underline the acid in each equation.

Each equation has either an alkali, a metal, a metal carbonate, or a metal oxide. Circle this chemical in each reaction.

- iv. Complete the chemical equations.

+ 2KOH → K₂SO₄ +

Al₂O₃ + → 2AlCl₃ +

+ → Zn(NO₃)₂ + H₂O + CO₂

2HCl + → CaCl₂ +

Task 2

ACID AND METALS

1. Take some sulphuric acid in a test tube. Add some small pieces of zinc.

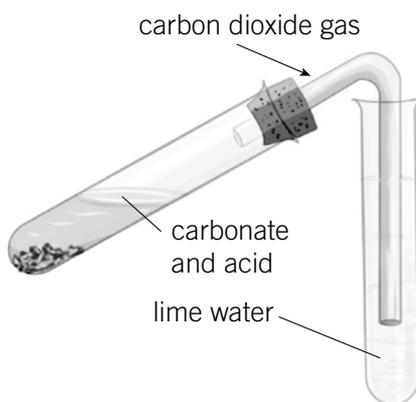
i. What do you observe?

ii. Write an equation for the reaction.

iii. How will you test the gas?

ACID AND METAL CARBONATE

2. In a test tube put calcium carbonate (limestone) as shown in the diagram below. Then add dilute hydrochloric acid. Pass the gas produced through lime water in the other test tube with cork and delivery tube.



i. Which gas is produced?

ii. How did you test the gas?

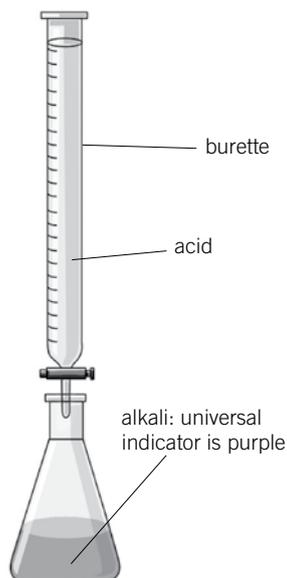
3. Do the same test with any other carbonate or any other acid.

i. Do you get carbon dioxide with every carbonate and acid?

ii. What three substances are formed when an acid reacts with a carbonate?

iii. Write an equation for an acid reacting with carbonates.

Fill a burette with Hydrochloric acid



Pipette out 25 cm³ of alkali into a conical flask and add phenolphthalein indicator. Run out acid from the burette into the conical flask till you get a light pink color.

Initial reading (cm ³)	Final reading (cm ³)	Volume difference between the two readings (cm ³)

i. How many cm³ of acid is neutralized by 25 cm³ of sodium hydroxide?

ii. What is the end point?

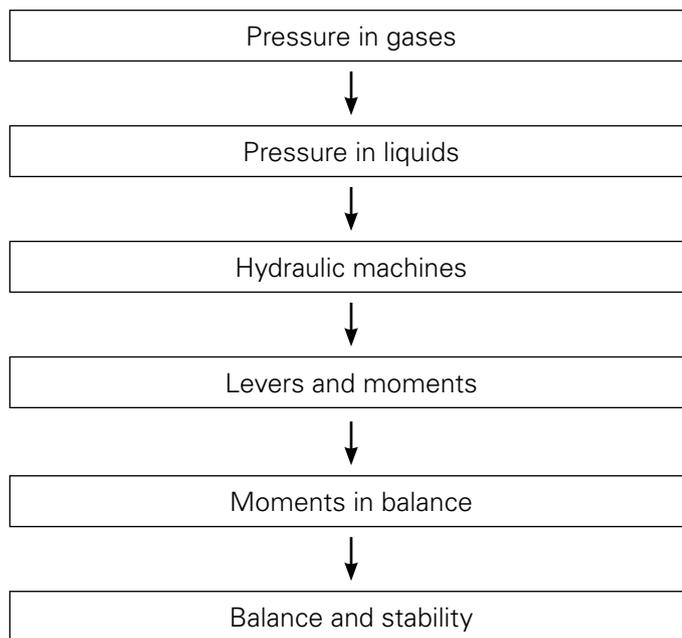
iii. What products are formed when an acid reacts with an alkali?

iv. Write a word equation for the neutralization reaction.

v. Give one use of titration.

10 Pressure and moments

UNIT FLOW CHART



INTRODUCTION

Suppose you were to bring into your class a hammer, a nail, and a piece of wood. You then asked the students to watch while you try to hammer the nail into the wood. However, you put the head of the nail on the wood and hammer the sharp point. Then, mystified, you ask your students what is wrong. At this point, they are probably laughing loudly and tell you that you have the nail the wrong way round. Without realizing, they already know about the relationship between pressure, force, and area.

This chapter can be explained very well with the help of simple demonstrations in class or examples from daily life. Use suitable videos from internet to explain the concepts given in the chapter.

Lesson 10-1

Pages 136 - 138

OBJECTIVES

- To explain the relationship between force, area, and pressure.

LEARNING OUTCOMES

The students should be able to:

- explain and use the relationship between force, area, and pressure.

START (15 minutes)

Have a look at page 136 of the Student book. Ask your students to hold the pencil as shown. Discuss what they feel and why. Can they give other examples about the size of the area in relation to pressure? You could think of camels' large feet not sinking into the sand, a sharp knife vs a blunt knife, poking a balloon with your finger vs a needle, tracks of a tank vs wheels of a car, etc.

Attach a sheet of chart paper onto the soft board with thumb pins and common pins. Which pins are easier to push into the soft board? Why? Why do you feel more pain when pushing common pins?

MAIN (20 minutes)

- The end of a common pin has a small area so it exerts more pressure on the thumb, whereas the head of a thumb pin has a larger area, so it exerts less pressure on the thumb. The pointed pin exerts more pressure on the soft board.

- Pressure depends on area and force.

$$P = \frac{\text{Force}}{\text{Area}}$$

Greater force, greater pressure. Smaller area, greater pressure.

- Hand out Worksheet 10-1 to students.

PLENARY (10 minutes)

'Test yourself' questions from page 138 of the Student book.

HOMEWORK

Question 3 & 4 of Student book or Questions 4 & 5 of Workbook.

Lesson 10-2

Pages 143 - 146

OBJECTIVES

- To show how levers operate, including the maintenance of balance in the human body.

LEARNING OUTCOMES

The students should be able to:

- explain the action of levers and use the principle of moments to perform simple calculations.
- describe how the human body can be kept in balance.

START (15 minutes)

Find a door which does not have a spring or other mechanism which closes it automatically. Put the door in such a position that it is open but can be opened further. Ask a student to use his/her index finger to gently push the door open by placing the finger first near the edge where the door handle is and then near the other side, where the hinges are. Do they feel a difference? (They need more force when pushing near the hinges.) Do not explain the reason for this.

Ask students if they enjoyed playing on a see-saw when they were small. Do some of them have younger siblings or relatives who want to play on the see-saw with them? Can two people of different weights still play? Allow some discussion but let them find the answer through task 1 of Worksheet 10-2.

MAIN (20 minutes)

- Read pages 143 and 144.
- Ask students to carry out the experiment described in Task 1 of Worksheet 10-2. Explain turning effect/ moment using the worksheet and example of see-saw.
- Machines makes our work easier. A lever is a simple machine which has a pivot, load, and effort. Explain a lever by showing the students examples e.g. a scissor.
- Show them the moment of force with a metre ruler on a stand with two weights on each side. Ask the students to balance the ruler and define moment of force.
- Explain that the greater the force that is applied away from the pivot, the easier it is to move the load with a lever. Give the example of a door.

PLENARY (10 minutes)

Go back to the start of the lesson. Can students now explain why more force is required to move the door when pushing near the hinge? What about the seesaw? And the scissors?

Ask students to summarize what they have learnt.

HOMEWORK

Question 4 and 5 of Student book.

Lesson 10-3

Pages 139 - 140

OBJECTIVES

- To compare pressure in gases with pressure in liquids, and give examples of their uses.

LEARNING OUTCOMES

The students should be able to:

- describe some effects and uses of gases under pressure.
- use the particle model to explain the behaviour of gases under pressure.

START (15 minutes)

- This is a great experiment for students to do. All you need is syringes without needles and some water. However, it is almost inevitable that they will end up squirting water at each other, so if you are confident that you will be able to restore order, please do this, but do it outside. Take two syringes. The first is filled with air and the second is filled with water. Which one is easier to compress? Why?
- Explain atmospheric pressure and demonstrate movement of liquids in straw.

MAIN (20 minutes)

Read pages 139-140.

Use particle theory to show what causes pressure in a sealed container or tyres. What happens if you put in more gas or if you take out some gas? If possible show students videos about gases under pressure e.g., <https://www.youtube.com/watch?v=t-lz414g-ro> or <https://www.youtube.com/watch?v=Grziaq-caVE>. The activities shown in these videos can be performed in class too.

PLENARY (10 minutes)

Discuss following questions in class:

- What causes pressure in tyres? How can you increase the pressure?
- Why do we use air in tyres and not water?
- What is atmospheric pressure? Where is air pressure higher, at sea level or at the top of a hill?
- When a gas is heated, what happens to the pressure? Explain in terms of particle theory.

HOMEWORK

Do pages 67 & 68 of the Workbook.

Lesson 10-4

Pages 140 - 142

OBJECTIVES

- To compare pressure in gases with pressure in liquids, and give examples of their uses.

LEARNING OUTCOMES

The students should be able to:

- use the particle model to explain why liquids cannot be compressed.

START (10 minutes)

Take a 1.5 litre water bottle. Make three holes, one above the other, the lowest hole being near the bottom of the bottle. (See page 140 of the Student book.) Fill the bottle with water and stand it upright. Ask students how the flow of water coming from the holes is different and discuss the reason.

MAIN (25 minutes)

- Explain relationship between density and pressure. Show them that it is very difficult to compress liquids. This property of liquids is helpful in our daily life.
- Hydraulics deals with pressure in liquids. Hydraulics are used in car brakes where a small force is magnified to produce a larger force. Explain with the example of two pistons: one pushed with a smaller force to produce a larger force. (Do the calculation on the board with a diagram.) the concept of hydraulic machines can be explained with the help of video such as <https://www.youtube.com/watch?v=TjzKpke0nSU> or

you may search for other videos using keywords such as hydraulic pressure, hydraulic machines etc.,

- Hand out Worksheet 10-4 to the class.

PLENARY (10 minutes)

Discuss the following questions:

- Why is oil used instead of gas in hydraulic brakes?
- Where will the pressure in a swimming pool be greater, and why?
 - at 10m depth
 - at 20m depth

HOMEWORK

Question no.6 of Workbook.

Lesson 10-5

Pages 145 – 148

OBJECTIVES

- To show how levers operate, including the maintenance of balance in the human body.

LEARNING OUTCOMES

The students should be able to:

- explain how joints and bones in human body act as levers.
- Explain how balance depends on the position of centre of gravity.

START (10 minutes)

- Ask the students to bend their arms and explain the working of tricep and bicep muscles.
- How would you find the centre of gravity of a square object and a circular object?
- How would you find the centre of gravity of irregular-shaped objects?

MAIN (20 minutes)

- Ask the students to balance a pencil, eraser, pen or ruler on their index finger. Explain an object is most stable if its centre of gravity is low and its base is wide, that is why it is easier to balance eraser and sharpener.
- Handout Worksheet 10-5 to students

PLENARY (15 minutes)

Ask students to find the centre of gravity of an irregular-shaped piece of cardboard, as the experiment given on page 147 of the Student book.

HOMEWORK

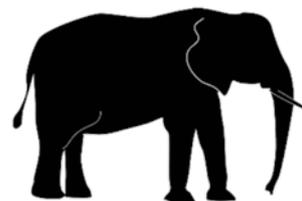
Question 9 of Workbook

Task 1

Your parents have just put a beautiful, new floor in your house. It is made of a rare and very expensive soft wood. They are inviting a lot of people to a party to show off their new floor. As you receive the guests at the door you come across the following situations:

One of the guests brings her cousin who is visiting from abroad. She is tall, not exactly slim, and wearing stiletto heels. You estimate her weight to be 100 kg and the surface area of each heel to be 1 cm^2 .

Another friend wants to bring in his new pet: an elephant! You estimate the elephant's weight to be 6000 kg and each of its feet to have a surface area of 0.18 m^2 .



- i. What pressure would each of these exert on your parents' new, soft wood floor?

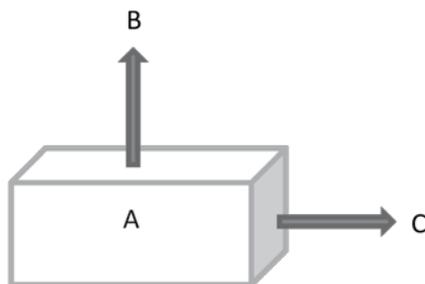
- ii. Which guest would cause less damage to the floor?

- iii. Now consider that each of these guests would not just be standing still. Would it change your answer?

Task 2

- 1. If you need to have an injection, would a sharp or a blunt needle hurt less?

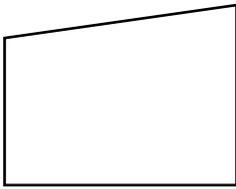
- 2. A box is to be kept on a weak base. Considering the different sides of the box, answer the following questions.



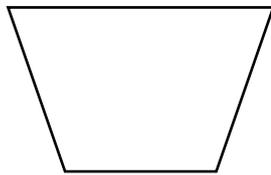
- i. Which side would create the smallest pressure? Why?

- ii. Which side would create the largest pressure? Why?

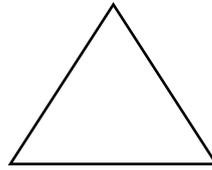
3. Suppose below are the shapes of objects standing on the solid surface. Considering the shapes answer the questions given below.



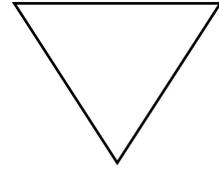
A



B



C



D

- i. Which of the shapes would exert most pressure? Why?

- ii. Which of the shapes would exert least pressure? Why?

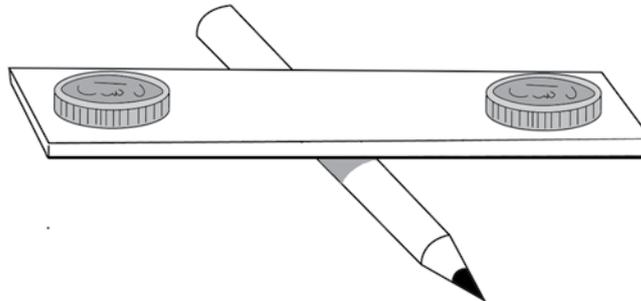
4. A person weighing 500N is sitting on a chair. If one leg of the chair has an area of 0.002m^2 , calculate the total pressure exerted by all four legs when in contact with the floor.

5. Why should the axe of a woodcutter be as sharp as possible?

Task 1

Take a ruler and pencil and make a see-saw.

Put a coin on each side and make sure the see-saw is in balance.



i. What is the position of each coin? How far is the centre of each coin from the centre (precise place where the ruler is touching the pencil) of the see-saw?

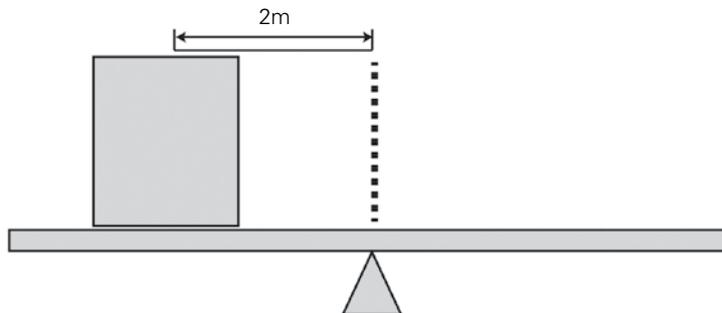
ii. Put two coins on one side and one on the other. Can you place them in such a way that the see-saw is balanced? What is the position of each coin? How far is the centre of each coin from the centre of the see-saw?

iii. Repeat this with three coins on one side and one on the other.

iv. Can you think of more variations on this? Record your results.

v. Can you see a pattern in your results? Is there a relationship between the number of coins and the distance from the centre?

2. A box having a force of 50 N acts on a lever at a distance of 2m from the pivot.

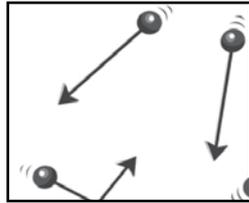


Calculate the size of the moment.

Task 1

On page 139 of the Student book, you see a particle model of a gas. One section of this diagram is shown again below. In the empty box, draw a particle model of a liquid. Think about the density of the particles in a liquid compared to in a gas, and about their size and speed.

a.



b. Use the above diagrams to explain what happens if you put pressure on a gas and on a liquid.

Task 2

1. What would happen if the hydraulic brakes of a car were filled with a gas rather than a liquid?

2. A driver applies a force of 5N on the brake pedal whose area of small master piston is 1cm². The area of the larger piston is 5cm². Calculate the force exerted by the brake pad.

3. Explain why tyres are filled with air and not with water.

4. What happens to the pressure in a tyre during summer when temperature rises? Explain in terms of particle theory.

5. A diver dives into the sea to a depth of 20m.

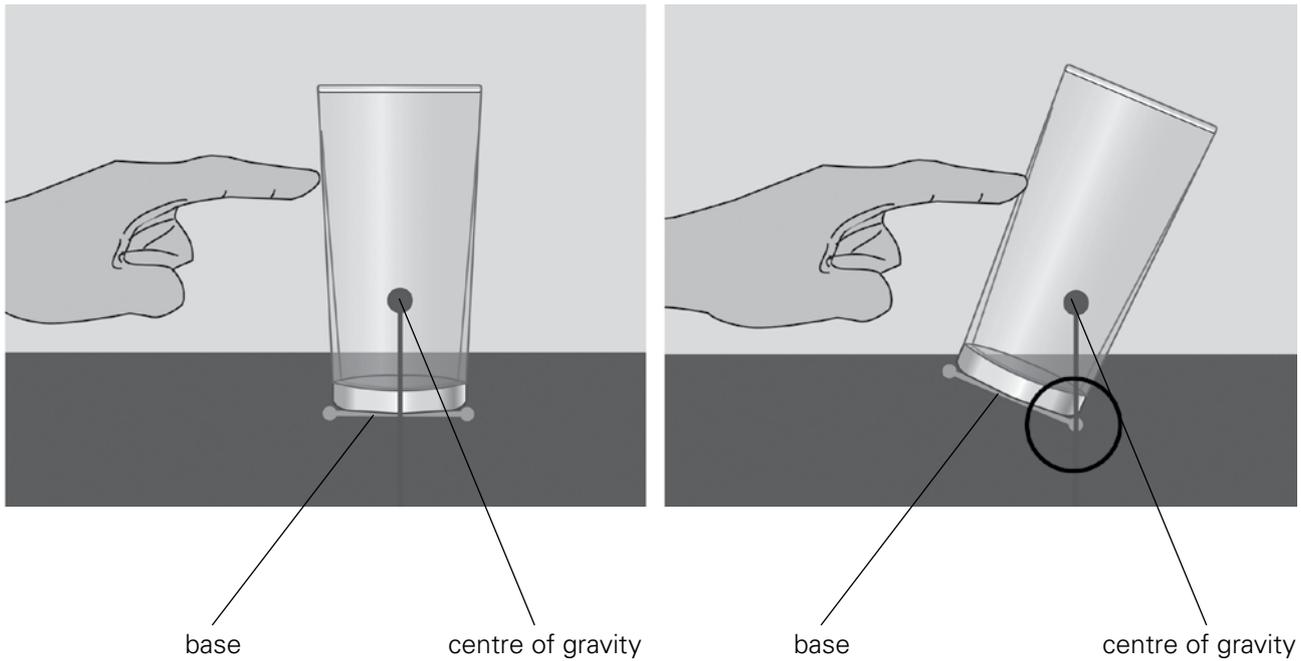
i. Why is the pressure at this depth greater than atmospheric pressure?

ii. Other than depth and atmospheric pressure, state one more factor which affects pressure in liquids.

6. State one difference between the arrangement of the molecules in the water of a lake and the molecules of air in a balloon.

Centre of gravity is the point at which we consider the weight of an object to be concentrated—the centre point from which the weight is evenly dispersed on all sides. The position of centre of gravity of an object affects its stability—when you disturb an object its centre of gravity moves and it tips over when its centre of gravity passes its base.

The ability of an object to maintain its balance after being disturbed is called stability. Centre of gravity tells us how stable an object is. Lower the centre of gravity more stable the object is. If an object is tilted it will topple over—if a vertical line from its centre of gravity falls outside its base.



Task 1

Your teacher will give you a plastic cup. If you gently push the cup as shown in the diagram, it will eventually tip over.

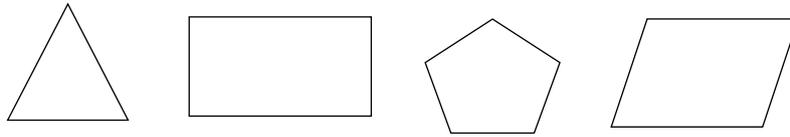
- i. Do this a few times so you know when the cup will fall. Push it to just before this point and measure the perpendicular distance from the cup’s rim to the table.

- ii. Put something heavy in the cup: maybe a few coins or erasers. Repeat what you did for i. and record the distance again. What do you notice?

- iii. Can you explain what caused the difference in your results for i. and ii.?

Task 2

1. Find the centres of gravity of the following regular objects.



2. Why do we use our back teeth rather than our front teeth for grinding food?

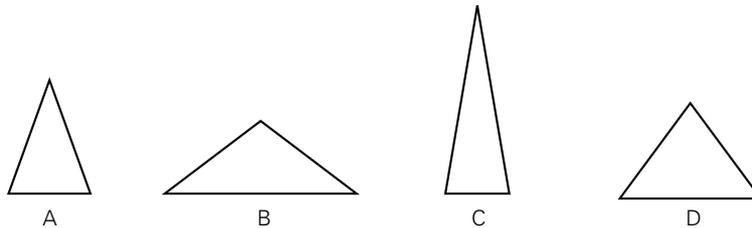
3. How do the following objects counter-balance themselves?

i. car park barrier

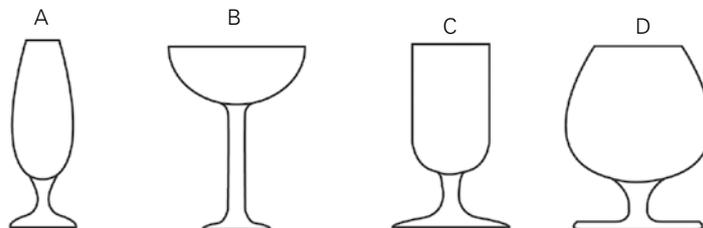
ii. kangaroo

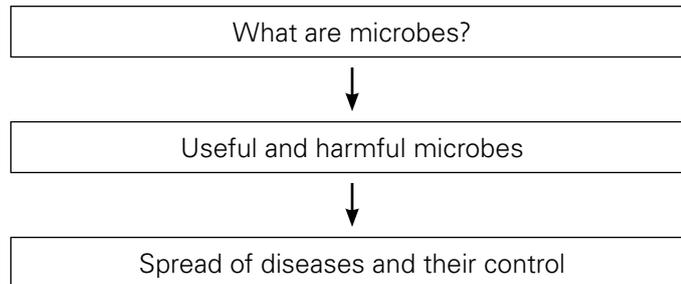
4. Why are sports cars designed to be closer to the ground than normal cars?

5. The four conical objects shown below are of equal weight. They are placed on a table. Which object is most stable? Why?



6. Below are diagrams of four glasses of water that have been placed on a table. Which one is least stable? Why?



UNIT FLOW CHART**INTRODUCTION**

Although there is insufficient conclusive evidence, many people who study the history of disease and medicine believe that pre-historic civilisations most likely related (some) diseases to the actions or influence of spirits. It is also likely that they had some knowledge of herbal medicine.

The Egyptian civilization developed writing so they could pass on knowledge beyond what was remembered. Doctors carefully observed the results of treatments and (religious) value was placed on cleanliness.

Chinese medicine initially thought disease was caused by evil spirits, but around 1000 BCE there is evidence that they used specific drugs to treat diseases. The earliest evidence for the use of acupuncture is from 100-200 BCE.

The Greeks continued the process started by the Egyptians. They still believed in many gods, but the influence they were believed to exert on people's lives diminished as the Greeks gained more scientific knowledge.

Roman medicine was influenced by the needs of the army and this resulted in a focus on prevention rather than cure.

Of course, we now believe we know a lot more and are beyond superstitions – but most of us will warn others to dress warmly in winter 'or you will catch a cold'. A 'cold', like a number of other diseases, is caused by infection by a virus, not by a drop in temperature. As it gets colder outside, we spend more time indoors, rebreathing the same air and in closer contact with others. If one of these has a 'cold', the opportunities for transmission are greater than they are when it is warmer.

In this chapter, we will learn about microbes – organisms we did not even know existed until the middle of the 17th century. Some microbes are certainly capable of causing a lot of harm (such as the bacteria which caused the plague and killed as many as 25 million people in the Middle Ages) but others are beneficial, and quite a few are essential to our lives.

Lesson 11-1

Pages 154 - 157

OBJECTIVES

- To introduce microorganisms as living things and to explain that they can be both useful and harmful.
- To explain how knowledge of microbes can help control the spread of infectious diseases.

LEARNING OUTCOMES

Students should be able to:

- explain that bacteria, viruses, and fungi are classified as microorganisms (microbes).
- explain that microbes can be useful and harmful.
- identify some examples of where microbes can be useful.
- explain the difference between biodegradable and non-biodegradable materials.

START (10 minutes)

Ask if any of your students has been sick recently. Ask them if they would like to say what was wrong with them and what caused it. Answers may include injury, genetic diseases, and things like colds and measles. Discuss the difference between injury and disease, and between infectious and non-infectious diseases (those which have, e.g. genetic causes, allergies, etc.).

It is worth spending some time on this since not all students may be clear on the causes of infectious diseases.

MAIN (25 minutes)

- Read pages 154 – 155.
- Draw students' attention to the fact that one bacterium, one virus, or one fungus is unlikely to have any effect, good or bad. So the reproduction of these organisms is what we want, or want to avoid. Ask students to complete Task 1 of Worksheet 11-1.
- In Task 2, students are asked to calculate bacterial growth. Either have them do this with a calculator or co-teach with your IT colleague (and do it in Excel). The aim is to develop the understanding that bacterial growth initially is small, but once a

sizable population exists, numbers increase very rapidly. You will refer to this when talking about disease.

- Task 3 and pages 156 and 157 stress that microbes are useful too. It is important that students realize this because it is a common perception that an absence of microbes would be ideal; but this is not the case.

PLENARY (10 minutes)

Not only is cheese made with bacteria, some cheeses, get their structure and taste from the (edible) fungus that grows on their crust.

Other foods which require the action of microbes are coffee, chocolate, olives, vinegar, etc. Ask students to investigate one of these or another type of food which involves microbes.

Recommended extension

You could consider doing a whole lesson on non-biodegradable materials. Do some research on where it goes. A video search on the internet, using, e.g., 'How Much Plastic is in the Ocean?' as your search term should provide you with a number of videos about this topic. It is recommended to download these videos and then show them to your students to avoid disappointment if there is a problem with the internet.

Have your students collect some waste, create posters, write articles for the school newspaper, or produce information brochures to send to parents. Showing parents that their children are learning about science in a practical way will impress most of them!

Homework

Read pages 154 – 157 and answer the 'Test yourself' questions on pages 156 and 157.

Lesson 11-2

Pages 158 – 159

OBJECTIVES

- To introduce microorganisms as living things and to explain that they can be both useful and harmful.
- To explain how knowledge of microbes can help control the spread of infectious diseases.

LEARNING OUTCOMES

Students should be able to:

- name some diseases that are caused by bacteria, viruses, and fungi, and explain how they are transmitted.

START (10 minutes)

Discuss the following with students:

- Would they be willing to shake hands with a classmate?
- What if they saw this person sneeze while covering his/her nose and mouth with his/her hand. Would they still shake hands?
- What if this person used this hand to open the door? Would the student be willing to touch the door handle?

What would be their reasons for being reluctant in any of the above scenarios? In Germany, it is fairly common for all students to shake hands with the teacher at the beginning and end of the lesson. While this may be considered polite, is it a good idea from the perspective of health? Suppose the first student carries some disease-causing microbes on his/her hands. Who would these microbes have spread to by the end of the lesson?

MAIN (25 minutes)

- Read pages 158 and 159. Discuss the diseases mentioned. Do any of your students know the symptoms?
- Ask students to complete task 1 of Worksheet 11-2.

PLENARY (10 minutes)

Discuss methods of transmission and what students can do themselves to prevent it. Use page 160 of the Student book. Does the school encourage hand washing at regular times? Are hand sanitizers available, maybe at certain times of the year? Should your students organize an awareness campaign for students and parents? If so, would they put together a play, make posters, give presentations? Should it be about hygiene in general, or focus on one disease?

HOMEWORK

Read pages 158 – 159 and answer the 'Test yourself' questions on page 159.

Lesson 11-3

Pages 161 - 163

OBJECTIVES

- To introduce microorganisms as living things and to explain that they can be both useful and harmful.
- To explain how knowledge of microbes can help control the spread of infectious diseases.

LEARNING OUTCOMES

Students should be able to:

- identify some of the defences the body has against diseases.
- describe immunization as a way of improving immunity.

START (10 minutes)

Ask and discuss the following questions:

- When people go swimming in a river or canal, there will be microbes in the water. Why do they not get sick?
- If you were to leave a piece of cheese out, it would be covered in mould after a day or two. How come we are not covered in mould?

MAIN (25 minutes)

- Read pages 161 -163.
- Discuss the concepts of keeping microbes out and the problems with an injury. Do task 1 of Worksheet 11-3.
- Discuss how vaccination can prevent disease, even if a microbe or two enters the body.

PLENARY (10 minutes)

Discuss vaccination with your students. Have they been vaccinated? Did they mind being vaccinated? What was worse: the actual injection, or the fear? Do they understand the benefits of one vaccination versus getting seriously ill?

HOMEWORK

Read pages 161 to 163 and answer the 'Test yourself' questions on pages 161 and 163.

**Task 1**

In the table below name the three groups of microbes and explain how they reproduce.

type of microbe	method of reproduction

Task 2

Your Student book says (page 155) that bacteria reproduce by dividing into two and that they may be able to do this every 20 minutes. So in the table below, you will calculate the growth of a population from one bacterium over time.

Time from start	Number of bacteria
0 minutes	1
20 min	2
40 min	4
1 h	
1 h 20 min	

Time from start	Number of bacteria
3 h 40 min	
7 h	

Use the numbers you calculated above to answer the following questions.

- i. If you had only one bacterium on your hand and you did not wash your hands for 7 hours, how many bacteria might be living on your hand at the end of that time?

- ii. What was the increase in the number of bacteria from 40 minutes to 1 hour?

- iii. What was the increase in the number of bacteria from 6 h 40 minutes to 7 hours?

- iv. How long does it take to grow 1,000 bacteria from 1? And how long to get from 1,000 to 2,000?

- v. Suppose you had washed your hands after 2 hours and cleaned them of all bacteria except one. How many bacteria would be on your hands after 2 hours and 20 minutes?

- vi. Suppose you wash your hands every 2 hours. What is the greatest number of bacteria that will ever be on your hands?

Task 3

- i. List the things which microbes do that we find useful.

- ii. Decomposition involves both bacteria and fungi. Which microbes are used in making cheese, yoghurt, and baking?

- iii. What happens to most plastics which are non-biodegradable?

Task 1

Harmful microbes are sometimes called 'germs'. Below is an incomplete table of some diseases, their causes, symptoms, and whether a vaccine exists.

- Use pages 158 and 159 to find out which type of microbe causes the disease and complete the second column of the table.
- Some of the diseases already have descriptions of their symptoms. For the others, copy the correct description from the word bank below.

muscle weakness, inability to move, may cause permanent paralysis	rash, fever, sore throat	red patches on skin
nausea, vomiting, diarrhoea, abdominal pain	raw skin, peeling, blisters	runny nose, coughing, sneezing, mild fever

Name of the disease	cause	description of symptoms and consequences	is there a vaccine?
athlete's foot		<i>raw skin, peeling, blisters</i>	No
chicken pox		itchy rash with blisters	Yes
cold		<i>runny nose, coughing, sneezing, mild fever</i>	(1)
flu		fever, coughing, sore throat, headache, fatigue	(1) (2)
food poisoning		<i>nausea, vomiting, diarrhoea, abdominal pain</i>	(1)
German measles (rubella)		rash, fever, swollen lymph nodes; if pregnant women get it, baby may have serious problems	Yes
measles		<i>rash, fever, sore throat</i>	Yes
mumps		fever, headache, muscle pain, swelling of some salivary glands in older males, it could cause sterility	Yes
pneumonia		fever, cough, difficulty breathing	yes, for bacterial pneumonia
polio		<i>muscle weakness, inability to move, may cause permanent paralysis.</i>	Yes

ring worm		<i>red patches on skin</i>	No
small pox		skin rash with blisters, leaving scars	Yes
tetanus		severe muscle spasms, fever	Yes
(oral) thrush		white lesions on tongue and inside mouth	No
whooping cough		runny nose, sore throat, intense coughing	Yes

- (1) Many different microbes can cause this disease so you would have to be vaccinated against each of them.
- (2) Flu viruses also change rapidly so new ones come up every year.

Dengue fever is caused by a virus which is transmitted by a mosquito. When you have dengue fever, you are likely to have a fever, headache, aching muscles, and a rash. Occasionally, complications occur and the patient may not recover. A vaccine has been developed recently and is available in some countries. Removing standing water (in flower pots, etc., but particularly in car tyres left in the open) will reduce the mosquitoes' breeding places, and keeping them away using screens and mosquito netting also helps in reducing the chance of contracting dengue. No drug exists to treat dengue.

Task 1

- i. What is one of the main functions of your skin?

- ii. Suppose you have a slight cut. What is the first thing that happens? How does it help keep microbes out?

- iii. After a few minutes, what is the next process that occurs which helps prevent infection?

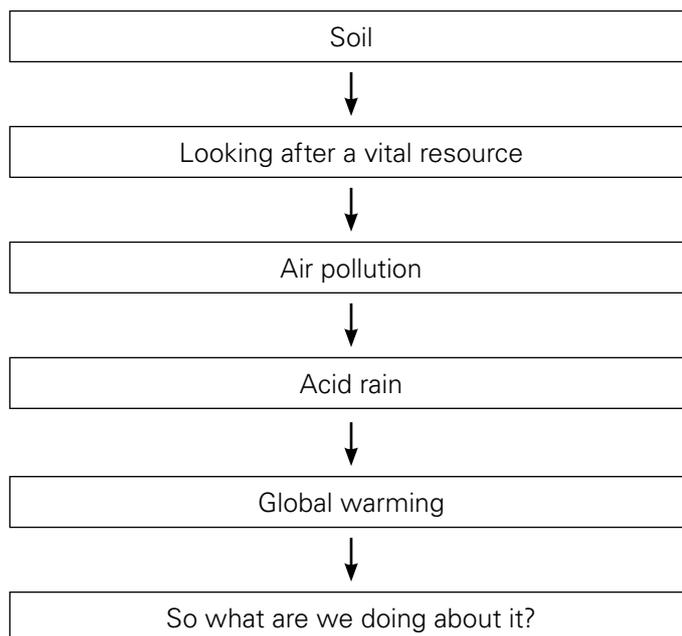
- iv. What are some good ideas when treating an injury? Cross out the bad ideas and put a tick next to any good ideas.
 - All injuries should be treated by a doctor, even better at a hospital.
 - Mild injuries can be treated at home.
 - Mild injuries do not need treatment at all.
 - Mild injuries should be rinsed with just water or water with a little salt.
 - Mild injuries need to be treated with strong antiseptics.
 - Dirt should be rinsed out or removed gently with sterile forceps.
 - Any dirt in a wound is already there so should be left.
 - Small scabs should be scratched off as often as possible.
 - Small scabs should be left until they fall off by themselves.
 - Scratching off scabs will leave fewer scars.
 - Serious wounds should be left to bleed.
 - Very serious bleeding should be stopped by applying direct pressure, if possible with a clean cloth, but if necessary with dirty hands to prevent extensive blood loss. Wounds where blood comes out in squirts always need urgent medical attention.
 - Use common sense but when in doubt, see a doctor.

Task 2

- i. Two kinds of white cells in the blood play an important role in a person's defence system. What does each of them do?

- ii. Which of these two responses is triggered by vaccination or immunization? How does it help to prevent you from catching the disease?

Antibiotics are fantastic drugs that kill bacteria while not really affecting the cells of our bodies. They have helped many people recover from disease or infection, or even prevent infection. However, some bacteria are becoming immune to antibiotics because they are used too much. Sometimes patients ask their doctor for antibiotics for a cold or flu and sometimes doctors just give them because it is easier. Be aware that this is not helping your health and you may be helping to make even more bacteria antibiotic resistant.

UNIT FLOW CHART**INTRODUCTION**

'Environment' is a scientific word for 'surroundings'. Your environment provides you with such things as air to breathe, water to drink and a suitable temperature in which to live. These are the physical or the non-living parts of the environment.

Your life is also affected by other living things. These could be the people in your class, your family, your pets and even the bacteria in the air.

Living things together with their physical environment form an ecosystem. In an ecosystem many different processes or cycles take place. These help to keep the environment the same as the years go by. We have to be careful that we do not upset the balance in our environment.

Lesson 12-1

Pages 168 - 172

OBJECTIVES

- To show that soils have a variety of characteristics.

LEARNING OUTCOMES

Students should be able to:

- describe soil and explain how it is produced from rock.
- identify some differences between soils.
- explain how soils can be kept healthy.

START (15 minutes)

Collect some samples of different soils. Examples can include potting soil (from a garden centre) and very sandy soil from the beach or any other sandy area. Give students a small sample of each (in a closed transparent bag if you are afraid it will make a mess) and ask them to describe each sample.

MAIN (20 minutes)

- Ask your students to complete task 1 of Worksheet 12-1. You can take several approaches:
 - they can just write their observations,
 - or you can direct them towards the traits that are usually considered by asking them to first read pages 170 and 171. Ask them to complete Task 2.
- You can draw the students' attention to the fact that describing each soil will give a different answer from listing similarities and differences and that they should consider exactly what they are asked when answering questions in an assessment or exam.

PLENARY (10 minutes)

Ask students what they have learnt about soil today. If you wish, you can give exit cards which they should complete, such as

'I used to think that but now I know that

HOMEWORK

Workbook questions 3 and 4.

Lesson 12-2

Page 175 – 179

OBJECTIVES

- To show how the environment is affected by natural processes and human activities.

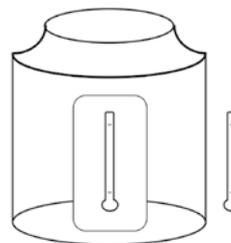
LEARNING OUTCOMES

Students should be able to:

- distinguish between different environmental problems (hole in the ozone layer, smog, acid rain, greenhouse effect).

START (10 minutes)

A simple experiment to show the greenhouse effect is to take two identical thermometers. Place one in a closed glass jar and place the other next to it. Place both jars in the sunlight and monitor the changes in temperature. The temperature in the glass jar should increase faster than outside the glass jar. The glass jar has the same effect as carbon dioxide in the atmosphere.

**MAIN (20 minutes)**

- Read pages 175 to 179.
- In the discussion about global warming caused by the greenhouse effect it is not helpful to pass judgement or blame any group or system. As far as possible, use data to show what the current situation is and how it can be improved. After all, due to the collaboration of many countries, the ozone layer is getting smaller and acid rain is decreasing, so we are capable of averting potential environmental catastrophies—we just need to figure out how, and then to do it. Again, here you can ask your students: 'If not you, then who? If not now, then when?' to make them realize that we should all be part of the solution.
- Help students do the calculations for Task 1 on Worksheet 12-2.

PLENARY (15 minutes)

Discuss global warming. Check that students have understood the roles of carbon dioxide and methane in global warming. They should realize that without any greenhouse effect, the Earth would be too cold for human life. The problem is the increase in carbon dioxide. If you wish, you can point out that the melting of the Polar ice replaces white snow/ice (reflecting light and heat) with dark water (absorbing light and heat).

If your students can handle conflicting data, you could discuss the concept that thawing out large areas of swamp, currently permanently frozen, might release significant amounts of methane. Two studies were done last year relating to this. One found no significant methane boost, while the other found that more methane than expected was released.

HOMEWORK

Read pages 175 – 179 and answer the 'Test yourself' questions on pages 176, 177, and 179.

Lesson 12-3

Pages 173 – 175

OBJECTIVES

- To show that soils have a variety of characteristics.
- To show how the environment is affected by natural processes and human activities.

LEARNING OUTCOMES

Students should be able to:

- describe, in terms of chemical reactions, how acid rain is formed, and how it affects rocks, building materials, and living things.
- distinguish between different environmental problems. (hole in the ozone layer, smog, acid rain, greenhouse effect)

START (10 minutes)

Get some bottled water, both fizzy and non-fizzy. Try to get the same brand of both kinds and bring some cups. Ask (some) students to taste both waters, ignoring the bubbles. Do they taste a difference?

It is possible that they think the fizzy water tastes a little sour.

MAIN (25 minutes)

When carbon dioxide dissolves in water, the following reaction occurs:

carbon dioxide + water → carbonic acid → hydrogen ion + bicarbonate



Fizzy water is created by bubbling carbon dioxide through water at high pressure. Some of the carbon dioxide dissolves and the result is a slightly acidic solution. Similarly, some of the carbon dioxide in the atmosphere will naturally dissolve in the water droplets in the air, making rain slightly acidic.

However, acid rain is more acidic. Read pages 174 and 175 to find the causes and effects of acid rain and ask students to complete Task 1 on Worksheet 12-3.

Task 2 of Worksheet 12-3 summarizes aspects of four environmental problems. The answers can be found in the Student book. Do support students in creating this summary.

PLENARY (10 minutes)

Quickly check that students have understood the four environmental issues and the implications of each. Avoid too much of a gloomy future. The situation with global warming is serious and not easy to solve, but we have taken measures to stop ozone depletion and acid rain so we should be able to stop further global warming too. However, make sure your students understand that the solution to this problem lies with all of us, including them.

HOMEWORK

Read pages 173 – 175 and answer the 'Test yourself' questions on page 175.

Task 1

Your teacher gave you some soil samples. Make sure you know the name of each sample and describe each of them below.

Sample 1 :

Name _____

Description

Sample 2 :

Name _____

Description

Sample 3 :

Name _____

Description

Task 2

- i. What do all the samples have in common?

- ii. What are the differences between the samples? Use the table below to name the property and then describe how this characteristic differs between the samples.

Properties	Sample 1	Sample 2	Sample 3
Name			

Soil formation

Task 3

Put the sentences in the correct order to describe how soil is formed. Put 1" in front of the sentence which describes the first part of the process of soil formation.

	The action of the Sun will warm and cool the rock, causing small cracks.
	Eventually, the rock has become many small grains of sand or clay.
	The cracks will fill with water.
	The longer and further the rock and its pieces are carried, the smaller they will become.
	The pieces of rock will roll down a slope and into a river.
	The rock will be carried by the water, bump into other rocks, and small pieces will wear off.
	The rock will break and pieces will fall off.
	The water will freeze in winter and make the crack larger.



Task 4

Read pages 170 and 171 and complete the table below.

You know soil contains grains of sand or clay. What else would you commonly find in soil and how does it help plants to grow?

component of soil	role in plant growth

Task 1

In 1960, the concentration of carbon dioxide in the atmosphere was 300 ppm (= particles per million).

- i. How many particles of carbon dioxide would you have found in 1000000 particles of air?

- ii. How many particles of carbon dioxide would you have found in 10000 particles of air?

- iii. In January 2017, the concentration of carbon dioxide in the atmosphere was 400 ppm.
How many particles of carbon dioxide would you have found in 1000000 particles of air?

- iv. How many particles of carbon dioxide would you have found in 10000 particles of air?

- v. What was the increase in carbon dioxide between 1960 and January 2017 per 10000 particles of air?

- vi. What was the percentage increase in carbon dioxide between 1960 and January 2017 in ppm?

The last ice age finished about 12000 years ago. During this ice age, 27% of the Earth was covered in permanent ice and glaciers and mammoths were roaming around. Currently, about 10% is permanently covered with ice and mammoths are extinct. The average temperature during the last ice age was only 4-7° C lower than it is now. Scientists expect an increase of 2-6°C over the next 100 years, an increase which in the past took 5000 years. Without any doubt, the impact will be significant.

Task 1

i. Rain is naturally slightly acidic (pH 5.5) but pure water has a pH of 7. What causes rain to be slightly acidic?

ii. Acid rain is more acidic than 'normal' rain. The acidity of acid rain can be as low as pH 4. What causes this low pH?

iii. What is the effect of acid rain on

a. fresh water lakes?

b. plant growth?

c. Do you think acid rain is a threat to our food supply? Explain your answer.

Task 2

Use pages 173 – 177 to complete the table below about the differences between the listed environmental problems.

	ozone depletion	smog	acid rain	greenhouse effect
Where is it found?				
What is the problem?	ozone levels reduced	its existence	rain is too acidic	too much greenhouse effect
What causes the problem?				
What did humans do to cause the problem?				

What damage does it cause?				
Has there been any improvement?	Yes, since 2000 ozone levels have been increasing, but it will take a long time before they are at the right level again.	This problem is only found in some cities at certain times; e.g. the situation in London has improved but some places have become worse.	Yes, due to strict laws on pollution.	There has been a lot of research into alternative sources of energy but with little effect on CO ² levels so far.

Due to specific conditions above Antarctica (the South Pole), the balance between breaking down ozone (O₃) and re-creating it (from O₂ and O), is such that, especially in spring time, there is very little ozone left in the atmosphere above this part of the world. The effects of this 'hole' in the ozone layer are most noticeable in Australia and New Zealand because they are close and a relatively large proportion of their population has fair skin which is more susceptible to skin cancer caused by UV radiation.

Answers

Chapter 1 Work and energy

Page 3

1. Work is done whenever a force makes something move.
2. joules (J)
3. 150 joules or 150 J

Page 5

1. Potential energy is the energy stored in an object due to its position or condition.
2. Downward motion is due to gravity.
3. Sir Isaac Newton got his idea about gravity after seeing an apple fall from a tree.
4. a. The weight of an object is the force of gravity pulling on it.
b. Weight is measured in newtons (N).
5. 10 N
6. gravitational field strength

Page 7

1. matches, food, battery or cell
2. elastic band, spring, bow
3. Elastic potential energy is the energy stored in an object that has been deformed by being pulled or pushed. Gravitational potential energy is the energy stored in an object due to its position above the ground.
4. Nuclear fission is when an atom is split to release energy. Nuclear fusion is when atoms are joined together to produce energy.

Page 8

1. Kinetic energy is the energy an object has due to its motion or movement.
2. mass and velocity (speed)
3. Because a flying aeroplane has greater mass than a flying insect.
4. The truck has a much greater mass than a car.

Page 9

1. i. Radiated energy is energy carried as moving electromagnetic waves.
ii. Light and radio waves.
2. Sounds are made whenever a force makes something vibrate.

3. When a hot object cools down, its atoms and molecules slow down and lose heat energy.
4. Moving electrons transfer energy from a battery to a light bulb.

Page 11

1. Energy changing from one type to another is an energy chain.
2. Energy cannot be made or destroyed, but it can be changed from one form to another.
3. The hammer has potential energy by way of its position above the nail. Once it moves down towards the nail the hammer has kinetic energy. When the hammer hits the nail sound and thermal energy are produced, plus some kinetic energy in the movement of the nail.
4. kinetic (foot) → sound (foot against ball) → kinetic (ball moving) → sound and heat (ball against wall)

Page 12

Exercise

1. Multiple choice questions

- | | | |
|-------|-------|--------|
| i. a | ii. c | iii. c |
| iv. b | v. c | |

2. True or false

- | | | |
|----------|-----------|-----------|
| i. False | ii. False | iii. True |
| iv. True | v. True | |

Page 13

3. i. 20 kJ = 20 000 J
ii. 10 MJ = 10 000 000 J
iii. 2.5 MJ = 2500 000 J
iv. 0.5kJ = 500 J
4. i. food
ii. $2000 \text{ N} \times 2 \text{ m} = 4000 \text{ J}$ or 4 kJ
iii. Gravitational potential energy
iv. a. Kinetic energy
b. Thermal and sound energy
5. i. Mass and Height above the ground
ii. a. An apple
b. An apple weighs more (has a greater mass) than an orange.
iii. The mass remains the same but the distance is a lot greater.

Page 14

6. i. racehorse ii. high jumper
 iii. bicycle brakes iv. electric kettle
 v. iPod
7. i. Mass and Speed
 ii. they will increase the kinetic energy because of additional mass
 iii. When the speed of a moving object is doubled, its kinetic energy increases by four times.

Page 15**Ideas for investigations**

Investigation 1 enables students to find out how much energy is produced when 1 g of fuel burns. It is very important that students make careful records of their measurements in this investigation. They are required to record the mass of fuel burnt and the rise in water temperature over a fixed period. Then, using the given formula, they should be able to work out how much energy is produced.

Almost certainly the results obtained by students will be much lower than those achieved by scientists using much more technical equipment. This is because of heat loss to the surrounding atmosphere despite the use of a draught shield.

Investigation 2 enables students to compare the energy produced by methylated spirits with that produced by methane gas. They should find that the energy produced by methylated spirits is much less than that produced by methane gas.

SAFETY NOTE: Put on safety goggles. Take care when using hot apparatus.

Chapter 2 Reproduction in plants**Page 17**

1. Flowers are the reproductive systems of plants. They contain the reproductive organs which produce male and female reproductive cells or gametes.
2. a. The male reproductive cells are called pollen grains.
 b. The female reproductive cells are called ovules.
3. a. Nectar is a sugary solution produced in special glands called nectaries, which are situated at the base of the petals.
 b. Insects such as bees feed on nectar.

4. Pollination is the transfer of pollen from anther to stigma.
5. When the pollen is transported from the anther of one flower to the stigma of another flower, we say that cross-pollination has taken place. When the pollen from a flower is deposited on its own stigma, we call it self-pollination.
6. Insects such as bees visit flowers to collect nectar and pollen for food. While they are doing this the hairy body of the insect becomes covered in pollen grains. As the insect visits other flowers, pollen is transported from the anther of one flower to the stigma of another.

Page 18

1. Wind-pollinated flowers have feathery stigmas that catch pollen grains as they are carried by the wind.
2. Differences between insect-pollinated and wind-pollinated flowers:

insect-pollinated flowers	wind-pollinated flowers
• have bright colours	• have small green flowers
• have scent	• have no smell
• reproductive organs enclosed inside the petals	• reproductive organs hang outside the flower
• pollen grains are sticky	• pollen grains are smooth and light

Page 19

1. a. Fertilization is the process when the nucleus of the male reproductive cell joins with the nucleus of the female reproductive cell.
 b. When a pollen grain lands on the stigma of a flower, it grows a pollen tube down towards the ovule. When the pollen tube reaches the ovule, the nuclei travel down the pollen tube. These nuclei join or fuse with the female nucleus and fertilize it.
2. The small and very smooth pollen grains were from the hazel catkins because hazel catkins are wind pollinated flowers. Small, smooth pollen grains are easily carried by the wind.

Page 21

- The flower withers and dies after fertilization.
 - The fertilized ovule grows inside the ovary until it develops into a seed.
 - The ovary wall grows to form the fruit.
- A seed contains a tiny embryo plant together with a large food store. Surrounding the seed is a tough seed coat which protects it. The embryo plant consists of an embryo root and an embryo shoot.
- The food store. This is needed to provide food for the growing plant until it can make its own by photosynthesis.
- Seeds should be scattered so that new plants that grow from them will not be over crowded.
 - Seeds can be scattered by wind, by animals, or by explosions.

Page 22

- Seeds need water, oxygen and a suitable temperature to grow.
- Water is taken into the seed and the root begins to grow. As more water is taken in by the growing root system, the embryo shoot starts to grow. As new leaves develop the young plant can start to make its own food.
 - The large food store in the seed.
- They are too dry.

Page 25

- Clones are genetically identical organisms.
- The products of asexual reproduction are genetically identical to each other and to their parent. Sexual reproduction involves combining genetic material from two different parents.
- Runners are special stems that spread over the ground. New plants grow from them.
 - A tuber is an underground stem that becomes swollen with stored food.
 - A bulb is a large underground bud with swollen leaves full of food.
- A cutting is a piece taken from a living plant.
 - Cuttings are usually taken from a stem. But may be taken from leaves or roots.
- Micropropagation means growing new plants from microscopic pieces.
- To prevent contamination of the plant and the growth medium.
- A growth medium contains everything plant needs for normal healthy growth.

- A growth medium contains hormones to encourage the growth of new roots.
- It is quick and does not take up much space.
- There is no genetic variation in cloning.

Page 26

Exercise

1. Multiple choice questions

- d
- a
- c
- c
- a

2. True or false

- True
- False
- False
- True
- False

Page 27

- Pollination is followed by **fertilization**. As in animals, 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. When it lands on the **stigma** of a female reproductive **organ**, a **pollen** grain grows a **tube** which goes down to the **ovary** where it enters an **ovule**. Male nuclei join with the female nucleus and fertilizes it.
- | | |
|-------------|--------------|
| A – stigma | B – anther |
| C – nectary | D – sepal |
| E – ovary | F – petal |
| G – style | H – filament |
 - anther
 - petal
 - stigma
- Dispersal of seeds means to scatter the seeds into new areas where they will not be overcrowded when they germinate.
 - 1 Seeds can be dispersed by the wind. Some seeds have tufts of hairs or wings which catch the wind and are carried well away from the parent plant.
 - 2 Seeds can be dispersed by animals. Some seeds have hooks on them that catch on the fur of mammals. These are later scratched off by the animals. Nuts are buried by squirrels who forget where they have buried them.
 - 3 Seeds can be dispersed by explosions. If left to dry, the pods of peas and beans suddenly burst open throwing the seeds well away from the parent plant.
 - See diagram on Page 20

6. i. Water, Oxygen, Suitable temperature
 ii. Stage 1: Water is taken into the seed and the root begins to grow.
 Stage 2: As more water is taken in by the growing root system, the embryo shoot starts to grow.
 Stage 3: As new leaves develop the young plant can start to make its own food.
 iii. The large food store in the seed.
7. i. Depends upon student's answer but must include significant points about natural and artificial clones taken from Pages 22-24.
 ii. Propagation is the process of creating new plants from a variety of sources such as seeds, cuttings bulbs and other plants parts. Micropropagation means growing new plants from very tiny (microscopic) pieces.

Ideas for investigations

Investigation 1 enables students to determine the conditions required for the germination of seeds. After a week at room temperature, the seeds in dish B should have germinated because they have all of the conditions required i.e. oxygen, water, and suitable temperature. Seeds in dish A are deprived of water so will not germinate. Seeds in dish C are deprived of oxygen so will not germinate either.

Investigation 2 requires student to produce seedlings with straight roots. Enough root growth will usually take place after several days. Once marked as shown, the seeds can be put back in the blotting paper roll and left for a further day or so. After a short while it should be possible to see that the gaps between the ink marks will be wider at the root tip than elsewhere. This shows that growth takes place only at the tips of growing shoots and not evenly along their length.

Chapter 3 Reactions of metals

Page 31

1. a. Properties of metals:
- they can reflect light
 - they are malleable and ductile
 - they can conduct heat and electricity
 - they have high melting points
- b. • Jewellery is made of gold.
 • Car bodies are made of steel.
 • Electricity cables are made of copper.
 • Cooking pots are made of aluminium.
2. a. graphite b. diamond
 c. plastic
3. Metals are malleable and they do not break easily. So they can prevent serious injury to the passengers.

Page 32

1. The high density of metals is because the atoms are very closely together.
2. a. i. Malleable means can be hammered into shape.
 ii. Ductile means can be drawn into wires.
 b. Metals can be hammered into shapes because the layers of atoms can slip over one another by the pushing and pulling forces applied on them.
3. a. Electrons are arranged such that they form a sea around the much larger positive ions. As a result they are able to move freely through the metal as a whole.
 b. When an electrical voltage is connected to the metal, an electric current flows because the electrons are free to move.
4. Non-metals do not have a sea of electrons in their structure so they do not conduct electricity.

Page 33

1. sodium
 2. magnesium and calcium
 3. calcium, sodium, and potassium
 4. An unreactive metal does not react with either water or acid. For example: gold
 5. They do not tarnish.
 6. Metals react most easily with acid, such as aluminium, zinc, iron, tin, and lead. These metals do not react with air or water readily. Metals that react with water often react very violently with acids, e.g. sodium, potassium, and calcium.

Page 35

1. Metals can be arranged in a sort of league table according to the way they react. This league table is called the reactivity series.
2. Potassium is at the top of the reactivity series because it burns in air, reacts fastest with water, and violently with acid.
3. K (potassium), Na (sodium), Ca (calcium), Mg (magnesium), Fe (iron), Cu (copper), Ag (silver)
4. a. Sodium reacts violently giving off hydrogen gas.
 b. Magnesium reacts violently with steam.

- c. Iron reacts very slowly forming a reddish coating (rust) on the surface.
- d. Gold is not affected by a weak acid.

Page 36

1. a. A more reactive metal such as iron (higher up in the reactivity series) takes the place of a less reactive metal such as copper (lower down in the series) during a chemical compound.
- b. In case of zinc, a similar reaction would have taken place where zinc ions would have replaced the copper ions to form zinc sulphate. No reaction would take place with silver because it is lower down in the reactivity series.
2. a. X could either be magnesium, iron, or lead.
- b. Put X into a solution of lead nitrate. Magnesium and iron will react, lead will not. Put X into a solution of iron sulphate. Magnesium will react, iron will not.

Page 37

1. silver
2. a. Compounds of metals found in rocks are called ores.
- b. This is because these metals are reactive and at some time in the past they have reacted with elements like oxygen and sulphur to form compounds like oxides and sulphides. This most likely happened in parts of the Earth where temperatures were very high.
3. a. oxygen b. sulphur c. oxygen

Page 39

1. First the metal is separated from the rock and other waste material. Next, the metal has to be extracted from the metal compound.
2. Metals lower in the reactivity series form less stable compounds, so they can be separated from their ores more easily.
3. a. Impurities are removed from the bauxite leaving pure aluminium oxide or alumina. The alumina is melted, and then an electric current is passed through the hot liquid; pure aluminium is produced.
- b. Magnesium could be extracted by the same method, as it is high in the reactivity series it forms stable compounds.
4. Carbon is added to iron oxide in a blast furnace so that oxygen is removed from it by forming carbon dioxide, leaving behind pure iron.

5. Aluminium is high in the reactivity series and forms stable compounds which need a lot of energy to split them. Iron being a metal lower in the reactivity series forms less stable compounds and can be separated from its ore more easily.

Page 41

1. An alloy is a mixture of two or more metals.
2. Alloys are usually made by melting metals together and then allowing the molten mixture to cool and harden.
3. a. Steel is stronger and more rust-resistant than iron.
- b. Bronze is stronger than copper.
- c. Duralumin is harder and stronger than aluminium.
4. a. Monel is strong and unaffected by sea water.
- b. Solder melts at low temperatures, and then sets hard.
5. a. solder b. stainless steel
c. bronze

Page 42

Exercise

1. Multiple choice questions

- i. b ii. d iii. b
- iv. c v. b

2. True or false

- i. False ii. False iii. True
- iv. True v. True

Page 43

3. i. Zinc dissolves and silver forms.
- ii. Hydrogen gas is given off.
- iii. Very slow reaction until surface is coated with magnesium oxide then reaction stops.
- iv. A violent reaction takes place.
4. i. In the tube containing water and air.
- ii. iron + water → iron oxide + hydrogen
- iii. It weakens the iron.
- iv. By oiling and by painting.
5. i. Metal D is the most reactive because it displaces iron in iron sulphate. Iron is higher up the reactivity series than copper and silver.
- ii. Metal B displaces copper in copper sulphate solution so must be higher in the series than copper. Metal B will react with hydrochloric acid to produce hydrogen gas.
- iii. It will displace the copper in copper sulphate solution.

Page 44

6. i. a. bauxite b. haematite
 c. copper pyrites
 ii. Aluminium is more expensive to extract from its ore.
 iii. It is corrosion resistant and it is light in weight.
 iv. Aluminium is expensive to extract so it is sensible to reuse what has already been made.
7. i. extracting iron
 ii. iron oxide, coke, and limestone
 iii. waste gases
 iv. hot air
 v. molten iron
 vi. Iron oxide is first separated from impurities in the haematite. It is then put into a blast furnace along with carbon, where it is heated strongly. Oxygen is removed from the iron oxide leaving pure iron. This process is known as smelting.
8. i. It is relatively cheap to produce compared with tin and aluminium.
 ii. Tin is used because it is non-toxic and less reactive than the iron in the steel.
 iii. The layer of steel might be exposed, which will then corrode and affect the food.

Page 45**Ideas for investigations**

Investigation 1 enables student to compare the reactivity of four metals with dilute hydrochloric acid. The results should clearly show the place of each of the metals in the reactivity series. Magnesium will react slightly more vigorously than aluminium which will be more reactive than zinc. The iron nail will react slowly with the acid.

Investigation 2 provides the opportunity for students to see a displacement reaction for themselves. The reaction is slow but after a while students should see the iron nail gradually change from grey to a red-brown colour as copper atoms form a layer on the surface of the nail.

SAFETY NOTE: Put on safety glasses. Take care when using acid.

Chapter 4 Speeding up**Page 47**

- The planets of the solar system orbit the Sun at a constant speed.
- a. They evaporate.
b. They freeze.
- To catch its prey; to run away from its enemies.
- Plants move/grow towards sunlight to get energy for photosynthesis.
- Scientists need to control the machines that they make.

Page 49

- a. 1.66m/s b. 1.43m/s
 c. 1.66m/s d. 1.73m/s
- a. 1000km b. 100km
- a. 2 hours b. 3.5 hours
- a. 1200m b. 0.25s

Page 50

- a. i. 3 m/s ii. 3 m/s
 iii. 1.2 m/s
 b. 30m/s c. 25s d. 10s
 e. 30m/s f. 30m/s

Page 51

- When the forces acting on a body cancel each other out and the body does not move, we say that the forces are balanced.
- When the forces acting on a body are not equal, we say that the forces are unbalanced. The body moves in the direction of the greater force.
- Newton's first law of motion states that: If something has no force acting on it, it will stay still if it is still, or if it is moving at a steady speed, it will stay moving at a steady speed in a straight line.
- The spacecraft does not need an engine to push it because there is no friction to slow it down; it just travels on at the same speed in the same direction.

Page 53

- It means that the speed of the car is increasing by 4 metres per second every second.
- a. 12m/s b. 4s c. 4 – 7 s
 d. 0 to 6m/s e. 3m/s² f. 7s
 g. Acceleration/retardation is given by

$$\frac{\text{change of speed}}{\text{time}} = \frac{12}{4} = 3 \text{ m/s}^2$$

Page 54

1. The weight of the object makes it accelerate to the ground.
2. a. Air resistance is the frictional force produced by air molecules.
3. Air resistance
4. If moving, it moves at a constant speed. If stationary, it does not move.

Page 55

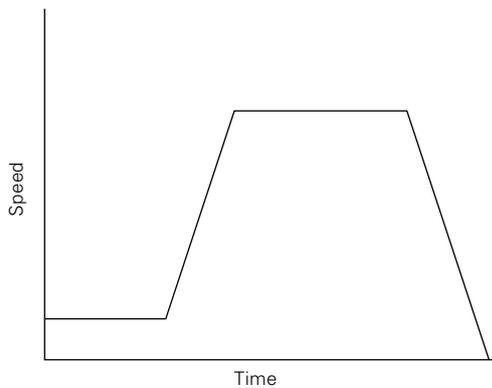
Exercise

1. Multiple choice questions

- i. b ii. c iii. d
 iv. c v. d

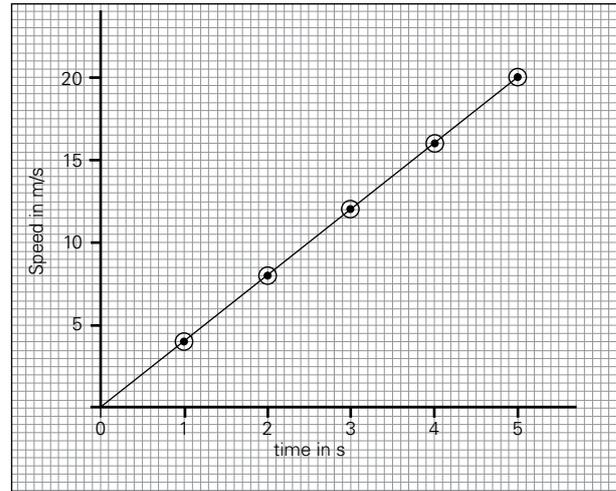
2. True or false

- i. False ii. True iii. True
 iv. False v. True
 3. a. 6 km/h b. 9 km/h c. 45 minutes
 4. a.



- b. The distance travelled by the driver can be found by calculating the area under the speed-time graph.
5. i. a. unbalanced
 b. The forces are unbalanced because the forward force is greater than the backward force.
- ii. a. The car would move.
 b. Since the forward force is greater than the backward force, the car will move.
- iii. a. Forwards
 b. $1500\text{ N} - 1000\text{ N} = 500\text{ N}$

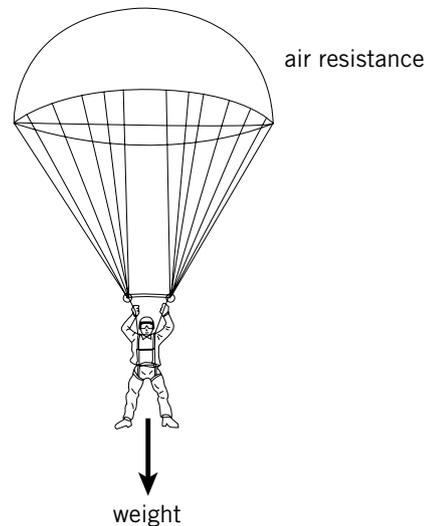
6. i.



- ii. acceleration = $20/5 = 4\text{ m/s}^2$
 iii. a. 24m/s b. 32m/s c. 40m/s
 iv. If it keeps accelerating at the same rate, the car will be going at an impossible speed after 50 seconds.

Page 57

7. i. a. 25m/s b. 50m/s c. 100m/s
 ii. $100/3 = 33.33\text{ m/s}^2$
 iii. 1s
 iv. 600m (area under the graph)
 8. speed = acceleration x time taken
 $= 3\text{ m/s}^2 \times 27\text{ s} = 81\text{ m/s}$
 9. i. terminal velocity
 ii.



- iii. The skydiver's weight is balanced at a low speed by the parachute's air resistance.
 iv. Slow it down.

Page 58**Ideas for investigations**

Investigation 1 Requires students to collect data to enable them to measure the speed of vehicles travelling along a road. The results from different motor vehicles can be compared by showing the results as a bar chart.

SAFETY NOTES:

Make sure students are standing well clear of the road when doing this investigation.

Tell students not to distract drivers with their signals.

Investigation 2 requires students to compare the effects of different sized parachutes on the speed at which they fall. Good results can be obtained by dropping the parachutes from a first floor window to the ground below or down a flight of stairs.

Investigation 3 requires students to compare the effect of using different weights on a fixed shape parachute on the speed at which it falls.

These two activities provide further opportunities for students to present their results in the form of a graph.

SAFETY NOTE:

Make sure students do not lean out of windows or over the safety rail of a staircase.

Chapter 5 Where does our food come from?

Page 63

1. Fertilizers contain the mineral elements required by plants for healthy growth.
 2. Natural fertilizers are made from plant and animal wastes. Artificial fertilizers are chemical substances which contain the elements essential for plant growth.
 3. sewage sludge, animal manure, compost
 4.
 - a. Nitrogen is essential for making new plant tissue.
 - b. Potassium is essential for flower and fruit growth.
 - c. Phosphorus is essential for proper root growth.
 - d. Magnesium is essential for chlorophyll formation.
5.
 - a. It has yellow leaves and weak stems.
 - b. It has poor flower and fruit growth.
 - c. It has poor root growth.
 - d. Leaves turn yellow from bottom upwards.
 6.
 4.
 - a. Eutrophication is the process by which a water ecosystem such as a pond or river dies, due to the addition of artificial fertilizers causing excess algal growth.
 - b. All the life in a pond or river eventually dies. This means that the water ecosystem dies.

Page 64

1. Plants compete for space, sunlight, water, and mineral salts.
2.
 - a) Fast growth helps them to reach sunlight faster than other plants.
 - b) A deep and wide root system helps plants to absorb more water as compared to plants with smaller roots.
 - c. Brightly coloured flowers help the plant to attract insects for pollination.
3.
 - a. Weeds are plants growing in the wrong place.
 - b. Weeds compete with the crop plants by taking valuable nutrients from the soil and restricting the growth of the crop.
4. Plants cannot hide from predators or shelter from bad weather.

Page 66

1.
 - a. Herbicides are chemicals which are selective weed-killers. They are used to kill weeds without harming the crop.
 - b. Fungicides are used to kill any fungal competitors that might affect food crops.
 - c. Insecticides are used to kill insects that might eat food crops.
2. They are called pesticides because they kill pests.
3. Farmers must produce the highest crop yields they can.
4. Problems of using pesticides:
 - Some pests are resistant to them.
 - They have to be used over and over again as their effect does not last long.
 - Useful insects such as ladybirds and bees are killed along with the pests.
 - People are becoming concerned about pesticides in their food.
 - Pesticides can cause pollution and seriously affect food chains.

5. a. The use of pesticides can be reduced by encouraging the natural predators of insect pests.
- b. Biological control has advantages over pesticides:
 - The pest does not become resistant to the predator.
 - The predator usually feeds only on one kind of prey.
 - There is no need to replace the predators—they breed themselves.

Page 68

1. 6 g
2. barn owls
3. Birds living over water have higher levels of DDT in their bodies because it is not biodegradable. It is absorbed in the bodies of the fish, which have absorbed DDT from the bodies of insects and smaller animals in the food chains.
4. Levels of DDT sprayed on the crops build up in the soil, from where it finds its way into streams and rivers and the oceans. As it is passed from consumer to consumer, it is stored in the fat layers of their bodies. Wood pigeons and moorhens do not absorb much DDT as they eat small insects which absorb small quantities of DDT sprayed on crop plants.
5. Used for killing lice and mosquitoes.

Page 69

1. Plants need light, water, carbon dioxide, minerals, and suitable temperature for healthy growth.
2. A greenhouse is a building, usually made of glass, used to grow crops under best conditions.
3. A greenhouse provides controlled conditions for plants to grow in. It protects plants from wind, rain, and pests such as insects and birds.
4. Plants use red and blue parts of the spectrum for photosynthesis.
5. It prevents the cross-pollination with plants growing in the wild, so the new variety that is being produced should have the characteristics which the farmer wants in his crops.

Page 71

1. mushrooms and toadstools
2. Dead and decaying things such as leaves and rotting wood.
3. Animals take in oxygen from the air and breathe out carbon dioxide as a result of respiration.

Plants take in carbon dioxide and produce oxygen during photosynthesis. The processes of photosynthesis and respiration are more or less in balance and maintain the levels of oxygen and carbon dioxide in the atmosphere.

4. Fossil fuels are made from dead plants which can no longer photosynthesise and remove carbon dioxide from the air. Burning fossil fuels produces carbon dioxide.
5. Bacteria in the soil break down the protein of dead animals and plants and release nitrates into the soil.
6. Peas and beans are leguminous plants which fix atmospheric nitrogen and make nitrates. When the dead plants are ploughed into the soil, they decay and release more essential nutrients for plants.

Page 72

Exercise

1. Multiple choice questions

- i. b ii. a iii. a
- iv. a v. b

2. True or false

- i. True ii. True iii. False
- iv. False v. True

Page 73

3. i. In the producer.
- ii. Energy loss is greatest at the start then remains constant.
- iii. Energy is lost at each link in a food chain so it is more efficient to eat plants at the start of the food chain.
- iv. The number of animals which human beings eat would increase and the plants on which the herbivores feed would be greatly reduced, and also the animals on which omnivores feed decrease.
4. i. a. The soil.
- b. Plants absorb them by their roots.
- ii. Leaves turn yellow from bottom upwards.
- iii. Artificial fertilizers containing nitrates and phosphates are important for plant growth and for fruit and seed development.
- iv. They are an excellent source of food for them and are in solution.
5. i. algae → shrimps → fish → sea otters
- ii. Algae will grow more rapidly than the shrimps can control. Algae will form a blanket over the

surface of the water cutting out light to plants below. These will stop photosynthesis, there will be no oxygen for the animals, so they will die.

- iii. Shrimps will take in the pesticide. Fish eat the shrimps and accumulate the poison in their bodies. Sea otters eat lots of fish and die.

Page 74

6. i. Plant A
 ii. It can avoid competition for light.
 iii. It can reach water more easily.
 iv. Plant A. It grows quickly and has a spreading root system which helps it to overcome competition with other plants.
7. i. approximately 200
 ii. More than 5000
 iii. The biological control organisms fed on the pests, reproduced and multiplied.
 iv. b. About 12 months
 c. The pests are also reproducing and multiplying.

Page 75

Ideas for investigations

Investigation 1 enables students to study the effect of adding fertilizer to a plant. It is important to use two similar plants otherwise the test is not fair. The investigation will take several weeks but after this time students should see some obvious differences in the growth and appearance of the two plants.

Investigation 2 looks at the effect of temperature on the growth of algae. After several days, students should be able to see a significant difference in growth between the algae in the three beakers. The algae in the fridge should show little growth whereas that at room temperature should show significant growth.

Chapter 6 Water

Page 78

1. i. In the oceans and seas
 ii. In lakes, rivers and in the ground
2. The movement of water in and around the environment.
3. i. The formation of clouds
 ii. Evaporation of sea water into the air.
4. Underground layers of porous rock
5. sulphur dioxide

6. organic matter, fertilizers, sand, silt, heavy metals, oil, detergents, solvents.
7. It runs off the surface of the land where building development is taking place.
8. In urban areas water is polluted more by sewage, factory discharge and waste products.
 In rural areas water is polluted more by discharge from farms, fertilizers, animal waste and other organic matter.

Page 79

1. A good indicator of the health of a river is the number of different animal and plant species living in it.
2. Sewage is treated to remove contaminants from water before it enters a river.
3. Raw sewage is untreated sewage
4. Effluent, clean, safe water leaving a sewage works.

Page 81

1. Clean water is water that is safe to drink or use for food preparation.
2. Most people (around 90 - 98%)
3. Drinking unclean water can cause diarrhea, cholera, and typhoid.

Page 83

1. i. swimming ii. skating
 iii. steam bathing in a sauna.
2. i. Irrigation is when water is artificially added to the soil to help crops grow.
 ii. Farmers use irrigation when weather is dry and water conditions in the soil are not suitable.
3. 20%

Page 84

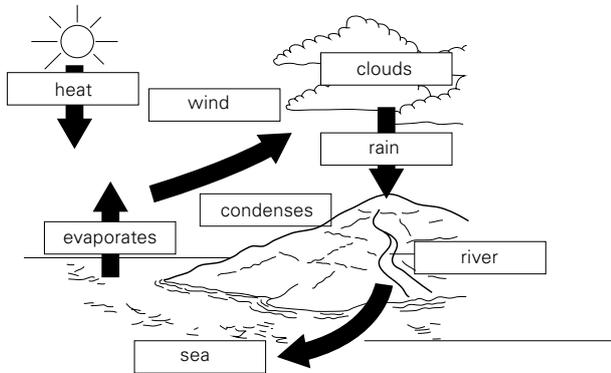
Exercise

1. Multiple choice questions

- i. d ii. c iii. b
 iv. a v. a
2. True or false
 i. False ii. False iii. True
 iv. True v. True

Page 85

3. i.



- ii. The diagram shows the water cycle. **Heat** from the Sun **evaporates** water from the **sea**. **Wind** blows water vapour over hills and the water vapour **condenses** to form **clouds**. **Rain** falls onto the hills and runs back to the **sea** along a **river**.
4. i. second filtering ii. digestion
iii. first filtering iv. sedimentation

Page 86

5. i.. Water is treated to remove contaminants.
ii. Reservoir
iii. Three
iv. Suspended solids such as silt settle to the bottom.
v. it is filtered
vi. to kill bacteria.
6. i. WC flushing and waste disposal
ii. 1 Car washing
2 Gardening
iii. 120 litres
iv. 3360 litres

Page 87

Ideas for investigations

Investigation 1 requires students to keep a record of the water they use in one week. They are provided by a useful guide of estimated values to help them in their calculations. Whilst individual students' results may not exactly match the chart given on Page 81, there may be some useful comparisons made between groups of students in a class.

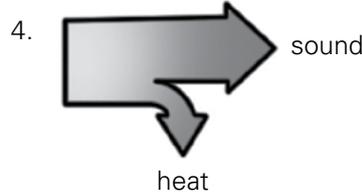
Investigation 2 provides students with the opportunity to model a water filtration bed. The two arrangements of coarse gravel, fine gravel and sand are significant and it might be useful to ask students what they expect the results to be before carrying

out the investigation. Students might be surprised to discover that the best filter is the one with the sand on the top.

Chapter 7 Electricity and Energy

Page 89

1. A Sankey diagram is a simple way of showing what energy changes take place and where energy goes. It looks like a set of arrows.
2. It means that only about 80% of the electrical energy is converted into light energy; the rest is wasted as heat energy.
3. a. electrical energy to kinetic energy
b. electrical energy to heat and light energy
c. electrical energy to mechanical and sound energy



Page 91

1. a. Voltage is the driving force of a current.
b. Volt (V)
2. 4.5V
3. voltmeter
4. The voltmeter should be connected in parallel with the bulb to measure the difference in the driving force from one side of the bulb to another.
5. She had connected the voltmeter in series with the circuit. It should have been connected in parallel.

Page 92

1. Resistance is the slowing down or stopping of the flow of electricity.
2. a. the thicker the wire the greater the resistance.
b. Some metals have a greater resistance than other e.g. nichrome wire has a greater resistance than copper wire.
3. a. 6V

Page 93

- 1.
2. A resistor can be used to control the flow of current in a wire.

- A variable resistor can change the current in a circuit. It has a sliding contact. As the contact is moved, the length of the resistance wire connected in the circuit changes and so the current changes.
- The current is proportional to the voltage.
- As voltage is directly proportional to the current we would need a very large piece of graph paper.

Page 94

- Mains electricity is produced at power stations by the electricity generating board.
 - It is sent along power lines to houses, factories, hospital, schools, and other users.
- The mains supply can supply very large currents. Touching them could give you a fatal electric shock.
- The mains voltage changes very rapidly. This makes the current flow backwards and forwards 50 times in each second. This is called an alternating current or AC with a frequency of 50 Hz.
- 3
 - One is called the live wire and the other is called the neutral wire.
 - The live wire is at about 230 volts and the neutral wire is at about 0 volts.
- Hz stands for hertz. It is used to measure frequency.

Page 96

- A consumer unit consists of all the fuses or circuit breakers that connect the electricity meter to all the electrical circuits in the house.
- It is important to use the correct fuse to replace the one that is blown because if it is rated at too high a current, it could allow an overload to cause damage without melting and blowing.
- A miniature circuit breaker is an automatic switch which turns off the current if it gets too high. Mcbs are quicker to respond to a dangerously high current than a melting fuse wire.

Page 97

- The main fuses in the consumer unit protect the house circuits from damage due to too much current.
 - Each appliance can be protected by a fuse in its plug. If the current gets too great, the fuse wire melts and breaks the circuit.
- 3A, 5A, 13A

- They are colour coded so that they can be recognized easily.
- $1500/250 = 6A$
A 13A fuse (brown) would be suitable.
 - $200/250 = 0.8A$
A 3A fuse (red) would be suitable.

Page 99

- The greater the power, the quicker the appliance takes energy from the mains.
- Electricity generating boards measure electrical energy in kilowatt hours (kWh). For example, if a 1kW toaster is switched on for 1 hour, then 1kWh or 1 unit of energy is supplied.
- $2kW \times 4h = 8 kWh \times Rs 4 = Rs 32$
 - $100/1000kW \times 5h = 0.5kWh \times Rs 4 = Rs 2$
 - $1/1000 \times 4 = 0.004kWh \times 4 = Rs 0.016$
- Appliances containing a heating/cooling element use up more power as compared to those which produce sound or light.

Page 101

- oil, gas, water, coal, nuclear fuel
 - coal
- It is generated in power stations by using an energy source.
- Electricity is made in power stations. Coal is used to heat water to produce steam. This steam is used to turn steam turbines which then turn the generators that produce electricity. Power stations convert heat energy of burning fuel into mechanical energy which rotates the turbines. Mechanical energy of the turbines is used to turn the generators which produce electrical energy.
- Potential energy in the water, stored high up in the mountains, is converted into kinetic energy of flowing water which is then converted into mechanical energy to turn the turbines. Mechanical energy from the turbines turns the generators, which change mechanical energy into electrical energy.

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- This means that only about 35% of energy in its fuel is changed into electrical energy.
- heat
 - mechanical and heat
 - mechanical and heat

3. a. Fossil fuels are fuels like coal, gas, and oil which were produced inside the Earth millions of years ago from the bodies of plants and animals.
 b. Burning fossil fuels produces carbon dioxide and acid rain.

Page 104

Exercise

1. Multiple choice questions

- i. d ii. a iii. b
 iv. b v. a

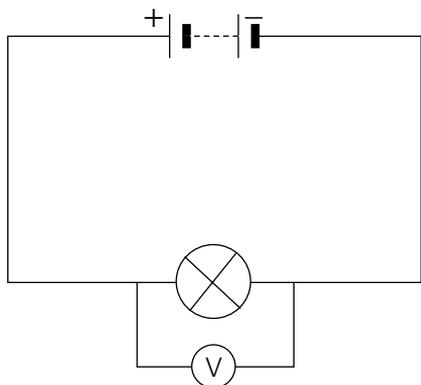
2. True or false

- i. True ii. False iii. False
 iv. False v. True

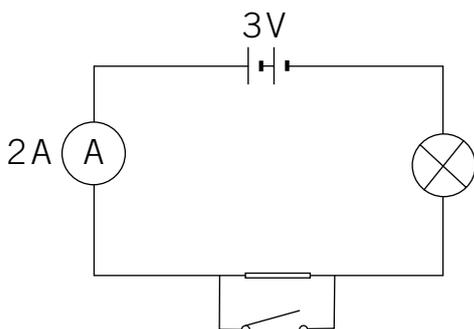
3. i. 12V
 ii.



- iii.



4. i.



- ii. The current flows directly to the bulb through the closed switch, instead of passing through the resistance.
 iii. resistance = voltage/current
 = 3V / 2A
 = 1.5 ohms

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5. i. In turbines
 ii. As heat
 iii. Electrical output: in X = 5600 – (600+2900 + 40 + 60)
 = 5600 – 3600
 = 2000MW
 Electrical output in Y = 5600 – (200+3800 + 40 + 60)
 = 5600 – 4100
 = 1500MW
 iv. Power station X is more efficient because it produces more megawatts of electrical power for the same amount of power input from the fuel (coal) being used.

Page 107

Ideas for investigations

Investigation 1 requires students to test three hypotheses. By carefully setting up and taking readings from the circuits shown, students should be able to find out for themselves that;
 A long wire has greater resistance than a short wire (hypothesis incorrect).
 A thin wire has greater resistance than a thick wire (hypothesis correct).
 A nichrome wire has greater resistance than a similar sized copper wire. (hypothesis correct)

Investigation 2 enable students to develop their understanding of fuses. It is important to use a bulb which can take a current greater than 1 A, otherwise it will 'blow' before the fuse does. The investigation requires accurate observations to be made if students are to determine the maximum current allowed by the fuse.

Investigation 3 is a simple comparison of battery types. By setting up and leaving two simple circuits connecting each battery and an identical bulb for a period, students should easily see which battery will last the longest. The cost of each battery should be considered when making a judgement about which is better value for money

Chapter 8 More organ systems

Page 111

1. So that all organ systems work together doing their jobs at the right time.
2. The brain, spinal cord and nerves.

3. The central nervous system is made up of the brain and spinal cord.
4. So that it is protected from damage
5. by electrical signals or impulses.
6.
 - a. motor nerves cells and sensory nerves cells
 - b. Motor nerve cells carry impulses from the central nervous system to the muscles. Sensory nerve cells carry impulses from sense receptors to the central nervous system.
 - c. Impulses can only travel in one direction so there have to be two different types of nerve cell.
7. They are long and thin.
8. A neurone is a single nerve cell. A nerve is a bundle of neurones.
9. The fatty insulation keeps impulses travelling along the correct pathway.

Page 113

1.
 - a. A stimulus is anything that induces a response in nervous system.
 - b. Touching a hot object
2.
 - a. A response is an action as a result of a stimulus.
 - b. Moving hand away quickly.
3. The drawing pin is the stimulus. Nerve endings in the skin are stimulated by the pin. Impulses are sent along a sensory nerve cell to the spinal cord. A relay nerve cell passes the message on to a motor nerve cell. Impulses pass along the motor nerve cell to a muscle which contracts and moves the body off the pin. Movement off the pin is the response.
4.
 - a. A synapse is a link between one nerve cell and other nerve cells.
 - b. Nerve cells do not actually touch. When stimulated, a chemical is released from one nerve cell which diffuses across the synapse and stimulates other nerve cells to produce an impulse.
5. One nerve cell can have many synapses with other nerve cells, so lots of connection can be made.
6. Flash of bright light, insect touches eyelid, food gets into windpipe, hand touches 'live' electric wire,
7. Picking up and drinking a cup of tea is a voluntary action. Voluntary actions require thought and involve the brain.

Page 115

1. Hormones travel around the body in the bloodstream.
2. A Target organ is a part of the body that responds to a particular hormone.
3. An advantage of a hormone system is that effects are slow and more general around the body.
4. The liver removes hormones from the blood when they are no longer needed.
5. The pituitary gland makes hormones which control the other endocrine glands.
6. Adrenaline.

Page 118

1. The kidneys are located above the waist at the back of the body.
2. Urea is poisonous.
3. The bladder is a bag which stores urine.
4. A ring of muscle at the base of the bladder keeps the bladder closed until you go to the toilet.
5. Nephrons are tiny tube in the kidney.
6. Nephrons filter and cleanse the blood.
7. Blood flows under high pressure into the nephrons where urea and other wastes along with some water, are filtered out into a tube. The filtered fluid goes along the tube where it becomes urine. The urine produced from all the nephrons combines and passes along a single tube to the bladder where it is stored until being released from the body.
8. The amount of water in the blood is monitored by the brain. The brain 'tells' the kidneys how much water to get rid of in urine or keep in the blood.

Page 119

Exercise

1. Multiple choice questions

- | | | |
|-------|-------|--------|
| i. b | ii. b | iii. b |
| iv. c | v. b | |

2. True or false

- | | | |
|-----------|----------|------------|
| i. True | ii. True | iii. False |
| iv. False | v. False | |

Page 120

3. The kidneys are like **filters** that clean the **blood**. Filtering is done in millions of tiny tubes called **nephrons**. 'Dirty' blood flows under **high** pressure from an **artery** into a bundle of **capillaries**. **Urea** and other wastes along with some **water** are filtered

out into a tube. The filtered fluid goes along the tube where it turns into urine. The urine joins up with urine produced in other nephrons and goes out of the kidney to the **bladder**.

4.
 1.
 - a. A reflex action is a fast response to a stimulus that does not involve thinking.
 - b. Moving your hand away from a hot object. (see table on page 113)
 - ii. A voluntary action requires thought and can be fast or slow. A reflex action does not.
 - b. Picking up and drinking a cup of tea, writing an email etc..
5. A - pituitary gland
B - pancreas
C - adrenal glands

Page 121

6.
 - i. endocrine glands
 - ii. in the reproductive organs
 - iii. adrenaline
 - iv. insulin
 - v. in the bloodstream.

Ideas for investigation

This investigation enables students to study reactions time by measuring how much a ruler falls between their fingers before they can catch it. After a bit of practise, students should be able to get some accurate results. It is important that the activity is done at least ten times so that an average can be calculated. Many students will improve their reaction times as they repeat the test, other may not. A bar chart can be drawn showing the distance travelled by the ruler before being caught by several students is a useful follow up exercise.

Chapter 9 Salts

Page 123

1. sodium chloride - add taste to food
copper sulphate – colouring glass
magnesium sulphate – fertilizer
calcium chloride – cheese making
2. The name of a salt has two parts. The first part comes from the metal, metal oxide or metal carbonate with which an acid is reacting. The second part comes from the acid itself.
3. When making a salt in the laboratory.

Page 125

1.
 - i. Hydrochloric acid and sodium hydroxide. Add just enough acid to neutralize the alkali – test with indicator paper. Pour the mixture into an evaporating basin. Heat gently until the water has evaporated leaving the salt in the dish.
 - ii. Wear safety goggles at all times and be careful when handling hot apparatus.
2.
 - i. A metal corrodes whenever a chemical attacks its surface.
 - ii. Water, air and acids.
3.
 - i. zinc + sulphuric acid → zinc sulphate + water
 - ii. $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2\text{O}$
4.
 - i. Place a lighted splint near the mouth of a test tube when it is full of hydrogen. A 'squeaky pop' explosion shows the gas is hydrogen.
 - ii. Hydrogen is colourless, odourless gas. Its presence can be detected by this test.

Page 127

1. calcium, carbon and oxygen.
2. Calcium chloride, water and carbon dioxide
3.
 - i. lead carbonate + nitric acid → lead nitrate + carbon dioxide + water
 - ii. $\text{PbCO}_3 + 2\text{HNO}_3 \rightarrow \text{Pb}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$
4.
 - i. This is also the test for hydrogen. (Could be dangerous if too much gas is present.)
 - ii. Bubble the gas through limewater. The limewater will turn milky if carbon dioxide is present.
5.
 - i. A mixture of sodium hydrogen carbonate and tartaric acid.
 - ii. When sodium bicarbonate is heated or reacts with an acid it gives off carbon dioxide which makes the cake mixture rise.

Page 128

1. A base is any substance that can neutralize an acid.
2. An alkali
3. Copper oxide is added to sulphuric acid and warmed.
The copper oxide dissolves and the solution turns blue.
Filter to remove any undissolved copper oxide.
Evaporate the filtrate carefully until blue copper sulphate crystals form.
4.
 - i. copper oxide + sulphuric acid → copper sulphate + water
 - ii. $\text{CuO} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{H}_2\text{O}$
5. lead chloride

Page 130

1. A titration is an experiment to find out how much alkali is exactly needed to neutralize an acid.
2. The point at which an alkali just neutralizes an acid is called the end point.
3. green
4. 25cm³

Page 131

1. Electrolysis is used to obtain useful substances from sodium chloride.
2. chlorine, hydrogen, and sodium hydroxide
3. Fertilizers contain elements that plants need to keep them healthy.
4. nitrogen
5.
 - i. Agricultural lime is a soil additive made from crushed limestone.
 - ii. It increases the pH of acidic soil making it more alkaline. It provides a source of calcium/Mg for plants. It improves drainage in heavy soil.

Page 132**Exercise****1. Multiple choice questions**

- | | | |
|-------|-------|--------|
| i. a | ii. b | iii. c |
| iv. b | v. c | |

2. True or false

- | | | |
|-----------|----------|-----------|
| i. True | ii. True | iii. True |
| iv. False | v. False | |
3.

i. chloride	ii. nitrate	iii. chloride
iv. sulphate		
 4.
 - i. It is a displacement reaction; hydrogen is replaced by zinc.
 - ii.
 - a. hydrogen
 - b. Bring a burning match near the gas. If the gas is hydrogen, it burns and makes a popping sound.
 - iii. zinc + hydrochloric acid → zinc chloride + hydrogen
 - iv. The reaction would be faster.
 5.
 - i. Magnesium oxide dissolves in it better.
 - ii. So that all the acid is used up.
 - iii. By filtration.
 - iv. The filtrate is heated carefully to evaporate some of the water. Then it is left to cool. Crystals of magnesium sulphate will be formed.

Page 134

6.
 - i. It is found in the sea as well as rock salt. It is very common.
 - ii. sodium hydroxide and chlorine
 - iii. This is done to dissolve the salt and bring it to the surface.
 - iv. It is so salty that nothing can live in it.
 - v. Take a known weight of sea water in a beaker and evaporate it to dryness by heating. Collect and weigh the amount of salt that is left behind.
7.
 - i. Fertilizers contain the essential elements to make plants grow and be healthy.
 - ii. ammonium nitrate, calcium nitrate, sodium nitrate
 - iii. ammonium nitrate, ammonium phosphate, potassium sulphate.

Page 135**Ideas for investigations**

Investigation 1 provides students with opportunity to study the effect of particle size on the rate of a chemical reaction. By carefully taking the time taken for the limewater to go milky in each of the tree experiments, student should find that the smaller the size of the marble chips, the quicker the rate of reaction. Results could be presented in the form of a bar chart.

Investigation 2 requires students to see if brown egg shells contain more (or less) calcium carbonate than white egg shells. Using the same apparatus as in Investigation 1, students must add the same volume of hydrochloric acid to equal amounts of crushed brown and white egg shell and time how long it takes each to produce enough carbon dioxide to turn the limewater milky. Students may be surprised to discover that, other than colour, there is no difference between the shell of a brown egg and that of a white egg.

SAFETY NOTE: Put on safety glasses. Take care when using acid.

Chapter 10 Pressure and moments**Page 138**

1. Pressure is the result of a force acting on a certain area.
2. The blunt end.

3. a. Surface area is indirectly proportional to pressure, the greater the surface area the lesser the pressure.
b. Force is directly proportional to pressure, the greater the force the greater the pressure.
4. A pointed pin with a small surface area will produce greater pressure. However when there are lots of pins/nails the overall surface area is increased so there is less pressure.
5. a. $P = F/A$
 $P = 550\text{N}/0.0001 = 5,500,000\text{Pa}$
b. $P = 550\text{N}/0.001$
 $= 550,000\text{Pa}$
c. A flat heel will produce less pressure because it has a greater surface area. This is because force is indirectly proportional to area—the greater the area the lesser the pressure.

Page 140

1. The molecules are far apart, so air can be squashed.
2. Compressing a gas heats it up because the molecules move faster.
3. If the volume of a gas is halved, the pressure is doubled.

Page 141

1. The weight of the liquid pushes down on the base creating a pressure. The deeper the liquid the greater the pressure.
2. Dense liquids have a greater weight for the same volume so they press down on the container with greater pressure.
3. If you observe the level of tea in a teapot, it is at the same level as the tea in the spout. Adding more water to the pot causes the tea to rise to the same level in each section. This shows that the pressures in the pot and the spout are the same.
4. Submarines need thick, strong walls because the water exerts a pressure on its body which may cause it to collapse. This pressure is called hydrostatic pressure.
5. a. $\text{Pressure} = \text{Force}/\text{Area} = 4500/1.5 = 3000\text{Pa}$
b. $6000/1.5 = 4000\text{Pa}$

Page 143

1. Liquids are very difficult to compress because their particles are very close together.
2. An input cylinder is narrow while an output cylinder is wider.

3. They have thick walls because they have to bear a lot of pressure exerted by the hydraulic system.
4. Pressure exerted on the narrow cylinder is transmitted by the oil to the wide piston. It produces an output force which is larger than the input force.
5. Air can be compressed so not all of the pressure applied to a brake pedal will be transferred to the brakes. This can be very dangerous.
6. Pressure on narrow syringe
 $(P) = F_1/A_1 = 6/0.0002 = 30,000\text{Pa}$
Force at wider end
 $(F_2) = P \times A_2 = 30,000 \times 0.0008 = 24\text{N}$

Page 145

1. A lever is a simple machine. It helps to make work easier.
2. a. Effort is the force that is applied to the end of a long lever.
b. Load is the force to overcome by a machine.
c. Pivot is the point of rotation of a lever.
3. A turning effect of a force is called a moment.
4. Clockwise moment is the turning effect of a force in a clockwise (towards the right) direction. Anticlockwise moment is the turning effect of a force in an anticlockwise (towards the left) direction.
5. 1. a. Fred should sit at a distance of 4 metres.
b. Jill is sitting in the right place i.e., at 3 metres from the pivot.
6. I would hang the bag of cement at one end of the wooden plank and make my friend sit at the other end and make my friend move backwards and forwards till they were in balance. Then I would calculate the moments on both sides:
Weight of bag \times distance from pivot = weight of friend \times distance from the pivot
 $250\text{ N} \times \text{distance from pivot}/\text{distance of friend from pivot} = \text{weight of friend}$

Page 146

1. A joint is the place where two bones meet.
2. Muscles move bones at joints.
3. a. At joints, muscles are arranged in pairs so that one muscle of the pair pulls the joint one way and the other pulls it back again. Because the muscles work against each other, they are called antagonistic pairs.
b. Because muscles can only pull and relax, not push.

4. a. When the biceps contract, it helps to flex or bend the arm.
- b. When the triceps contract, it helps to straighten or extend the arm.
5. Gymnasts have to perform accurate precise movements so must have good control over their muscles.

Page 148

1. A ruler, like all objects, is made of particles which have a tiny weight. When balanced, the weight of particles on one side of the ruler exactly equals the weight of particles on the other side.
2. Centre of gravity is the place where gravitational force acts. It is usually in the middle of an object.
3. When something falls over easily when pushed, it is unstable. When something is difficult to topple over, it is stable.
4. Something falls over when its centre of gravity moves outside its base.
5. When a ball rolls, its centre of gravity always stays over its base, never outside it.

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Exercise

1. Multiple choice questions

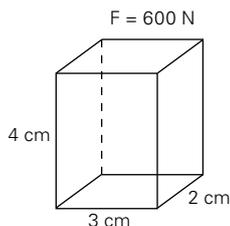
- i. c ii. b iii. d
iv. b v. a

2. True or false

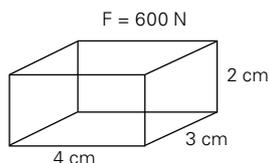
- i. True ii. False iii. False
iv. False v. False

Page 150

3. i. a.



- b.



$$\begin{aligned}
 \text{ii. } P &= F/A \\
 &= 600 / (3 \times 2) \\
 &= 600\text{N} = 600\text{N} \\
 6\text{cm}^2 &= 0.0006\text{m}^2 \\
 &= 600/0.0006 \\
 &= \mathbf{1\ 000\ 000\text{Pa}} \\
 P &= F/A \\
 &= 600 / (4 \times 3) \\
 &= 600\text{N} = 600\text{N} \\
 12\text{cm}^2 &= 0.0012\text{m}^2 \\
 &= 600/0.12 \\
 &= \mathbf{500000\text{Pa}}
 \end{aligned}$$

- iii. a. Position 2 is most stable
- b. The block has to turned further in order to move the centre of gravity outside its base.
4. i. a. Y
- b. Turning effect of Y is $40\text{N} \times 0.2\text{m} = 8\text{Nm}$
Turning effect of X is $20\text{N} \times 0.3\text{m} = 6\text{Nm}$
- b. By applying the force at the end of the spanner Y instead of at the centre.
- c. A moment.
5. i. The moment at the left-hand side is $10 \times 2 = 20\text{Nm}$. The moment at the right-hand side is $3 \times 4 = 12\text{Nm}$. These forces are not balanced.
- ii. By adding a force of 2N to the right-hand side we could balance the plank.
6. i. Traffic cones have stable equilibrium.
- ii. Bowling pins have an unstable equilibrium.
- iii. Passengers standing on the upper deck raise the centre of gravity of the bus so making it unstable.
- iv. A half empty bottle is more stable than a full one because its centre of gravity is lower than that of a full bottle. Therefore we say that the half-empty bottle is in stable equilibrium.

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Ideas for investigations

Investigation 1 enables students to study the effect of changing surface area on pressure. The use of a constant mass means that all the students are required to change is the area covered by that mass. The depth of the depression created by one block should be the greatest. Using the formula given, students will hopefully see the inverse relationship between surface area and pressure.

Investigation 2 presents students with the opportunity to see how hydraulic systems work. It is important when assembling the apparatus that no air is trapped inside the tubing or syringes. Assembly is best done under water. By putting their results in the table, and using πr^2 to calculate the surface area of each plunger, students should be able to see the relationship between surface area and distance moved in this system. A large movement by the small plunger produces a smaller movement in the large cylinder and vice versa.

Having calculated the pressure (P_1) produced by the small syringe, students then need to use the following formula to calculate the force on the plunger of the large syringe.

$$\text{force (N)} = P_1 \times \text{area of plunger of large syringe.}$$

Chapter 11 Microbes and disease

Page 156

1. a. Microbes which make things rot are called decomposers.
b. Decomposers are useful because they get rid of dead animals and plants and turn them into useful chemicals in the soil.
2. Many microbes feed on the remains of dead animals and plants. They produce certain enzymes which rot or decompose the food into liquid on which they then feed.
3. a. Sewage consists of urine and faeces from our bodies, water from washing, and some industrial wastes.
b. Sewage contains some harmful microbes that could spread disease.
4. Microbes need enough air and an even temperature in order to grow in a compost heap.

Page 157

1. a. Milk contains microbes which make it go sour and lumpy. The lumps are called curds.
b. Milk is boiled to kill off any unwanted microbes. Then a small amount of curd is added to the warm milk. This acts as a starter for the microbes to multiply inside the milk and change it into yoghurt.
2. Milk is boiled to kill off any unwanted microbes.
3. a. The process by which yeast feeds anaerobically on sugar is called fermentation.
b. The waste products of fermentation are carbon dioxide and alcohol.

4. When yeasts feed on the sugars in the dough they respire anaerobically and produce bubbles of carbon dioxide which make the dough rise.

Page 159

1. An infection occurs when harmful microbes enter the body and cause disease.
2. a. Bacterial diseases: diarrhoea, whooping cough, pneumonia
b. Viral diseases: cold, flu, chicken pox
c. Fungal diseases: athlete's foot, ringworm, thrush
3. a. Ringworm is caused by a fungi.
b. It probably got its name because of the reddish round patch which appears on the skin.
4. Answers depend on students.

Page 160

1. Microbes can enter the body through: the breathing system, the digestive system, by touching an infected person or using things they have used and by animals, especially insects.
2. Food poisoning is caused by food or drink infected with bacteria. Food and drink can be infected by coughs, sneezes, dirty hands, insects or unhygienic cooking methods.
3. Diseases such as colds and flu are caused by breathing in harmful microbes which are released in the air by the coughing and sneezing of people infected with them.
4. Mosquito nets are used to avoid being bitten by mosquitoes which have dangerous microbes in their saliva and cause diseases such as malaria.
5. The lungs of smokers do not have the tiny hairs which sweep away dust and germs from the respiratory system. That is why they can get lung diseases easily.

Page 161

1. a. The skin is a very effective barrier against microbes. If it is damaged, the blood quickly clots to repair the hole and keep the microbes out.
b. As a defence against harmful microbes.
2. The immune system consists of white blood cells which attack microbes that enter the body. Some white cells eat the microbes, while other white blood cells make antibodies which kill microbes.

3. a. Antibodies are chemicals, made by white blood cells, which kill microbes.
b. Antibodies work in different ways. Some make microbes stick together so that white blood cells can eat more of them quickly. Others dissolve the walls of the microbes so that they burst open and die.
4. We should bathe regularly to remove sweat and dirt especially from our hair, feet and underarms.
5. Anyone handling food in a shop should cover a cut with plaster because germs from the cut might enter the food he/she is handling.

Page 163

1. A vaccine is made from dead or weakened disease-causing microbes which are injected into our bodies. We get a mild form of the disease. We do not really get sick, but the vaccine is enough to cause the white blood cells to make antibodies against the disease. If, in future, live bacteria or viruses of the same type enter into our bodies, we are already protected against or immune to them.
 2. Polio, tetanus, mumps, measles, tuberculosis (TB)
 3. a. She had a mild attack of the disease due to the vaccination.
b. Cholera is a disease that is caused by germs which are present in water that is infected by the faeces and vomit of infected persons. She had to be protected against cholera as she was going to a poor country where people are malnourished and have poor water supply.
 4. a. 7000 b. 65000
c. Immunization was introduced.
d. The introduction of a free National Health Service in 1948 has helped to keep the numbers of infections low.
4. i. Sewage contains urine and faeces from our bodies, water from washing, and some industrial wastes. It also contains some harmful microbes that spread diseases.
ii. Raw sewage is left to settle in large tanks. Faeces settle at the bottom to form sludge. This is later used to make fertilizer and methane gas.
iii. The liquid from the tanks is sprinkled over stones covered in bacteria which feed on any waste that remains in the liquid.
iv. This means that the components of sewage can be decomposed.
v. The clean water is pumped into rivers or the sea.
 5. i. a. Blood poisoning, whooping cough
b. Flu, small pox
c. Athlete's foot, ring worm
ii. a. Once you have had a disease you are usually protected from catching it again.
b. The doctor would give you a vaccination to make you immune to the disease.
 6. i. Some diseases like cold and flu are spread by germs in the air.
ii. Cooking thoroughly kills most of the germs in food.
iii. Some germs are carried by dirty hands.
iv. Bathing keeps our bodies clean.
v. Towels of an infected person carry germs.

Page 166**Page 164****Exercise****1. Multiple choice questions**

- | | | |
|-------|-------|--------|
| i. a | ii. c | iii. b |
| iv. a | v. b | |

2. True or false

- | | | |
|-----------|-----------|------------|
| i. True | ii. False | iii. False |
| iv. False | v. True | |
3. i. B ii. C iii. A

7. i. Diseases which occur when harmful microbes enter the body are called infectious.
ii. 25%
iii. Diseases caused by round worm and hook worm.
iv. It is a disease which is caused by inhaling germs from the air.
v. Mosquitoes are only found in hot climates.
vi. a. Diarrhoeal diseases
b. Diarrhoeal diseases are caused by germs that are transmitted through water contaminated by the faeces and vomit of infected patients.
8. i. A is the mouth of the housefly. When the fly applies its mouth to the food, it pumps saliva over it to digest it. The digested food is then sucked back and pumped into its digestive system. When the fly sits on some other food it again pumps its saliva on to the food. In this way germs from one food might be carried to another and thus spread disease.

- B The hair on its body catch germs from the rubbish heaps that a fly sits on.
 - C Flies sit on food and deposit their faeces on it. When we eat such contaminated food we can get infected.
 - D When a fly sits on food it rubs its feet and body to clean it. While doing this it rubs off germs on its body on the food.
- i. 1 Food should be kept covered when it is lying outside.
 - 2. Food should be cooked thoroughly and kept in the refrigerator to prevent germs contaminating it.

Page 167

Ideas for investigations

Investigation 1 gives students the opportunity to find out in what conditions mould fungi grow best. Ideal growing conditions for mould fungi are warm damp places with a plentiful supply of food. Mould fungi will grow in a refrigerator and even quite hot places but more slowly. Light or dark should make no difference to the growth of mould fungi.

Investigation 2 is an extension of investigation 1, this time requiring students to compare the growth of mould fungi on a variety of food materials. Of the food materials suggested, jam will probably give the best results.

Chapter 12 Environmental chemistry

Page 169

1. 4.6 billion years old.
2. Humans have exploited natural resources; they are burning fossil fuels and they are causing environmental pollution.
3. petrol, diesel, paraffin.
4. Most of it has been dug up.
5. When it burns it produces water.

Page 171

1. When rocks are weathered by Sun, rain, wind, and frost, tiny grains of rock are broken off. These grains make up most of the soil on Earth.
2. Humus is mostly made up of material from dead animals and plants which slowly rot away. It helps to keep the soil in good condition in different ways, including breaking it down to provide useful materials which plants use for healthy growth.

3. Bacteria, fungi, microscopic worms, earthworms, beetles, and moles.

Page 173

1.
 - a. Clay soils are made up of lots of tiny grains stuck closely together. They have few air spaces and have water trapped between the grains.
 - b. Sandy soils are made up of bigger grains with bigger spaces between them. Sandy soils are light, easy to dig, and easily drained.
2. Loam is a mixture of clay, sand, and lots of humus.
3. Torrential rain and flooding on steep mountain sides can wash the soil off the slopes very easily. Strong winds can blow away huge amounts of soil.
4. Planting grass on open land can help prevent soil being washed away by rain or being blown away by wind.

Page 175

1. Harmful substances in the atmosphere.
2.
 - i. Ozone is a form of oxygen gas (O₃).
 - ii. It forms a layer in the atmosphere high above the Earth which filters out harmful ultraviolet (UV) radiation.
3. aerosols, refrigerators and air conditioning systems.
4. CFCs break up the ozone layer allowing harmful UV radiation to get to the Earth's surface.
5. Smog is brown or blue haze that builds up over cities where traffic produces poisonous gases.
6. oxides of nitrogen, sulphur and carbon.
7. Blue smog contains more which is poisonous.
8. From respiration.
9. The increased burning of fossil fuels all over the world has increased the acidity of rain
10. Sulphur dioxide dissolves in rain water producing sulphuric acid which is a strong acid.
11. sulphur dioxide + water + oxygen → sulphuric acid

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1.
 - a. Gases in the atmosphere which keep the heat in are called greenhouse gases.
 - b. carbon dioxide and methane
2. The increasing greenhouse effect is causing the Earth to slowly warm up. This is called global warming.

3. Greenhouse gases act like a layer of insulation, keeping heat in. The increased greenhouse effect is causing the Earth to slowly warm up.
4.
 - a. Fewer trees means less photosynthesis, which means less carbon dioxide is taken from the air.
 - b. Methane comes from marshy areas, such as where rice is grown.
 - c. Methane comes from cattle as they belch and break wind.

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1. More ice in the Arctic and Antarctic will melt. Sea levels will rise as the ice caps melt. Low lying areas of the world will be flooded.
2.
 - a. Some areas will suffer drought; crops will fail, and people will starve.
 - b. Mosquitoes and other insects which live in warm places will spread to new areas, possibly carrying disease.
3. Locusts are found in hot parts of the world like Africa. However, in the last few years, locusts have populated southern parts of Europe. Crops there have been decimated.

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1.
 - a. Carbon dioxide levels have been rising since 1860.
 - b. The average global temperatures are rising.
2. Fossil fuels keep a country's economy going. Factories, transport systems, and power stations all rely on a steady supply of fuel.
3. People drive around in big cars, run lots of electrical appliances, and fly around the world on business and holidays.
4. We should accept that global warming is a problem; we should try to conserve our natural resources and we should try to find clean renewable sources of energy.

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Exercise

1. Multiple choice questions

- | | | |
|-------|-------|--------|
| i. c | ii. c | iii. a |
| iv. a | v. b | |

2. True or false

- | | | |
|----------|-----------|-----------|
| i. True | ii. False | iii. True |
| iv. True | v. True | |

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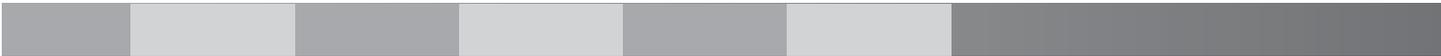
3.
 - i.
 - a. The diagram on the right
 - b. The diagram on the left
 - ii.

clay soil	sandy soil
smaller particles	bigger particles
less air between particles	more air between particles
holds more water	holds less water
 - iii. Clay soils can hold more water as their particles are very close to each other therefore they are called heavy soils.
 - iv. A mixture of the two types of soil is called loam. It is very good for plants as it holds water as well as air. It also contains a lot of humus.
4.
 - i. carbon dioxide and sulphur dioxide
 - ii. When they dissolve in rainwater, they produce carbonic acid and sulphuric acid which cause the rain to become acidic.
 - iii.
 - a. They corrode stonework of buildings.
 - b. They kill trees.
 - c. They kill the animals living in lakes.
 - iv. Acid rain can be reduced if we reduce the burning of fossil fuels.
5.
 - i. In phase 1
 - ii. In phase 3
 - iii.
 - a. They are used up rapidly.
 - b. Pollution of the environment occurs.
 - iv. By keeping a check on the use of our energy resources.
 - v. We can conserve petrol and gas by cycling instead of driving around in big cars.

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Ideas for investigations

Investigation 1 requires students to find the volume of air in a sample of soil. It is a straightforward investigation which should generate good results if the instructions are followed correctly. It is important that the water is added slowly to the measuring cylinder and that the mixture is thoroughly stirred in order for the all of the air to escape from it. Students record their results in the table and carry out the simple calculation to find the volume of air in their soil sample. A useful extension would be to compare the amount of air in different soil types from different areas.



Investigation 2 is also about soil. This time students are required to find the percentage mass of water and percentage mass of humus in a sample of soil. The investigation is in two parts, Part 1 must be carried out first.

In Part 1 it is important the students do not heat the soil too much. A warm oven (60 -80°C) should be sufficient to dry the soil samples after an hour or so. Students record their results in the table and carry out the calculation to find the percentage mass of water in their soil sample.

In Part 2 students are required to heat their dry soil sample from Part 1 of the investigation, strongly with a Bunsen flame. It is important that students carefully stir the soil at it is heated so that all of the humus is burnt off. The ash can be gently blown from the surface of the soil to remove it. Students record their results in the table and carry out the calculation to find the percentage mass of humus in their soil sample from Part 1.

SAFETY NOTE: Put on safety glasses. Take care when using hot apparatus.

Answers (Workbook)

Chapter 1 Work and energy

1. State whether the following statements are True or False.

- i. True ii. False iii. False
iv. True v. False

2. Choose the correct option.

- i. d ii. c iii. d
iv. b v. b

3. electrical → light/sound

chemical → heat/light

electrical → light/heat

chemical → kinetic

sound → electrical

kinetic → sound/heat

4. i. 100 N ii. 200 m

iii. $100 \times 200 = 20\,000$ J/joules or 20 kJ/kilojoules

iv. $100 \times 400 = 40\,000$ J or 40 kJ

5. catapult - elastic potential energy

ball - kinetic energy

iron - electrical energy

matches, apple and battery - chemical energy

skier - gravitational potential energy

loudspeaker - sound energy

6. The work done (measured in **joules**) is equal to the **force** (in newtons) multiplied by the **distance** moved (in metres). 1 joule is the work done when a force of one **newton** moves a distance of one **metre** in the **same** direction.

7. i. chemical → thermal → kinetic → gravitational potential

ii. chemical → thermal → electrical → heat

iii. gravitational potential → kinetic → light + heat

8. i. $GPE = m \times g \times h = 1 \times 10 \times 1 = 10$ joules/J

ii. a. When it is on the edge of the table

b. Just before it hits the floor.

iii. 10 joules/J (GPE has been fully converted to kinetic energy)

iv. Sound and heat energy.

2. Choose the correct option.

i. b ii. a iii. a

iv. a v. b

3. Clones are genetically **identical** organisms. Cloning can happen **naturally** in plants. Today cloning is a 'high tech' **business**. A lot of commercial plant growers use the technique to produce **large** numbers of plants in a **short** period of time.

As well as being able to produce **seeds**, many plants are able to reproduce by growing new parts which can live as **separate** plants. This is called asexual reproduction because no **gametes** are involved.

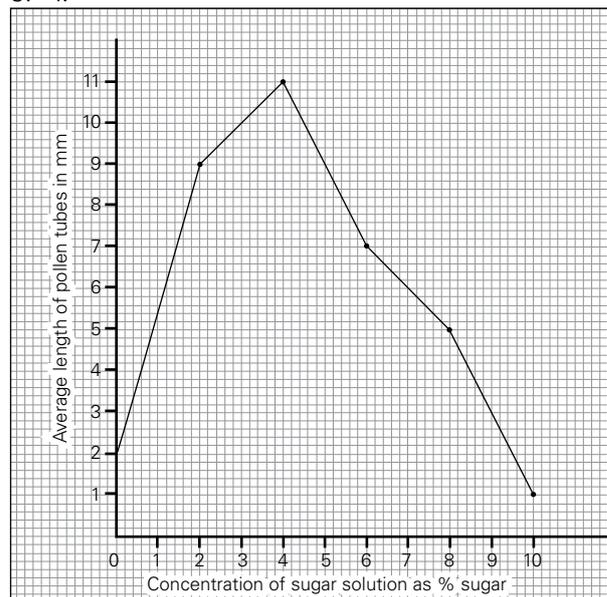
The only problem with asexual reproduction is that there is no **genetic** variation. If one plants gets a **disease**, so will all of the others.

4. i. A anther B stigma

ii. So they are exposed to the wind

iii. Because they do not have to attract insects to pollinate them.

5. i.



ii. a. 9 mm b. 7 mm

iii. a. 4% b. 10%

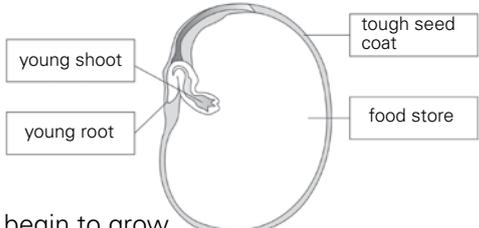
iv. Insects have to push past the reproductive organs in order to reach the nectaries.

Chapter 2 Reproduction in plants

1. State whether the following statements are True or False.

- i. True ii. False iii. False
iv. False v. True

6. i. Dandelion seeds have a parachute mechanism which helps them to float in the air. Sycamore fruit uses its helicopter-like wings as it flies in the air carrying the seeds to distant places.
- ii. Cherries are eaten by mammals and their seeds are left behind as animal waste.
- iii. Burdock seeds have hook-like spikes which cling to animal fur as they pass.
- iv. Seeds should be scattered far away from the parent plant so that each one gets enough food, water, and light to grow properly.

7. i. 
 - ii. begin to grow
 - iii. young root
 - iv. Provides food for energy production until the first green leaves emerge to photosynthesis.
 - v. It takes a while before the first green leaves to begin to emerge and photosynthesize therefore large food store helps in providing food till then.
8. i. wheat germ
- ii. a. the outer coat of the wheat grain
b. to make breakfast cereals
- iii. the food store
- iv. Wholemeal bread is made from the whole seed. White bread is made from flour only.

Chapter 3 Reactions of metals

1. **State whether the following statements are True or False.**
 - i. False ii. True iii. True
 - iv. False v. False
2. **Choose the correct option.**
 - i. d ii. c iii. b
 - iv. b v. b
3. A **more** reactive metal can protect a **less** reactive metal in a process called **sacrificial** protection. Plates of reactive metals such as **magnesium** are 'sacrificed' to save such metals as **iron** or steel from corroding. This method is used for protecting **ships**. Because the hull is always under water, it cannot be **painted** regularly. Underground gas and water pipes can be protected in the same way.

4. i. a. The particles are closely packed.
b. Pushing or pulling forces make the layers in the crystal slip over one another. The metal does not break but it does change shape.
c. Metals have a sea of electrons which carry heat as they move. So copper is a good conductor of heat.
- ii. When atoms in a metal are close together, their outer electrons are able to move freely through the metal as a whole. When an electrical voltage is connected to the metal, an electric current flows because the electrons are free to move.
5. i. a. potassium b. gold
- ii. Gold is an unreactive metal so it can be dug out as a pure metal, but iron is very reactive so it can only be found as a compound in iron ore.
- iii. They are shiny metals which do not react with any other element easily.
- iv. a. No
b. Aluminium is the most abundant metal in the Earth's crust, but it is found in the form of an ore called bauxite.
6. U, P, O
7. i. Test tube 1—no reaction
Test tube 2—no reaction
Test tube 3—the nail is rusty
- ii. The oxidation of iron can only take place in the air with moisture.
- iii. iron gate - painting
steel dustbin - galvanizing
kitchen tap - electroplating
ship's hull - sacrificial protection
8. i. An alloy is a mixture of two or more metals.
- ii. Bronze is an alloy of copper and tin. Tin is stronger than copper, so a bronze model is harder to deform.
- iii. Bronze is used to make statues.

Chapter 4 Speeding up

1. **State whether the following statements are True or False.**
 - i. True ii. True
 - iii. False iv. True
 - v. True

2. Choose the correct option.

- i. b ii. c iii. a
 - iv. c v. a
3. If a block of iron is hung from a piece of string, the downward force (**weight**) is **balanced** by an upward force in the string (**tension**). The iron block stays at rest. If the string is cut, the weight makes the block **accelerate** downwards. On Earth, **gravity** makes falling objects accelerate at about 10m/s^2 . This means that after 1 second the block will be falling at **10m/s**, after 2 seconds it is falling at **20m/s**, after 3 seconds it is falling at **30m/s** and so on. This is only true for objects falling in a **vacuum**.
4. 1. i. a. 8m/s b. 8m/s
c. 10m/s
- ii. In 1 hour the snail travels 50cm.
In 2 hours it travels $50 \times 2 = 100\text{cm} = 1\text{m}$
- iii. a. 2 hours b. 15 minutes
5. i. 10s ii. 30m/s
- iii. 10s iv. 15m/s
- v. a. 150m b. 450m
- c. 525m
6. i. air resistance and road friction
- ii. a. in diagram 2
b. The bicycle travels at a steady speed.
- iii. It will increase.
- iv. a. diagram 1
b. The forward force is greater than the air resistance.
7. i. gravity ii. air resistance
- iii. Air resistance becomes greater.
- iv. The air resistance slows down the sky diver as he reaches the ground. When he lands, the upward force of the solid ground stops him sinking into it.
8. i. Girl 2 ii. Girl 1
- iii. 5s iv. 7m/s
- v. This means that her speed is changing at the rate of 2m/s in every second.

Chapter 5 Where does our food come from?

1. State whether the following statements are True or False.

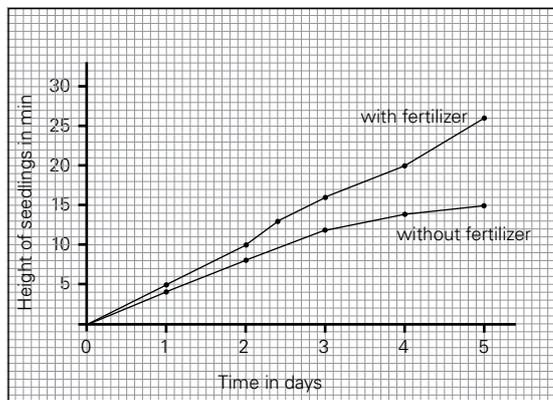
- i. False ii. true iii. true
- iv. True v. True

2. Choose the correct option.

- i. b ii. a iii. a
- iv. d v. b

3. The **transfer** of energy along the food chain is very **inefficient**. There is about 98% energy loss between the **Sun** and producers, and about 95% energy loss between producers and consumers. There is another 95% loss of remaining energy when a **secondary** consumer eats a primary consumer. This energy loss could be **reduced** if people were to eat food from further **down** the food chain.
- Eating **plants** instead of the **animals** that feed on them makes better use of the available energy.

4. i.



- ii. 14mm
 - iii. More than 3 days.
 - iv. Fertilizers are chemicals that are necessary for the growth of plants.
 - v. Seedlings which were given fertilizer grew at a much faster rate.
5. i. It is washed away from fields with the rain water.
- ii. Fertilizer provides the nutrients for algae which then rapidly grows.
- iii. Light cannot pass through the water to the plants below, so they die.
- iv. Bacteria decompose the dead plants using up the oxygen in the water. Less oxygen causes fish and other aquatic animals to die.
- v. eutrophication
6. i. They are orange in colour and prey on spider mites.
- ii. The predatory mites feed on the spider mites. This way they will help protect the tomato plants from being eaten by the spider mites.
- iii. This method is useful because the pest does not become resistant to the predator; the predator usually feeds on only one kind of prey; there is no need to replace the predator—they breed themselves.

- iv. In a greenhouse the orange predatory mites cannot escape as they would in open fields.
 - v. biological control
- 7.
- i. It kills insects.
 - ii. A material which can be broken down by bacteria and fungi is called biodegradable.
 - iii. It accumulates in the organisms in a food chain. The further along the chain the more DDT there is in the organism.
 - iv. As DDT passes along the food chain it accumulates in the fat layers of the animal's body. As time passes, the concentration of DDT increases in the grebe's body.
 - v. As the concentration of DDT reaches its peak, ultimately the grebe will die.
- 8.
- i. a. A b. It can reach light faster.
 - ii. It can absorb more water and mineral salts.
 - iii. space
 - iv. good seed dispersal mechanisms
- 9.
- i. A greenhouse is a house made of glass which can provide plants with all the necessary conditions for them to grow.
 - ii. a. The supply of carbon dioxide can be increased enabling plants to photosynthesize more and grow quickly.
 - b. Maintains the best temperature for plant growth.
 - c. Provides the best light (blue and red) for photosynthesis.
 - ii. a. The amount of minerals.
 - b. Plants get the correct amount of essential minerals for their healthy growth.

Chapter 6 Water

1. State whether the following statements are True or False.

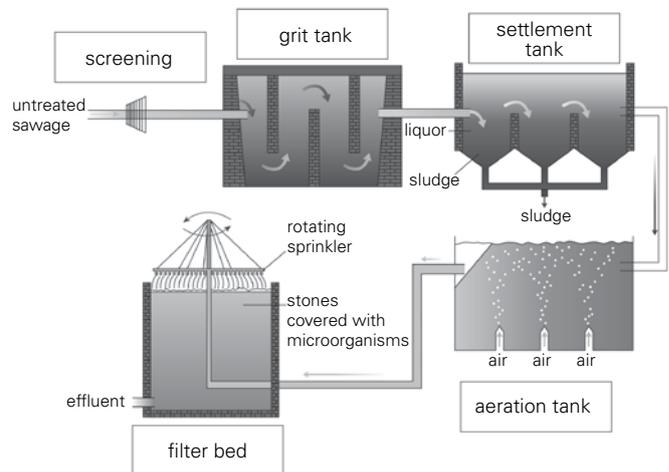
- i. True ii. False iii. False
- iv. false v. False

2. Choose the correct option.

- i. d ii. b iii. a
- iv. c v. a

3. i.
- 1 evaporation
 - 2 transpiration
 - 3 wind
 - 4 rain
 - 5 surface run off
 - 6 seepage
 - 7 ground water
 - 8 soil run off

- ii. a. condensing water vapour
 - b. further condensation to form rain
 - iii. heat from the Sun causes water to evaporate from the seas and oceans
- 4.
- sand, silt, and clay - industry
 - oil, detergent, and heavy metals - industry
 - fertilizers and pesticides – agriculture (crops)
 - organic matter from animals – agriculture (animals)
 - household sewage – small towns and villages
 - sewage effluent – large towns and cities
5. i.



- ii. Aerobic bacteria digests organic waste such as urine.
 - iii. The microorganisms feed on any remaining waste.
6. i.
- a. sedimentation b. filtration
 - c. chlorination
- ii. Storing in reservoirs ensures a continuous supply of water. Rivers may dry up in times of low rainfall.
7. i. car engine, metal drilling machine
- ii. household drinking water, irrigation of fields
 - iii. hydroelectric power, water mill
 - iv. sailing boat, swimming
 - v. ice skating, skiing
8. i. a. Rawalpindi b. Jacobabad
- ii. Twice as much rain falls on D I Khan than Karachi
 - iii. 1 Bahawalpur
 - 2 Hyderabad
 - 3 Jacobabad
- iii. Because one year may not be typical for that city.

Chapter 7 Electricity and energy generation

1. State whether the following statements are True or False.

- i. True ii. True iii. True
 iv. True v. False

2. Choose the correct option.

- i. c ii. d iii. a
 iv. a v. b

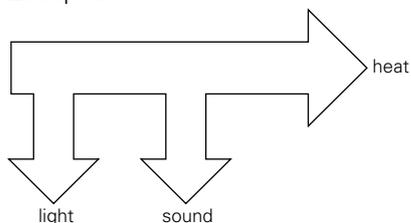
3. Electricity is produced in power stations. Most countries produce their electricity using the chemical energy in **fossil** fuels, and the **nuclear** energy in uranium. Power stations which convert the energy from fuels into electrical energy are called **thermal** power stations.

Thermal power stations **waste** more energy than they produce. The **efficiency** of a typical coal burning power station is only about 35%. Burning fuels like coal produce **acid** rain and carbon dioxide. Water from power stations, **warmed** during energy production, is often dumped into the local river, or the sea. Increased water temperatures can cause serious changes to these **ecosystems**.

4. i. C ii. B iii. D
 iv. A

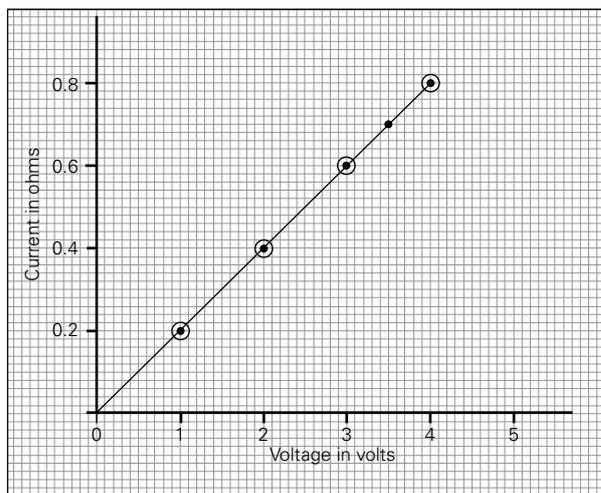
5. i. 1 electrical energy → sound energy
 2 electrical energy → light energy
 3 electrical energy → heat energy

- ii. Escapes
 iii.



6. i. a. 3V b. 3V c. 3V
 ii. a. zero b. zero c. zero
 d. 9V
 iii. The pointer moves the wrong way and the meter may be damaged.
7. i. Resistance is the measure of how different materials resist the flow of electricity through them.
 ii. Resistance is measured in units called ohms.
 iii. resistance (R) = voltage (V)/current (I)
 = 6V/ 4A = 1.5 ohms

8. i.



- ii. a. 0.7A b. 0.5V
 iii. the current doubles
 iv. resistance (R) = voltage (V)/current (I)
 = 1V / 0.2A = 5 ohms

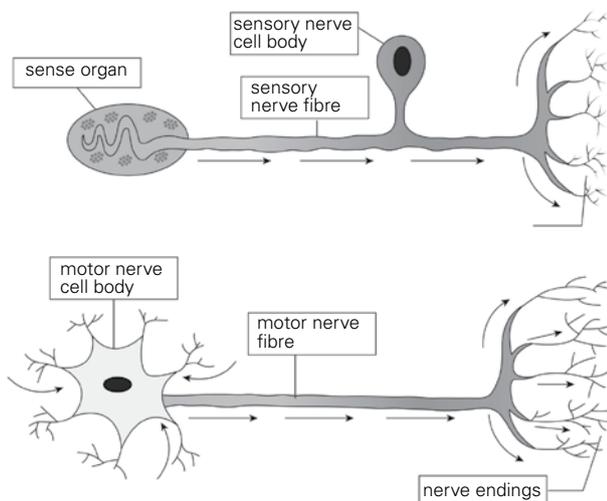
9. i. a. 20W b. 100W
 ii. kWh is a unit of electricity, which is used to measure the amount of electrical energy an electric appliance can use up in an hour.
 iii. energy in kWh = power in kilowatts × time in hours
 = $\frac{20}{1000}$ kW × 1000 hours
 = 20 kWh
 iv. energy in kWh = $\frac{100}{1000}$ kW × 1000 hours
 = 100 kWh
 v. cost of using the low energy bulb = 20 kWh × Rs 10 = Rs 200
 cost of using the high energy bulb = 100 kWh × Rs 10 = Rs 1000

Chapter 8 More organ systems

1. State whether the following statements are True or False.
 i. True ii. False iii. False iv. True
 v. True
2. Choose the correct option.
 i. b ii. b iii. d iv. c
 v. c

3. Hormones are chemicals made in special glands called **endocrine** glands. This is why the hormone system is sometimes called the **endocrine system**. Like the nervous system, the hormone system **coordinates** the body but in a different way. A nerve impulse travels from the **brain** or spinal cord to one particular **muscle** very quickly. Hormones however travel in the **bloodstream** which means they travel very slowly and their effects are more **general**. Once released from a gland, a hormone travels round the body until it reaches a **target organ**. This is the part of the body that respond to a particular hormone.

4. i.



5. i. A **stimulus** is detected by a **receptor in skin**. The receptor is stimulated and sends a nervous impulse along a **sensory neurone** to the **spinal cord** which is part of the **central nervous system**. In the spinal cord impulses are passed to a **relay nerve** and then on to a **motor neurone**. The motor neurone carries nerve impulses to a **muscle** which contracts to cause a reaction to the stimulus.

ii. A reflex action

iii. Messages pass from one nerve to another by a special link called a synapse. The branching ends of one nerve cell lies very close to the cell body of another nerve cell. They do not actually touch. When an impulse moves along one nerve cell, it releases a chemical that diffuses across the gap and stimulates the other nerve cell.

6.

Voluntary actions	Involuntary actions
chewing food	blinking when a fly touches your eye
hitting a ball	mouth 'waters' when you smell nice food
painting a picture	shivering when you are cold
waving at your friend	sneezing when something tickles your nose
writing on a piece of paper	sweating when you feel hot

7. i. A person may have drunk a lot of water.
 ii. A person may have been exercising and been sweating a lot.
 iii. The brain detects a change in the water level of the blood. If the level is too high the brain 'tells' the kidneys to remove more water from the blood. If the level of water in the blood is too low, the brain 'tells' the kidneys to remove less water from the blood.

Chapter 9 Salts

1. State whether the following statements are True or False.

- i. True ii. False iii. False
 iv. True v. False

2. Choose the correct option.

- i. a ii. b iii. b
 iv. c v. a

3. A salt is made whenever an acid **reacts** with an alkali. It is possible to find out just how much acid is needed to **neutralize** an alkali by carrying out a **titration**. This is an **experiment** that uses equipment that can measure the **volume** of a solution accurately. Acid is added to alkali until a **neutral point** is reached. The solution now contains salt and **water**. The salt can be obtained by **evaporating** the water away.

4. salts have high melting points ✓
 some salts contain a small amount of water ✓
 all salts form crystals ✗
 most salts will dissolve in water ✓
 salts are insoluble ✗
 all salts are solid ✓
 all salts are white in colour ✗
 some salts are solids ✗
 salts are not always the same colour ✓

5. i. aluminium + hydrochloric acid \rightarrow aluminium chloride + hydrogen
 ii. zinc + sulphuric acid \rightarrow zinc sulphate + hydrogen
 iii. lead + nitric acid \rightarrow lead nitrate + hydrogen
 iv. calcium + hydrochloric acid \rightarrow calcium chloride + hydrogen
 v. iron + sulphuric acid \rightarrow iron sulphate + hydrogen
 vi. magnesium + hydrochloric acid \rightarrow magnesium chloride + hydrogen
6. i. a. 60 cm^3 b. 65 cm^3
 ii. a. 8 s b. 40 s
 iii. 65 cm^3
 iv. hydrogen
 v. Put on safety glasses. Hold a lighted splint close to the open top of the test tube containing the reactants. If hydrogen is present it explodes with a 'squeaky pop'.
7. i. a. 4 b. 3
 ii. sulphuric acid + calcium carbonate \rightarrow calcium sulphate + carbon dioxide + water
 iii. $\text{H}_2\text{SO}_4 + \text{CaCO}_3 \rightarrow \text{CaSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$
 iv. Carbon dioxide and water.
8. i. It speeds up the reaction.
 ii. So that all of the sulphuric acid is used up. Safety.
 iii. Filter the mixture.
 iv. Evaporate the filtrate.
 v. A base.
9. i. To help them grow and keep them healthy.
 ii. a. bone meal, fish meal, hoof and horn
 b. nitrate of potash
 iii. phosphate potash
 iv. a. No and Yes
 b. Root vegetables such as parsnips and carrots need nitrogen and potash/potassium not phosphate. Leaf vegetables such as cauliflower, cabbage and lettuce need nitrogen and phosphate

Chapter 10 Pressure and moments

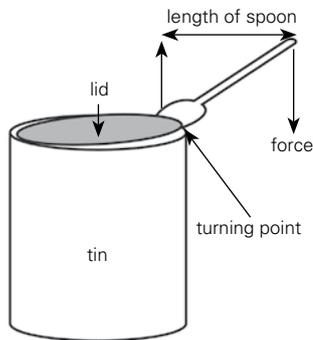
1. State whether the following statements are True or False.

- i. False ii. True iii. True
 iv. True v. True

2. Choose the correct option.

- i. c ii. d iii. a
 iv. d v. c
3. Muscles move bones at joints so that individual bones can act as **levers**. When muscles contract they get **shorter**. This produces a pulling force. When the muscles **relax** they go back to their normal length but they cannot **push**. At joints, muscles are arranged in pairs. One muscle of the pair pulls the joint one way and the other pulls it back again. Because the muscles work against each other they are called **antagonistic** pairs. The human **forearm** is a good example. The **biceps** (flexor muscle) flex or bend the arm. The **triceps** (extensor muscle) extend or straighten the arm.
4. i. Pressure is indirectly proportional to area. Stiletto heels have a very pointed base which has a small area as compared to the weight of the person wearing it.
 ii. Snow shoes have a wide base so they will have lesser pressure as compared to shoes with narrow bases.
 iii. Football shoes have studs which have a narrow area to give the players a better grip on the ground when they are running.
 iv. A bed of nails has a wider area than a single nail, so the pressure of the bed of nails will not hurt him.
 v. The handles of the heavy bags have a narrow area as compared to the force of the things inside so the pressure is greater.
 vi. The area of the camel's feet produces less pressure as area is indirectly proportional to pressure, so a camel can easily walk on the sand without sinking.
5. i. $P = F/A$
 $= 120\text{N} / 0.01\text{m} = 12,000 \text{ Pa}$
 ii. $P = F/A$
 $= 120\text{N} / 0.001 = 120,000 \text{ Pa}$
 iii. It has an unstable equilibrium when it is made to stand at its pointed end.
6. i. $50 / 0.002 = 2500 \text{ Pa}$
 ii. 2500 Pa
 iii. Force = pressure \times area
 $= 2500 \times 1$
 $= 2500 \text{ N}$
 iv. A
7. i. a. spanner 2
 b. The force is applied at a longer distance so less effort is needed to turn the nut.

- ii. spanner 1:
 moment = force x weight of the arm
 = 10N x 0.2m = 2Nm
- spanner 2:
 moment = force x weight arm
 = 10N x 0.4m = 4Nm
- iii. a moment
- iv. A small effort applied at the handle of the spoon overcomes the force holding the lid in the tin.
 This is similar to the working of a spanner where the long handle of the spanner allows a small effort to overcome the large force holding the nut on.



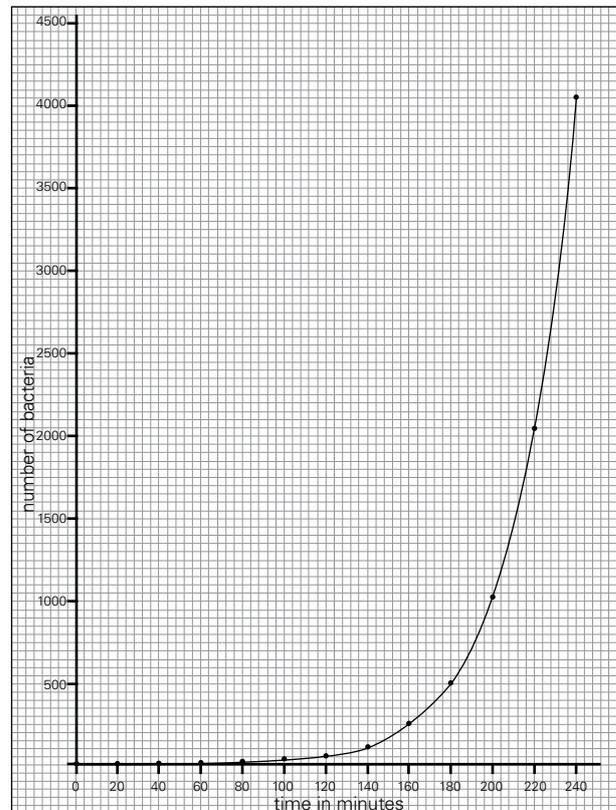
8. See-saw 1
 i. a. 900Nm b. 600Nm
 ii. unbalanced
- See-saw 2
 i. a. 300Nm b. 600Nm
 ii. unbalanced
- See-saw 3
 i. a. 600Nm b. 600Nm
 ii. balanced
9. The beaker has a stable equilibrium.
 The test tube has an unstable equilibrium.
 The cylinder has a stable equilibrium.
 The filter funnel has an unstable equilibrium.
 The conical flask has a stable equilibrium. It has a wide base.

Chapter 11 Microbes and disease

1. State whether the following statements are True or False.
- i. False ii. True iii. True
 iv. False v. False

2. Choose the correct option.

- i. b ii. c iii. a iv. d
 v. b
3. Microbes that enter the body are attacked by **white** blood cells. These are the main part of a defence system called the **immune** system. Some white blood cells **eat** the microbes. Other blood cells make chemicals called **antibodies** which **kill** microbes. Your defence system has a 'memory'. Once you have had a disease you are usually **protected** from getting it again – you have **immunity** to the disease.
4. i. They are tiny organisms that can only be seen with the help of a microscope.
 ii. a. C b. A c. B
5. i.



- ii. 64 c)
 iii. 3 ½ hours
 iv. 32448
6. i. a. To make the dough rise.
 ii. The yeast is killed.
 iii. evaporating alcohol
 iv. Holes are made from the carbon dioxide which is produced by the anaerobic respiration of yeast.

7. i. a. Germs are coughed or sneezed into the air by a diseased person and are breathed in by a healthy person, who then catches the infection.
b. Heat kills germs.
c. Hands pick up germs when we touch things.
d. Bathing cleans the whole body especially parts that are otherwise not cleaned regularly like under arms, hair, etc.
e. Germs can get into the cut and cause an infection.
8. i. 12 years old
ii. a. A doctor b. Gloucestershire
iii. a. 1. smallpox 2. cowpox
b. smallpox
iv. He noticed that milkmaids never seemed to catch smallpox, although they did catch cowpox from the cows they milked.
v. He had become immune to smallpox because he had been given cowpox.

Chapter 12 Environmental chemistry

1. State whether the following statements are True or False.

- i. False ii. False iii. False
iv. True v. True

2. Choose the correct option.

- i. c ii. c iii. a
iv. d v. b
3. i. a. decaying animal and plant material in the soil
b. It helps to keep the soil in good condition in different ways, including breaking it down to provide useful minerals which plants use for healthy growth.
ii. Plant roots need air to breathe. In a water-logged soil there is no air so plant roots die.
iii. a. Mass of water lost:
 $155.7 \text{ g} - 132.5 \text{ g} = 23.29 \text{ g}$
b. Mass of humus lost:
 $132.5 \text{ g} - 128.6 \text{ g} = 3.9 \text{ g}$
4. i. rain, wind, and frost
ii. Soils have different colours because they contain different types of minerals in them.
iii. a. Y b. X c. Z
d. Z
5. i. a. carbon dioxide
b. sulphur dioxide
ii. Carbon dioxide dissolved in rain water makes carbonic acid.
Sulphur dioxide dissolved in rain water makes sulphuric acid.
iii. Sulphuric acid
iv. a. When acid rain falls on plants it destroys their leaves and kills them.
b. The acid in rain reacts with marble or limestone of buildings and brings about their erosion.
v. We should stop burning fossil fuels and find alternative energy sources.
6. i. Acids in the soil can make the soil more acidic. The pH will be reduced.
ii. 1. carrots
2. potatoes
iii. 1. yams
2. mushrooms
iv. onions and yams
v. onions, beans, mushrooms.
7. i. It has increased.
ii. a. Sea levels will rise causing flooding in the low-lying areas.
b. Due to global warming, the polar ice caps will melt causing ocean levels to rise.
iii. 1. severe droughts
2. frequent storms and floods
8. i. Many people do not really think climate change is a problem. They still want to drive around in big cars, run lots of electrical appliances and fly around the world on holidays.
ii. Fossil fuels keep the economy of a country going. Factories, transport systems, and power stations all rely on a steady supply of fuel.
iii. a. China
b. It relies on fossil fuels to keep its economy going.
iv. 1. Cut down the use of big cars, aeroplanes, and lots of electrical appliances.
2. Find clean, renewable sources of energy as quickly as possible.

Answers (Worksheets)

Chapter 1

Worksheet 1-1

Task 1

- Work is done when a force is used to make something move.
- joule (or kilojoule)
- 1 joule of work is done when a mass of 1 N is moved over a distance of 1 m.
- work = force \times distance
donkey's work = $100 \text{ N} \times 2000 \text{ m}$
 $= 20,000 \text{ joules} = 200 \text{ kJ}$
- No work was done since the car did not move. (It is likely that the men are tired though!)

Task 2

- On rough surface more force is applied so more work will be done.
- $1 \text{ KJ} = 1000 \text{ J}$
 $1 \text{ MJ} = 1000,000 \text{ J}$
- Work done = force \times distance
 - $10 \times 10 = 100 \text{ N}$
 $100 \times 3 = 300 \text{ Nm}$
 - $30 \times 10 = 300 \text{ N}$
 $300 \times 4 \times 2 = 2400 \text{ Nm}$
 - $5 \times \frac{40}{100} = 2 \text{ Nm}$
 - $20 \times \frac{300}{100} = 60 \text{ Nm}$
 - Potential energy to kinetic energy

WORKSHEET 1-2

Task 1

Potential energy	Kinetic energy
gravitational potential energy	mechanical energy
elastic potential energy	radiated energy (including light)
chemical potential energy	sound energy
nuclear potential energy	thermal energy
	electrical energy

NB The Student Book describes five kinds of kinetic energy. The first type described on page 7 is mechanical energy.

releasing a rubber band	P
atomic bomb	N
barbecue	T
dolphin	K
extension cord	EK
hair dryer	EK
playing a guitar	S
producing electricity	EK
skateboard	P
battery	C
bell	S
coal	C
lighted match	C
merry-go-round	K
moon	K
ski jumper about to start	P
Sun	N, K
tea	T
batsman	K
petrol	C
tree	P

K = kinetic; P = potential; G = gravitational;
 Ep = elastic; C = chemical; N = nuclear;
 M = mechanical; R = radiated; S = sound;
 T = thermal; Ek = electrical

- d. One could consider some of these in different ways: a cricket ball in the air has both mechanical energy and potential gravitational energy, and a swimming dolphin has mechanical energy but when it makes a sound, it releases sound energy. In particular, the one about 'producing electricity' is open to interpretation as the method is not specified. Electricity can be produced by burning (fossil) fuels, by nuclear reactions, hydropower, solar power, wind energy, etc. It is fine if students have different ideas. Any answer that is properly explained and makes sense at their level of knowledge should be accepted.
2. i. a burning candle : heat and light energy
 - ii. a stretched string is released : potential energy is converted into kinetic energy
 - iii. a car running on petrol : chemical energy is changed into kinetic energy

Task 2

Objects	Parts	Energy
i. power station	coal burning	Chemical
	steam turning turbine	Kinetic
	generator	Electrical
ii. aeroplane	propeller	Kinetic
	fuel	Chemical
	engine	Heat
	whole plane	Kinetic
iii. TV when switched on	wiring	Electrical
	speaker	Sound
iv. pendulum swinging to and fro		Kinetic

Worksheet 1-3

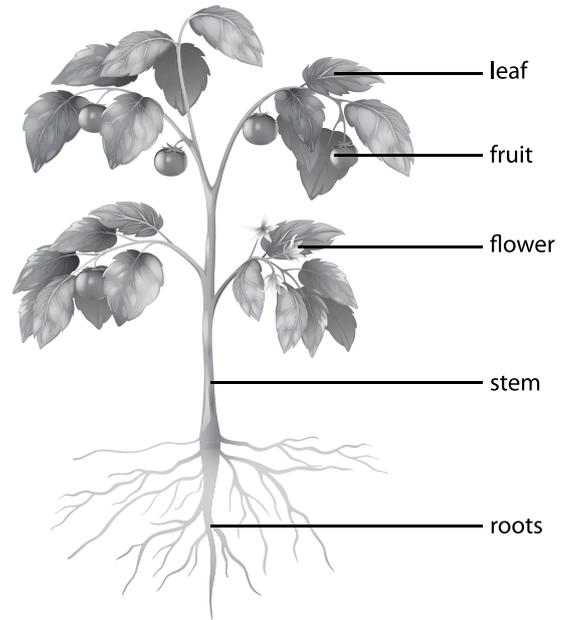
1. i. Electrical into kinetic energy
- ii. Nuclear into sound and heat
- iii. Electrical into kinetic energy
- iv. Electrical into kinetic energy
- v. Kinetic energy into sound
2. In LED 99 J of light energy are produced only 1 J is wasted as heat energy.
3. turn off unnecessary lights, use energy savers, use bicycles for short distances, pool cars, insulate roofs, turn heaters and AC off when not in use etc.

Chapter 2

Worksheet 2-1

Task 1

1. Students might be able to draw a picture like this:

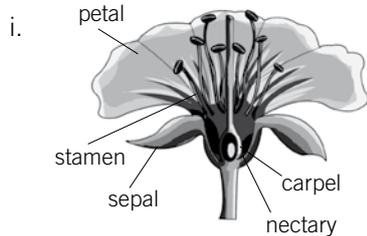


2.

part of the plant	function
roots	anchoring the plant; water uptake
stem	transporting water and minerals (from root to leaves) and sugars (from leaves to root)
leaves	photosynthesis (or making food)

part of the plant	function
flower	attracting insects; producing gametes/reproduction
fruit (with seeds)	fruits are for seed dispersal; seeds are the final stage of reproduction, germinate into new plant

Task 2



- ii. Answers will depend on which flowers are used. For the pictures, answers could include the following:
- petals : different number per flower, different shapes (and colours); the petals of the fuchsia plant are fused to make a tube.
 - stamen : different numbers and shapes; some are deep in the flower (like the tulip) some sticking out (like the fuchsia)
 - carpel : single or multiple (buttercup), stigma is placed above or below the stamen, deep in the flower or sticking out.

Task 3

- To attract insects.
- Stamen
- Ovules

WORKSHEET 2-2

- Self-pollination
 - This is an example of insect pollinated flowers because flowers are colourful to attract insects and are scented.
- Wind
 - Insects
 - Insects
 - Wind
 - Animals
 - Insects
 - Animals
 - Wind
 - Wind
 - Insects

WORKSHEET 2-3

- Refer to Student Book page 16.

WORKSHEET 2-4

- No, only one of the “halves” has a small structure attached.
- The structure is the embryo and each of the two halves is a food store
- The sweet corn cannot be divided into two halves but it also has an embryo and stored food.

WORKSHEET 2-5

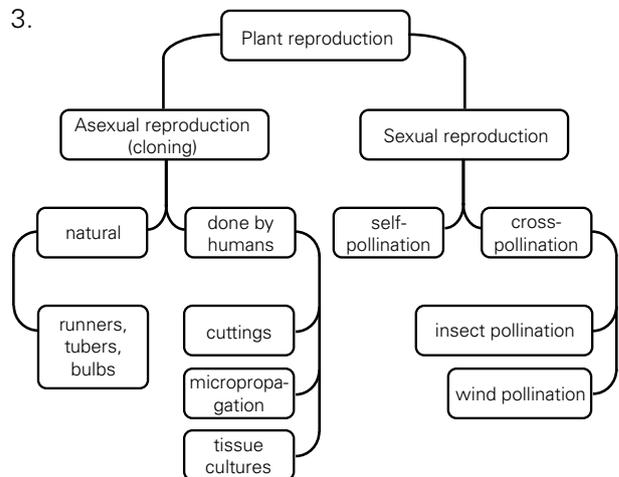
- seed dispersal: scatter the seeds into new areas so that the new plants will not be overcrowded
 - germination: the beginning of the growth of a new plant from a seed, after a period of dormancy
- Pollination by insect: insects (e.g. bees) go into flowers to find nectar and are covered with pollen. When they visit the next flower, some of this pollen is transferred.

Pollination by wind: pollen is carried by the wind from one flower to another.

ii.

pollen transported by insects	pollen transported by wind
larger and heavier	smaller and lighter
rough surface to “stick” to insects	smooth surface
relatively fewer than pollen transported by wind	many more than pollen transported by insects

3.



Chapter 3

Worksheet 3-1

Task 1

metals	non-metals
<i>ductile</i>	<i>brittle</i>
<i>good conductors of electricity</i>	<i>poor conductors of electricity</i>
<i>good conductors of heat</i>	<i>poor conductors of heat</i>
<i>high density</i>	<i>low density</i>
<i>high melting and boiling points</i>	<i>low melting and boiling points</i>
<i>malleable</i>	<i>brittle</i>
<i>shiny when polished</i>	<i>dull looking</i>
<i>sonorous</i>	<i>dull sound when hit with hammer</i>
<i>strong</i>	<i>brittle</i>

Task 2

Answers will vary but they should include the following information.

- Metals are strong because the particles are close together and do not separate easily. But metals are ductile and malleable because the particles slide over each other easily. So it is hard to make a hole in a metal but not so hard to change its shape.
- The particles in metals are positive ions with a 'sea' of electrons which can freely move between the particles. These electrons can move in one direction and conduct electricity in this way, but they also carry thermal energy, conducting heat.

Task 3

- malleable: property of a metal or any other material to be able to be hammered or pressed into shape without breaking or cracking.
 - Ductile: property of a metal to be able to be drawn out into a thin wire.
- a metal made by combining two or more metallic elements
- monel: nickel and copper
bronze: copper and tin
steel: iron and chromium
- Although graphite is a non-metal but it conducts electricity unlike other non-metals.

Worksheet 3-2

Task 1

P	Na	Ca	Mg	Al	Zn	Fe	Sn	Pb	Cu	Ag	Au	Pt
---	----	----	----	----	----	----	----	----	----	----	----	----

Task 2

- Answers depend on the experiment performed.
- Magnesium, zinc, iron and copper
- Aluminium is sometimes surrounded by a layer of oxide which protects it.
- It rusts
- Iron oxide
- Magnesium, zinc and iron

Worksheet 3-3

Task 1

In the end, the more reactive metal will be in solution. If you started with the more reactive metal already as a salt in the solution, nothing will happen. But if the metal in solution was the less reactive metal, then it will be displaced by the more reactive metal. This causes the less reactive metal to deposit (on the piece of more reactive metal).

Task 2

	magnesium nitrate	zinc nitrate	lead nitrate	copper nitrate
magnesium	S	Y	Y	Y
zinc	N	S	Y	Y
lead	N	N	S	Y
copper	N	N	N	S

- The metal and the metal of the salt (in solution) are the same so nothing will happen.
- You will see a different metal covering the metal that was added to the solution.

Worksheet 3-4

- electrolysis
- heating ore mixed with carbon
- No, because Aluminium is above Carbon in the reactivity series, Carbon cannot replace Aluminium.

Chapter 4

Worksheet 4-1

Task 1

- The sign indicates that the maximum speed at any time should be no more than 50 or 30. The units depend on the system of the country and they are km/h or miles per hour (mph).
- 50 km iii. 25 km iv. 100 km
- speed = $\frac{\text{distance}}{\text{time}}$.
To answer the questions above, you needed to work out that
distance = speed * time.
- speed = $\frac{\text{distance}}{\text{time}}$
distance = speed × time
time = $\frac{\text{distance}}{\text{speed}}$

Task 2

- speed = $\frac{\text{distance}}{\text{time}}$
distance travelled = $5 \times 800 = 4000\text{m}$
time taken = $30 \times 60 = 900\text{ sec}$
speed = $\frac{4000}{900} = 4.44\text{ m/s}$
- average speed = $\frac{\text{total distance travelled}}{\text{total time taken}}$
average speed of Ali = $\frac{5000}{0.25} \left(\frac{15}{60} = 0.25\right)$
= 20,000 miles/s
average speed of Sara = $\frac{15000}{0.75} \left(\frac{45}{60} = 0.75\right)$
= 20,000 miles/s
Both have same average speed.
- 1 km = 1000 m so
 $\frac{8 \times 1000}{3600} = \frac{8000}{3600} = 2.222\text{ m/s}$
- $\frac{100\text{m}}{20\text{ sec}} = 5\text{ m/s}$
 - time interval 0- 10 sec
 - to reduce air resistance

Worksheet 4-2

Task 1

- The object will remain at rest or continue to move at the same speed in the same direction.
- 100 km/h = 100000 m/h
1h = 60 minutes = $60 \times 60\text{ seconds}$
= 3600 seconds
100000 m/h = 100000 m in 3600 seconds
= $\frac{100000}{3600}\text{ m/s} = 27.8\text{ m/s}$

The car went from 0 km/h to 100 km/h which is the same as from 0 m/s to 27.8 m/s.

So it accelerated 27.8 m/s in 2.5 s.

To calculate the acceleration per second, we divide 27.8 by 2.5 but we must do the same with the units.

$$\frac{27.8\text{ m/s}}{2.5\text{ s}} = 11.12\text{ m/s}^2.$$

- Some 2017 models of the McLaren 720S reach 148.2 mph in 9.9 seconds.
1 mile is 1609 m
148.2 miles = $148.2 \times 1609 = 238454\text{ m}$
148.2 miles per hour = 238454 m in 3,600 s
= 66.2 m/s

So the McLaren went from 0 m/s to 66.2 m/s in 9.9 seconds

To calculate the acceleration per second, we divide 66.2 by 9.9 but we must do the same with the units.

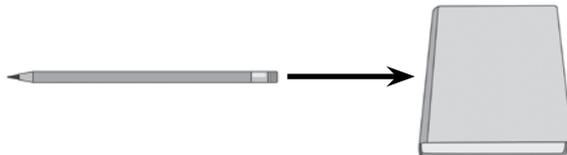
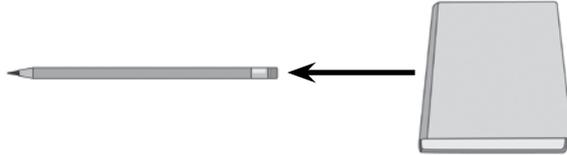
$$\frac{66.2\text{ m/s}}{9.9\text{ s}} = 6.7\text{ m/s}^2.$$

Task 2

- speed = $\frac{\text{distance}}{\text{time}}$
- Acceleration = $\frac{\text{change in speed}}{\text{time taken}}$

Worksheet 4-3

Task 1

- The book will move in the direction that the pencil pushes.
- 
- The resistance of the book on the table.
- The resistance of the book on the table is greater than the force pushing it.
- 

Task 2

- Yes, the force of gravity and the reaction force of the table.
- Yes, because if they were not, the book would move.

Chapter 5

WORKSHEET 5-1

Task 1

- i. Algae → mollusk → human
- ii. Algae → sandworm → fish → bird
- iii. Food chain is one single chain and when many chains are interlinked they make food web.
- iv. Mollusk, sandworm, arthropod
- v. Secondary: fish , tertiary: bird

Task 2

- i. To show a decrease in energy from one organism to another.
- ii. Animals who eat plants are herbivore (caterpillar). Animals who eat other animals are carnivores (bird). Animals who eat both plants and animals omnivore (human).
- iii. Because energy is lost to the surrounding or when the organism is functioning.
- iv.
 - a. grass → cow → human
 - b. plants → worms → insects → chicken → human
 - c. 1 kg of cow needs 10 kg of grass.
1 kg of chicken needs 10 kg of insects, which needs 100 kg of worms, which needs 1000 kg of plants.
 - d. Just 1 kg of plant material.
 - e. The longer the food chain, the more plant material is needed to support it. So if we ate the plants instead of feeding them to the animals, there would be more food for people.

WORKSHEET 5-2

- i. Height, leaves, roots
- ii. Phosphorus (helps to make roots), magnesium (helps to make chlorophyll), potassium (helps to make flowers)
- iii. Due to lack of magnesium
- iv. Due to lack of potassium
- v. Due to lack of nitrogen which helps to make protein

WORKSHEET 5-3

1. Green houses give protection from wind, rain and also pests such as insects and birds. The also prevent cross pollination in plants. Extra heat and light can be provided to grow plants well.
2. **Advantages:** carbon dioxide, water, light, temperature can be controlled easily. Give protection from wind, rain & pest.

Disadvantages: they are expensive to make if a disease occurs they all are effected.

3. Greenhouses made by using polythene sheet stretched over metal frames are called polytunnels.
4. Herbicides, fungicides and insecticides are all pesticides.
5. Pesticides are useful because they kill pests. They are harmful because pesticides cause pollution and seriously affect food chain.
6. DDT is not biodegradable. It does not break down and keeps on accumulating from one organism to another. Animals at the end of food chain have high concentration of DDT.

WORKSHEET 5-4

Task 1

1. a 2. c 3. c 4. b 5. d

Task 2

Recycling in an ecosystem

1. PRODUCERS green plants
2. CONSUMERS animals
3. DECOMPOSERS bacteria and fungi

The carbon cycle

1. GREEN PLANTS Build CO₂ into organic compounds and produce oxygen by photosynthesis.
2. ANIMALS convert plant material into animal tissue
3. PREHISTORIC PLANTS Form deposits of coal, petroleum, and natural gas.
4. ATMOSPHERIC CARBON DIOXIDE

The nitrogen cycle

1. absorption 2. eaten 3. death
4. excretion 5. defecation and death
6. decay

Chapter 6

Worksheet 6-1

Task 1

- i. Black portion is water and white is land.
- ii. About 70% of the Earth' surface is water.
- iii. Earth is sometimes called the blue planet because all this water gives it that colour.

Task 2

- i. evaporation and the treatment of water before and after we use it
- ii. The Sun provides the energy for evaporation. The energy for treatment could come from fossil fuel, from hydro-electricity, from wind energy, from bio-fuel, or from nuclear power.

- iii. The steep slope. On the gentle slope, the water runs more slowly so has more time to seep into the soil.

Task 3

- i. domestic, recreational, agriculture, cooling machines, hydro=electricity.
- ii. Hydro=electricity because it only uses the energy of the water.

Task 4

1. **plants:** minerals are dissolved in water to be absorbed by roots. Plants use it as raw material to make food during photosynthesis.

Animals: most of chemical reactions take place in solution form in body. Water transports digested food and waste products of body.

2.
 - i. H_2O
 - ii. water is a compound because it can only be broken down by chemical means. H and O are always taken in a fixed ratio to form water i.e., 2:1.
3. ice, steam

Worksheet 6-2

Task 1

- i. sedimentation, filtration, chlorination
- ii. Because water does not run through the water storage tank all the time, it is possible that bacteria and /or algae grow in it. Drinking this water could have a negative effect on your health. (Leave a plastic bottle containing tap water in the sun for a few days and you will see some growth of micro-organisms.)

Task 2

- i. urban areas and farm land
- ii. organic and detritus; dissolved minerals
- iii. urban: oil, solvents, heavy metals; farmland: sand and clay; fertiliser; pesticides

Task 3

- i. Fertilizers cause rapid growth of algae and lower oxygen level in water. Pesticides poison aquatic life or animals.
- ii. Diarrhoea, cholera and typhoid are the diseases caused by untreated sewage.
- iii. Animals can get injured due to being entangled in litter or suffer from swallowing plastic or Styrofoam.

Worksheet 6-3

Task 1

- i. filtering, sedimentation, digestion, filtering
- ii. Filtering. The first time, a metal grid removes large items. The second time, micro-organisms attached to stones remove any remaining (organic) waste.
- iii. They become stuck to the metal grid which then needs to be cleaned. (This means people in protective suits and masks have to go in and remove these items from the grid. This is a nasty job and totally unnecessary if people dispose of these items properly, i.e. with the household rubbish.)

Task 2

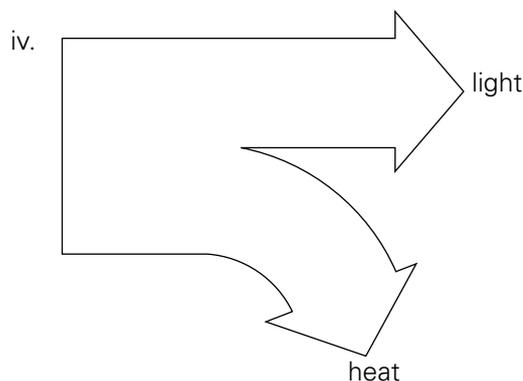
Both processes include filtering and sedimentation. The main difference is that drinking water is chlorinated (although not in all countries) while sewage goes through a process where bacteria digest the organic components of the waste.

Chapter 7

Worksheet 7-1

Task 1

1. No, a pie chart or a bar chart would be better.
2.
 - i. 90 % is wasted as heat energy
 - ii. Only 10% is made use of as useful light energy.
 - iii. With energy savers 99 J of energy is made use of only 1 J is wasted as heat energy.



Worksheet 7-2

Task 1

Voltmeters should be in parallel to the lamp (or other device), ammeters in series.

Task 2

1.

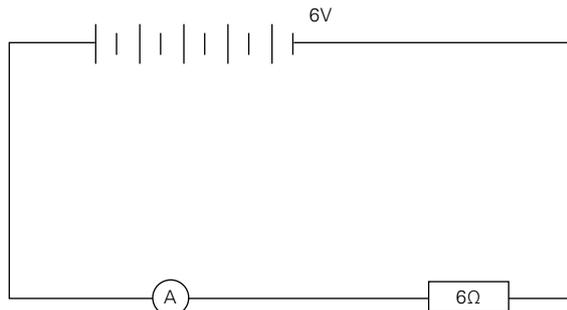
Components	Symbols	Definitions	Formulas
1. voltage	V	Push of electric current round a circuit	$V = R \times I$
2. current	I	Flow of electron	$I = V/R$
3. resistance	Ω	Opposition to flow of current	$R = V/I$
4. resistors		Something which resists the flow of electricity	
5. power	P	Rate at which electrical energy is transformed into another type of energy	$P = I \times V$
6. energy	E	Ability of a body to do work	$E = \text{Power} \times \text{time}$

2. A. battery B. switch C. bulb
 D. voltmeter E. variable resistor

3. A. $\frac{2V}{6V}$ B. $\frac{2V}{6V}$ C. $\frac{2V}{6V}$
 D. $\frac{6V}{6V}$ E. $\frac{6V}{6V}$ F. $\frac{6V}{6V}$

4. In series circuit voltage across the cells is the same as the total voltage across the components. In parallel circuit voltage is the same across each individual component in the circuit. In series circuit current is the same at all points. In parallel circuit current is divided.

5.



$I = V/R$
 $I = 6v/6\Omega = 1 \text{ Amp}$

Worksheet 7-3

Task 1

- i. The switch will show 'OFF'.
 ii. The metal in the centre has melted and the two sides are no longer connected.

- iii. When the current going through the circuit breaker or fuse exceeds the maximum value allowed. This could be caused by a short circuit in a piece of equipment and/or too many devices drawing current from the same circuit.

Task 2

1. i. wind, water (in rivers or tidal power), fossil fuel (coal, oil, gas), wood, bio-fuel (e.g. bio-ethanol), organic waste, nuclear power
 ii. renewable: wind, water, wood, bio-fuel, waste
2. i. chemical
 ii. kinetic, electrical
 iii. electrical
 iv. heat, friction
3. Gravitational potential, kinetic, electrical
4. Energy can neither be created nor destroyed. It can only change from one form to another.
5. i. Energy in kwh = power (in kilowatts) x time (in hours)
 $1000 \text{ watt} = 1 \text{ kw}$
 $= 1 \text{ kw} \times 2 \text{ hr}$
 $= 2 \text{ kwh daily}$
 For 30 days = $2 \times 30 = 60 \text{ kwh}$
 If each unit costs Rs 6 per kwh
 $60 \times 6 = \text{Rs } 360$
- ii. Hair dryer
 Converting 10 minutes into hours
 $10/60 = 0.16 \text{ hrs}$
 Energy = $\text{kw} \times \text{h}$
 $= 1 \times 0.16 = 0.16 \text{ kwh}$
 For 30 days:
 $0.16 \times 30 = 4.8 \text{ kwh}$
 Cost = $4.8 \times 6 = \text{Rs } 28.8$
- iii. $800/1000 = 0.8 \text{ kw}$
 $45/60 = 0.75 \text{ hrs}$
 Energy = $0.8 \text{ kw} \times 0.75 \text{ hrs} = 0.6 \text{ kwh}$
 For 30 days:
 $0.6 \times 30 = 18 \text{ kwh}$
 Cost = $18 \times 6 = \text{Rs } 108$
- iv. $1500/1000 = 1.5 \text{ kw}$
 Energy = $1.5 \text{ kw} \times 1.5 \text{ hr} = 2.25 \text{ kwh}$
 For 30 days
 $2.25 \times 30 = 67.5$
 Cost : $67.5 \times 6 = \text{Rs } 405$

Chapter 8

Worksheet 8-1

Task 1

- The difference between the size of the pupil at its smallest and at its largest is much bigger in cats than in humans. This means cats can enlarge their pupil more. The larger the pupil, the more light it will be able to catch. This is the reason why cats can still see when it seems to be pitch dark.
- The size of the pupil is controlled by reflexes and is not under voluntary control.

Task 2

- | | |
|-----------------------|-------------------|
| i. brain, spinal cord | ii. neurons |
| iii. impulses | iv. sensory |
| v. motor | vi. sciatic nerve |
| vii. hormones | viii. hormones |
| ix. endocrine | x. target |

Worksheet 8-2

Task 1

- Hormones are chemical messengers produced in special glands called endocrine glands.
- They travel via the blood.

Task 2

- Both systems send out messages which coordinate the actions of other parts of the body.
 - Both systems use chemical messages: the nervous system uses neuro-transmitters and the endocrine system uses hormones.
 - Each affects the other system.
-

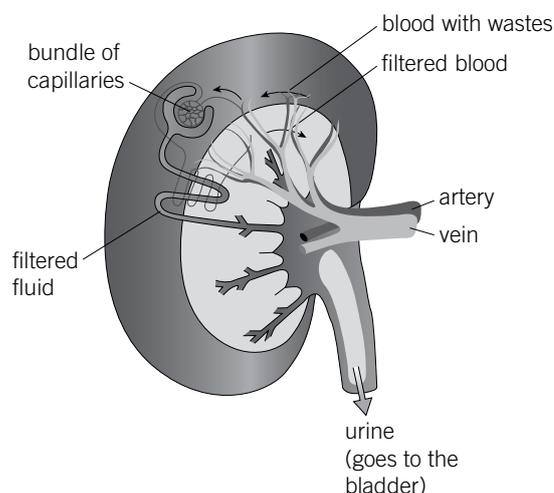
	nervous system	endocrine system
Which cells are involved?	sense receptor	gland
What is the nature of the message?	electrical impulses	chemical (hormones)
How are the messages carried?	by nerve cells	by the blood
Where do the messages reach?	specific cells	all cells
What responds to the messages?	effector (muscle or gland)	target organ (with the right receptors)

How fast is the system?	fast	usually slower
How widespread is the effect of the message?	specific target	usually wider spread across more than one organ
How long is the effect of the message?	short duration	long duration
Voluntary or involuntary?	voluntary and involuntary	always involuntary

Worksheet 8-3

- It makes adrenalin which prepares the body for fighting or running away.
 - It makes hormones which control other glands.
 - They make a hormone that controls chemical reactions in the body.
 - Makes insulin for the control of blood sugar. producing enzymes for digesting food.

2.



- Excretion is the removal of waste products of chemical reactions, excess water, and salts taken in with food from the body.
- Carries oxygenated blood from heart to kidney
 - Renal vein carries deoxygenated blood back from kidney to heart
 - Kidneys are like filters that clean the blood.

Chapter 9

Worksheet 9-1

- A salt is any compound formed by neutralizing an acid with an alkali.

Any compound made from the reaction between a metal and an acid is a salt.

- ii. Salts are made by:
- By neutralizing an acid with alkali.
 - Reaction between acid and metal.

iii.

Salts may have different colours.	true
Most salts (but not all) are soluble in water.	true
Not all salts have a salty taste. (but NEVER taste anything in the lab.)	true
Most salts have a high melting point.	true
Some salt crystals have water in them.	true
Most salts are solids at room temperature.	true
Solid salts do not conduct electricity, but liquid salts and salt solutions are good conductors.	true

- iv. a. copper chloride
b. potassium sulfate
c. calcium nitrate
d. magnesium chloride

Worksheet 9-2

Task 1

- i. acid + alkali → salt + water
acid + metal → metal salt + hydrogen
acid + metal carbonate → metal salt + carbon dioxide + water
acid + metal oxide → metal salt + water

- ii. Test for hydrogen: hold a glowing splint near the top of the test tube. If hydrogen is present, then you will hear a "pop" sound.

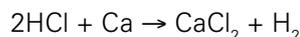
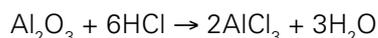
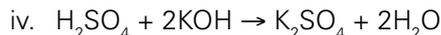
Test for carbon dioxide: bubble the gas through lime water. If carbon dioxide is present, then the lime water will turn cloudy.

- iii. zinc oxide + hydrochloric acid → zinc chloride + water

sodium carbonate + hydrochloric acid → sodium chloride + carbon dioxide + water

magnesium + sulfuric acid → magnesium sulfate + hydrogen

hydrogen bromide + potassium hydroxide → potassium bromide + water



Task 2

- Bubbles are produced. Chemical reaction takes place.
 - zinc + sulphuric acid → zinc sulphate
 - Bring a lighted splint near the gas it explodes with a pop sound.
- Carbon dioxide
 - By passing the gas through lime water which turns milky.
- Yes
 - Salts, carbon dioxide, and water
 - Lead carbonate + nitric acid → lead nitrate + carbon dioxide + water

WORKSHEET 9-3

- Answer depends on experiment conducted
- When acid neutralizes the alkali indicator changes colour. This is called end point.
- salt and water
- sodium hydroxide + hydrochloric acid → sodium chloride + water
- Used to find out the concentration of solutions in laboratories.

Chapter 10

Worksheet 10-1

Task 1

- i. Lady: assume 75% of the lady's weight is on the ball of her feet (because of the heels).
That leaves 25% of 100 kg = 25 kg on two heels of 1 cm² each.
force per heel: 25/2 kg = 12.5 kg = 125 N
area per heel : 1 cm² = 1/10,000 = 0.0001 m².
pressure = 125 N/0.0001 m² = 1,250,000 N/m²

Elephant:

mass of 5,000 kg so a force of 50,000 N on four feet.

that is 50,000/4 = 12,500 N per foot

Each foot is 0.18 m².

So pressure = 12,500 N/0.18 m² = 69,444 N/m²

- ii. The lady would cause small but deeper “dents” into the soft floor than the elephant.
- iii. When the lady walks, when she puts one foot down, for a short time, all of her weight will be only on the heel of one of her shoes. So the pressure would become $1000 \text{ N}/0.0001 \text{ m}^2 = 10,000,000 \text{ N}$.

A walking elephant will always have at least two feet on the ground so the most weight one foot will carry will be 25,000 N. This means the pressure will be $25,000 \text{ N}/0.18 \text{ m}^2 = 13,889 \text{ N/m}^2$. So if one considers the pressure when walking, the lady would be even less welcome. In the case of the elephant, when considering walking, the pressure also is greater than when only thinking of the elephant standing still but the difference is less.

However, one could ask the lady to take off her shoes but it might be difficult to get the elephant through the door!

Task 2

1. A sharp needle would require less force so would hurt less.
2. i. Side ‘A’ because larger the area smaller the pressure.
ii. ‘C’ because it has smaller area so it will exert more pressure.
3. i. D is pointed so it has very small area it will exert more pressure.
ii. Shape ‘A’ because it has larger surface area so it will exert least pressure.
4. Pressure = force/area
= $5000\text{N}/0.002 \times 4$
= 625000 N/m^2
5. The sharp axe would be having least area so it will exert more pressure.

Worksheet 10-2

Task 1

1. i. – v. Answers will vary but it should be clear that the more coins on one side, the closer they need to be to the pivot.

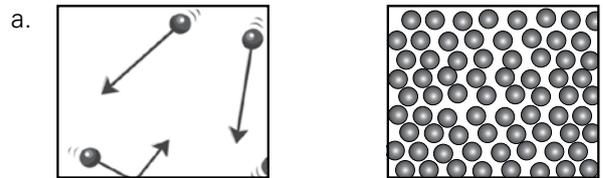
Extension

If you want you can ask (some of) your students to calculate the moment of the coins on each side of the pivot. If the ruler is balanced, these moments should be equal.

2. Moment of force = force x distance
= 50×2
= 100 Nm

Worksheet 10-4

Task 1



- b. When you put pressure on a gas, it is squashed/compressed because the particles are pushed closer together. This is possible because there are large empty spaces between them. The particles in a liquid are already close together so they cannot be compressed. Putting pressure on a liquid will distribute the pressure over all sides but the liquid will not be compressed.

Task 2

1. The brakes would not work because air is compressed and cannot transfer forces. Liquids cannot easily be compressed therefore can transfer forces.
2. Area of smaller piston is $1 \text{ cm}^2 = 1/100 \times 100 = 0.0001 \text{ m}^2$
Force of smaller piston = 5N
Pressure of smaller piston = $5\text{N}/0.0001\text{m}^2 = 50,000 \text{ N/m}^2$
Pressure in the larger piston will be the same
Area of larger piston is $5 \text{ cm}^2 = 5/100 \times 100 = 0.0005\text{m}^2$
Force of large piston = $P \times A$
= $50,000 \times 0.0005$
= 25 N
3. As particles in air are far away it can be compressed however water cannot be compressed.
4. When the temperature rises during summers the particles of gas move faster and exert more pressure.
5. i. The greater the weight, greater is the pressure. Air pressure at this depth is greater than the air pressure.
ii. Density, dense liquids have a greater weight.
6. Molecules of water in the lakes are nearer to each other than the molecules of air in balloon which are far from each other.

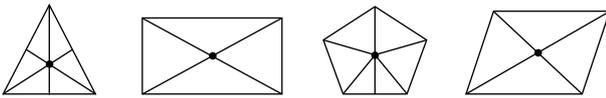
Worksheet 10-5

Task 1

- i. and ii. Answers will vary but the distance under ii. should be smaller than under i.
- iii. Adding some (relatively heavy) objects to the cup will shift its centre of gravity down. The cup will tip when its centre of gravity no longer lies above its base. With the centre of gravity further down, the cup can tilt further before the centre of gravity is outside the base.

Task 2

1.



- 2. Back teeth exert more pressure than the front teeth, as they are pointed.
- 3. i. Long rod on one side of the barrier is balanced by the weight placed on smaller rod side.
- ii. To prevent the foot rotating sideways and ankle being twisted the tail is counter balanced.
- 4. To lower the centre of gravity and make it stable as it helps to turn the car in speed.
- 5. B is more stable because its base is widest and centre of gravity is lowest.
- 6. D because object is stable as it has wide base and low centre of gravity.

Chapter 11

Worksheet 11-1

Task 1

<i>type of microbe</i>	<i>method of reproduction</i>
bacteria	Bacteria reproduce by dividing into two.
viruses	They can only reproduce inside other living cells. They take over a cell and make it produce more viruses.
fungi	They reproduce by growing 'buds' on the side. When the buds are big enough, they drop off.

Task 2

<i>Time from start</i>	<i>Number of bacteria</i>
0 minutes	1
20 min	2
40 min	4
1 h	8
1 h 20 min	16
1 h 40 min	32
2 h	64
2 h 20 min	128
2 h 40 min	256
3 h	512
3 h 20 min	1,024

<i>Time from start</i>	<i>Number of bacteria</i>
3 h 40 min	2,048
4 h	4,096
4 h 20 min	8,192
4 h 40 min	16,384
5 h	32,768
5 h 20 min	65,536
5 h 40 min	131,072
6 h	262,144
6 h 20 min	524,288
6 h 40 min	1,048,576
7 h	2,097,152

- i. 2,097,152 – 2 million 97 thousand one hundred and fifty two.
- ii. 4
- iii. 1,048,576 – one million 48 thousand five hundred and seventy six
- iv. 1 → 1,000 takes 3 h 20 min; 1,000 → 2,000 takes 20 min
- v. 128
- vi. 64 (at two hours, just before washing them)

Task 3

- i. Decompose organic material, e.g. in sewage and compost
Change milk curds into cheese
Change milk into yoghurt
Cause dough to rise
- ii. cheese and yoghurt : bacteria; baking : yeast.
- iii. they stay around and usually end up in landfills or the oceans.

Worksheet 11-2

Task 1

Name of the disease	type of microbe causing it	description of symptoms and consequences	is there a vaccine?
athletes foot	fungus	raw skin, peeling, blisters	no
chicken pox	virus	itchy rash with blisters	yes
cold	virus	runny nose, coughing, sneezing, mild fever	(1)
flu	virus	fever, coughing, sore throat, headache, fatigue	(1) (2)
food poisoning	bacteria	nausea, vomiting, diarrhoea, abdominal pain	(1)
German measles (Rubella)	virus	rash, fever, swollen lymph nodes if pregnant women get it, baby may have serious problems	yes
measles	virus	rash, fever, sore throat	yes
mumps	virus	fever, headache, muscle pain, swelling of some salivary glands. in older males, it could cause sterility	yes
pneumonia	usually bacteria	fever, cough, difficulty breathing	yes, for bacteria
polio	virus	muscle weakness, inability to move, may be permanent	yes
ring worm	fungus	red patches on skin	no
small pox	virus	skin rash with blisters, leaving scars	yes
tetanus	bacteria	severe muscle spasms, fever	yes
(oral) thrush	fungus	white lesions on tongue and cheeks	no
whooping cough	bacteria	runny nose, sore throat, intense coughing	yes

- Many different microbes can cause this disease so you would have to be vaccinated against each of them.
- Flu viruses also change rapidly so new ones come up every year.

Worksheet 11-3

Task 1

- Intact skin is an effective barrier against microbes.
- The wound bleeds and flushes out microbes.
- Next, the blood forms a clot to prevent microbes from getting in.
- All injuries should be treated by a doctor, even better at a hospital.

- Mild injuries can be treated at home.
- Mild injuries do not need treatment at all.
- Mild injuries should be rinsed with just water or water with a little salt.
- Mild injuries need to be treated with strong antiseptics.
- Dirt should be rinsed out or removed gently with sterile forceps.
- Any dirt in a wound is already there so should be left.
- Small scabs should be scratched off as often as possible.
- Small scabs should be left until they fall off by themselves.
- Scratching off scabs will give fewer scars.
- Serious wounds should be left to bleed.
- Very serious bleeding should be stopped by applying direct pressure, if possible with a clean cloth but if necessary with dirty hands to prevent extensive blood loss. Wounds where blood comes out in squirts always need urgent medical attention.
- Use common sense but when in doubt, see a doctor.

Task 2

- One type eats the microbes and the other type makes antibodies, specific to the microbes.
- The type that makes antibodies. When the right type of antibodies has been made to deal with the vaccine, they will protect you if the same bacteria or viruses should enter your body again.

Chapter 12

Worksheet 12-1

Task 1

Answers will differ depending on the soil samples provided.

Task 2

Answers will differ depending on the soil samples provided. Properties that could be considered might include:

- size of the grains
- colour
- smell
- amount of water
- other components (e.g. decaying plant material)

If you want, you can experiment with the samples. For example, students could check the time it takes for a certain amount of water to completely drain through a fixed amount of soil – i.e. how long does it take ml of water to filter through ... g of each type of soil. (Usually, the smaller the grains, the longer it will take.)

Task 3

1	Action of the Sun will warm and cool the rock, causing small cracks.
8	Eventually, the rock has become many small grains of sand or clay.
2	The cracks will fill with water.
7	The longer and further the rock and its pieces are carried, the smaller they will become.
5	The pieces of rock will roll down a slope and into a river.
6	The rock will be carried by the water, bump into other rocks and small pieces will wear off.
4	The rock will break and pieces will fall off.
3	The water will freeze in winter and make the crack larger.

Task 4

<i>component of soil</i>	<i>role in plant growth</i>
water	Plants need a constant supply of water, which they get through their roots.
air	Oxygen is needed by the roots of plants and by creatures that live in the soil.
humus	It helps to keep the soil in good condition in different ways, including breaking it down to provide useful minerals which plants use for healthy growth.
living organisms	Bacteria and fungi break down humus, producing useful minerals for healthy plant growth.

Worksheet 12-2

Task 1

- i. 300 particles of CO₂ per 1,000,000 particles of air.
- ii. 3 particles of CO₂ per 10,000 particles of air.
- iii. 400 particles of CO₂ per 1,000,000 particles of air.
- iv. 4 particles of CO₂ per 10,000 particles of air.
- v. 1 particle of CO₂ per 10,000 particles of air.
- vi. the increase was from 3 to 4. So an increase of 1 from the original number of 3 is $\frac{1}{3} \times 100\%$ is 33%.

Worksheet 12-3

Task 1

- i. Carbon dioxide dissolves in water, resulting in bicarbonate and hydrogen ions.
- ii. Sulphur oxide dissolves in water, resulting in sulphate and hydrogen ions. These “extra” hydrogen ions make the rain more acidic.
- iii.
 - a. it kills fish and birds which eat them
 - b. their leaves drop off and roots are damaged; this is likely to kill the plants
 - c. answers will vary but could include “No, only a small proportion of our food comes from fresh water lakes and the land around them” or “No, because acid rain is becoming less of a problem since strict laws reduce the emission of sulphur oxide in many countries”. If a student answers “yes” and has a sound explanation, please consider it correct.

Task 2

	ozone layer	smog	acid rain	greenhouse effect
Where is it?	high above Earth' surface	at the Earth surface	from clouds to the surface	above Earth' surface
What is the problem?	ozone levels reduced	its existence	rain is too acidic	too much greenhouse effect
What causes the problem?	CFCs break up ozone	sunlight on poisonous gases	extra sulphur oxide and nitrogen oxide in the air	extra carbon dioxide and methane in the air
What did humans do to cause the problem?	CFCs and other chemicals in aerosols and fridges	pollution from cars and burning stubble from crops	burning coal and other fossil fuels	using fossil fuel and cutting down forests
What damage does it cause?	damage to plants, (skin) cancer in humans	breathing problems and death for humans	kills aquatic life, trees, plants, damages statues and buildings	sea levels rise and flood coastal areas; more extreme weather, increase of insect borne diseases



Is there any improvement yet?	yes, since 2000 ozone levels are increasing but it will take a long time before they are at the right level again.	this problem is only in some cities at certain times; e.g. London has improved but some places got worse.	yes, due to strict laws on pollution	a lot of research into alternative sources of energy but little effect on CO ₂ levels so far.
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