LEARNING AREA **NATURAL SCIENCES**

GRADE 7

ENERGY TRANSFER AND FORCES

Unit 2

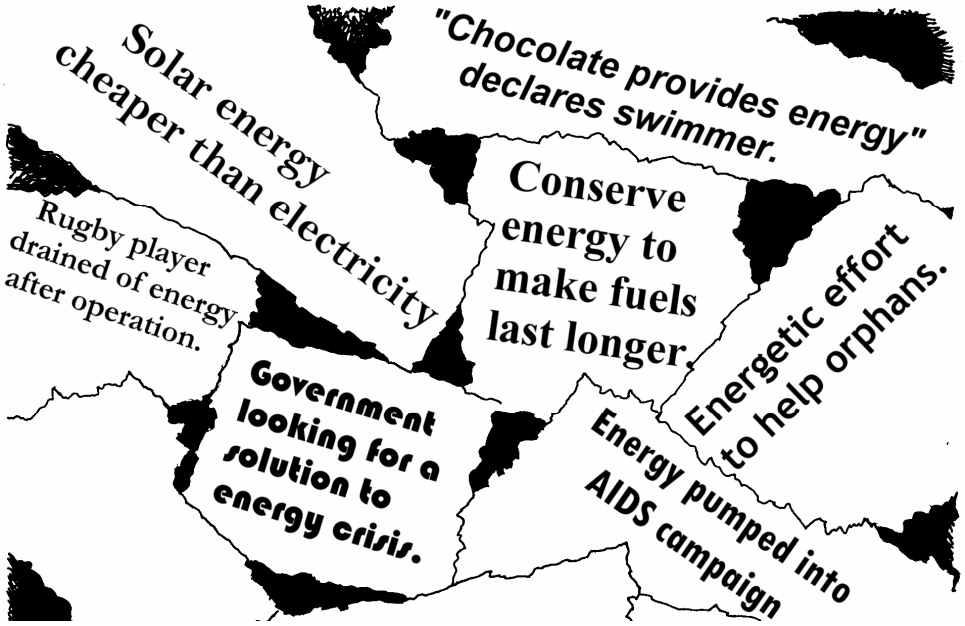
MODULE FRAMEWORK AND ASSESSMENT SHEET

LEARNING OUTCOMES (LOs)	ASSESSMENT STANDARDS (ASs)	FORMATIVE ASSESSMENT			SUMMATIVE ASSESSMENT	
		ASs *Pages*	*(mark out of 4)*	*LOs* *(ave out of 4)*	*Tasks or tests* *(%)*	*Ave for LO* *(% and mark out of 4)*
LO 1 **SCIENTIFIC INVESTIGATIONS** The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.	***We know this when the learner:***					
	1.2 conducts investigations and collects data: organises and uses apparatus/equipment or sources to gain and record information:	2, 13				
	1.2.1 tests two or more items and compares results;	3, 11				
	1.2.2 uses a specific procedure for observations;	37, 38, 39				
	1.3 evaluates data and communicates findings: generalises in terms of relevant aspects and describes how the data support the generalisation:	4, 13				
	1.3.1 points out evidence in support of findings.	25				
LO 2 **CONSTRUCTING SCIENCE KNOWLEDGE** The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.	***We know this when the learner:***					
	2.1 recalls meaningful information: the minimum requirement is an ability to recall definitions and complex facts:	1, 27				
	2.1.3 explains how magnetic forces affect different materials;	38				
	2.2 categorises information: compares features of different categories of objects, organisms and events;	11				

LEARNING OUTCOMES (LOS)	ASSESSMENT STANDARDS (ASS)	FORMATIVE ASSESSMENT ASs Pages	(mark out of 4)	LOs (ave out of 4)	SUMMATIVE ASSESSMENT Tasks or tests (%)	Ave for LO (% and mark out of 4)
	2.3 interprets information by identifying key ideas in text, finding patterns in recorded data, and making inferences from information in various forms (e.g. pictures, diagrams, text);	9, 15, 40				
	2.4 application of knowledge: applies knowledge appropriately by connecting the learnt concept to a variation of the known situation:	28, 42, 43, 44				
	2.4.1 identifies the forms of energy that are transferred.	15				
LO 3 **SCIENCE, SOCIETY AND THE ENVIRONMENT** The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.	***We know this when the learner:***					
	3.1 understands science as a human endeavour: compares different interpretations of events;	33				
	3.2 understands sustainable use of the earth's resources: analyses information related to renewable and non-renewable sources:	18, 22				
	3.2.3 prepares different means by which cooking can be achieved; uses different kinds of fuel and determines the cost of each fuel.	23				

LEARNING UNIT 1

1. WHAT IS ENERGY



Activity 1.1 | **TO UNDERSTAND THE USE OF THE TERM "ENERGY" IN A BROAD SENSE** | **LO 2.1**

Read the above newspaper headlines attentively. The word energy occurs in each one. Discuss the meaning of this word in your groups.

(a) Write your own definition for the word.

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.....

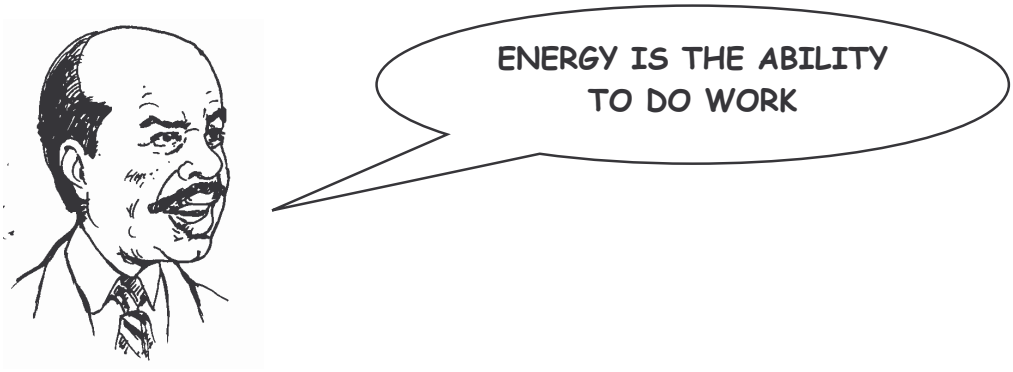
(b) Discuss three different meanings of the word as used in the headlines.

(i) .....

(ii) .....

(iii) .....

Well, it was not that easy to define the word, was it? When a scientist has to define something, he or she writes a brief, concise sentence that sums up the most important aspects of that thing. The following probably provides the best definition of energy:



From where do we get the energy to do our work or to practise sport?

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One of the newspaper headlines quotes a swimmer saying that chocolate provides energy.

Activity 1.2

TO COLLECT INFORMATION ON NUTRITIONAL VALUE IN FOODSTUFFS

LO 1.2

Collect some wrappers or packaging from foodstuffs. Study the information provided on these:

1. What is the unit of measurement for energy?.....

2. How many of these units should you take in daily?.....

3. Try to explain why someone who is on a hunger strike should not be selected to take part in a marathon.

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2. WHERE DOES ENERGY COME FROM?

We obtain almost all energy indirectly from the sun. The sun radiates heat and light and still retains enough nuclear power to continue shining for the next 5 000 million years.

A bus or a train uses **fuel** to transport passengers from one point to another in the same way that a person uses the sun as a source of energy.

Fuel is the substance in which energy is contained.

Activity 1.3

TO IDENTIFY THE SOURCES OF ENERGY OF COMMON ITEMS

LO 1.2

Think of some of the items in your homes and of any other things that are able to perform some kind of movement. Then do the following activity with a partner by trying to complete the list:

ITEM	SOURCE OF ENERGY
1. car	petrol/diesel
2. train	electricity/coal
3.	
4.	
5.	
6.	
7.	

3. FUELS

The plants and animals that existed millions of years ago absorbed the sun's energy while they were growing. They were buried under the layers of rock that eventually formed over them. Then their remains were gradually changed into oil, coal and various gases by means of chemical reactions. These fuels are known as **fossil fuels**. Oil, coal and gases are **non-renewable**, i.e. they cannot be replaced. In addition, they have to be mined from underground reserves and burning them damages our environment and our health. One non-renewable energy source that is not derived from fossils, is nuclear power. Some metals, like uranium, release enormous amounts of energy when they undergo nuclear fission. Nuclear power is utilised for manufacturing electricity, e.g. at the nuclear power station at Koeberg where electricity is generated for the use of the inhabitants of Cape Town. A small amount of nuclear power produces large amounts of nuclear fuel and causes very little environmental pollution. At present also large amounts of nuclear fuel are available. Nuclear power stations have to be built near the sea, because they need great amounts of water for cooling. This means that the energy sometimes has to be transported over long distances. Radioactive radiation can lead to health risks and it takes hundreds of years for radioactive nuclear waste to lose its radioactivity. Such waste therefore has to be buried underground in special containers for many years. Nuclear power, however, does not cause acid rain or contribute to the greenhouse effect, which is what fossil fuels do.

Because these non-renewable fuels are not expected to be available in the future, we need to conserve energy and begin to make use of alternative energy sources like the sun, water, wind, waves, tides and bio-gases for power. Great progress has already been made with the development of these forms of energy.

Activity1.4 **TO LIST FUELS AND THEIR USES** **LO 1.3**

(a) Name five common fuels and one use of each:

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.....	.....

(b) It is very important for people to find other sources of energy. Try to suggest ways in which people can use energy differently or make use of other sources, e.g. electric cars.

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(c) Name three advantages and three disadvantages of:

(i) **Fossil fuels**

ADVANTAGES	DISADVANTAGES
1.	1. ....
2.	2. ....
3.	3. ....

(ii) **Nuclear fuels**

ADVANTAGES	DISADVANTAGES
1.	1. ....
2.	2. ....
3.	3. ....

(d) Consider the sources of energy that we have been discussing and then draw up a list to show how you could conserve energy, e.g. by switching off the lights in the classroom when the sun is shining.

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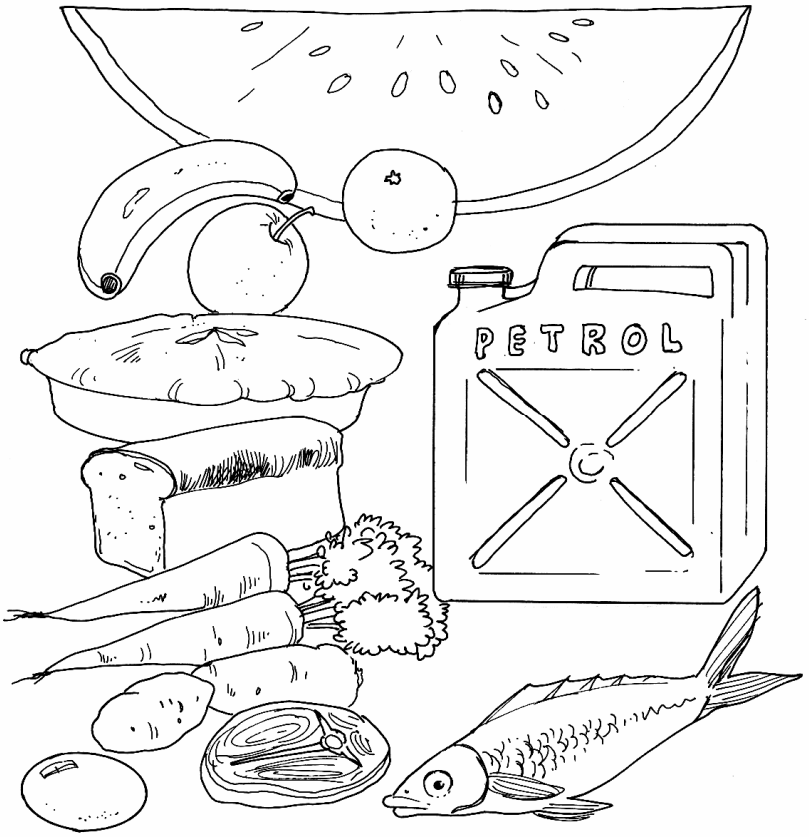
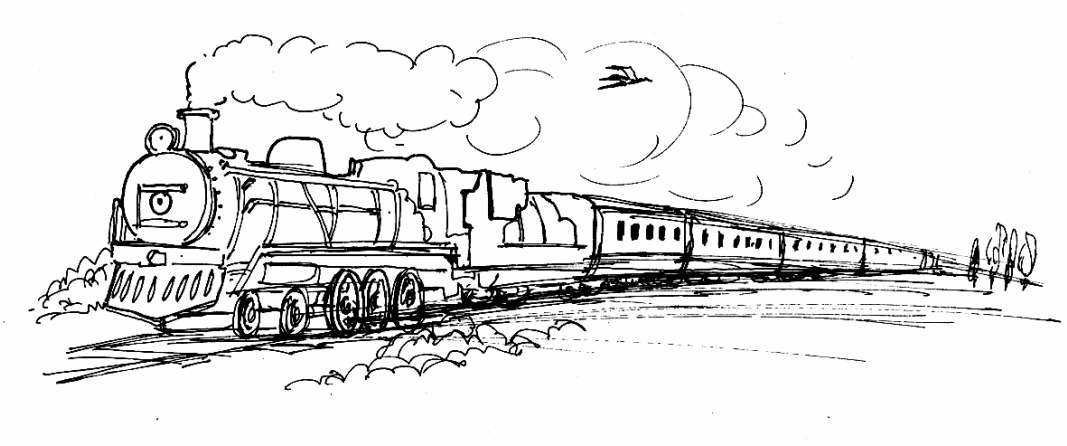
4. FORMS OF ENERGY

The human body does not use fuel (food) in the form in which we take it. The food is broken down into simple substances that are conserved in the muscles, in the particular form that can be used by the muscles. There therefore is energy in the substances that are stored in the muscles. Energy that is stored in chemical substances like food and fuel is known as chemical energy. All fuels therefore contain chemical energy.



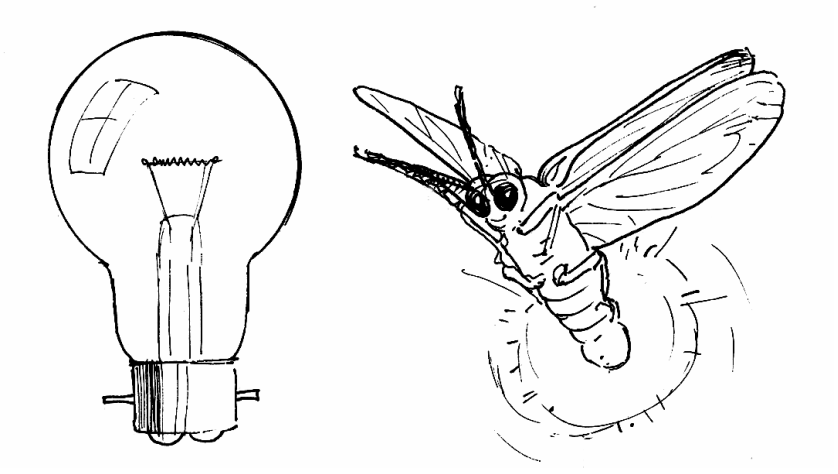
Chemical energy is released when some reaction occurs. If coal is burnt, for instance, it releases heat that can then be used to generate steam for a steam locomotive.

Heat energy is used every day. We need it to cook our food and to keep warm.



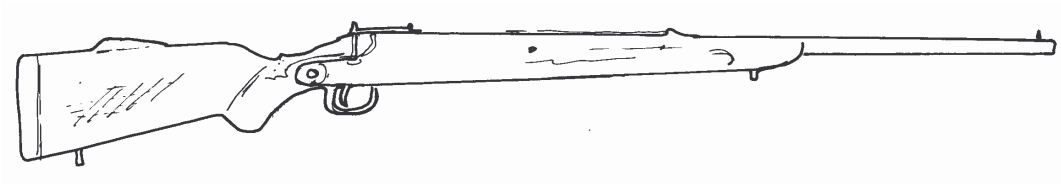
Heat energy boils the water in the locomotive's kettle and this forms steam. The steam drives the locomotive.

The sun provides us with light, as do fuels and electricity. When electricity flows through the filament in a light bulb, the wire is heated and glows. It releases **light energy**, as well as a small amount of heat energy. Some worms, fireflies and fish also radiate light energy.



Kinetic energy results from movement. Moving water can turn a water wheel, while wind can drive a wind pump.

Energy that is stored in things and waiting to be released by some means or other is called potential energy. The spring of an air gun that is loaded has the ability to fire. We therefore say that the loaded spring has potential energy.



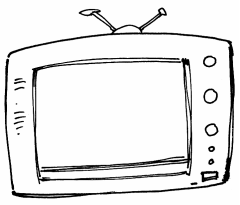
INTERESTING

Energy cannot be created or destroyed
BUT
energy can be transformed from one form to another.

Activity 1.5	TO DESCRIBE FORMS OF ENERGY	LO 2.3	

Label the following sketches by naming the energy source that is depicted.

(a)



Television

(b)

"Jack-in-the-box"

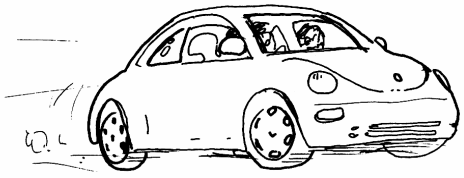
(c)

Lighthouse

(d)

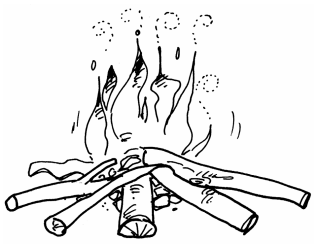
Lightning

(e)



Moving vehicle

(f)



Burning fire

a) .....

b) .....

c) .....

d) .....

e) .....

f) .....

5. THE TRANSFER OF ENERGY

(a) Conduction

Conduction occurs when heat moves through solid substances. Take a length of wire and hold it over a flame. What do you discover after a little while?

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The heat was transferred to your hand by means of conduction. Metals like copper, iron and aluminium are better conductors of heat than non-metals such as wood, water and cork. Particular metals also conduct heat faster than others.

Paste or draw such materials here.

Activity 1.6

TO COMPARE THE CONDUCTIVITY OF VARIOUS SUBSTANCES

LO 2.2

(a) Test the following metals by warming them in a flame or in boiling water. Let each member of the group hold a different metal rod. Report it as soon as the heat reaches your hand. Arrange the metals in such a manner that the metal that is the fastest conductor – the one that gets hot first – is placed in the first position.

Metal	Position
Iron	
Copper	
Aluminium	
Lead	

(b) Why is it that some substances are better conductors than other substances?

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(c) Use your knowledge of conduction to answer the following questions.

(i) Which metal would you use to build a hut that needs to be cool in summer – clay or corrugated iron?

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(ii) Why have you chosen this as the building material?

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(iii) Have you ever thought about the reason for wearing woollen clothing in winter? Try to explain why winter garments contain wool.

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(iv) You have an opportunity to design a pot for cooking food. Which materials would you use, and why? (Remember that a pot also needs handles!)

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(v) Why do we put a bottle of cool drink in cold water when we want to keep it cool?

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(vi) Try to explain why cool drink in a bottle would remain cold longer than cool drink in a tin.

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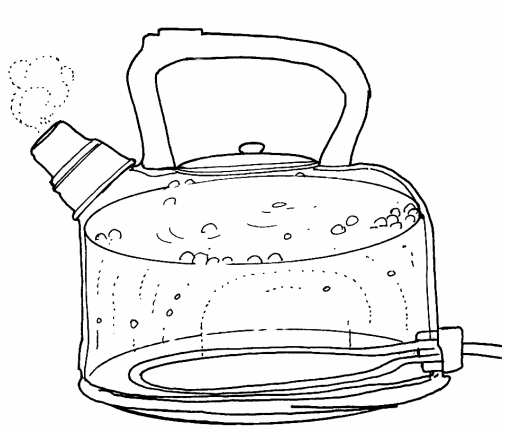
Activity 1.7	TO EXPLAIN CONVECTION AS A NATURAL PHENOMENON	LO 1.1	
		LO 1.2	
		LO 1.3	

(b) Convection

Convection is the main way in which heat moves through liquids. Water is a poor conductor of heat, but a kettle does manage to let water boil quickly. The reason is that liquids are able to move. Water rises when it becomes warm. The colder water then sinks down to take the place of the warmer liquid that is rising. The accompanying illustration shows how the circular movement, the convection current, distributes the warmth through the liquid until all the water is hot enough to come to a boil (100℃ – boiling point for water at sea level).



Although air is a poor conductor of heat, it is possible to heat a room with the help of a heater. Take a burning candle. Note the direction of the smoke while you

(i) hold the candle in an upright position .....

(ii) hold the candle at an angle .....

(iii) Hold the candle upside-down .....

Have you noted your observations? What do you deduce from this?

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As warm air rises, convection also occurs in nature. Have you ever thought about the origins of wind? Warm air rises and cold air moves to take its place.

Consider the principle of convection currents in air to help you distinguish between land and sea winds. You could make a sketch to help explain your observations.

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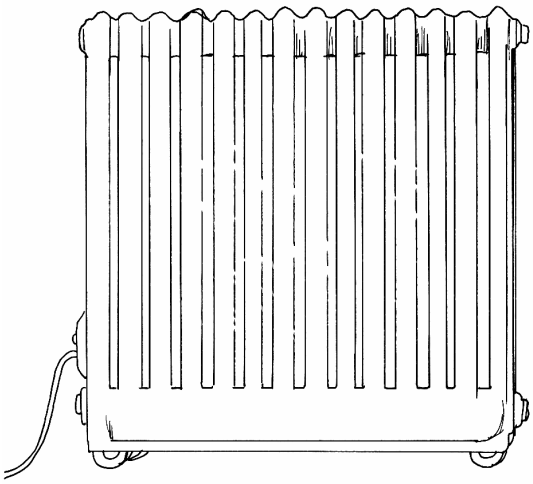
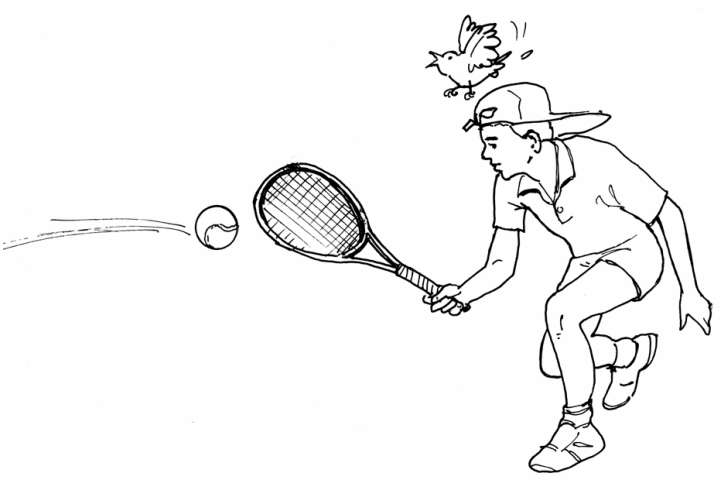
(c) Radiation

The transfer of heat by means of conduction or convection requires a solid substance, a liquid or a gas. There must be some substance to transfer heat energy. Such a transfer of energy through empty space is possible through radiation. Heat energy from the sun moves through space and the earth's atmosphere and heats any object that it reaches.

If you drive along any road where you can see ahead into the distance on a hot day, it often seems as if there is water on the road. The hot tar of the road radiates heat. Using an electric heater to heat a room in winter is an example of the use of radiation in an everyday situation.



6. CONVERSION OF ENERGY



Which kind of energy is used when a boy hits a tennis ball?

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What kind of energy does the moving tennis ball have?

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This has probably made you suspect that energy can be changed. When there is a change in energy from one kind to another kind, we speak of the conversion of energy.

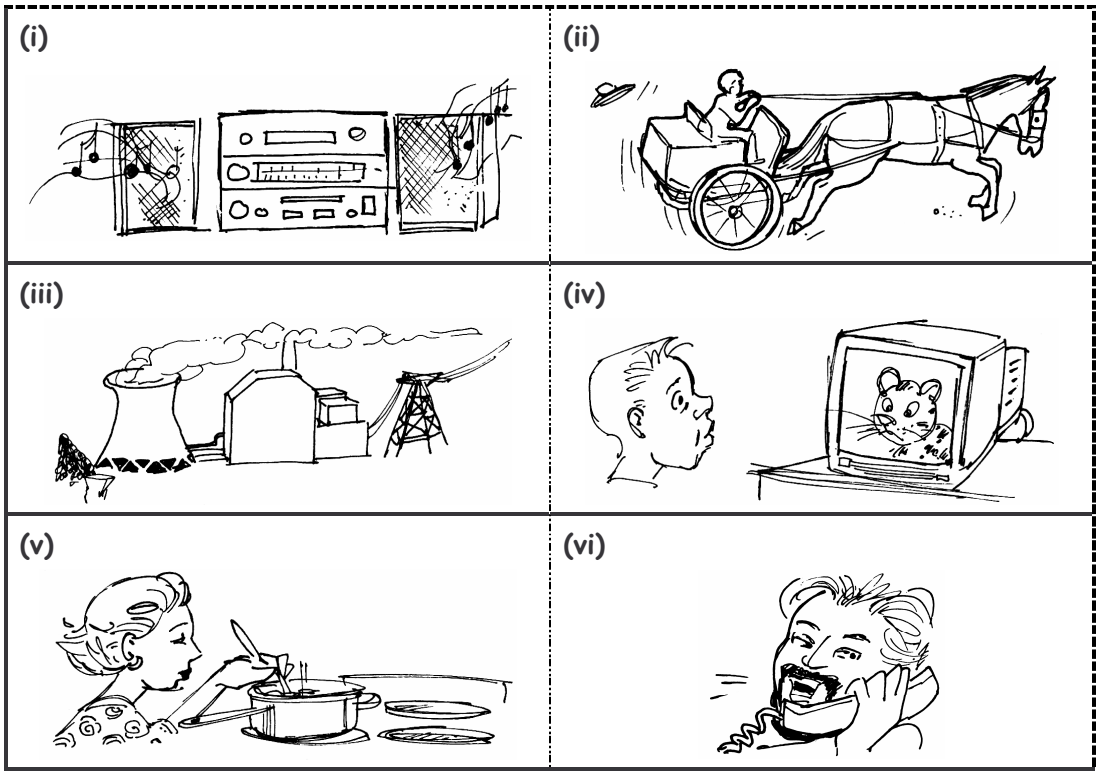
Activity 1.8	TO IDENTIFY VARIOUS FORMS OF ENERGY CONVERSION	LO 2.3	
		LO 2.4	

Conversion of energy in motorcar engines

(a) Chemical energy is converted to electrical energy in the battery of a car. In the engine, the electrical energy is converted to kinetic energy (movement energy). When the engine overheats, the kinetic energy is converted to heat energy and when the engine cools down again, the heat energy is converted to chemical energy.

Identify the various energy transfers by underlining.

(b) Examine the illustrations that follow and indicate what kind of energy conversion has taken place.



(i) .....

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(ii) .....

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(iii) .....

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(iv) .....

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(v) .....

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(vi) .....

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(c) **Having fun with energy conversion**

MAKING YOUR OWN TOY "TRACTOR".

REQUIREMENTS:

- ✔ Empty cotton reel
- ✔ Rubber band
- ✔ 2 toothpicks
- ✔ Candle wax disk cut from a round candle, with a hole in the middle

METHOD:

1. Thread the rubber band through the hole in the cotton reel.
2. Secure the rubber band in the hole by inserting half a toothpick through the loop of the protruding rubber band.
3. Place the candle wax disk against the opposite end of the cotton reel, threading the rubber through the hole in the wax disk.
4. Insert the remaining toothpick into the second loop of the rubber band.
5. Wind the "tractor" by turning the second toothpick to twist the rubber band.
6. Hold the toothpick to prevent the band from unwinding and place the reel on the ground.
7. What kind of energy conversion is illustrated?

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7. ENERGY ISSUES

The utilisation of energy sources causes serious damage to our planet. We looked at the advantages and disadvantages of fossil and non-fossil fuels earlier in the module. One of the disadvantages of nuclear fuels is that radioactive waste material cannot be destroyed. A leakage of radioactive material would have disastrous results.

Some countries do not have oil (a fossil fuel) and have to buy oil from oil producing countries. This has to be transported in large oil tankers. These tankers frequently cause extensive oil slicks when they run aground along coastlines.

Activity 1.9

TO EMPHASIS THE SENSIBLE USE OF THE RESOURCES OF THE EARTH

LO 3.2

RESEARCH ASSIGNMENT

(a) Do research into the nuclear accident that occurred at Chernobyl in Russia in 1986. Write (at least one folio sheet) on the fearful effects of the tragedy with regard to the inhabitants and the environment

or

(b) Find out what happens to marine life when ships leak oil. Write about it.

(c) Arrange a class debate. Form two groups.

One group has to protest against nuclear power and the other group must offer arguments in favour of the use of it.

Make use of your knowledge of nuclear fuels and fossil fuels, as well as of renewable energy sources (the sun, wind and water) when you prepare your arguments.

Make use of the questionnaire that follows to assess your input.

SELF ASSESSMENT

Research

Name : .....

Subject : .....

Grade : .....

	LEARNER		EDUCATOR	
	YES	**NO**	**YES**	**NO**
Have you used more than one source?				
Are you sure that you have used your own words throughout?				
Do you have a meaningful introduction?				
Did you enjoy the assignment?				
Were you able to extend your knowledge by executing the assignment?				

SELF ASSESSMENT

Debating

Name: ..... **Date: .....**

	Always	Some-times	Never
1. Have I stated my arguments clearly?			
2. Did the other participants listen to my arguments?			
3. Did I support the arguments of the other members of my group?			
4. Could I elaborate on the arguments put forward by the other members of my group?			
5. Did I use appropriate words?			
6. Could I refute the arguments put forward by the other group?			

8. CONSERVATION OF ENERGY

Alternative sources of energy, e.g. wind energy, is more environment friendly but very expensive. We therefore have to continue using fossil fuels (coal, oil, gas) and wood. Although new coal and petroleum reserves are still being discovered, these will eventually be exhausted. It is therefore of great importance to use our sources of energy as effectively as possible.

Electricity is convenient and practical, but is has to be generated and this incurs costs. Electrical appliances are classified according to their use of electricity. This is measured in watt or kilowatt (1 kilowatt = 1 000 watt) Electricity accounts are calculated according to the number of units recorded by an electricity meter. This unit is a kilowatt-hour (kWh), i.e. the amount of electricity used by a one-kilowatt appliance in one hour. An automatic washing machine is usually classified as a three-kilowatt appliance. This means that one can expect an account for three units of electricity for each hour that the machine is operated.

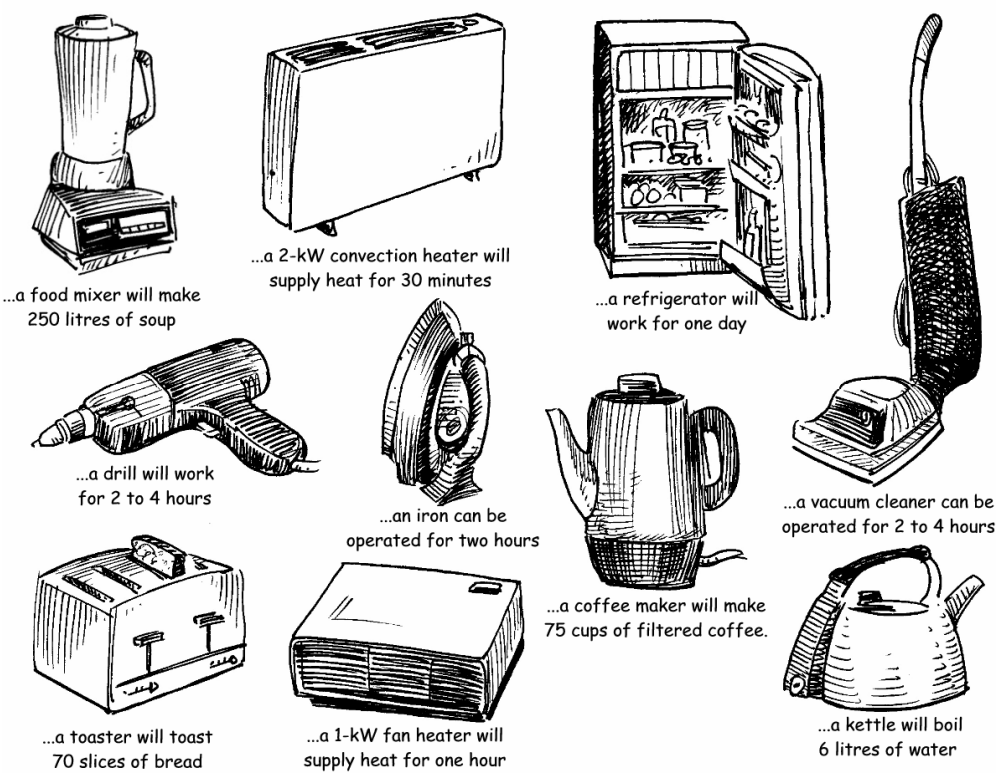
Activity 1.10

TO COMPARE THE ENERGY CONSUMPTION OF A VARIETY OF ELECTRICAL APPLIANCES

LO 3.2

(a) Study the following and answer the questions that follow:

With one unit of electricity.....



The above illustrates the working costs of some household appliances with reference to their consumption per unit of electricity.

(i) Which three appliances use the least energy?

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(ii) Which three appliances are the most expensive to operate?

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(iii) Which appliances are used most frequently in households?

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(iv) Which appliances would you regard as unnecessary and replaceable with other appliances that do not use as much fuel, or as altogether dispensable.

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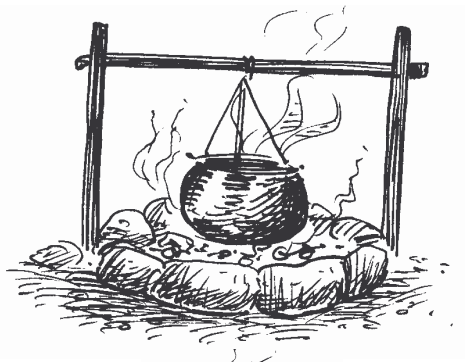
(b) Many people in South Africa do not have access to electricity and have to use fuel wood, paraffin or gas as fuels to cook their food and warm their houses. Fuels, especially wood, are becoming scarcer and people often have to walk great distances to collect what they need. These fuels also need to be used effectively to help with conservation.



Many of the people who depend on fuel wood use open fireplaces and much heat energy is transferred into the surrounding air. Often people also use gas stoves incorrectly and waste energy.

GROUP WORK

Each group is to select a means that is used for cooking by a majority of South Africans in rural areas, e.g. an open fire, a gas stove, etc. This must be represented practically by means of a model and a report must be written on its use. The report should cover the following questions:

- ? Which fuel is used?
- ? Is it easily obtainable?
- ? Is a particular colour recommended for the pot? If so, what is the reason for it?
- ? Which measures can be taken to limit heat energy being lost into the air around the pot?
- ? What is the cost of the fuel?

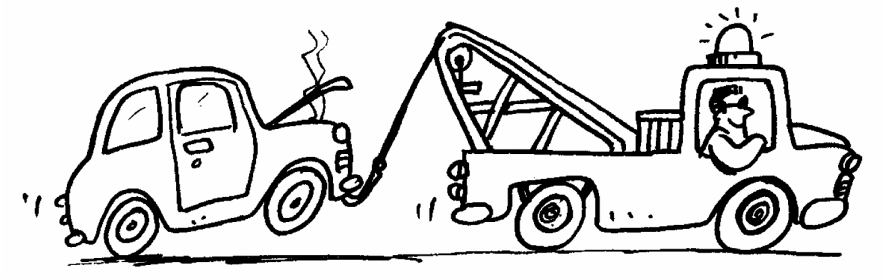
Educator's Assessment:

Criteria		1	2	3	4
Assignment:	Correctly executed; complete; relevant; handed in on time				
Model:	Effective; fuel indicated; creative representation				
Report:	All questions addressed; reporting neat; good language use				
Co-operation within group:	Effective; differences resolved; all learners involved				
DOMINANT CODE					

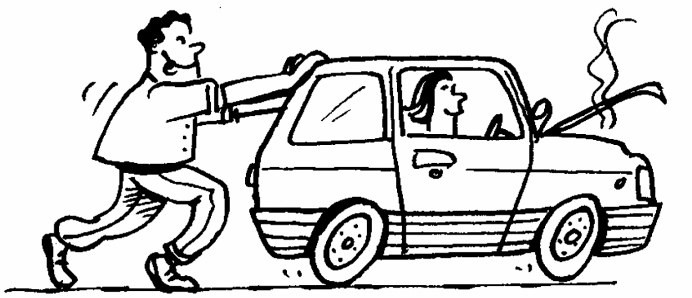
LEARNING UNIT 2

A. FORCES

1. CONTACT FORCES



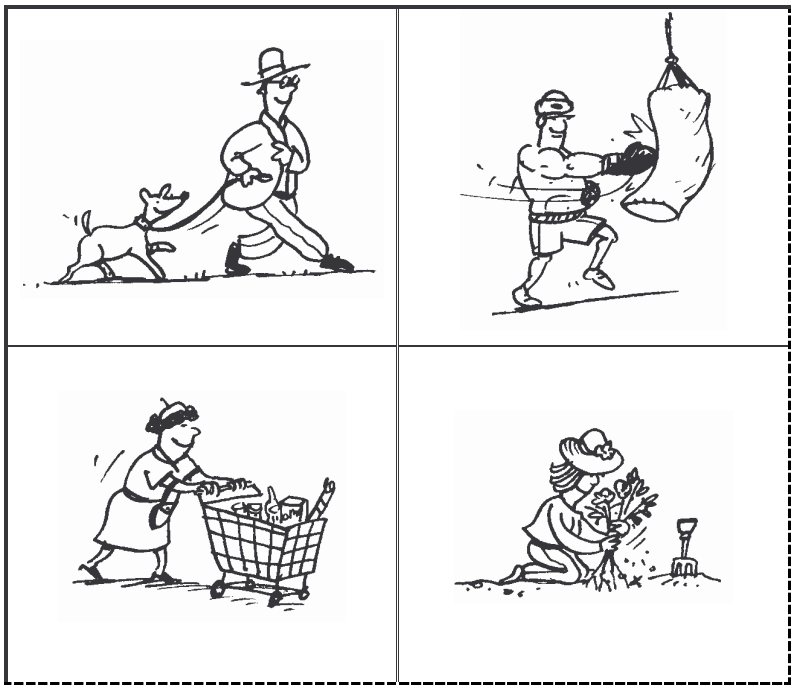
The vehicle in the illustration has broken down and cannot move by itself. The tow truck has to **pull** it.



This car also cannot move by itself. The man has to **push** it.

When something has to be pulled or pushed, we say that we must **exert force on it**. You use the **force of thrust** to push something away from you, or the **force of attraction** to pull something towards you.

Examine the following illustrations and indicate whether they show forces of thrust or of attraction.



We cannot see force, but we know that it is there because we observe its **effect**. The above illustrations show that force can move a stationary object.

Activity 2.1

TO IDENTIFY THE EFFECT OF FORCES

LO 1.3

The following illustrations show more of the effect of forces. Are you able to identify them?

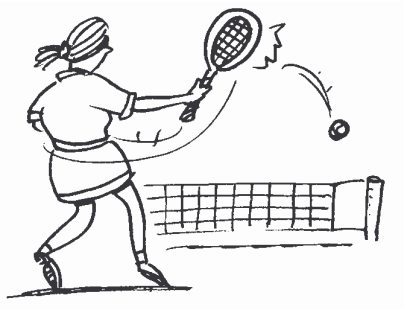


Fig. 1: The tennis player hits the ball away from her.

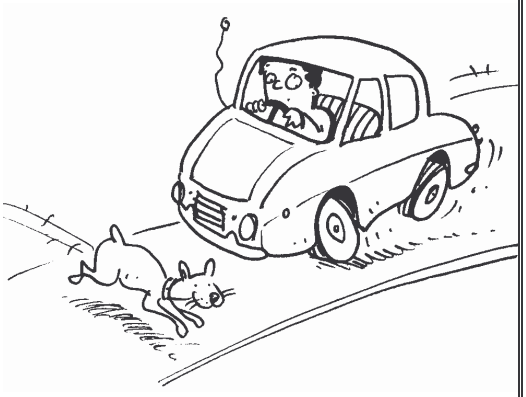


Fig. 2: The driver uses the brakes to stop the car.

Fig. 3 The force of attraction is exerted on the elastic band.

Fig. 4: The force of thrust in the same direction as the motion is exerted on the rolling ball.

Fig. 5: The athlete swings the hammer to rotate it around him

Note down your deductions:

Fig 1: .....

.....

Fig 2: .....

.....

Fig 3: .....

.....

Fig 4: .....

.....

Fig 5: .....

.....

INTERESTING

Can you see the effect of the force that the man is exerting on the wall?

Sometimes the effect of force is not visible. When you push against a wall, you are using force, but the effect cannot be seen. But when there is an egg between your hand and the wall, you will be able to observe that you have exerted force quite plainly!

2. FORCES THAT OPERATE OVER DISTANCE:

It is even possible to bring objects into motion or to change the direction of the motion **without any contact**. Forces that affect objects without making contact are identified as **forces that operate over distance**.

Three kinds of force can have an effect without any contact with objects:

- Φ **Magnetic force**
- Φ **Electrostatic force**
- Φ **Gravitational force**

Activity 2.2

TO DESCRIBE THE FUNCTIONING OF ELECTROSTATIC AND GRAVITATIONAL FORCE

LO 2.1

We will be finding out more about magnetism as we work through this module. So, choose one of the other two forces that are able to operate at a distance and write a paragraph to describe it and to explain how it operates.

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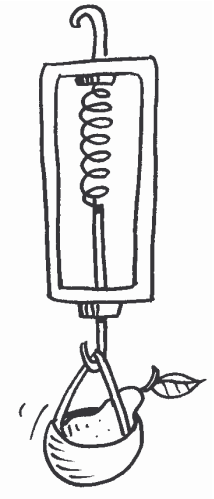
.....

.....

3. MEASURING FORCE



Forces can be measured by noting their ability to stretch a spiral spring or an elastic band. Many years ago, Robert Hooke, a British scientist, discovered that the stretch of a spring is equal to the force that causes the stretch. If a particular force can stretch the spring 1 cm, a force that is three times greater will stretch the spring to 3 cm. The heavier the object, the more the spring will be stretched.

If an object is heavy, we say that the force of attraction between the earth and the object is great. Weight, therefore, is the force of the attraction that the earth exerts on the object. This means that the weight of any object can be determined by measuring the stretch of a spring.

The unit that we use for measuring force (weight) is Newton (N). The name is derived from Sir Isaac Newton, one of the greatest scientists of all time. For measuring a force, we use a spring balance calibrated in Newton. We can also refer to it as a dynamometer.

Activity 2.3 | **TO BUILD YOUR OWN DYNAMOMETER** | **LO 2.4**

Build your own dynamometer

REQUIREMENTS:

- ✔ Wooden plank (30 mm x 300 mm)
- ✔ Screw (± 25 cm in length)
- ✔ Elastic band
- ✔ Nail
- ✔ Tin can lid
- ✔ String
- ✔ White paper
- ✔ Retort stand and clamp

Step 1: Glue the white paper to the wood.

Step 2: Screw the screw in at the top of the plank.

Step 3: Suspend the elastic band from the screw and clamp the plank in the stand.

Step 4: Use the hammer and nail to pierce four holes at equal distances along the edge of the tin lid.

Step 5: Attach four pieces of string (each ± 150 mm long) to the lid, by tying them through the holes. Tie the four loose ends of string to another length of string (± 300 mm long). Then attach this longer length of string to the elastic band.

Step 6: Make a mark on the paper immediately below the elastic band. This is the O position.

Step 7: Now place the mass pieces (to a total of 102 grams) on the lid. Mark the new position of the elastic band as "1".

Step 8: Repeat step 7, increasing the mass of the mass pieces as you proceed, until you have marked 5 graduations on the paper. Avoid putting too much strain on the elastic band – if it is stretched too far, it might snap.

You have now built a simple dynamometer calibrated in Newton. 1 N is equal to ± 102 g. One kilogram is therefore equal to approximately 10 N.

Use this dynamometer or another spring balance to determine the weight of the following objects:

OBJECT	WEIGHT IN N
1. one pen	..... N
2. five such pens	..... N
3. your shoe	..... N
4. both your shoes	..... N
5. an object of your choice	..... N

Complete:

Deduction:

The greater the ....., the greater the

..... . that the earth exerts on it.

4. Let's see what you know. Do turn back to the earlier work in the module if you are unsure of yourself. This means that you may refer to the module as a source of information.

(a) Write one sentence to explain what we mean when we speak of force.

.....

(b) What is the unit that we use for measuring weight? .....

(c) Which instrument is used to measure the weight of an object?

.....

(d) What is your mass? .....

Consider your body as an object. What is the weight of your body in Newton? .....

(e) What is weight? .....

.....

(f) Name three forces that are exerted around us in nature.

.....

.....

.....

(g) Name two kinds of force that can be exerted.

.....

.....

(h) Name five effects of forces on objects.

.....

.....

.....

.....

.....

(i) Underline the example that illustrates the force of gravity.

(i) Magnets that repel one another.

(ii) A person doing a long jump.

(iii) A spoon falling off the table and landing on the floor.

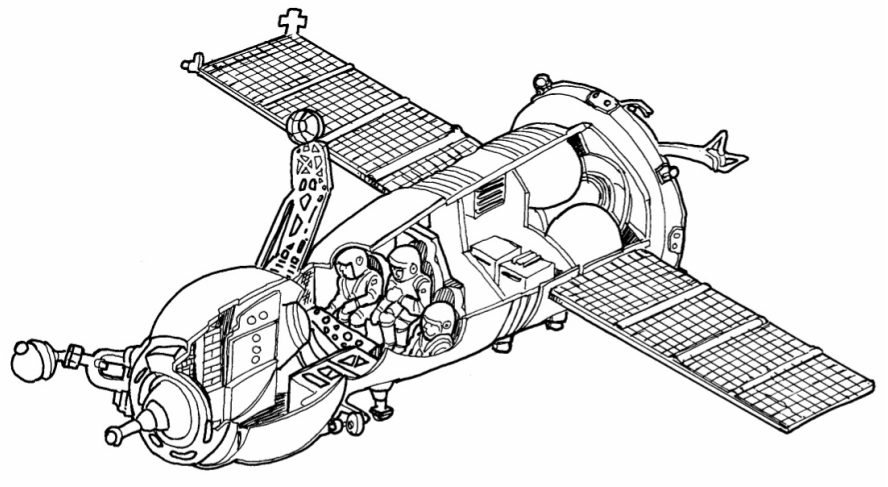
(iv) Two people running into one another.

(j) When forces cause an object to move in a circle, we say that they cause a ..... of the object.

Summative (10)

5. A JOURNEY THROUGH SPACE

The most difficult part of space travel is escaping the Earth's gravity. Space travellers need rockets to travel to outer space. A rocket is a powerful engine that is strong enough to overcome gravity and to guide the spacecraft into space.



On 25 April 2002, Mark Shuttleworth became the first South African and African to undertake space travel.

Activity 2.4

TO REPORT ON A HUMAN ACHIEVEMENT IN SCIENCE

LO 3.1

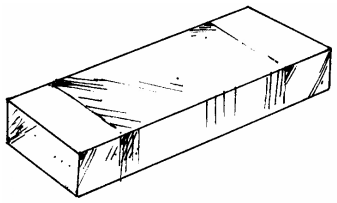
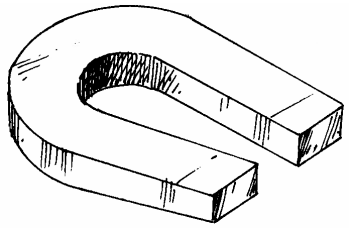
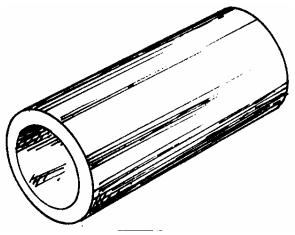
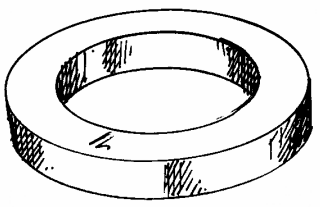
Newspapers and magazines published many articles on Mark Shuttleworth's space travels because he can be regarded as a pioneer in this field. Use these articles as sources of information to write a report (± two folio sheets in length) on his journey. More interesting information and photographs are available on the website: http://www.africaninspace.com.

Guidelines for assembling the contents of your report:

1. Mark Shuttleworth, his dreams and ideals
2. Preparing for the journey
3. Reasons for the journey
4. The journey
5. The significance of the journey for people in general and for South Africa?

B. MAGNETISM

It is said that the Greeks discovered a strange type of stone more than 2 000 years ago. While Magnes, a young shepherd boy, was looking after sheep one day, he realised that a strange black stone that exerted so much force on it that he could not withdraw the staff attracted the iron tip of his staff. The fable suggests that the word 'magnet' is derived from the name of this boy. Of course, we cannot verify this, but it is a fact that certain kinds of black stone attract similar stones and certain metals. Many such stones are found in the vicinity of Magnesia, in Turkey, and they are called lodestones, or magnet stones. The word 'magnet' therefore is probably derived from the name of this city. These stones are natural magnets. We nowadays use synthetic magnets made of iron or steel. These magnets are manufactured to attract objects very forcefully and to retain their magnetism for a long time. The magnets in your school's laboratory may come in any of the following four different shapes:

Bar-shaped magnets	
Horseshoe-shaped magnets	
Cylindrical magnets	
Ring-shaped magnets	

Magnets have to be handled with care to prevent loss of magnetism.

Bear the following in mind when you use a magnet:

Do not handle the magnets roughly, i.e. do not drop it or knock against it.

Do not heat magnets.

Always store magnets with their locking devices in position.

1. MAGNETIC AND NON-MAGNETIC MATERIALS

Magnets do not attract all materials. The following experiment will help us to determine whether a material substance is magnetic or non-magnetic.

Activity 2.5

TO TEST MAGNETISM IN VARIOUS SUBSTANCES

LO 1.2 | **LO 1.3** | **LO 2.1**

Select a variety of objects. All the members of the group should bring objects from home for testing in the class. Note down your results in the following table.

ATTRACTED	NOT ATTRACTED

Complete:

A magnet attracts magnetic materials. All the objects attracted by the magnet are therefore regarded as ..... and are made of materials that contain ....., ... or ..... .

Objects that are not attracted by the magnet are referred to as .... and are made of materials such as ..... , ..., ... and .....

2. POLARITY OF MAGNETS

Take good note of what happens when your educator is busy with the following experiment:

Activity 2.6

TO DEMONSTRATE THE MAGNETISM IN THE POLES OF A MAGNET

LO 1.2

For the educator: Place a thick line of iron filings on a clean sheet of paper. Carefully insert a bar magnet into a test tube. Draw the test tube through the line of iron filings.

Observation: .....

.....

.....

Deduction: .....

.....

.....

Φ The ends of the bar magnet are known as the poles of the magnet. The red end is the north pole (north-seeking pole) and the blue end is the south pole (south-seeking pole).

3. FORCES BETWEEN MAGNETS

When magnets are near one another, forces are generated between them. The following experiment will make it possible to find out what these forces are.

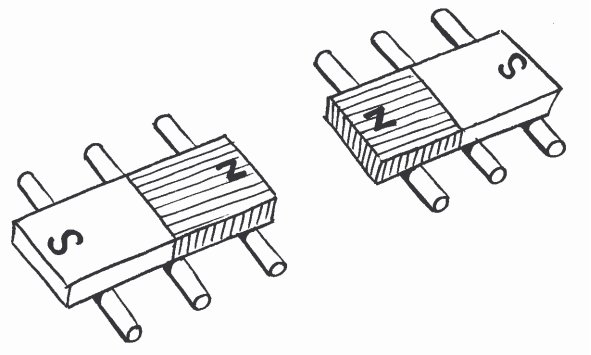
Activity 2.7

TO DEMONSTRATE THE POLARITY OF BAR MAGNETS

LO 1.2

Use two bar magnets and six short drinking straws. Bar magnets usually are painted in two colours. One half is red and the other is blue, but some bar magnets are painted silver and red.

Arrange the straws and place the bar magnet on them as indicated in the illustration. Observe what happens.

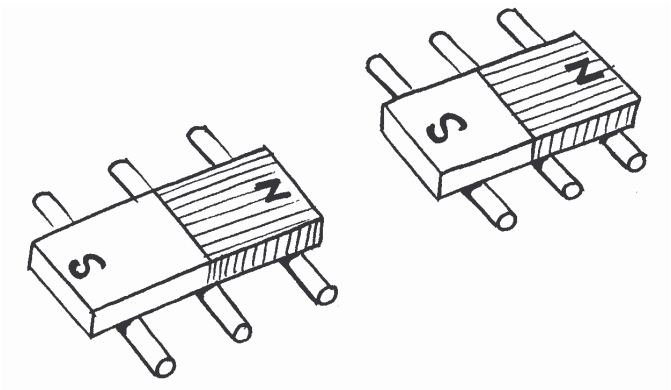


Observation: .....

.....

.....

Try to predict what will happen if you arrange the magnets as indicated in the next sketch.



Prediction: .....

.....

Observation: .....

.....

.....

Did you predict correctly? .....

Deduction: .....

.....

.....

This is the law of magnetic poles.

4. MAGNETIC FORCE ACTING THROUGH DIFFERENT MATERIALS

Let us see whether a magnet is able to exert attraction through a magnetic material and through a non-magnetic material.

Activity 2.8

TO TEST THE MAGNETIC FORCE OF A MAGNET ON MAGNETIC AS WELLS AS NON-MAGNETIC SUBSTANCES

LO 2.3

(a) Tie one end of a length of sewing thread to a paper clip and use wonder glue / Prestik to secure the other end to your desk. Hold a bar magnet above the paper clip and lift it.

What do you observe? .....

.....

Now place the lid of a tin can between the paper clip and the magnet.

There must be no contact between these objects.

What happens when you do this?.....

.....

.....

(b) Repeat the procedure of 4(a), but insert a sheet of paper between the magnet and the paper clip.

What happens now? .....

.....

What deduction can you make from this? .....

.....

.....

Remember that paper is a non-magnetic material and the tin can lid is a magnetic material.

Try to explain why the tin can lid is magnetic, while tin is not.

.....

.....

.....

5. A MAGNETIC FIELD

A magnet is surrounded by a magnetic field. This is the area around a magnet in which it can experience force. The earth must therefore be surrounded by a magnetic field, and this would mean that we are living in a magnetic field! What would happen if there were no magnetic field around the earth?

.....

.....

.....

We will now use iron filings to help us examine the magnetic field of a bar magnet.

Activity 2.9

TO EXAMINE THE MAGNETIC FIELD OF A BAR MAGNET

LO 2.4

Cover a bar magnet with a transparency or sheet of paper placed over it. Sprinkle an even layer of iron filings on the covering sheet. Tap it lightly to help spread the iron filings.

Sketch what you see.

Use a compass to determine the direction of the magnetic field and draw arrows to show this on your sketch.

6. MAKING A MAGNET

Magnets are made from steel. Steel can be magnetised by using electricity or by stroking it with another magnet.

Activity 2.10

GROUPWORK: TO LEARN HOW TO MAKE A MAGNET

LO 2.4

Each group will need: a bar magnet
a steel knitting needle
Prestik / wonder glue
10 paper clips

1. Use wonder glue to secure the knitting needle on the desk.
2. Slide the magnet along the knitting needle from end to end, making sure that you stroke the knitting needle in the same direction and use the same end of the magnet all the time. (Make a mark on the point of the knitting needle at which you lift the magnet while you are stroking it.)
3. Repeat the stroking movement 10 times and then check to see how many paper clips can be lifted with the needle.

   .....
4. Repeat the stroking movement for another 10 times and see how many paper clips can be lifted now.

   .....
5. What kind of pole do you have at the end where you have made the mark? .....

   (Use the magnet with which you stroked the knitting needle for determining this and remember the law of magnetic poles, bearing in mind that the half of the magnet that is painted red is the north pole.)
6. Write down two things that you could do to destroy the magnetism of the knitting needle.

   .....

   .....
7. Follow your suggestions in point no. 6 to see if this does happen. YES / NO
8. Make a magnet of your own at home, but make use of electricity to create an electromagnetic magnet. Your teacher will explain how to do it. Check to see whether your magnet is able to attract magnetic materials when you bring it to class. This will serve as a measure to test the success of your work.

7. USES OF MAGNETS:

Magnetic force is used daily to make our lives easier.

Activity 2.11

TO DESCRIBE THE USEFULNESS OF MAGNETS IN EVERYDAY LIFE

LO 2.4

(a) A magnet that rotates freely is known as a compass. A compass is used to show direction.

The needle of a compass always comes to rest with one pole – the north or north-seeking pole of the compass - pointing northwards. The other pole of the needle is the south or south-seeking pole.

List two situations in which the use of compasses is necessary:

.....

.....

(b) Some screwdrivers are magnetised.

What value does this have for the person using it?

.....

.....

(c) Fridges and some cupboards have magnets in the door.

Why are magnets used in doors?

.....

.....

(d) Doctors also use powerful magnets.

Can you work out why they do this?

.....

.....

.....

(e) Telephones and loudspeakers contain magnets.

What is the purpose of having magnets in such instruments and appliances?

.....

.....

.....

(f) Some toys have magnets.

Which toys that you know have magnets and why do they have them?

.....

.....

.....

.....

8. FUN WITH MAGNETS

(a) Remove a paper clip from a glass full of water without getting your hands wet or emptying the glass.

(b) Try to move magnetic materials without touching them or letting your friends know how you manage it.

9. SOMETHING INTERESTING

There are trains that work on the simple principle that opposing poles of magnets affect one another. A magnetic force draws arms below the train towards the tracks and thereby lifts the train so that it can float. Another magnetic field propels the train forwards. The train does not touch the track and there is therefore little friction to cause wear to the brakes or the track. Another example of such levitation (or floating) is that the train can achieve very high speeds.

10. LET'S TEST OUR KNOWLEDGE. You may refer to your module to assist you with your answers.

(a) Complete: While two N poles will ..... each other, a N pole and a S pole will ..... one another.

(b) How will you determine whether a material is magnetic or non-magnetic?

.....

.....

(c) Which of the poles of a magnet is more powerful: the N pole or the S pole? .....

(d) Complete: The direction of magnetic field lines around a magnet is from the ..... pole to the ..... pole of the magnet.

(e) Underline the characteristic that does not relate to magnets:
repelling, attracting, directional; expansion; polarity.

(f) Underline the name(s) of the non-magnetic material(s): copper, steel, iron, cobalt, nickel.

(g) True or false? Magnets can attract materials through other magnetic materials. .....

(h) Picture one end of a bar magnet being held close to the N pole of the needle of a compass. What will the polarity of that end of the bar magnet be?

.....

(i) Complete: If a steel knitting needle is stroked repeatedly with the south pole of a powerful magnet, the tip of the needle at which the stroking ends will

become a ..... pole

(j) How can you determine whether a steel needle has been magnetised?

.....

.....

Summative (10)