Natural Sciences and Technology

Grade 4-B
Teacher's Guide

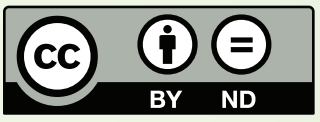
CAPS

Developed and funded as an ongoing project
by the Sasol Inzalo Foundation in partnership
with Siyavula and volunteers.

Distributed by the Department of Basic Education.

COPYRIGHT NOTICE

Your freedom to legally copy this book



AUTHORS LIST

This book was written by Siyavula and volunteer educators, academics and students. Siyavula believes in the power of community and collaboration. By training volunteers, helping them network across the country, encouraging them to work together and using the technology available, the vision is to create and use open educational resources to transform the way we teach and learn, especially in South Africa. For more information on how to get involved in the community and volunteer, visit *www.siyavula.com*

Siyavula Core Team

Megan Beckett, Ewald Zietsman

Siyavula Extended Team

Neels van der Westhuizen, René Toerien, Bridget Nash, Heather Williams, Dr Mark Horner

Contributors

Ronald Arendse, Prof Ilsa Basson, Rudolph Basson, Mariaan Bester, Darryl Bimray, Brandt Botes, Novosti Buta, Michaela Carr, Kade Cloete, Julian Cowper, Dawn Crawford, Zorina Dharsey, Octave Dilles, Shamin Garib, Sanette Gildenhuys, Nicole Gillanders, CelestÈ Greyling, Martli Greyvenstein, Lee-Ann Harding, Dr Colleen Henning, Anna Herrington, Ruth-Anne Holm, Adam Hyde, Karishma Jagesar, Wayne Jones, Kristi Jooste, Louise King, Paul van Koersveld, Dr Erica Makings, Dhevan Marimandi, Dowelani Mashuvhamele, Glen Morris, Busisiwe Mosiuoa, Andrea Motto, Gladys Munyorovi, Johann Myburgh, Mervin Naik, Alouise Neveling, Owen Newton-Hill, Mthuthuzeli Ngqongqo, Godwell Nhema, Brett Nicolson, Mawethu Nocanda, Seth Phatoli, Swasthi Pillay, Karen du Plessis, Jennifer Poole, Brice Reignier, Irakli Rekhviashvili, Jacques van Rhyn, Kyle Robertson, Ivan Sadler, Thaneshree Singh, Hèléne Smit, Karen Stewart, James Surgey, Isabel Tarling, Rose Thomas, Dr Francois Toerien, Antonette Tonkie, Wetsie Visser, Vicci Vivier, Karen Wallace, Dawid Weideman, Dr Rufus Wesi, Matthew Wolfe

A special thank you goes to St John's College in Johannesburg for hosting the authoring events which led to the first version of these workbooks.

THIS IS MORE THAN JUST A WORKBOOK!

In many places you will see there are “Visit” boxes in the margins. These boxes contain links to videos online, interesting websites which pertain to the content, or else games or activities for learners to complete.

To access these websites or videos, simply type the link provided into your address bar in your internet browser. The links look like this for example, *goo.gl/vWKnF*

You can use these links in your lessons or else explain to your learners that they can watch them at home on a PC, laptop or on their mobile phones.

To download these workbooks or learn more about the project, visit the Sasol Inzalo Foundation website at *http://sasolinzalofoundation.org.za*

THE NATURAL SCIENCES AND TECHNOLOGY CURRICULUM

Science as we know it today has roots in African, Arabic, Asian, European and American cultures. It has been shaped by the search to understand the natural world through observation, testing and proving of ideas, and has evolved to become part of the cultural heritage of all nations. In all cultures and in all times people have wanted to understand how the physical world works and have needed explanations that satisfy them.

Natural Sciences and Technology complement each other

This is the first year that Natural Sciences and Technology have been combined into one subject, which is compulsory for all learners in Grades 4 to 6. Natural Sciences and Technology are also both compulsory subjects for all learners in Grades 7 to 9. These two subjects have been integrated into one subject as they complement each other.

	Natural Sciences	Technology
Goal	Pursuit of new knowledge and understanding of the world around us and of natural phenomena.	The creation of structures, systems and processes to meet peoples' needs and improving the quality of life.
Focus	Focus is on understanding the natural world.	Focus is on understanding the need for human–made objects and environments to solve problems.
Developmental methods	Discovery through carrying out investigations.	Making products through design, invention and production.
Major processes	Investigative and logical processes • planning investigations • conducting investigations and collecting data • evaluating data and communicating findings	Practical solution-orientated processes • identifying a need • planning and designing • making (constructing) • evaluating and improving products • communicating
Evaluation methods	Analysis , generalisation and creation of theories.	Analysis and application of design ideas.

ORGANISATION OF THE CURRICULUM

In this curriculum, the knowledge strands below are used as a tool for organising the content of the subject Natural Sciences and Technology.

Natural Sciences Strands	Technology Strands
Life and Living Matter and Materials Energy and Change Earth and Beyond	Structures Processing Systems and Control

Allocation of teaching time

Time for Natural Sciences and Technology has been allocated in the following way:

- 10 weeks per term, with 3.5 hours per week
- Grades 4, 5 and 6 have been designed to be completed within 38 weeks
- 7 hours have been included for assessment in terms 1, 2 & 3
- Term 4 work will cover 8 weeks plus 2 weeks for revision and examinations

Below is a summary of the time allocations per topic. The time allocations provide an indication of the weighting of each topic. However, this is a guideline and should be applied flexibly according to circumstances in the classroom and to accommodate the interests of the learners.

Life and Living and Structures

Chapter	Time Allocation
1. Living and non-living things	2 weeks (7 hours)
2. Structure of plants and animals	2.5 weeks (8.75 hours)
3. What plants need to grow	1 week (3.5 hours)
4. Habitats of animals	2 weeks (7 hours)
5. Structures for animal shelters	2.5 weeks (8.75 hours)

Matter and Materials and Structures

Chapter	Time Allocation
1. Materials around us	3.5 weeks (12.25 hours)
2. Solid materials	2 weeks (7 hours)
3. Strengthening materials	2 weeks (7 hours)
4. Strong frame structures	2.5 weeks (8.75 hours)

Energy and Change and Systems and Control

Chapter	Time Allocation
1. Energy and energy transfer	2.5 weeks (8.75 hours)
2. Energy around us	2.5 weeks (8.75 hours)
3. Movement and energy in a system	2.5 weeks (8.75 hours)
4. Energy and sound	2.5 weeks (8.75 hours)

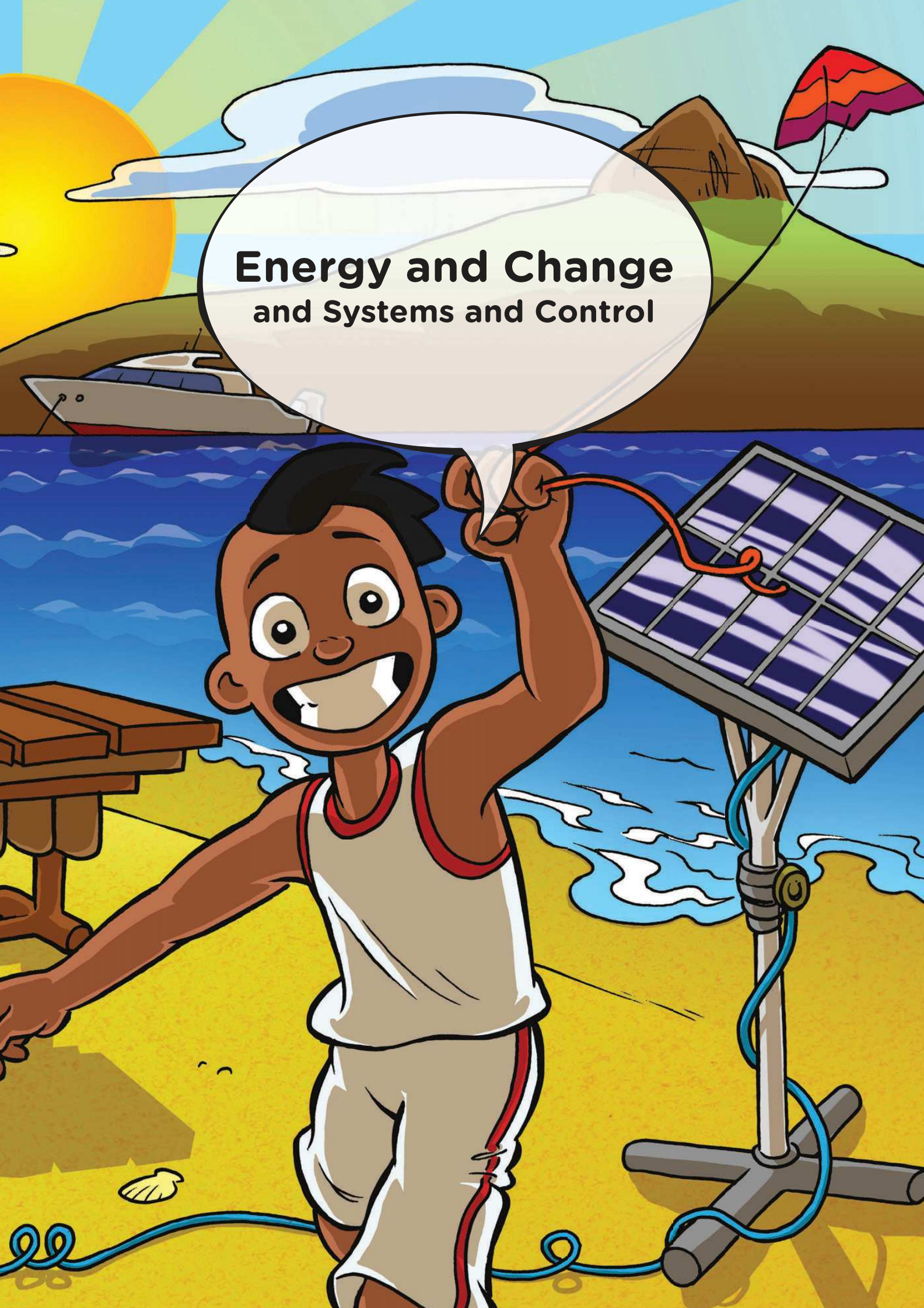
Earth and Beyond and Systems and Control

Chapter	Time Allocation
1. Planet Earth	2 weeks (7 hours)
2. The Sun	1 week (3.5 hours)
3. The Earth and the Sun	1 week (3.5 hours)
4. The Moon	2 weeks (7 hours)
5. Rocket systems	2 weeks (7 hours)


www.thunderboltkids.com

Table of Contents


ICE


Energy and Change
and Systems and Control

1 Energy and Energy transfer

KEY QUESTIONS

- What do we need energy for?
- Where does energy come from?

1.1 Energy for life

Scientists say energy is the ability to do work. We need to understand what this means. A way to think of it is that energy can make something happen.

ACTIVITY: Energy is the ability to do work

Teacher's Note

The idea of this activity is to have some fun playing a game so that the learners are tired afterwards. You can then introduce the idea that they used energy to run around - energy is the ability to do work and move.

Let us have some fun playing a game!

INSTRUCTIONS:

1. Divide into groups of six and go outside for 10 minutes to play "Hide and Seek".

2. These are the rules of the game:

    a. One person needs to be the seeker.

    b. The seeker needs to find a home - a tree or the wall will work well.

    c. The seeker closes their eyes and counts to 20.

    d. Everyone else must hide. They are the hiders.

    e. When the seeker has counted to 20, (s)he must find the others and tag them by touching

    f. If the hiders can get to the seekers' home without him or her seeing them, they can block themselves and cannot be tagged by the seeker.

    g. If the seeker finds a hider s/he runs to their home, touches it and says " *1,2,3 Tag Emma!*" (or whoever they saw).

    h. If there is time left over, you can choose a new seeker and play again.

3. Return to class after 10 minutes and talk to in your group about how you feel.

4. Each group must choose a leader who will report back to the class.

5. Write down the words that are being used to describe how you are feeling after the game.

6. Write down some of the descriptive words below.

This game requires that you do a lot of running. You might even get tired from it. This means that energy is being used to do work.

Teacher's Note

Discussion questions for teacher to raise with the class after this activity:

- Why do we need energy?
- Where do you get your energy from?
- What other things have energy? (other animals, plants, machines, houses and cars)
- Where do these things get their energy from?
- What would happen without these sources of energy?

We saw that we got tired from running and playing a game in the last activity. We use energy for everything we do.

So you mean even when I do a handstand I am using Energy!

Yes, that is right Jojo! Everything you do needs energy.

ACTIVITY: Energy is all around us.

INSTRUCTIONS:

1. Think about what you do from when you get up in the morning until you go to sleep at night. Think about what happens around you everyday.
2. Write down five things that you have thought about that you could not do without energy.

Teacher's Note

Teachers may ask learners to do this activity in groups and get each group to make a poster or do a short presentation to the class

In our daily lives there are many things that we do that needs energy. As we get energy from food it is important for us to eat breakfast because that is where we get our energy from. Learners need to be able to recognize where energy is needed for living and other processes. Cleaning teeth, walking, running, reading, writing all need energy. Turning on lights and cooking food use energy. Warming our homes in winter or cooling our homes in summer uses energy. Drying clothes on the washing line. There are bicycles, motor cars, motor bikes and aeroplane and all these kinds of transport need energy to move. It is up to the teacher to ask as many open ended questions as possible to get learners to discuss the different uses of energy.

We need energy to carry out all our life processes. Do you remember learning about the life processes in the beginning of the year?

QUESTIONS

Write down the 7 life processes that are carried out by all living

organisms.

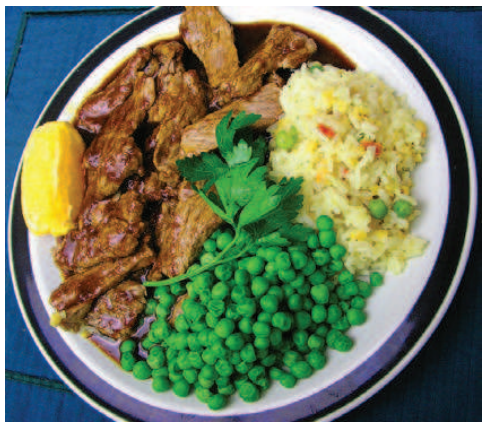
Feeding, growing, reproducing, breathing, excreting, sensing, moving.

I love running around, but where do I get all my energy from?!

That is a very good question. Think about why you need to eat! We get our energy from the food we eat.

We eat plants and the food made from plants to give us energy. We also eat the meat from animals to give us energy.

But where does this energy in the food come from? Energy in our food comes from the Sun!



We get our energy by eating plants and animals.

1.2 Energy from the Sun

Before going on with the rest of this chapter, let's identify some of the new words we will be learning about.

ACTIVITY: Word search

INSTRUCTIONS:

1. Complete the wordsearch by finding the words listed below.
2. Circle them with a coloured pen or pencil.
3. Once you have found all the words, discuss with your partner what you think the word means to you.

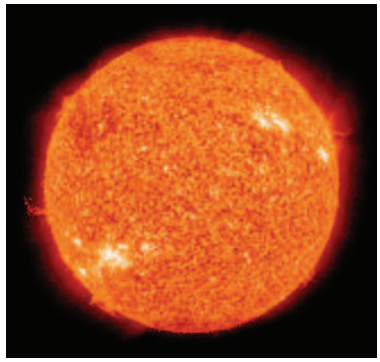
Words to find:

food, energy, work, movement, sun, energy, change, light, heat, absorb, reflect, transfer, chain

R	S	U	N	Q	F	D	L	W	E	A	M
C	E	D	J	G	O	D	O	O	K	S	O
H	H	F	F	S	O	W	O	R	K	K	V
A	C	O	L	I	D	W	X	L	S	A	E
N	O	H	D	E	N	E	R	G	Y	S	M
G	F	G	A	I	C	W	J	U	S	N	E
E	V	V	X	I	B	T	Z	L	Q	K	N
H	E	X	Q	W	N	H	E	E	D	B	T
E	Q	V	C	T	R	A	N	S	F	E	R
A	E	Y	U	J	E	D	F	N	Y	Y	B
T	T	T	Z	U	T	K	L	I	G	H	T
K	E	P	A	B	S	O	R	B	H	U	M

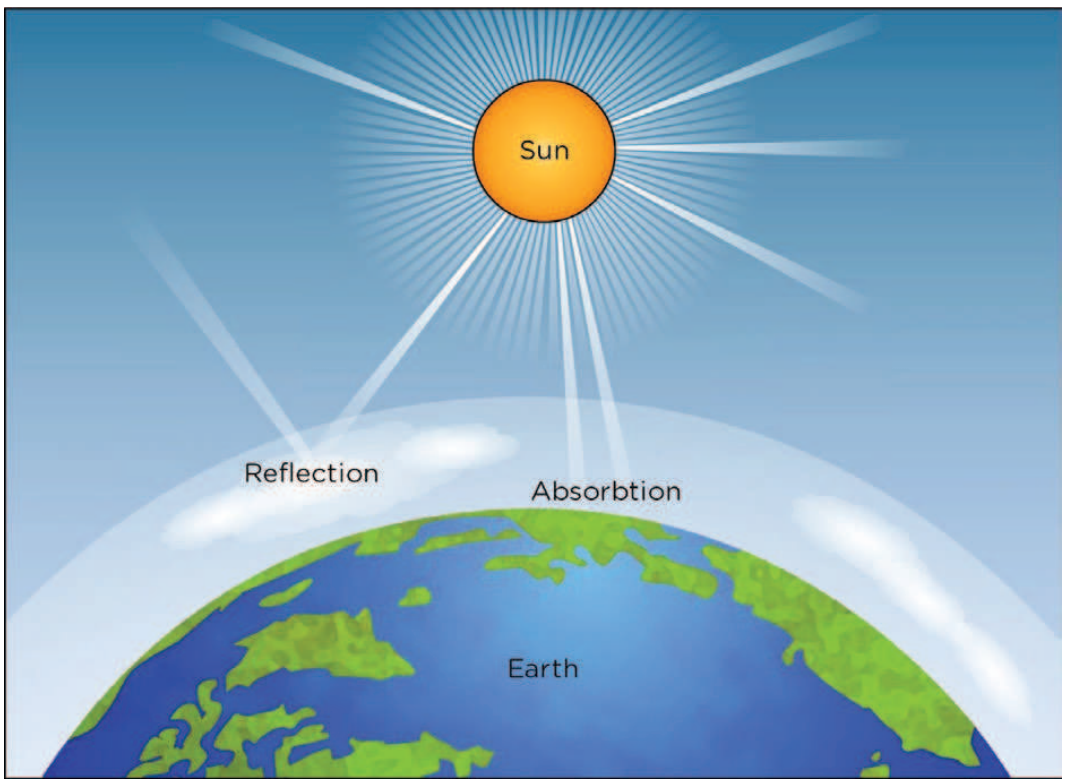
We get almost all of our energy on Earth from the Sun. We call this energy solar energy. Sol means Sun. Next term in Earth and Beyond, we will learn a lot more about the Sun!

The Sun is the closest star to Earth. A star is a giant ball of gas which releases energy. Some of this energy from the sun travels to the Earth in rays. Some of the rays are light that we can see. Other rays like ultraviolet light and X-rays we can not see.



The Sun photographed by NASA

When the rays reach the Earth, some reflect back into space. The Earth absorbs most of the solar energy. This heat warms the Earth and the air around it.



Rays from the Sun reach the Earth. Some are reflected and some are absorbed by Earth.

QUESTIONS

Use your dictionary to write down definitions for

1. reflect

   To bounce back from a surface eg light is reflected back from a shiny surface

2. absorb

   To take something in eg a sponge absorbs water, the earth absorbs heat

ACTIVITY: Energy from the Sun causes heating

When light energy from the Sun hits objects, some of the energy is absorbed. Some of the energy bounces back.

MATERIALS (what you will need):

- 4 thermometers
- black paper
- white paper

INSTRUCTIONS (what you must do):

1. Put one thermometer in a shady place.
2. Put three thermometers in a sunny place on the same surface.
3. Cover the bulb of one thermometer with black paper, cover the bulb of another thermometer with white paper, and leave the last thermometer in the sun with no paper covering it.
4. Which thermometer do you think will show the highest temperature after 10 minutes?
5. Wait for ten minutes and then write down the temperature reading on each thermometer in the table.

Thermometer	Temperature (°C)
In shade	
In the Sun with black paper	
In the Sun with white paper	
In the Sun with no paper	

6. Which thermometer had the lowest temperature after 10 minutes?

   The thermometer in the shade.

7. Did the thermometer in the Sun with the black or white paper covering have the highest temperature after 10 minutes?

   The thermometer with the black paper covering.

8. Explain your results.

   The short answer: Black paper absorbs light so thermometer temperature is greater. White paper reflects light so thermometer gets less light. In the shade, thermometer is sheltered from the Sun, so less heat reaches thermometer so temperature will be less.

   A longer explanation for these results - A thermometer measures the temperature of the air around its bulb. The more energy the air particles have, the higher the temperature will be. When we place a thermometer in the shade it is sheltered from the direct rays of the Sun. The air around the bulb will have less energy than the air around the thermometer which is in direct sunlight, and the temperature will be less.

   The thermometer that has the black paper around it will have a higher temperature reading than the one with the white paper, because black paper will absorb more energy and make the air around the bulb hotter.

Without the Sun, the Earth would be a cold place with no life. Energy from the Sun has many different uses.

Light and warmth: We use the light from the Sun so that we can see during the day. We use the energy from the Sun to warm us.

People enjoying the Sun on the beach. [1]

Plants use light from the Sun to grow: Do you remember learning about what plants need to grow in the first term? Plants use light, water and air as requirements for plant growth. As the plant grows it stores some energy in its roots, leaves and fruit. We will learn a lot more about this in Grade 5 and 6!

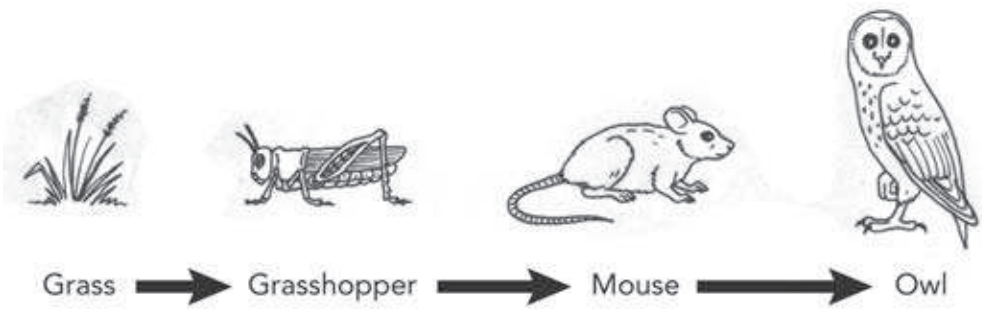
Plants use the energy from the Sun to make food, such as these mielie plants.

Animals eat plants to grow. The energy stored in the plants is used by the animals for life processes.

These cows are eating grass to get their energy.

The transfer of energy from the Sun to plants to people is called an energy chain or food chain. It is a chain because each organism forms a link in the chain as energy is passed along from one organism to the next.

The arrows show the direction of the energy flow from one thing to the next. Look at the example of the food chain below.



An example of a food chain.

Teacher's Note

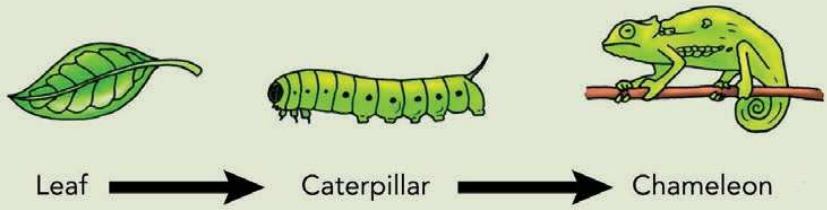
Before reading or going through the next paragraph, or when you are explaining this concept to learners, first ask the question "What sort of energy does the Sun give off?" The answer is light and heat energy. You can then go on to explain how the light energy given off the Sun is used by the grass to make food and the energy is transferred from one organism to the next in the food chain. This ensures that you do not restrict the learners view that the Sun gives off both light and heat energy.

In this food chain, the Sun gives off light energy which is used by the grass to make food. The grasshopper eats the grass. The mouse then eats the grasshopper and the energy is transferred (moved) from the grasshopper to the mouse. Lastly, the owl eats the mouse.

ACTIVITY: Describing the transfer of energy from the Sun

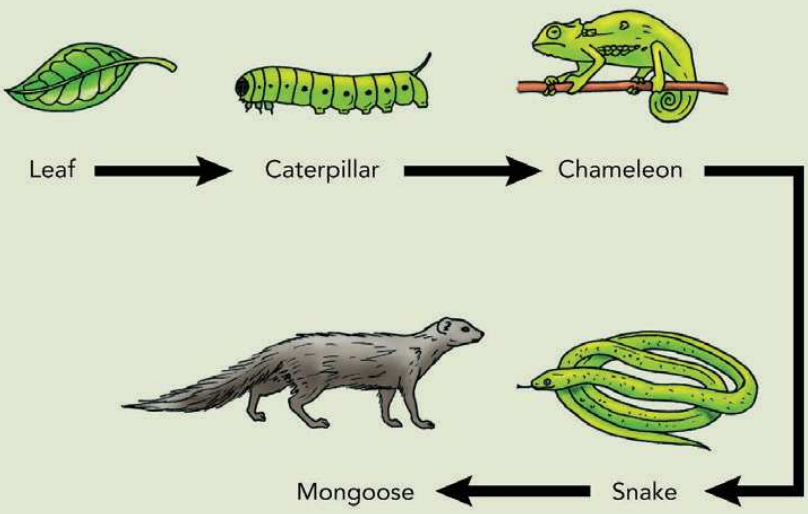
INSTRUCTIONS:

1. Look at the following food chain.
2. In the space below, describe the transfer of energy from one organism to the next.



The Sun gives off light energy which is used by the plant to make food. The caterpillar eats the leaf to get energy to grow and move. The chameleon then eats the caterpillar.

3. This food chain could be much longer! As more organisms eat the previous organisms, the food chain gets longer, and the Sun's energy is passed further along from one animal to the next. Look at the longer food chain below.



4. In this food chain, what does the mongoose eat to get energy?

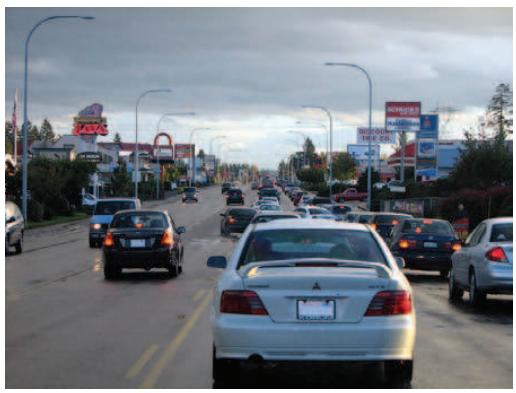
The snake.

We burn wood to get warmth from the energy that is released.

Trees are plants and so they get their energy from the Sun to grow. As it grows, the tree stores some of this energy in its wood. When we need heat and light at night and when it is cold, we burn the wood so that we can use the stored energy.

Long ago before dinosaurs lived on Earth, plants and animals also used the energy from the Sun to grow. Today some of these old dead plants and animals have turned into coal, oil and natural gas. Coal, oil and natural gas are called fossil fuels. We mine fossil fuels so that we can use the energy from the Sun that was stored millions of years ago.

When we use petrol or diesel to make cars or tractors go, we are really using stored energy which came from the Sun millions of years ago.



We use petrol or diesel to drive our cars.

KEY CONCEPTS

- We use energy for everything we do
- We get our energy from our food
- Energy in our food comes from the Sun
- An energy chain or food chain is used to show the transfer of energy

REVISION:

1. What is solar energy?

   It is energy from the Sun

2. Explain how animals get energy for life processes.

   Firstly, the plants get energy from the Sun. The plants use the light energy to make food and grow. Animals then eat the plants or other animals that have eaten the plants in order to get their energy for the life processes.

3. Draw a food chain to show the flow of energy from the sun to a lion that has just eaten an impala.

   sun → grass and shrubs (plants) → impala → lion

4. List some fossil fuels.

   Some fossil fuels are coal, natural gas, oil.

5. Where do fossil fuels come from?

   Plants and animals from millions of years ago stored energy from the sun. These plants and animals died and were buried over time. They have been under the ground for millions of years and have turned into fossil fuels

6. Draw and label a diagram to show where you get energy from when you eat pap and when you eat wors.

   pap: sun > mealies > pap > person

   wors: sun > plants > cow > wors > person

2 Energy around us

KEY QUESTIONS

- What forms can energy take?
- What are energy sources?
- Can energy be transferred from one form to another?

2.1 Energy

Energy comes in many different forms and is all around us.

ACTIVITY: Identifying energy all around us

Teacher's Note

In our daily lives there are many things we do that need energy. As we get energy from food it is important for us to eat breakfast because that is where we get energy from. Movement requires energy and in this picture some people are carrying some boxes also using energy. There are also different kinds of energy in this picture .

Learners need to know all these different kinds of energy. There are bicycles, motor cars, motor bikes and an aeroplane and all these kinds of transport need energy to move. Also there are electric lights on the streets which give us the light we need. There is sound energy coming from the man playing a guitar, from people talking, from the traffic. A lady is sun tanning on her roof and absorbing the Sun's energy. There are many activities happening in this town. It is up to the teacher to ask as many open ended questions as possible to get learners to discuss the different uses of energy.

INSTRUCTIONS:

1. Look at the picture below.
2. Draw a circle around all the places where you think energy is being used.
3. If you have coloured pencils, you can colour the picture in.

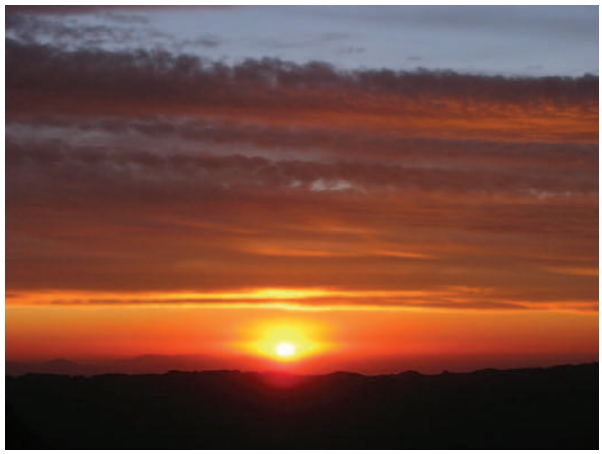
QUESTION:

1. Write down five of the activities that you circled.

We saw in the activity that energy comes in many different forms, such as light, heat, movement and sound energy. Let's take a closer look at these different forms of energy.

Light

Light is energy that travels in rays. Some of these rays we can see, so we call that visible light. Some of the rays we cannot see but we can feel their effect on us. We cannot see ultraviolet rays but they burn our skin when we are in the Sun without sunblock. We can also not see infrared rays but we can feel how hot they are on our skin.



Living things need light energy from the Sun to survive.

Your body also needs sunlight to make Vitamin D in your skin. Without Vitamin D your body cannot absorb calcium and your bones cannot grow and get strong.

Light comes from a light source. Anything that produces light is called a source of light.

- The sun is a source of light
- Stars are sources of light
- A fire is a source of light
- A candle is a source of light
- An electric bulb is a source of light

ACTIVITY: Having fun with shadows

A shadow of an object forms when light cannot pass through it. Let's see how many different and interesting shadows we can make!

MATERIALS:

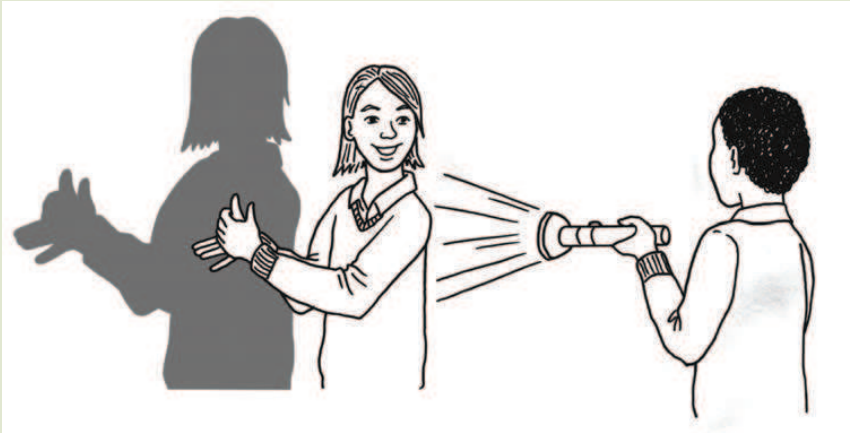
- different shaped objects
- a torch

Teacher's Note

Teacher can provide some interesting objects for the class, such as differently shaped cut-outs. This activity could also be done as a teacher demonstration if enough equipment is not available.

INSTRUCTIONS:

1. Work in pairs.
2. Find some objects around the classroom.
3. Once you all have some objects, ask your teacher to turn the lights off and close the curtains in your classroom.
4. Stand with your partner near a wall.
5. One of you must hold a torch and shine it onto an object that you have found so that a shadow is made on the wall.
6. Your partner must guess which object it is from the shadow. Do not peak at the actual object!
7. Experiment in your pairs with one object and answer the questions.



Can you make a shadow shaped like a dog?!

QUESTIONS:

1. How can you make the shape of the shadow bigger?
   Hold hands/object closer to the light source.
2. How can you make the shape of the shadow smaller?
   Hold hands/object further away from the light source.

Heat

Do you enjoy standing outside on a warm summer day and feeling the warmth from the Sun on your skin? What about warming your hands on a frosty cold morning in front of a fire? You are feeling heat! We discussed that the Sun provides us with light, but it also provides us with heat.

Look at these lions enjoying lying in the heat from the sun!

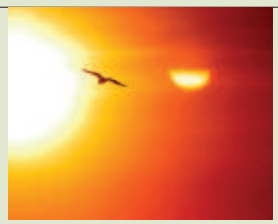
Heat can be found in many different places. Anything that provides us with heat is a source of heat. Let's look more closely at different sources of heat energy.

ACTIVITY: Sources of heat energy

INSTRUCTIONS:

1. Look at the pictures of some sources of heat energy below.
2. Can you recognize the source of heat energy in each picture?
3. Fill in the sources for each picture in the space above it.
4. Can you think of any other sources of heat energy from everyday life? Add some of your own sources of heat energy into the blank blocks.

Examples can include: Electric-blanket, bar heater, wall heater, fan heater.

Candle	*Wood fire*	*Sun*
 1		 2

ACTIVITY: Extend your thinking

INSTRUCTIONS:

1. Look at the picture of the lady in the image below.
2. Answer the questions.

QUESTIONS:

1. How does the blanket help her to stay warm?

   It stops the heat from her body leaving

2. Do you think a blanket should be included in the table above showing the SOURCES of heat energy? Complete the sentence below by drawing a line through the option you do not want. Then write an explanation for your choice:

   Yes I think it IS a source of heat energy / No, I think it is NOT a source of heat energy

   because...

   Prompt questions to walk children through this thought process.. What is the blanket actually doing for us? i.e. does it give off/contain heat energy? NO. So, therefore a blanket is not a SOURCE of heat energy, it is a means by which to KEEP heat energy in a space. The blanket is providing insulation.

Movement

When objects are moving they have movement. The faster the object is moving the more movement it has. Look at the examples of movement below.

While you are riding your bicycle, you have movement.

A race car that is travelling has lots of movement.

A rocket that is taking off has a huge amount of movement.

When I am dancing I have movement!

QUESTIONS

Look at the front cover for Energy and Change. Three of the Thunderbolt Kids have movement. Who are they and explain

why they have movement?

Jojo has movement energy as he is running as he flies a kite. Farrah has movement energy as she is swinging her arms as she plays the marimba/instrument. Sophie has movement energy as she is kayaking and moving her arms and body through the water.

Sound

Did you know sound is also a type of energy?! Sound is everywhere.

ACTIVITY: Observing sound energy around us

INSTRUCTIONS:

1. Close your eyes and be very quiet for two minutes.
2. Be very still and listen to your surroundings.
3. Write down five different sounds that you heard.

Sound is a special type of movement. Sound is energy that makes substances vibrate. Sound travels as vibrations that we can hear and sometimes even feel. All sounds are caused by vibration of substances.

QUESTIONS

Use your dictionary to write down a definition for vibration
a rapid to and fro (back and forth) movement across a central point that is repeated

Sound can come from different sources. You can clap your hands, stamp your feet, talk, sing or play a musical instrument. Different vibrations will make different sounds.

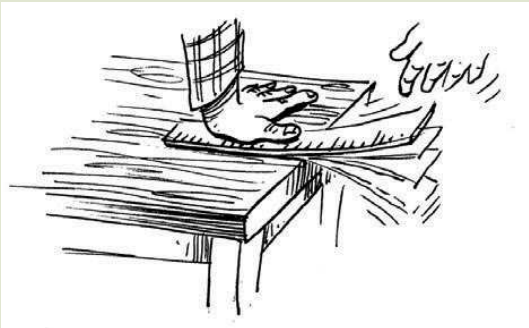
ACTIVITY: Use a ruler to make sound

MATERIALS (What you will need):

- a ruler
- the edge of a desk

INSTRUCTIONS (What to do):

1. Put the ruler on the table so that it sticks out over the edge.
2. Push the ruler down.
3. Pluck the ruler and hear the sound.



QUESTIONS:

1. You can see the vibrations of the ruler as it moves. Can you hear the vibrations?

Teacher's Note

Discuss these conclusions from this activity with your learners:

- You cause vibrations by giving energy to the ruler.
- The ruler gets vibration energy from you.
- The ruler is a very simple musical instrument!

Stored energy

Energy is also stored in some sources. Stored energy is the energy that is stored in our food, in petrol, in wood, oil and other chemicals. Batteries also contain chemicals which are used to store energy. This stored energy can be used for different purposes.

Examples:

1. When we eat food, the stored energy in the food can be used by our bodies.
2. When we burn wood or coal, the stored energy is released as heat energy that we can use to keep us warm.
3. When we burn gas, we can use it to cook our food.
4. When we turn on a car, we use the energy in the petrol to give movement energy to the car.

Energy is stored in food, such as eggs, which we eat for breakfast.

Burning coal releases the stored energy as heat and light. [3]

Natural gas stores energy which is released as heat when it burns to cook our food.

When your parents turn on the ignition in their car, the energy stored in the petrol or diesel is released.

Transfer of energy

Energy can also be transferred (moved) from one part of a system to another part.

You must have heard of electricity before? We use electricity every day in our modern lives. Electrical energy can be transferred from a source to the appliance or light bulb.

QUESTIONS

Write down some things which you think need electricity in your life.

Anything from lights in the house, the stove, the fridge, boiling the kettle, using a hair dryer.

Look at this picture of the light bulb below. Electrical energy is transferred from a source to the light bulb to make it glow.

A light bulb gives off light energy and heat energy. [4]

In a torch energy is transferred from the batteries to the bulb.

Have you ever used a torch before? How do you think the bulb lights up in the torch? The batteries are the source of energy in the torch. When the torch is turned on, the energy is transferred from the batteries to the bulb to make it light up so you can see in the dark.

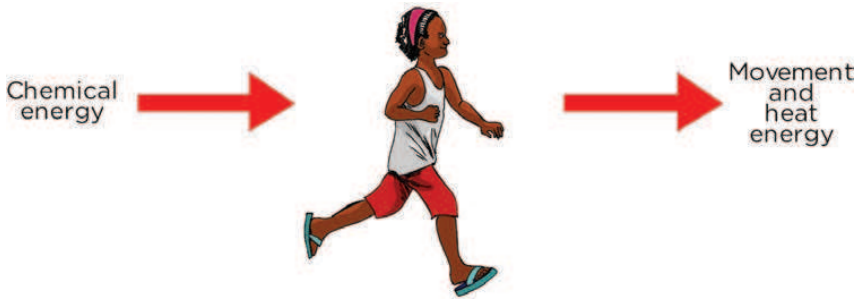
This brings us to the next section. We can think of the energy in the batteries of the torch as being the input energy and the light energy that is given off by the bulb as the output energy.

2.2 Input and output energy

Whenever anything happens, energy is transferred from one component into another. People, machines and appliances need an energy input to work. They also have an energy output that may be useful.

Let's look at some examples.

Example 1: A girl is running a race. In order for the girl to have energy, she needs energy from somewhere. Her input energy is the chemical energy from the food that she ate. By running the race, she is giving out energy in the form of movement energy and heat.



Example 2: Your TV will only work if it is plugged in. It needs energy to work. While watching TV, electrical energy is the input and light and sound is the output.

Example 3: A torch will not work when you turn it on unless it has batteries. The input energy for the torch to work comes from the chemical energy in the batteries which is changed to electrical energy. The output energy from the torch is light and heat energy.

Machines and appliances

We use lots of appliances in our lives. These machines and appliances need an input energy to make them work. This is usually electrical energy. The output energy (the work the appliance or machine does) is something that is useful to us.

Let's look at some examples.

ACTIVITY: Investigating the input and output energy of appliances.

Teacher's Note

After going through this activity to identify what the output energy is (and there are often more than one), go through the appliances in which there are output energies which are incidental and not the main purpose of the appliance. For example in a lamp, the main purpose is to get light energy, but heat energy is also given off. Heat energy is the incidental energy. many learners struggle to identify what the core phenomena are (the output energy which is essential to the function of the appliance, such as light energy in a lamp) and what the peripheral ones are.

This activity presents an ideal opportunity to start teaching some of these appliances. Once you have gone through all the appliances, perhaps explain the concept with the lamp as it is easy to understand and then go through the others and ask learners what the essential output energy is that you want from the appliance and which are the incidental ones which also occur. For example, with a drill the main, essential output is movement, and the peripheral, incidental output energies are sound and heat energy. Another concept to note, which can be subtly introduced at this point, is that in order to make an appliance energy efficient, you want to minimize the energy conversion to the incidental energy output and maximise the energy conversion to the essential energy output.

INSTRUCTIONS:

1. Below are pictures of different appliances.

2. Each one has an input energy (electricity) and an output energy which is transferred to the surroundings, such as heat, sound, light or movement.

3. Look at each image and write down the type of output energy that it transfers to the environment.

4. Some of the appliances may transfer more than one type of energy to the surroundings!

Appliance	**Output energy transferred to surroundings**
Stove 	*Heat energy*
Kettle  5	*Heat energy (and movement energy of the water)*
Lamp  6	*Heat and light energy*

Hair dryer 	*Heat and sound and movement energy*
Vacuum cleaner 	*Sound and movement (air) energy*
Electric fan  7	*Movement energy and sound energy*
Drill  8	*Movement and sound energy, and heat energy (the motor and drill bit gets hot)*

In summary we can say, in appliances and machines, the input is normally electrical energy and the output depends on the appliance:

- Heat energy - from a geyser, stove, kettle, hair dryer
- Sound energy - from a drill, vacuum cleaner, hair dryer
- Light energy - from a lamp, torch
- Movement - from an electric fan, drill

KEY CONCEPTS

- Energy is all around us
- Energy can be moving in the form of light, heat, sound and moving objects
- Energy can be stored in food, wood, coal, oil and natural gas

REVISION:

1. In the table, fill in examples of different sources of energy.

Light energy source	Heat energy source	Sound energy source	Stored energy source
sun	*fire*	*drums*	food
candle	*sun*	*talking*	*coal*
torch	*stove plate*	*guitar or instrument*	*petrol*
lamp	*kettle*	*radio*	*oil*

Teacher's Note

There are many correct answers for this table. As with the last activity, you can also distinguish between the primary (functional) conversions and the secondary (incidental) conversions.

2. Which sense organ do you use to detect sound?

   You use your ears.

3. A hearing-impaired person cannot hear music. How do you think someone who is hearing impaired could still dance to the music?

   They can feel the vibrations through their feet or hands. They can feel the music.

4. Which sense organ do you use to detect light?

   You use your eyes.

5. For each of the following appliances, decide what is the input energy and identify the output energy?

Appliance	**Input Energy**	**Output Energy**
radio	*chemical or electrical*	*sound*
hair dryer	*electrical*	*heat and moving energy*
car moving	*chemical from petrol*	*moving energy and heat*
riding a bicycle	*chemical from food*	*moving energy and heat*
playing drums	*chemical and moving*	*sound*
lights in your home	*electrical*	*light and heat*
plants growing	*light and heat / solar*	*chemical*

6. What does "energy is transferred" mean?

   Energy is changed from one form to another

7. List three substances that contain stored energy that we can use.

   Three substances could be food, wood, oil, petrol, coal

3 Movement and energy in a system

KEY QUESTIONS

- How do music instruments make music?
- Are there different types of musical instruments in different parts of the world?

Teacher's Note

This chapter leads on from the last in that it is taking movement energy further and looking at how movement energy produces sound energy in the form of the parts of the instrument that move and the vibrations which carry the sound energy.

NB: A suggestion is to rather do the next chapter on "Energy and Sound" before this chapter on "Movement and energy in a system" instead of after as it states in CAPS. There are many concepts in the chapter on "Energy and sound" which can be used when learners have to make a musical instrument in this chapter. Logically and conceptually, this does make more sense as sound is introduced as a form of energy in the previous chapter on "Energy around us" and then the chapter on "Energy and Sound" investigates sound further, before sound is applied to the use in musical instruments. This however is your choice as a teacher and how you would like to progress through the chapters.

3.1 Movement and musical instruments

Look at the photo of the orchestra. There are many different instruments that all make music. All the sounds are combined together to make a wonderful noise.

An orchestra consists of many musical instruments playing together.

Let's make some music!

ACTIVITY: The joy of sound - making a body band

INSTRUCTIONS:

1. Work in groups of 4 - 5.
2. You can make music with your body. You can clap your hands or stamp your feet. You can make clicking sounds with your tongue or puff out your cheeks and tap them. You can beat a rhythm on your thighs.
3. In your group, find interesting ways to use your bodies to make a short (1 minute) music piece.
4. Be creative. Present your 'body band beat' to your class.
5. Some of you could even dance while the others make the music!

3.2 Movement causes sound

In your body band, you made lots of different sounds. Every sound that you made involved you moving a part of your body.

Many musical instruments use movement to make sounds. Let us look at a few common musical instruments.

A man plucking the strings on a guitar.

When a guitar string is plucked, the string vibrates and causes a sound wave to occur. The sound is amplified (made louder) by the air vibrating in the hollow inside of the guitar as well. We can then easily hear the sounds produced by the guitar.

A group of drum players. [1]

A drum has a thin membrane or skin that is stretched tightly over the opening of something hollow. As the drummer beats this membrane, the membrane vibrates and makes the sound we hear.

A trumpet player in a marching band. [2]

VISIT

Zulu drums.
goo.gl/WK7sM

The trumpet player blows through closed lips into the trumpet. This makes a buzzing sound which causes the air inside the trumpet to vibrate. The vibrating air causes sound which we can hear.

Many musical instruments work because movement causes vibrations which cause sound.

3.3 Indigenous musical instruments in South Africa

VISIT

Harpist playing (video).
goo.gl/ZTwug

Music and musical instruments and very important in many cultures and societies. Different cultures have different musical instruments which are part of their traditions. The instruments which were developed by a group of people and are used in a particular area, are called indigenous instruments. Indigenous instruments are unique to a particular society or culture.

Although the instruments are different, they all work because movement causes vibrations which cause sound.

Africa has a rich musical culture and many unique musical instruments. Some examples are shown below.

QUESTIONS

On the front cover for *Energy and Change*, one of the Thunderbolt Kids is playing an instrument on the beach! Who is it and what instrument is it?

Farrah is playing a marimba.

Let's look at examples of western and African instruments. We will look at musical instruments in which you blow, and at musical instruments where you pluck the strings. There are lots of similarities in the instruments of these two cultures.

ACTIVITY: Musical instruments from two different cultures

Teacher's Note

The idea of this activity is to not juxtapose the differences in the instruments between African and Western cultures, but to rather show the similarities and that both cultures have similar instruments which are played in similar ways, but made from different materials. A suggestion here is to start this activity with a class discussion on what a culture is, how different learners perceive culture and what it means to them and to highlight the many cultures that we have in South Africa. Encourage learners to start expressing their opinions and ideas by asking direct questions. Then go on to do the activity below.

INSTRUCTIONS:

1. Study the examples of musical instruments shown in the following table.
2. Pay special attention to how each one is played and the material they are made from.
3. Answer the questions which follow.

Western Culture	**African Culture**
 Flute	 Kwela Flute
 French Horn	 Kudu Horn

Harp 	Krar 
Violin 	 Traditional Musical Bow

VISIT

How a flute is made (video).
goo.gl/XW0qd

QUESTIONS:

Compare the instruments by filling in the table below:

Instrument	***How it is played?***	***What is it made from?***
Flute	*blowing*	*Silver plated metal*
Kwela Flute	*blowing*	*Wood*
French horn	*blowing*	*Brass*
Kudu horn	*blowing*	*Horn of a kudu, beads to decorate*
Harp	*plucking*	*Wood and nylon strings*
Krar	*plucking*	*Wood, cloth and string*
Violin	*plucking*	*Wood and string made from steel*
Traditional musical bow	*plucking*	*Sticks, calabash, string made from hide*

QUESTIONS

Remember when we spoke about input and output energy? What do you think is the input energy and output energy for most musical instruments?

The input is movement and the output is sound.

Let's now make our own musical instruments!

ACTIVITY: Design and make your own musical instrument

Teacher's Note

Learners need to research, design, make and evaluate a musical instrument. Examples they could consider include: guitar, pan pipes, whistles, flutes. The scene is set below with the Thunderbolt Kids needing to make musical instruments for a local festival. The emphasis is on indigenous instruments, although not limited to this. The learners should be encouraged to identify one of the characters to help to design and make an instrument following the Design Process.

The educational value in Technology lies in the investigating, thinking and designing that children must do. Technology aims to make children capable; capability means the children's ability to turn thinking into **doing** and **completing**. When they learn new science knowledge, the learning has a purpose: they must use that knowledge in producing good designs. When they have made a product, they should be able to explain **to you** all the reasons why they designed it like that (even if they could not make it in the way they wanted to).

Teacher's Note

So some very important learning happens during a Technology project, and you need to guide them through all the stages. If you trained as a technology teacher, you will recognise the NCS pattern of technology projects - do you remember IDMEC? You can remind the learners of this:

"I stands for **Investigating** the problem which some people have, investigating existing products, and investigating concepts and skills that you will need to solve the problem.

D stands for **Designing** - that means using what you learned from investigations to think of good ways to solve the problem.

M stands for **Making** - when you make your model, you use materials and tools, you make your model look good, and you show the teacher what you learned in your investigating." (Notice that most **children design with their hands**, not only with pencil and paper. As they work with materials they get more ideas, and their design improves. So we should expect them to go back and forth between Designing and Making. It's really all the same stage of a project.)

E stands for **Evaluating** - after you have made your model to solve the problem, you have to ask, does it work? Is this what the people wanted? Could we make a better one?

C stands for **Communicating** - you must show other people how you decided on your solution to the problem. You need to write and draw your ideas." (The learners should be drawing and writing all through the project. Don't leave the writing to the end, because they find it boring at that stage. When they are getting new ideas they often enjoy writing because they are writing about their own ideas; this is a great strength of technology in school. A technology project gives the children reasons for reading and reasons for writing. And so - this is very important - we can address the literacy problem through the subject of science and technology.)

The Thunderbolt Kids want to participate in the local Art Festival after the holidays. They want to make a band of four and participate in the section for Indigenous Bands. Any instruments used must be indigenous instruments which are hand made.

The Thunderbolt Kids want a variety of different instruments.

Sophie can play the flute so she would like an instrument which she can play by blowing, such as a whistle or pan pipes. Tom likes to play his electric guitar, but he can't use this as the instruments need to be traditional and handmade, so Tom needs an instrument which he can play by plucking strings. JoJo loves playing the drums and Farrah likes to dance with a shaker!

Check out their photo below which they had taken for their poster to advertise for the festival!

The problem is, none of the Thunderbolt Kids have an instrument to play. So you need to help one of them to design and make a musical instrument.

DESIGN BRIEF:

You need to design and make an instrument for one of the Thunderbolt Kids. Write a design brief below where you identify which Thunderbolt Kid you are going to help and which type of instrument you are going to make.

INVESTIGATE:

The next step in the Design Process is to investigate and do some research about the instrument that you are going to make. You can use books and the internet to do your research. Perhaps you know someone who plays this instrument?

We already looked at some instruments and what they are made from and how they are played.

Answer these questions when doing research about your instrument:

1. How do you play the instrument?
2. What is it normally made from?
3. Is this instrument part of any culture and their traditional ceremonies?
4. What other interesting facts did you find out about this instrument?

DESIGN:

Now that you know a bit more about the instrument, you need to design how you are going to make your own.

Your instrument has the following specifications:

- It must make a sound by blowing on it or by plucking strings
- You must be able to play at least two different sounds

Your instrument has the following constraints:

- You must make it in class

Answer these questions:

1. What shape and size will your instrument be?
2. What materials will you need to make it?
3. What tools will you need to make it?

Now you need to draw some designs for your instrument. Use scrap pieces of paper to do your first designs. Once you are happy with your design, use the space below to draw your design. Label your drawing showing what materials you are going to use for the different parts.

When you are making your instrument you might get better ideas to improve the sound. So come back afterwards and draw on the bottom half of the page; show what you really decided to make.

MAKE:

Now make your instrument in class! After you have all finished making your instruments, take turns to play them for each other. Perhaps you can even form your own bands!

Teacher's Note

Once learners have finished making their instruments in class, go around and evaluate whether each learner's instrument can be played. You can do this as a whole class where each learner has a chance to present their instrument, explain what it is, and then attempt to play two different sounds. If time permits, you can break the class up into groups and they can form a band where they have to put together a song and then present it to the class.

EVALUATE:

Answer the following questions on your musical instrument after you have finished making it and testing to see ifit can be played.

1. Does your musical instrument look like your initial design?
2. How do you play your instrument?
3. Can you play two different sounds (notes) on your instrument? If not, why can't you?
4. How would you improve your design so that your instrument makes a better sound or is easier to play?

COMMUNICATE:

Now, do not forget that we were trying to help the Thunderbolt Kids design and make musical instruments for their local arts festival!

Write a paragraph below where you tell the Thunderbolt Kid whom you decided to help about the musical instrument that you made. Tell them what worked and what did not work, so that they can also learn from what you did and make a great instrument to play in their band!

KEY CONCEPTS

- Many musical instruments use movement input energy to work
- Many musical instruments have parts that can move or vibrate
- Sound is the main output energy of musical instruments

REVISION:

1. What do most musical instruments have in common that allow them to make music?

   A moving part that causes vibrations

2. Sounds are caused by vibrations. What is a vibration?

   A vibration is a very quick movement (to-and-fro) of an object or its parts in the same place.

3. How do you make a sound on a guitar? And how do you think the shape of the guitar helps to make the sound louder?

   You make sound by plucking the strings. The sound is amplified (made louder) by the air vibrating in the hollow inside of the guitar

4. What does the word "indigenous" mean?

   originating and characteristic of a particular place or people

5. What is your favourite musical instrument? Explain how it looks, how you would play it, and why you like it so much.

4 Energy and Sound

KEY QUESTIONS

- How does sound travel from where it is made to where it is heard?
- How can we make loud or soft sounds?
- How can we make low or high sounds?
- What is noise pollution?

Teacher's Note

For this chapter, keep the musical instruments which were made by the learners in the previous chapter on display in the classroom. You can then use these instruments to demonstrate various concepts in this chapter. Alternatively, this chapter could be done before the chapter on "Movement and Energy in a System" where a musical instrument is made as this chapter deals with a lot of concepts and investigations into sound that can then be explored when making the musical instrument. Or else, if you are doing this chapter now after making a musical instrument, then use what they first experienced by investigating hands on when you now deal with the theory.

4.1 Vibrations and sound

We have seen that musical instruments make sounds through vibrations. You saw in the previous chapter that when you plucked the strings on some instruments the strings vibrated and made sound.

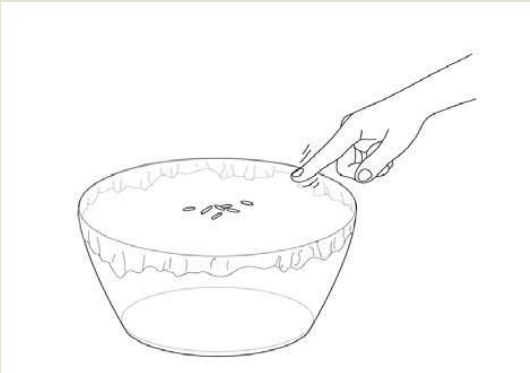
We can hear and feel vibrations

We know that vibrations cause sound. But can sound also cause vibrations?

ACTIVITY: Observing vibrations

MATERIALS:

- a deep glass dish
- cling film
- some rice grains (or any other small, dry particles)



VISIT

Sounds causing water vibrations (video). http://goo.gl/7Id8p

INSTRUCTIONS:

Part A:

1. Cover the bowl with the cling film.
2. Make sure it is tightly covered, but not too tight to start tearing.
3. Put the rice grains between the middle and the edge of the clingfilm.
4. Tap the cling film lightly. Do this away from where you put the rice grains.
5. Now tap it harder.
6. Do you see that your rice grains are moving or jumping up and down?

Part B:

Can you get the rice grains to jump using just your voice? When they jump you know the cling film is vibrating.

1. Hum over the bowl. Near the cling film but away from the rice grains.
2. Make your voice deep and try again.
3. Make your voice high and try again.
4. Hum louder. Hum softly.
5. Try SHOUTING, but do not blow on the cling film or the rice. Your sound must make the rice jump about, not your breath.

QUESTIONS:

1. What happens to the rice grains when you tap the cling film?

   The rice jumps when the cling film moves.
2. When you hum, the cling film vibrates? Explain why there is a vibration.

   The cling film vibrates because of the sound waves traveling through it make it vibrate.

So what did we learn from this activity?

- Tapping the cling film gives it energy to vibrate.
- The rice grains are only there so we can see the vibrations. They do the job well!
- Making a sound near the cling film causes the rice grains to move.
- This means the cling film is vibrating from the sound.
- Sound causes vibrations that you can see.

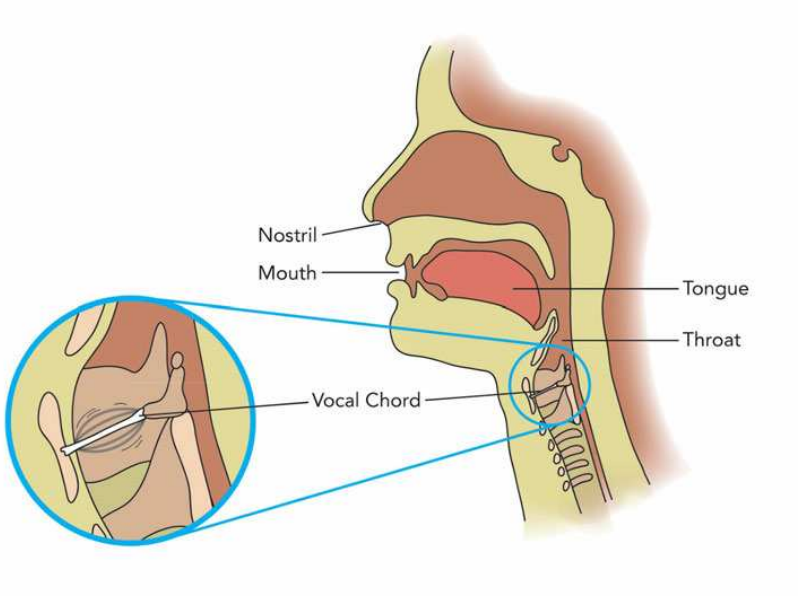
Can we feel vibrations too? Let's find out!

ACTIVITY: How do we make sound when we talk or sing?

INSTRUCTIONS:

1. Rest your hand gently on your neck and hum.
2. Make low humming sounds and higher humming sounds.
3. What do you hear?
4. What do you feel?

There is a vibration in your throat when you hum which you could feel with your hand. It causes the sound you make when you speak and when you shout and when you sing.

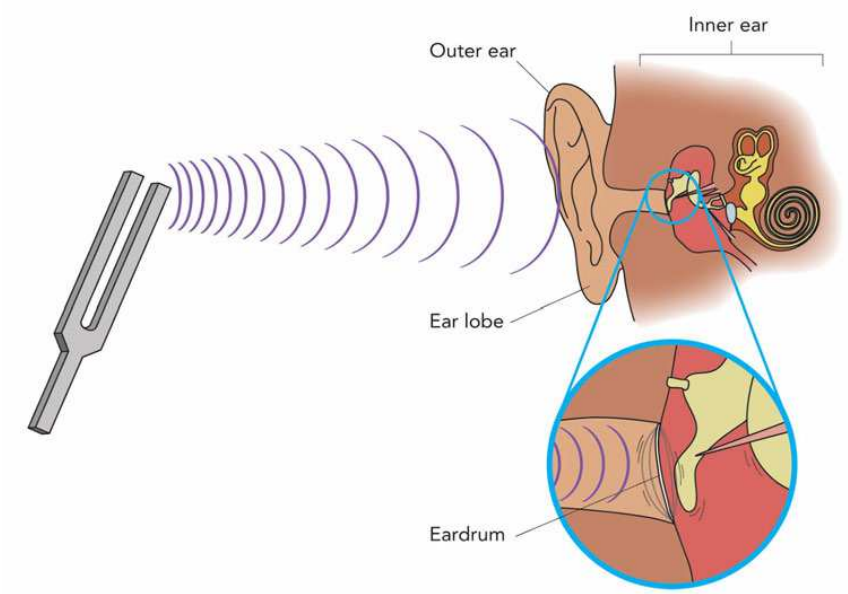


Can you see the vocal chords which vibrate to make a sound when we talk or sing?

What is vibrating in your throat? You have vocal chords in your throat. As air moves over them they vibrate. As they vibrate they cause sound. Look at the picture below. The vocal chords are almost like the layer of cling film over the bowl in the previous activity which vibrates.

So we make sounds when our vocal chords vibrate, but how do we hear sounds? In your ear you have eardrums. Eardrums helps us to hear the sound. Your eardrum acts like the clingfilm. Your eardrums vibrate when a sound goes into your ear. This is how you hear sounds!

The human ear is actually made of many small parts! Your outer ear is what you can see on the sides of your head. Your inner ear is inside your skull and made of small bones. Look at the picture below. Can you see the eardrum which vibrates? This vibration then bumps the little bone next to it and the brain can read this as a sound.



Wow, that all sounds quite complicated! And it's all happening in both my ears every time I hear a sound!

VISIT

Are you listening? (video on hearing).
goo.gl/o2KHT

That's right Jojo, the human body is amazing!

Vibrations travel through a material

Sound vibrations need a material to travel through. We call this material a medium. When you are listening to your teacher talk in class, the sound vibrations are travelling through the air to your ears.

ACTIVITY: How does sound travel through air?

Teacher's Note

The following idea seems quite tangible... just letting the kids "move" to experience how the vibration is transmitted from one place to another by vibrations of the air is valuable. This interpretation requires no mention of waves. Sound waves are only introduced in the later grades. This activity can help to entrench most of the ideas developed so far (vibrations, how energy gets from one place to another etc) in a tangible way.

INSTRUCTIONS

1. Get a group of your friends and stand in a straight row.
2. Stand side by side all facing the same way. Your shoulders must not touch, but you must be close
3. Each one of you is an air particle.
4. Two more friends must stand at the ends of the row. One friend is a vocal chord. The other friend is the eardrum
5. The "vocal chord" must bump the first "air particle" and move back and stand still.
6. The first "air particle" must bump the second "particle" and then move back and stand still.
7. The second air "particle" must do the same to the third and move back and stand still and so on...
8. When the last air particle bumps the eardrum, the eardrum moves and then stand still

So sound is able to move from where it is made to where it is heard by air particles vibrating and passing the vibration from one particle to the next particle.

But does sound travel through other materials?

ACTIVITY: Making a telephone

Teacher's Note

This activity can also be done as a class demonstration and you only need to make one telephone instead of each pair making one. This activity and the next one on tapping and listening through the wall demonstrate the same concept. So, if you do not have time to do both, then just perform one of them.

MATERIALS:

- Two old tin cans or two yogurt containers (ask an adult to make sure the tin cans have no sharp edges that might cut someone!)
- Some string (2 to 5 m long).

INSTRUCTIONS:

1. Work in pairs.
2. Ask your teacher to make a small hole at the bottom of each of the tins. You want to connect the two tins with the string.
3. Tie a big knot at one end of the string.

4. Pull the string through the hole in one of the tins. The knot must be on the inside of the tin.
5. Feed the other end of the string through the hole in the other tin. Feed it from outside the tin.
6. Tie a big knot at the end of the string.
7. Now you have a funny sort of telephone!
8. Get a friend to hold one tin to his or her ear.
9. Take turns to speak into the tin and listening to your friend speak to you.

QUESTION:

1. Why does this tin-telephone work? How does the sound you make get to your friend? After discussing this in class, write down your answer below.

Teacher's Note

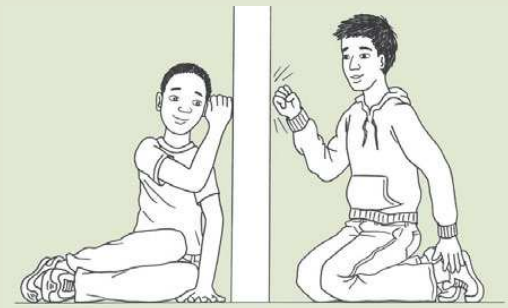
Teacher note for discussion: The sound travels along the string. It also travels through air, but its not the same as the sound travelling through the string. The conclusion is that sound exists only in a medium, and it travels better through the string than through the air. For interest a quick discussion about sound in space: Sound cannot travel in space even if vibrations occur - there is no medium for it to move through. Here sound is carried in three stages: through air from vocal chords to base of tin; through string from base of first tin to base of second tin; through air from base of second tin to eardrum. A rich and valuable class discussion can evolve from asking how exactly the vibration energy of the speaker's vocal chords ends up as vibration energy of the hearer's eardrum.

Let's do another fun activity to see how sound travels through other mediums!

ACTIVITY: Secret code through a wall

INSTRUCTIONS:

1. Work in pairs.
2. Make up a secret tap code: maybe three quick taps means hello. You can make up words using taps.
3. Sit on opposite sides of a wall with your partner.
4. Put your ears to the wall and talk with your tap code through the wall.
5. You may have to knock if tapping is too soft.



Sit on opposite sides of a wall and communicate to your friend!

VISIT

Bell ringing in a vacuum jar (video)
goo.gl/yjsj6

Let's summarize what we have learned about sound and how vibrations move:

- Sound must travel through something.
- Your voice can travel through air.
- Your voice can travel through string.
- The tapping sounds can travel through a wall.
- We say that sound needs a **medium** to travel through.
- The medium your voice travels through is air.
- Sound travels through wood and bricks.

- Sound travels very well in solids.

QUESTIONS

1. Why does sound travel well through solids?

   This might be hard for learners to answer as it has to do with the arrangement of particles in solids and gases. It is because the particles in solids are close to each other. In gases they are quite far apart compared to solids. This is why solids can carry sound energy better and further than gases.

2. Whales communicate (talk to each other) under water even when they are very far from each other. Explain how the sound that one whale makes travels to another whale.

   The whale causes the particles in the water to vibrate. As water particles are close to each other, the vibrations can move from one particle to the next and the sound can travel through the water.

What happens when there is no medium? If you are able to watch the video of a bell ringing in a vacuum, then do so. Sound needs a medium to be able to travel. A vacuum is where there is no air or any other matter. So do you think you will be able to hear a bell ringing in a vacuum?!

Teacher's Note

As an extension, if you are able to watch the video, then it shows a bell ringing in a vacuum. First the bell is in a jar that is full of air. We can hear the bell ringing. Slowly the air is pumped out of the jar by the vacuum pump. The bell sounds softer and softer until you can't hear it all. Explain the observations: Initially there is air in the jar so the vibrations from the bell can be carried through the air by one particle of air causing the next particle of air to vibrate. Once the air has been removed, the bell can't cause anything to vibrate so the sound cannot be carried from the bell to your ear.

QUESTIONS

Can sound travel from the Moon to the Earth? Why?

No. There is no air between the moon and the earth - no molecules or anything to act as medium.

Making sounds

Sometimes you need to speak softly when you whisper a secret to a friend. But other times you need to shout loudly to your friend on the other side of the playing field! Sounds have different volumes.

Also, a mouse makes a very squeaky, high sound. But a lion makes a low growl. The sounds that these animals make have different pitches.

ACTIVITY: Let's make sounds with an elastic band

Teacher's Note

This activity can also be done as a demonstration. Instead of cutting the elastic bands, it can be pulled over a lunch box. Pulling it tighter or more loosely will change the sound. You can also use elastic bands of different thickness to produce different sounds.

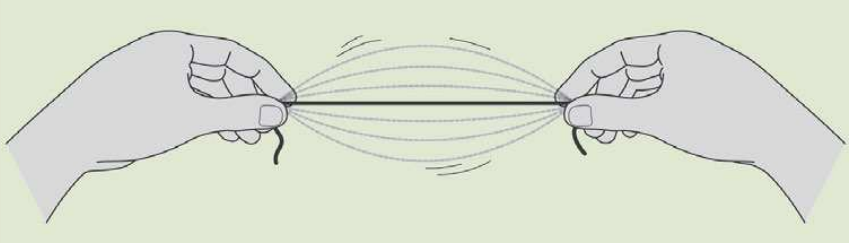
MATERIALS :

- The biggest elastic or rubber band you can find (a hair band will not work very well)

INSTRUCTIONS:

1. Work in pairs.
2. Cut your elastic band in one place to make one long elastic strip.

3. One partner must hold the elastic at both ends.
4. The other partner can pluck the elastic to make it move.
5. Try to make loud and soft sounds with your elastic.
6. Try to make high and low sounds as well. (High sounds are squeaky like a mouse, low sounds are deep like a lion's growl)



The elastic makes a sound when it moves.

QUESTIONS:

1. Describe how you made the sound loud.
2. Describe how you made a high sound.
3. Describe the movement of the elastic band.

Teacher's Note

The teacher should emphasise here that the we get different types of movement - running, riding a bicycle, water flowing, clouds blown by the wind. Teach learners that the movement made by the elastic is another type of movement that we call vibration and that this vibration causes sound.

In this activity we have seen that movement causes vibration that causes sound. Different types of movement cause different sounds.

- When the elastic is plucked (pulled) hard the sound is loud. You can see the elastic makes big movements.
- When it is plucked gently (pulled just a little) the sound is soft. You can see the elastic makes small movements.

- When the elastic is looser and your partner's hands were closer together, the sound has a lower pitch. Did you see the elastic move slower?
- When the elastic is tighter and your partner's hands were farther apart, the sound has a higher pitch. Did you see the elastic move quicker?

What we have learnt about volume:

- Soft sounds are caused by small vibrations.
- Loud sounds are caused by big vibrations.

What we have learnt about pitch:

- A high sound is made by fast vibrations.
- A low sound is made by slow vibrations.

Teacher's Note

Use some of the instruments made by the learners to show the difference between loud and soft sounds, for example hitting softly or loudly on a drum to make small and big vibrations respectively. Or if you have another instrument with different length strings, pluck the strings to show the difference in pitch. The shorter strings will vibrate quicker and therefore produce a higher pitch, whereas the longer strings will vibrate more slowly and produce a lower pitch.

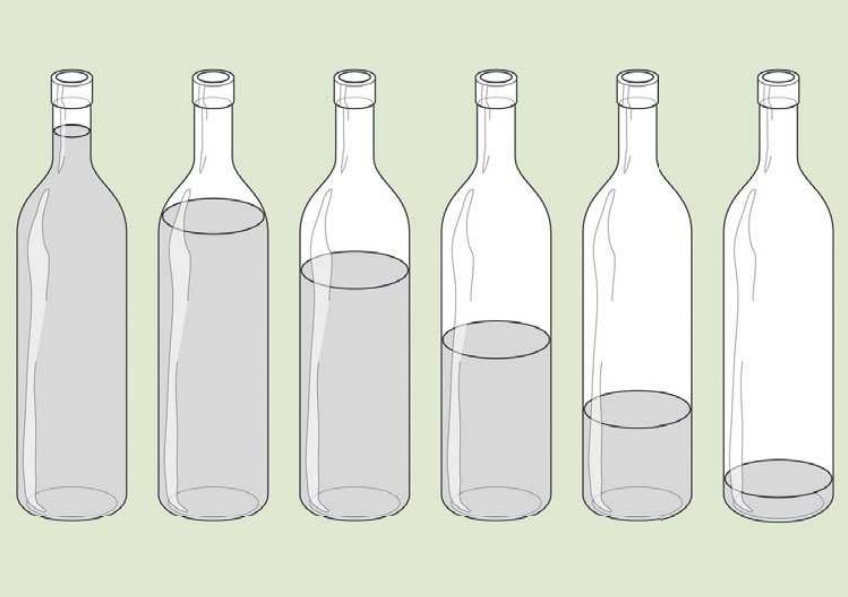
ACTIVITY: Making a water marimba

MATERIALS:

- Six or more glass bottles or jars (they must all be the same kind)
- Water

INSTRUCTIONS:

1. Pour a small amount of water into one bottle.
2. Pour a lot of water into another bottle.
3. Pour water into the other bottles - all bottles must have different amounts of water as shown in the picture.
4. Arrange the bottles from the fullest to the emptiest, like in the picture below.
5. Blow over the mouth of the bottles or tap them with a pencil.
6. You have made a water marimba!
7. Try making up a song.



A water marimba.

QUESTIONS:

1. If you hit the bottles with the same strength, which bottle made the highest sound?
2. If you hit the bottles with the same strength, which bottle made the lowest sound?
3. Compare the sound made by the same bottle when you tap it gently or tap it hard.

Tapping gently makes a soft sound. Tapping hard makes a loud sound

What did we learn from our water marimba:

- The height of water in the bottle changes the pitch of the sound made.
- When you tap a bottle gently or hard, you change the volume of the sound.

How can we make sounds louder? Have you ever seen someone talking over a megaphone? A megaphone makes our voices louder and travel further. Let's make our own megaphone.

ACTIVITY: Make a megaphone

Teacher's Note

This activity can also be done as a class demonstration. Each child does not need to make one.

MATERIALS:

- Thin cardboard or stiff paper
- Sticky tape
- A pair of scissors

INSTRUCTIONS:

1. Roll the card or paper into a funnel shape. There must be a hole at the narrow end (about 5cm wide).
2. Tape the card so that the funnel will keep its shape.
3. Neaten up the funnel. Use the pair of scissors to cut off any pointy bits at the two open ends.

4. If you have some extra paper you can make a handle for your megaphone. Decorate your megaphone.
5. Now you can speak or sing through the small opening.
6. Test the difference if you speak normally or into the megaphone.

Speak into your megaphone like this.

QUESTIONS:

1. The megaphone (also called a loudhailer) makes your voice sound louder. How do you think it does this? Discuss this as a class and write an answer down.

   This can be quite tricky for learners to answer by themselves so do it as a class discussion. This presents a good opportunity to allow a bit of reasoning to take place in these discussions. There is a paradox to be resolved: louder sounds mean more sound energy reaching your ears, but if you speak in the same way with and without a megaphone, the sound must have the same energy. The idea is that the sound is reflected from the internal walls of the funnel and projected forwards towards the large opening. The sound is therefore concentrated in one direction meaning that more of the sound energy travels towards the hearer making it seem louder than it is without the device.

2. Is your voice really louder or does the funnel shape just make it seem that way?

   The funnel makes your voice seem louder.

Many instruments make sounds louder in some way. Wind instruments (tube instruments) use a tube as a funnel to make sounds seem louder, similar to what you did with the megaphone. String instruments do the same, but using a hollow shape.

ACTIVITY: Making sound louder with a box

Teacher's Note

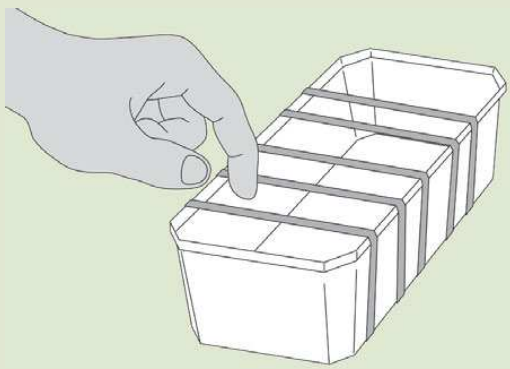
This activity can be combined with the elastic band activity earlier on.

MATERIALS:

- A cardboard shoe box or plastic box (a margarine tub or lunch box will work well)
- An elastic (rubber) band

INSTRUCTIONS:

1. Stretch the elastic between your hands and ask a friend to pluck it.
2. Now pull the elastic band over the box. The elastic must be tight. If it is not tight use a smaller elastic or a bigger box.
3. Pluck the elastic.
4. Feel the sides of the box as the elastic vibrates. Can you feel that the box is also vibrating? You may put a few rice grains inside to show the vibration of the box.

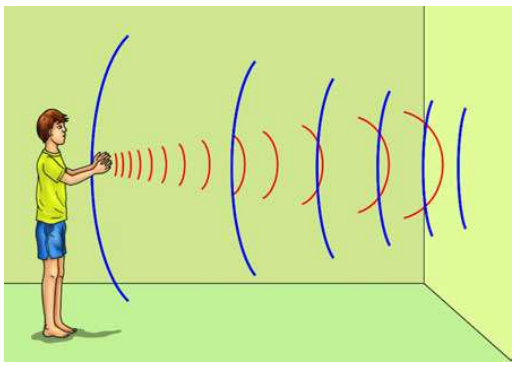


The box makes the sounds louder.

Let's summarize what we learned from this activity:

- The box makes the sound seem louder.
- The box vibrates with the elastic.
- The vibrations of the box make sound inside the box.
- This makes the sound seem louder.
- Some musical instruments have a hollow shape.
- The sound is reflected inside the hollow.
- The walls of the hollow shape also vibrate as the sound echoes inside.
- This makes the sound seem louder.

Do you know what an echo is? An echo is when the sound bounces back off a surface and you hear it many times. Look at the picture below.



An echo occurs when sound bounces back off a surface and you hear it again.

QUESTIONS

Why do you think a guitar has a big hollow base?

This question leads on from the previous activity and from the previous chapter. The hollow base makes the sounds louder when the strings are plucked as the sounds reflect off the walls in the base causing the sound to be amplified as the vibrations are intensified.

4.2 Noise pollution

There are many kinds of pollution. Unfortunately we are familiar with litter lying around the pavements and waste and rubbish in our rivers and dams. This is ground and water pollution.

Litter polluting the side of the road.

Look at the pollution in this pond!

Air pollution is when smoke and chemicals end up in the air which means it is not good for us to breathe it in.

Can you see the air pollution in this city which makes it look smokey? This is called smog.

There are other types of pollution as well including light and noise pollution.Noise pollution is any sound that continues for a long time and is loud, unpleasant or harmful to our ears.

ACTIVITY: Identifying noise pollution

QUESTIONS:

1. List five sounds that are very noisy. Sounds that can hurt your ears. Or just sounds that are difficult to live with.

Teacher to bring 'noise making instruments' to school - pots and pans to bash together, lids of the pots and pans to bash together, repeatedly running nails over a chalkboard, playing a trumpet or other similar instrument without any knowledge of how to do this - all just MAKING NOISE! motor bike revving, loud music, cheering at sports games, aeroplane taking off, formula 1 racing, drilling holes with a drill

2. Look at the picture of a learner in a very noisy environment. Identify all the sources of noise pollution.

A very noisy environment!

People talking, noise from the taxi, people shouting out the taxi, the jackhammer on the pavement, the aeroplane in the sky, the exhaust and hooter from the red car, the music blasting from the stereos in the furniture shop.

3. List some sounds that are sometimes not noisy, but other times can be noisy.

   Music from other cars/neighbours, children playing, sports games, car driving, barking dog

4. Are there any noises at school which you find distract you during class and cause a disruption? This is also noise pollution. Write down some of these, and also some ways which you think your class could minimize the noise pollution in your class.

   Can include noise pollution from other learners walking past the classroom outside, perhaps workers or builders are at the school and making a noise, perhaps there are noisy lawnmowers outside. Possible solutions would be to maybe put up signs outside the classroom to tell learners to be quiet when walking down the corridors during lesson time, or working out a solution with the school that the most noisy

activities, whether building or lawn mowing happens outside oflesson time (ie. in the afternoon).

ACTIVITY: Role Play about noise pollution

Teacher's Note

You will have to facilitate this activity with the class. Go through the brief with them and give them time to develop a script. Then give the pairs an opportunity to act out their situation. It is very important to open the situation up to a general discussion. There is usually no clear right or wrong in these matters. Only consideration and respect for others. Sometimes "noise" is a necessary result of work and sometimes it is a natural result of relaxation activities. Allow the learners to see their own responsibility towards others in a situation, no matter whether they are the "noise" makers or the "noise" sufferers.

INSTRUCTIONS:

1. You are going to role play a situation where noise may cause a problem. Do this in pairs.
2. Choose an activity that may be noisy (watching television, playing music, drilling holes with an electric drill, or any other activity you can think of).
3. One of you must be the person doing this activity. You must have your own reasons for making the "noise". You must also have your own ideas about how much noise you are making.
4. The other person must be nearby. This person feels that the first person is making too much "noise". You must have your own ideas about what too much "noise" is.
5. Act out a discussion for the class between the two members of the group.

Think about the following:

The person who is making the "noise" has rights. The person who is complaining also has rights. Can you get along? Can you come to an agreement? Can you make a compromise?

Each person has their own idea about noise. We need to get along with each other. No one likes to feel uncomfortable. Always be aware of the comfort of others. We also need to understand that sometimes noisy activities are necessary. Always remember: What is okay for you may not be okay for someone else.

Loud noise can damage your ears

Noise pollution makes the area we live or work in very unpleasant. Noise pollution can be harmful and cause permanent damage to hearing. Even music that is too loud is noise pollution.

Most outdoor noise pollution comes from construction sites and noise from cars and trucks. If you live near an airport, there is a lot of noise pollution from the sounds made by the aeroplanes.

- Loud sounds can damage your hearing.
- Doctors have found that people who work with very loud machinery become hearing-impaired when they are still young.
- They have also found that loud music can also cause hearing loss. Powerful amplifiers and speaker systems can be bad for your hearing. Headphones playing loud music can damage your hearing.
- Do not listen to very loud music, especially through ear phones.
- Some people are born with a hearing problem and they can use hearing aids to help them hear better.

VISIT

Ocean noise pollution (video).
goo.gl/vCHf8

A hearing aid is very small and fits inside the ear of a hearing-impaired person.

A construction worker wearing ear muffs to protect his ears.

At times, noise pollution cannot be avoided. Some factories and building sites are noisy places.

Animals can be harmed by noise pollution. A good example is the whale. Whales communicate with each other by making sounds. The sound can travel over long distances through the water from the one whale to the next. When there are lots of ships present, they make additional noise. Water carries these noises very well and very far. This makes it difficult for whales to communicate with each other. This can cause whales to get lost in the ocean.

A race horse with ear muffs on its ears.

QUESTIONS

Can you see the ears of the race horse are covered? Why do you think this is so?

This protects the race horse from noise pollution from the crowd and stadium so that it does not get distracted when racing.

KEY CONCEPTS

- Musical instruments make sound through vibrations
- Vibrations can be heard and felt
- Sound travels away from the moving part that is vibrating
- Sound needs a medium (material) to travel through
- Sounds can be loud or soft (volume)
- Sounds can be high or low (pitch)
- Sound can be unpleasant and harmful
- Loud sounds can damage hearing

REVISION:

1. Why is sound important to us?

   communication, entertainment

2. You built a "telephone" with a string joining two tins. Explain how your telephone works.

   Speaking in the tin causes the end of the tin to vibrate. This vibration travels along the tight string. The tin at the other end picks up the vibration which allows you to detect the vibrations and hear them

3. If a sound is made on the moon, it cannot be heard even on the moon. Explain why.

   Sound needs a medium (material) to be able to travel through. There is no air on the moon and so vibrations cannot travel.

4. Whales can talk to each other over hundreds of kilometers in the ocean. Do you think the particles in water are close together like in a solid or far apart like in a gas?

   close together as the sound can travel far

5. When your doctor has to check your heartbeat she uses a special instrument. It is called a stethoscope.

A stethoscope is simply a long tube of air with a membrane on the side that goes on the patient's chest or back. Explain how you think a stethoscope works.

A doctor using a stethoscope.

This is a tricky question and learners might need guidance or a hint when answering. The membrane against your chest or back vibrates as it picks up your heart beat. This vibration travels through the air in the tube to the doctors ears so they can hear the heartbeat.

6. When you listen to the radio or TV, you can adjust the volume. What happens to the vibrations making the sound when you increase the volume?

   vibrations increase in size

7. What makes some sounds pleasant, while other sounds are unpleasant?

   pitch, volume and personal preference

8. List three jobs where there is loud noise.

   jackhammer operator, ground crew for an aeroplane, working in a steel mill, anything sensible

9. The people doing these jobs, are in danger of damaging their hearing. Give them some advice on how to protect their ears.

   wear earplugs

10. Why is the man in the picture below wearing ear muffs over his ears?

A man wearing ear muffs. [1]

He is wearing ear muffs as the car he is driving probably makes a very loud noise. Over time, if he did not protect his ears, they could become damaged.

11. Why is it a health risk to expose yourself and youngsters to loud music?

    It damages your ears and affects your hearing forever


Earth and Beyond
and Systems and Control

1 Planet Earth

KEY QUESTIONS

- The Earth is shaped like a ball. So why do we not fall off the ball?
- If the Earth is shaped like a ball, why does it look flat?
- What is the difference between a continent and an island?
- Are an ocean and a sea the same thing?

Teacher's Note

NB. The last section in this strand is on the Moon. The order has been changed slightly compared to CAPS so that you do not run out of time at the end of the year to do the Design Activity on modelling a rocket as some important skills will be learned in this. However, if you would like to stick to the order in CAPS, then do so. The chapter on the Moon requires learners to do a Moon watch where they observe and record the changing shape of the light on the moon for at least a month. Bear this in mind during the 4th term as you will need to start this activity a month before you get to the Moon chapter so that it is completed in time.

1.1 Features of the Earth

Teacher's Note

Remind the learners that the Earth looks flat or level to us if we look around outside. Now ask them to imagine what the Earth would look like if they went high, very high. Many of them have seen images of the Earth as a ball, photographed from spacecraft. They will tell you, "That is the Earth." But they may have difficulty if you ask them to show you where they are on the Earth at this moment. It is not because they do not know the continents - their problem is making the mental shift between being in Space and

being on the Earth. For that reason we spend some time in this Unit developing their ability to look at things from a different point of view. This is a mental ability that normally develops when children are about 10 or 11, and as teachers we can ensure that it does develop for these learners.

The Earth is our home. It is the planet that we live on. Our Earth is a very special planet, which is why we can live on it. Let's have a look at why Earth is special.

Features on the surface of the Earth

Earth is the place where all people live. The ground under your feet is part of the Earth. We live on the surface of the Earth. The surface is the outside of the Earth. Miners can dig deep tunnels under the surface of the Earth.

Plants grow in soil. The soil comes from rock that was deep under the ground. Rain washes soil away and it exposes the rock. We say that the rain erodes the soil and the rock as it breaks little pieces off and washes it away.

As the rain erodes the surface of the earth it makes hills and valleys, rivers and seas. The features of the Earth are the hills and valleys, rivers and seas. Look at the following pictures showing the different features of Earth's surface.

The Orange River.

There are lots of rocks in this landscape.

The rocky sea shore on the Garden Route.

A deep valley between the mountains. [1]

Hills and flat farmlands. [2]

A river surrounded by mountains. [3]

Do you remember when we looked at the habitats on Earth in Term 1 in Life and Living? These habitats are influenced by the features of the Earth.

ACTIVITY: Habitats on Earth

INSTRUCTIONS:

1. Look at the pictures again on the page before this activity showing different features of the Earth's surface.
2. Answer the questions below.

QUESTIONS:

1. Name some of the living things you can find on the Earth.

   Plants and animals is the short answer. But make sure the learners give you plenty of examples. Examples are trees, bushes, grasses, birds in the trees, insects that the birds eat, goats, etc. Build up the idea ofliving things here, because you will have to teach how the Sun provides light and warmth for them.

2. In the pictures, where do the birds live?

   In the trees, on the beach and river-banks, some float on the water and dive for fish.

3. In the pictures, where do fish live?

   In the river and in the sea.

4. Where can cattle live?

   Along the banks of the river, on the grasslands

5. What kind of animals can live in deserts? A desert is a place with almost no water.

   Snakes, bats, meerkats, jackals are examples.

6. What kinds of animals live in forests?

   Buffaloes, elephants, bushpigs, monkeys, are examples.

7. A habitat is a place where animals can find food, water, shelter and have their babies. Habitats have unique features, such as the rocky shore habitat has crashing waves and big rocks. Name four habitats that you have seen in the pictures.

   Rivers, seas, grasslands, forests, mountains.

8. Name four non-living things you can see in the picture.

   The features like air, clouds and rivers are all non-living things. Many learners won't believe this; for example, they consider that a river and a cloud are living. Remind them of what you did in Term 1 for Life and Living.

The Earth has air in the atmosphere. Air is all around you and it moves. When air moves, we call it wind. You know when air moves because you can feel a wind blowing. When you look up at the sky, you sometimes see clouds. The clouds move in the air. Although you cannot see air, it is still a feature of Earth, like the rocks and soil which make up the mountains and hills and the water which makes up the rivers, seas and lakes.

QUESTIONS

1. Is there air high up in the sky? Give a reason for your answer.

   Many learners will agree that there is air around our noses, but may be unsure whether there is air under the table and many more are unsure whether there is air high up. They

may say that up high you find atmosphere, but are unsure whether there is air there. They do not understand that the atmosphere is all the air around the Earth.

2. Are clouds all equally high?

   Some are very high, some are lower. We want children to begin thinking of what it would be like to go very high - soon we want them to think what the Earth looks like from a spacecraft!

Clouds high in the sky. [4]

Clouds low near the ground. [5]

Sometimes, it is hard to see the features of the Earth if we are standing low on the ground. For example, you might be standing in a valley and then not be able to see all the surrounding mountains. Also, the features of the Earth look different depending on where you are viewing from. Do you think a bird flying in the sky will view the landscape the same as you if you are standing on the ground? Let's have a look.

ACTIVITY: What do things look like from above?

MATERIALS:

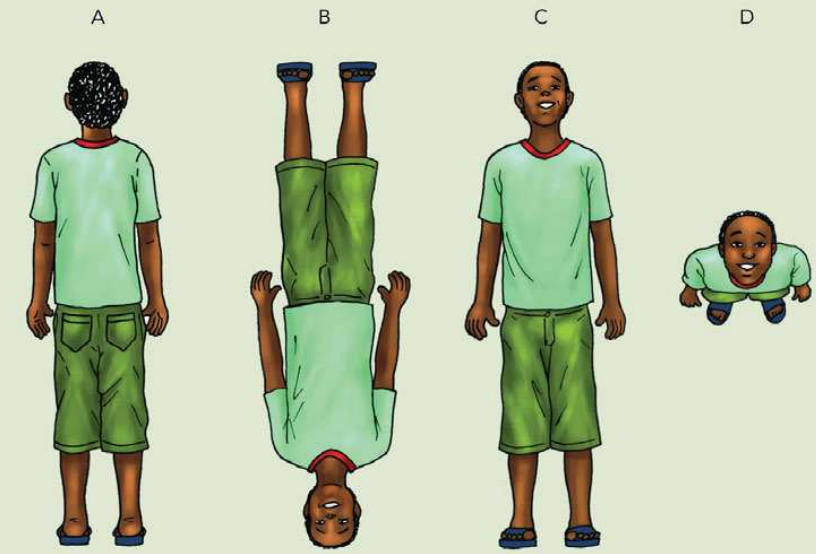
- pencil
- coloured pencils
- rubber

INSTRUCTIONS:

1. Let's look at what a bird sees when he flies over a boy. Can you see the bird flying over the boy in the picture below?
2. Answer the questions that follow.

QUESTIONS:

1. When the bird looks down, what does it see? Choose the right picture from (a), (b), (c) or (d) by drawing a circle around it.



Teacher's Note

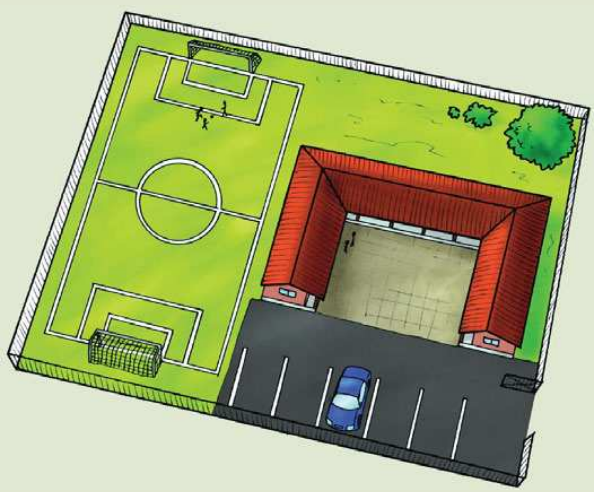
Here you are developing the learners' ability to mentally put themselves in another place and imagine how things look from there. This is a mental ability they must have, in order to understand models of the solar system

2. Imagine you are a fly on the ceiling in the classroom. You look down and see the classroom. Now draw the classroom as the fly sees it using the space below. Draw the chalkboard, the cupboard, the door and the teacher's table. You don't have to draw the people. You can use some colour if you want to.

Teacher's Note

This task develops the learner's skill in visualising things as they look from a different point of view. You may find that only a few learners can imagine the features of the classroom as they look from the ceiling. For example, many learners will draw the cupboard as they can see it from the front. But they must draw the cupboard from above; they could see the doors if they were above the cupboard. Instead, they would see the things that you have put on top of the cupboard.

The next picture shows you a school as it looks to a bird flying over.



The school yard as seen by a bird.

3. Labels have been given below for some objects in the picture. Draw the letters A, B, C and D onto the picture to label the correct objects.

    - A is the gate
    - B is the roof of the school
    - C is the soccer field
    - D is the tree

4. An aeroplane flies over the same school. This picture shows you how the school looks from an aeroplane; the aeroplane is flying higher than the bird.

The school yard as seen by people in a low flying aeroplane.

5. Find the soccer field now. Label the soccer field on the picture.

6. Why is the soccer field much smaller than in the picture where the bird is flying over the school?

    We are much higher now, so things look smaller.

7. Find the shop. It is across the road from the school. What do you see outside the shop?

    *Answer is cars. The learners have to **make an inference** that the other building is a shop.*

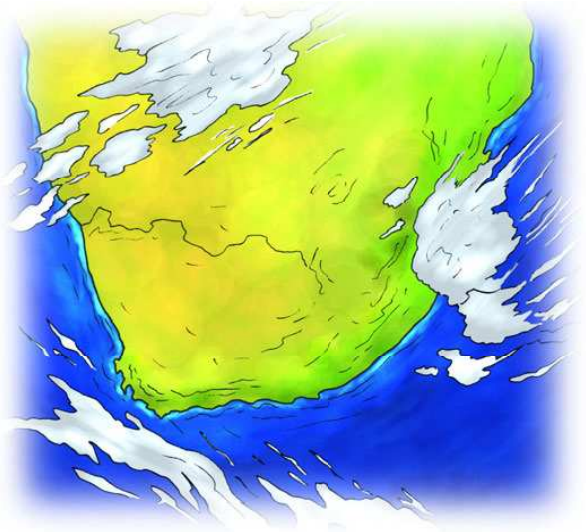
The aeroplane now flies higher up into the sky. You can now see what the town looks like to people in the aeroplane flying very high.

The town as seen by people in an aeroplane flying high over head.

8. In the picture, label the river, a road and a cloud.

   *The learners must **make an inference** that it is a river, road, cloud. It is not labelled. Making inferences from pictures and text is a process skill.*

What we have seen in this activity is that as you go higher and higher up, the objects appear smaller and smaller. So, when photographs are taken from an aeroplane or helicopter, we get a better idea of the features of the Earth's surface and we can see more. If we go even higher up and up and up into space then we can't go in an aeroplane anymore. Then astronauts fly up in a spacecraft. In the picture below you see what South Africa looks like to people in a spacecraft high above South Africa.



This is what people in a spacecraft see when looking at South Africa from space.

ACTIVITY: Looking at the Earth from Space

Now look at the picture. An astronaut in a spacecraft took this photo.

Planet Earth. This is how the Earth looks from a spacecraft very far above the ground.

QUESTIONS:

1. What shape is the Earth?

   It is round like a ball. Ask them what else they have seen in the sky, that looks round. (Answer is the Moon)

2. Find Africa in the photo. Point to it with your finger.

3. What are the blue parts of the photograph?

   The oceans, also called the seas.

4. What are the white things in the photograph?

   Clouds

5. Where is Earth's air, in the photograph?

   The air is like a thin skin all over the planet. You can see a blue-ish ring around the edge of the Earth.

6. Is there more sea or more dry land on the surface of the Earth? Look at the picture and work out your answer.

   There is more sea (oroceans) than dry land. The learners cannot see the other side of the Earth but you can tell them that there is about twice as much sea as dry land.

VISIT

More pictures of Earth taken from space:
goo.gl/DZW9o

Continents and islands

A continent is one big piece ofland on the Earth. A continent has many countries. Africa is a continent with more than 50 countries.

The Earth has seven continents, they are:

1. Africa
2. North America
3. South America
4. Asia
5. Europe
6. Australia
7. Antarctica

QUESTIONS

Which continent do we live on?

Africa

Do you know what a globe is? A globe is a model that shows what the Earth looks like. The globe shows you the continents of the Earth, and the oceans. The blue parts of the globe are the oceans. Sometimes it is hard to talk about different parts of the Earth without being able to see them, so we use a globe.

A globe is a model that shows you where the continents are.

Teacher's Note

For the following activity, only one globe is needed. Ask the learners to come up in groups to complete the exercise. If you cannot obtain a globe, then use a map. But a globe is preferable for learners to be able to see the shape of the earth.

ACTIVITY: Find the continents on a globe

MATERIALS:

- a globe

Teacher's Note

the class just needs one globe

INSTRUCTIONS:

1. Find the continent of Africa on the globe. Show the edges of Africa with your finger.
2. Show with your finger where South Africa is in Africa.
3. Show where these countries are on the globe: Namibia, Mozambique, Zimbabwe and Botswana. These are our neighboring countries.

4. The picture below is a flat map of all the continents. This is what the continents look like, if you take the paper cover off the globe and spread it out flat on a table. Find the continents on the globe and write their names onto this flat map.

VISIT

An introductory video to Madagascar.
goo.gl/weSYp

An island is some land with water all around it. Madagascar and Mauritius are African countries that are islands.

ACTIVITY: Islands

MATERIALS:

- An atlas or a globe
- Information on an island of your choice
- Pictures of this island
- Colouring in pencils
- Scissors

INSTRUCTIONS:

1. Look in your atlas or on your globe and find an island along the coast of South Africa.
2. Bring information on that island to school.
3. Your information must cover the following questions:

a. What is the name of the island?
b. On which coast of South Africa do we find this island?
c. Which South African city or town is the closest to this island?
d. In which ocean is this island situated?
e. How big is the island?
f. Do people live on this island? Why / why not?
g. Why is this island important?
h. Why is it an island and not a continent?

4. Use the space provided to make an information brochure about the island.

QUESTIONS

What is the difference between a continent and an island?

A continent is a big piece of land made up of many countries. an island is a small piece of land surrounded by water. It is either part of a country or only one country.

The oceans and seas

Most of the Earth is covered by water, and you can see this on the map. When astronauts go into space, all the water on our planet makes it look mostly blue. This is why we call Earth the Blue Planet.

ACTIVITY: Find the oceans on the globe

MATERIALS:

- a globe

INSTRUCTIONS:

1. Turn the globe around and find these oceans: the Indian Ocean, the Atlantic Ocean, the Pacific Ocean.

2. Now write the names of those three oceans on the flat map of the world.

QUESTION:

1. Is there more dry land or more water on the surface of the Earth?

   There is much more water than dry land.

VISIT

Earth's oceans (video).
goo.gl/nCx2x

Many people use both the words "ocean" and "sea" when talking about the ocean. But, when we are talking about the Earth's surface, it is important to know that there is a difference between an ocean and a sea.

An ocean is a very large mass of water which covers a huge part of the Earth's surface. A sea is much smaller than an ocean and a sea is normally surrounded by land on some sides.

1.2 The Earth in Space

The Earth is a planet in space. From the Earth we can see the Sun, Moon and stars. Space begins about 100 km up from the Earth's surface. Space is a very strange and foreign place to us, which is why humans have been so interested in what goes on in Space for thousands of years. There is no air in Space either.

*I have lots of **BIG** questions about Space! You probably do too!*

Let's look more at Earth in relation to Space!

Teacher's Note

This is the first time that the concept of space is introduced and in terms of our place in space. NASA has a great website for resources for images and activities for learners. Also, all NASA images have been released into the Public Domain meaning they have no copy right and you are free to use them however you want. NASA's website is [6]and the website aimed at kids, where there are fun games and activities is [7].

The Earth is shaped like a ball

We saw that Earth is shaped like a ball. Something that is shaped like a soccer ball is called a sphere. We see the shape of Earth when we go very high and get far away from it, for example an astronaut in a spaceship can see the shape of Earth when looking out the window of the spaceship and back at Earth.

VISIT

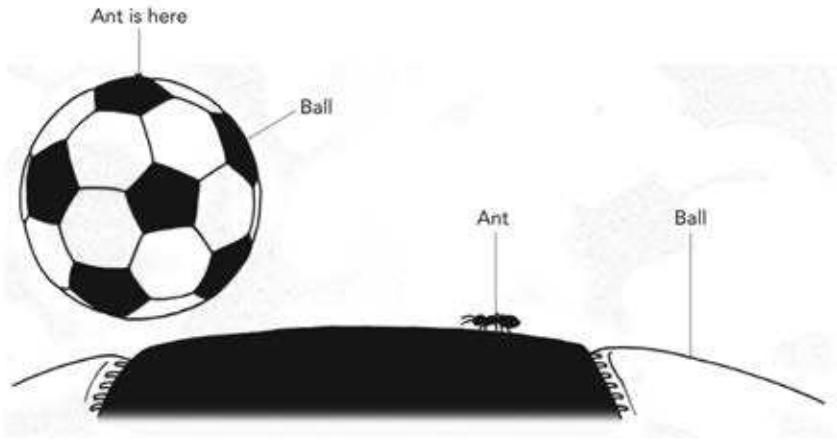
A fun site about astronomy.
goo.gl/NQZdF

But if we look out of the classroom window, the Earth looks flat, not ball-shaped. Many people long ago believed that the Earth is flat, because it **looks** flat. It is so big that we can't see that it is curved.

Pretend you are an ant on a soccer ball. You are so small that the ball looks flat. You can't see the other side of the ball, and you can't see that it is a ball. Look at the picture of the ant on the soccer ball. All the ant can see is a flat surface. He does not even know he is on a round ball because it is so much bigger than he is!

Teacher's Note

This reminds us that in science we cannot go straight from an observation to a conclusion!



The ant on the ball sees a flat surface as it is so small compared to the ball.

This is the same as us on Earth. We are so small compared to the Earth that when we are standing on the surface, the Earth looks flat to us. We cannot see that the Earth is actually round unless we look at pictures of the earth taken from Space!

If I am standing in South Africa, which is near the bottom of the sphere, why don't I fall off the Earth's surface?!

QUESTIONS

Why don't we fall down off the Earth, if the Earth is a ball?

This can be a class discussion. It is an introduction to gravity. It can be left as an open ended question which will be addressed in the next activity.

ACTIVITY: Which way is up and down on Earth?

Teacher's Note

This is an extension activity, though it deals with the very basic question, why don't we fall off the earth?

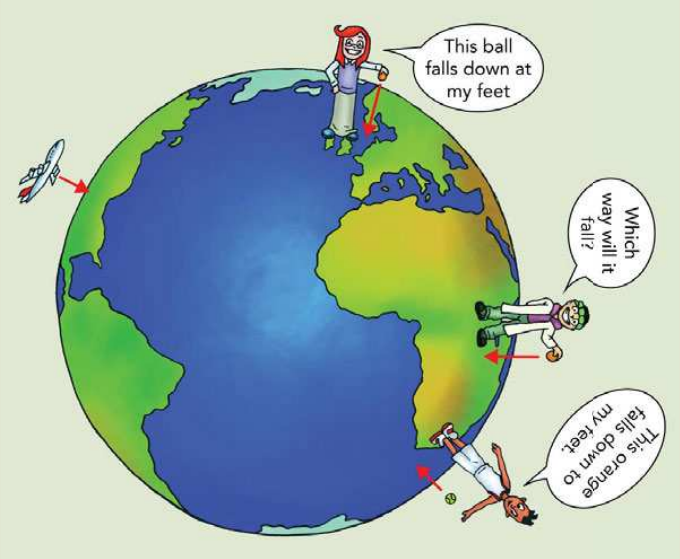
MATERIALS:

- the classroom globe
- a pencil
- a rubber

INSTRUCTIONS:

1. Read this paragraph and answer the questions.

When a pencil falls off your table, it falls because the Earth and the pencil pull each other with the force of gravity. The force of gravity pulls everything towards the centre of the Earth. But remember that the Earth is shaped like a ball. The picture shows you which way the force of gravity pulls on things.



Jojo, Sophie and Tom are each standing straight up on the Earth.

2. Look at the classroom globe again, and find South Africa and England on the globe.
3. Now look at the picture; it shows Jojo standing in South Africa; when he drops the ball it falls towards his feet and he says that direction is the downwards direction.
4. Now look at Sophie in England. When she drops an orange, it falls towards her feet and she says that is the downwards direction. So for both of them, the downwards direction is towards the centre of the Earth.

VISIT

NASA's website for kids:
goo.gl/B5ku7

QUESTION:

1. Find the Congo on the globe, and then look at the picture. Tom is standing in the Congo. Draw an arrow there to show the direction the ball will fall from Tom's hand.

   The learners should draw an arrow that points towards the centre of the Earth. The ball will fall towards his feet, that is, towards the centre of the Earth. Some learners however will draw an arrow pointing towards the bottom of the page. Show them the globe and point inward to the middle of the globe from both sides. You are pointing in the direction of the force of gravity.

Down means "towards the centre of the Earth"! There is a force which pulls objects together. This is called gravity. We are pulled towards the centre of the Earth because of gravity.

KEY CONCEPTS

- The Earth is a planet. There are seven other planets moving around the Sun.
- The features of the Earth are the land with mountains and valleys, the water in dams, lakes, rivers and seas, and the air all around the Earth.
- Very big areas ofland are called continents, and areas of land with water all around them are called islands.
- Living things grow on the land and in the water. The Earth has many habitats for many different living things.
- If we go up high above the Earth, everything looks different to the way it does when we are on the ground.

REVISION:

1. A person's nose and eyes and mouth are **features** of his or her face. Name four **features** of the Earth.

   Land (mountains, hills, valleys), water (oceans, seas, rivers, lakes), air (clouds)

2. The Earth is shaped like a ball. People do not fall down off the ball. What is the reason for that?

   The down direction is the direction that points to the centre of the Earth. Gravity pulls everyone towards the centre of the Earth.

3. List the 7 continents of the Earth.

   Africa, Antarctica, Asia, Europe, North America, South America, Australia

4. Name an island near South Africa.

   Madagascar. Robben Island. Dassen Island. Seal Island. Mauritius

Teacher's Note

Let the learners use whatever language they are most fluent in, and then teach the English words later. Their tables should then have both the mother-tongue and the English words in them

5. If we look up into the sky during the day, we can see objects up there. At night, we can see different objects up there.

   Complete the table. The first two answers are there already.

Things I can see in the day	**Things I can see at night**
Birds	Stars
clouds	*Moon*
aeroplanes and helicopters	*aeroplanes with lights on*
Sun	*meteors, but only sometimes*
rainbows	*satellites*
the Moon. You can see it in daytime, sometimes. Some children might doubt this; they think they can see the Moon only at night. You could let the class vote on on whether it's true or not. Then ask them to look carefully. the learner who sees the moon in daytime can call the whole class outside to look!	*planets (most Grade 4 children will not know about planets. Venus is a planet but many people call it the evening star or the morning star.*

6. Which of these things you wrote in the table are higher than other things? Write these things in order. Write the thing that is nearest the ground first, and write the one that is highest last. Grass grows on the ground, so you write "grass" first.

   You are teaching the learners the concept of sequence or ordering:

   Grass, the Moon, roof of the school, a cloud, a star, the Sun, bird flying, aeroplane flying. Note: Some aeroplanes fly low and some birds can fly high, and so you might hear the learners debating the answer. The debate is good, because they realise that there is not always one right answer to a question.

7. Complete these sentences. Write out the **whole sentence** on the open lines, and use some of the words in the word-box to complete your sentence.

   Word box:
   - water
   - continent
   - Blue Planet
   - one part
   - clouds

   a. The planet Earth looks blue and white from space. It is called the _____ because it is covered with _____ and _____.

   a. A continent is a large piece ofland. For example, Africa is a _____ and South Africa is just _____ of Africa.

   Blue planet; water; clouds

   Continent; one part

Learners need practice in writing long sentences.

2 The Sun

KEY QUESTIONS

- What is the Sun made of?
- What are stars made of?
- How far away is the Sun?
- The Sun looks so small in the sky, so how can it be bigger than the earth?
- Why is the Sun so important to us and all living things on earth?

Teacher's Note

How to introduce the topic

[what is the Sun? Where does it go at night? Why is it sometimes hot and sometimes cool? Is it weaker in winter?]

You should explain to the learners that the Sun is not burning like a fire. A fire needs fuel such as wood or coal, and it needs air. The Sun does not burn like that. The gas is called hydrogen and it is changing into another kind of gas called helium, all the time, and this change makes the Sun very hot. You can tell the children that the Sun is burning by nuclear reactions. Hydrogen is being squeezed together so hard in the middle of the Sun that it changes into helium. They don't have to understand the words "nuclear reactions" but it allows us to say that the Sun is not burning like a fire.

There are two activities that teach how big the Sun is compared to the Earth. Later this will become important. The learners must understand that the Sun is so massive that its gravitational pull on the planets can keep them in orbit even though they may be as far away as the planet Neptune.

2.1 The Sun is the closest star

We call the Sun a star. But you probably thought that you could only see stars at night? And why does the Sun look so much bigger than the other twinkling stars? This is because the Sun is the closest star to us on Earth. The other stars in the sky are much, much further away. Let's find out more about the Sun.

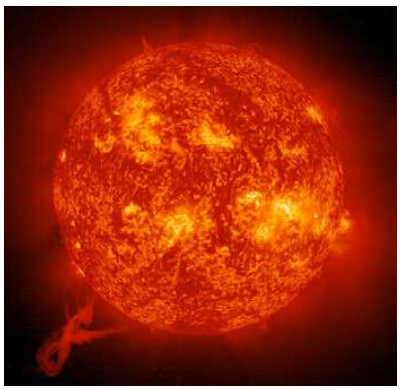
The Sun during different stages of the early morning.

VISIT

Watch crayons melting in the sun.
goo.gl/59Emx

The Sun is a huge ball of very hot gas

Our Sun is really a very hot, very big ball of hydrogen gas. The gas is changing into helium gas, all the time, and this change gives off energy which makes the Sun very hot.



The Sun looks like this through a special camera. You must not look at the Sun with just your eyes.

VISIT

A video on the sun
goo.gl/PDHrD and sun spots
goo.gl/JbKJR

The temperature of the Sun is about 5 500 degrees celsius on the surface. 5 500 degrees celsius is hot enough to melt rocks!

The Sun has dark spots on it that we can see with special cameras. The dark spots move on the surface of the Sun as the gas in the Sun is moving all the time. In the photo you can see that the Sun throws out huge streams of hot gas. Can you see this in the bottom left of the picture?

The Sun is very much bigger than the Earth

The Sun may look smaller than the Earth up in the sky. But this is actually because it is very, very far away. The Sun is much bigger than the Earth.

Teacher's Note

The following activity can be done outside on a pavement where you can draw with the chalk, or else in a sandy area where you can just draw with your finger. But the pavement would work better.

ACTIVITY: How big is the Sun, compared to the Earth?

MATERIALS:

- a piece of pavement
- a ruler or tape measure
- a piece of string longer than 60 cm
- a piece of chalk

INSTRUCTIONS:

1. Draw a circle 1 cm in diameter on the pavement with the piece of chalk. This represents the Earth.
2. Now, move about 1.5 to 2 meters away from the little Earth and give yourself enough space to draw the Sun.
3. Draw a circle 108 cm in diameter - this represents the Sun.
4. **To draw a circle with a diameter of 108 cm,** tie a string around the chalk. Measure 54 cm of string from the chalk and tie a knot there. Hold the knot on the board and move the chalk around the knot to draw a circle.

QUESTIONS:

1. If the Sun is so much bigger than the Earth, why does it look so small to us?

   Because the Sun is so very far away.

The pavement drawing shows the Earth quite close to the Sun. The Earth is actually very far from the Sun. It is 150 million kilometres from the Earth. That is 150 000 000 kilometres.

That is a really long way from the Earth to the Sun. If you went in a car at freeway speed of 120 km/h, you would have to travel for 146 years to reach the Sun. So, the Sun is far away and it is very big and very hot.

If the Sun is so far away, why does it look as big as it does? The Sun is so big that it is difficult for us to understand how big it really is. A model can help us to understand.

ACTIVITY: Use a model to show how far the Earth is from the Sun.

Teacher's Note

This is a demonstration - the class need not go outside but can watch through the windows. Alternatively, set this up so that the learners see the learners with the soccer ball and the grain of rice as they enter the classroom

MATERIALS:

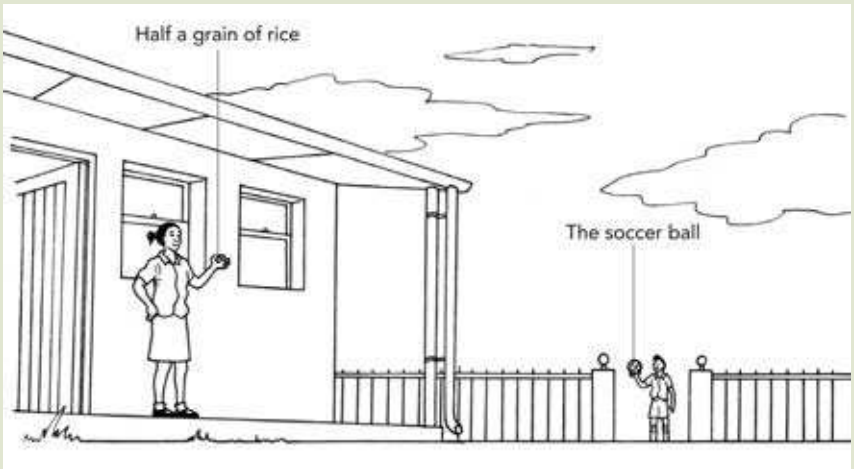
- a grain of rice; break it in half.
- a soccer ball
- space to move, such as the playground or soccer field

INSTRUCTIONS:

1. Look at the picture below.
2. One learner stands in a place where there is a lot of room all around them. This learner holds the soccer ball; this ball represents the Sun.
3. Another learner stands next to her and holds the half-grain of rice. It represents the Earth.
4. The learner holding the rice walks away from the learner holding the soccer ball with 24 of the biggest steps he can make. That distance is about 24 metres. The 24 metres represents the distance from the Sun to the Earth.

5. Now the learner carries the half-grain of rice, walking to walk to his right side. He must always stay 24 metres from the soccer ball. If he does this he will walk in a circle around the soccer ball.

This model shows us that the small Earth moves in a circle around the big Sun.



The soccer ball represents the Sun, and the half-grain of rice represents the Earth.

QUESTIONS:

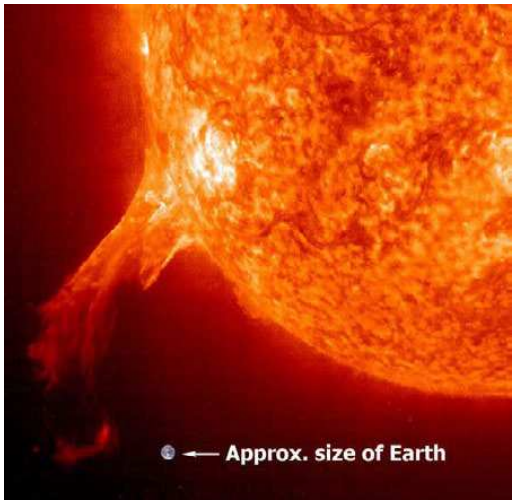
1. Stand 24 metres away from the soccer ball. Hold up one finger in front of you, and cover the soccer ball with your nail. Is the soccer ball really as big as your fingernail?

   No

2. Why does the ball look as big as your nail?

   Because the ball is so far away.

The Sun is so big that thousands and thousands of Earths can fit inside the Sun. In the picture you can see how their sizes compare.



This is how the size of the Earth compares to the size of the Sun. The Earth is not really this close to the Sun.

The Sun is the closest star to Earth

Our Sun is like the stars we see in the sky at night. Many of those stars are very much bigger than the Sun. They look small because they are so very far away. All the stars are made of gas that is glowing and very hot.

Do you know what a telescope is? It is like a big pair of very strong binoculars which let us view the objects in outer space. Without a telescope we can see about 2 500 stars, but when we use a telescope we can see millions of stars.

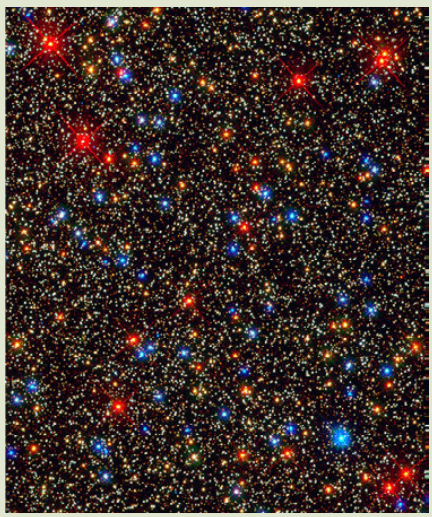
Hundreds of thousands of stars seen through the Hubble telescope. [12]

Stars that look orange-reddish are not as hot as the Sun, and stars that look blue-white are much hotter than the Sun.

ACTIVITY: The colours of stars tell us about their temperatures

INSTRUCTIONS:

1. Look at the photo below and answer the questions that follow.



This is a photograph from NASA of the Star cluster of Omega Centauri, showing all the different colourful stars.

QUESTIONS:

1. Are there more red or blue stars in this picture?
2. Which of the stars are the hottest?

   The blue stars
3. What colour star is the Sun?

   Yellow

The Sun is the nearest star to Earth. The second-nearest star is called Proxima Centauri. Light from the Sun takes 8 minutes to reach your eyes, but light from Proxima Centauri takes over 4 years to reach your eyes. The Voyager 1 is a spacecraft that launched from Earth many years ago. It is travelling away from the Sun so fast at a speed of 17 kilometers every second! If Voyager were to travel to Proxima Centauri it would take more than 73 000 years to arrive.

The Sun is important to life on Earth

Without the Sun, life on Earth would not be possible. It would be completely dark and freezing cold. In other words, the Sun provides us with light and heat. Because of this light and heat, many other things become possible.

The Sun sends out heat and light to the Earth. The Earth gets only a small part of the heat and light that the Sun sends out but even that is enough to make us feel uncomfortable on a hot day!

We hang our washing outside to dry. The heat from the sun helps the clothes to dry. [3]

People used to tell the time using a sun dial like this one. [4]

QUESTIONS

What else can you think of that the sun helps with on Earth?

We are able to find direction, plants grow using sun light energy, tan in the sun, warm up.

The Sun provides every living thing on Earth with energy. Do you remember last term in Energy and Change, we learned how the Sun provides energy for life on Earth?

The Sun's heat and light provide energy throughout the Solar System, but Earth is the only planet we know has is life. Plants and animals survive on Earth because the planet is warm and the atmosphere has air to breathe.

Some people have special heaters on the roofs of their houses. These are called solar water heaters. They use the heat energy from the Sun to heat water for bathing and washing.

A solar water heater on the roof of a house. The water is in the tank. [5]

Unfortunately the sun also has harmful effects on Earth, and especially on people if we do not protect ourselves properly.

When there is not enough rainwater, drought can occur.[6]

The Sun can damage your skin if you are not careful and do not put suncream on when outside.

KEY CONCEPTS

- The Sun is a star. It is a very, very big ball of gas. It is more than a million times bigger than the Earth!
- Earth is 150 million kilometres from the Sun. That is a very long distance.
- The Sun is so hot that it gives the Earth all the light and heat we need.
- The nearest other star is so far away it looks like a dot made with a pin on paper.

REVISION: Revision

Write out these sentences and complete them. Choose some of the words from the word box to complete the sentences. Write out the whole sentence.

Word box: (You do not need to use all the words)
hydrogen gas
helium gas
plants
light
heat
half a grain of rice
Sun
a soccer ball
the Moon

1. When we compare the size of the Earth to the size of the _____, the Earth is the size of _____ compared to the size of a soccer ball.

   Sun; half a grain of rice

2. The Sun gives _____ and ____ to the Earth. All ____ need light and heat.

   light; heat; plants

3. The Sun is not burning like a wood fire. The Sun is hot because _____ is changing into _____.

   hydrogen gas; helium gas

3 The Earth and the Sun

KEY QUESTIONS

- Why does the Earth move in a circle around the Sun?
- Why must 365 days past between my birthday and my next birthday?
- What is the solar system?

3.1 Moving around the Sun

Four months ago in the middle of the year the days were short. The nights were cold and the Sun was low in the middle of the day. We are in the fourth term now. The days are longer and the Sun is much higher in the middle of the day. Soon we will have summer. Then winter will come again. The seasons repeat every year. We say that the seasons repeat in a cycle.

Cycle is when things happen the same way, again and again. For example, do you remember learning about the water cycle in Term 2 in Matter and Materials? This is a cycle. Water evaporates from the oceans, lakes and rivers and becomes water vapour. Then the water vapour condenses and becomes liquid water again.

Scientists explain why the seasons change in a cycle. They find that the Earth is moving around the Sun. Earth needs a year to go around the Sun once and come back to the same place. As the Earth moves around the Sun, we experience different seasons.

When it is summer in South Africa.... [1]

....it is winter in England. [2]

Teacher's Note

The learners do not have to know about the tilt of the Earth's axis. The axis is tilted at $23\frac{1}{2}$ degrees from vertical. As a result, South Africa gets more sunshine when the Sun shines mostly on the southern hemisphere and less sunshine when the Sun shines mostly on the northern hemisphere. More sunshine means we have summer and less sunshine means we have winter.

QUESTIONS

Name the four season and place them in the correct order starting with summer.

Summer, Autumn, Winter, Spring.

ACTIVITY: Make a model of the Earth moving around the Sun

Teacher's Note

This is a demonstration, using two learners at a time. One learner must run with the ball to get it moving in a circle. You need plenty of room; at least a clear 10 metre diameter circle. The long string helps to give learners the correct idea that the Earth's orbit is at a very great radius from the Sun. Plan this to happen at the start or end of a period, because the learners take time to move outside.

MATERIALS:

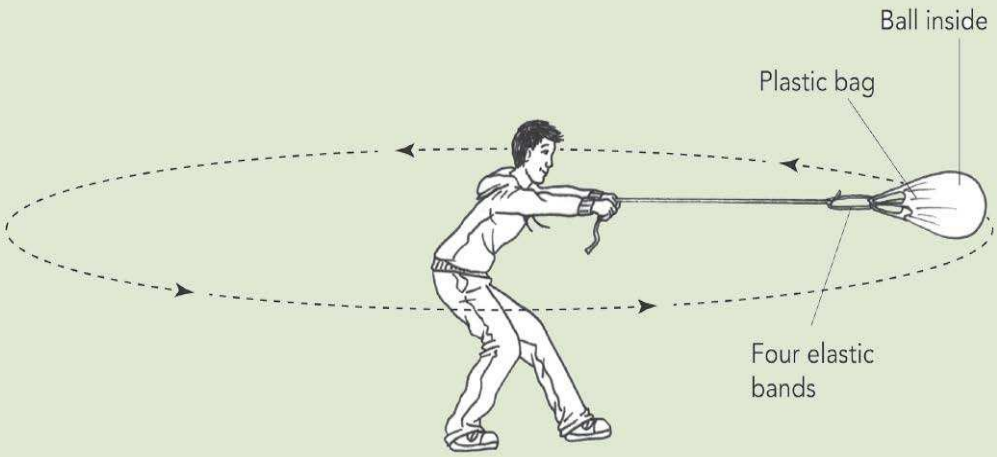
- strong string about 5 metres long
- a ball in a plastic bag
- four thick rubber bands

INSTRUCTIONS:

1. Join the bag to the string, with four rubber bands.
2. Someone must run with the ball in the bag to help you get it going.
3. Then swing the ball around as fast as you can, on the end of the string. The rest of the class must watch the plastic bag carefully to see whether the rubber bands stretch.
4. You see the learner swinging the ball around himself. The learner represents the Sun and the ball represents the Earth. If you look carefully at the rubber bands, you can see that the ball is pulling on the learner, and the learner is pulling on the ball.
5. Take turns to swing the ball; feel how hard you need to pull on the ball to keep it going around.

VISIT

Play a game to make the Earth orbit the sun.
goo.gl/qlo4i



The ball orbits in a circle path around the learner.

QUESTIONS:

1. What do you feel as you swing the ball?

   You will feel the string pulling on your hand.

2. If the ball in its bag could feel, what would it feel?

   the ball will feel an equal force of the string pulling on it.

3. If the string breaks, in what direction will the ball carry on travelling? Point with your hand to show your answer.

   Give learners time to think about this, and perhemselves to an answer. The answer is that the ball will continue travelling in the action of gravity it's going at the moment the string breaks. Learners can test this answer by letting tthe he string the go.

4. Why can you not see a circle in the picture above? Does the ball really move in a circle when you swing it?

   Skill: interpreting a diagram. Learners must understand that the ball is actually moving in a circle but from the side it looks like an ellipse. We must teach learners how to "read" diagrams.

5. The ball represents the Earth. You swing it quite fast, but how long does the Earth really need to go once around the Sun?

   One year

The planet Earth orbits around the Sun in $365\frac{1}{4}$ days and we call that one year. As Earth moves to new positions around the Sun, we have four seasons: summer, autumn, winter and spring, and then summer comes again.

Now in Space, the Earth keeps on going around the Sun at more than 100 000 kilometres per hour. But there is no string pulling on the Earth, so what pulls on the Earth?

Gravity force pulls the Sun and the Earth towards each other.

There is no string in Space between the Earth and Sun! The Sun pulls on the Earth and the Earth pulls on the Sun with the forces of gravity. The pull is so strong that it works at a distance of 150 million kilometers! Like the string, gravity force keeps the Earth moving in its orbit around the Sun, year after year.

3.2 The Earth and other planets

Some of the bright things we see in the sky at night are not stars, they are planets. Venus is the easiest planet to find because it is big and bright. You can find it in the evening just after the Sun has set, or in the morning just before the Sun rises. African names for Venus are *iKhwezi*and *Naledi ya masa*.

We can see the planet Venus near the sunset.

The differences between stars and planets

Stars are balls of very hot gas and they make their own light. Planets do not make their own light; they reflect light from the Sun. Planets are a long way from Earth but stars are much further away.

ACTIVITY: The differences between stars and planets

INSTRUCTIONS:

1. Complete the table.
2. Choose sentences from the box below and write them under the heading "Planets".

Choose the best sentence to write in the table

- Planets orbit around our Sun.
- Planets are not as far away as stars.
- We can see only 7 other planets in our solar system.
- Planets do not make their own light; they reflect the light from the Sun.

Stars	Planets
Stars are hot balls of gas that shine brightly and give out light and heat	*Planets do not make their own light; they reflect the light from the Sun.*
We can see thousands of millions of stars with a telescope.	*We can see only 7 other planets in our solar system.*
Stars are very, very far away from us	*Planets are not as far away as stars.*
Stars do not orbit around our Sun.	*Planets orbit around our Sun.*

There are eight planets moving in orbits around the Sun

Mars is another planet you can find on some nights. It has an orange colour.

The names of the planets are:

- Mercury
- Venus
- Earth
- Mars
- Jupiter
- Saturn
- Uranus
- Neptune.

We used to call Pluto a planet, but not anymore. Now it has been decided that Pluto, is not strictly speaking a planet anymore so there are only 8 planets. Pluto is now what is known as a "Dwarf Planet". The decision to reclassify Pluto has been a long debate. Some of the facts which made scientists decide that Pluto is not a planet is that it is much smaller than any of the other planets.

VISIT

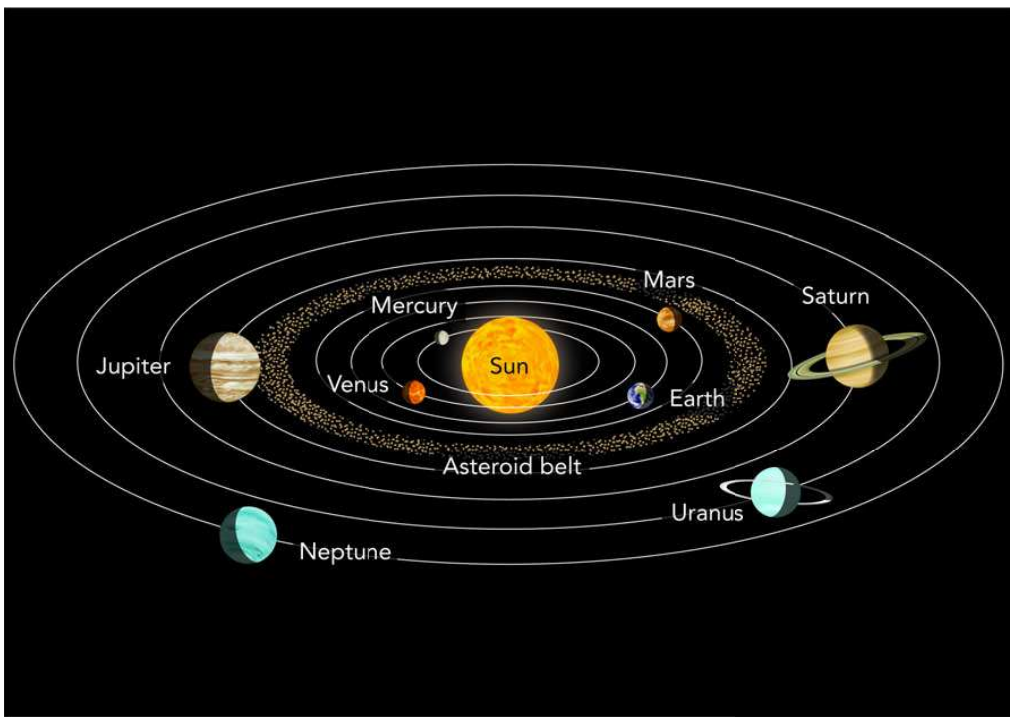
A song about the planets.
goo.gl/IzUM9

Unlike the other planets, Pluto also does not have a regular orbit around the Sun.

Here is a tip! To remember the names of the planets, say this rhyme: **M**y **V**ery **E**ager **M**om **J**ust **S**erved **U**s **N**achos. This is what each word stands for:

Rhyme	**Planets**
My	Mercury
Very	Venus
Eager	Earth
Mom	Mars
Just	Jupiter
Served	Saturn
Us	Uranus
Nachos	Neptune

The planets all move around the Sun in orbits. The path of the orbits are shown in the diagram. The Sun is the star at the centre of our solar system.



Drawing of the planets orbiting around the Sun. The planets are really much further away than you see here.

The Sun and planets are called the solar system. A system is a set of parts that work together or push and pull on each other. The Sun and all the planets pull on each other as the planets move around the Sun.

ACTIVITY: The planets of the solar system

INSTRUCTIONS:

1. Look at diagram of the solar system again.
2. Answer the questions.

QUESTIONS:

1. Why do the planets all keep on moving in orbits around the Sun?

   The gravity force between the Sun and each planet keeps them moving in their orbits. The Sun is so big and heavy that it can cause a gravity force that pulls even the furthest planet, Neptune, into its orbit.

2. Which planet is the closest to the Sun?

   Mercury

3. Is Venus or Earth closer to the Sun?

   Venus

4. Write the names of the planets in order, beginning from the one that is closest to the Sun.

   Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

5. Which planet is the coldest, do you think?

   Neptune

6. What is the reason that planet is the coldest?

   It is the furthest from the sun

VISIT

A song about the solar system.

goo.gl/3yE7T

3.3 The Sun and life

There are eight planets in the solar system. People often wonder if the other planets have creatures called aliens living on them. Perhaps you have seen movies about creatures from other planets. In this section you learn why Earth is the only planet that humans can live on. We need food and our food comes from plants.

Teacher's Note

The following investigation leads on from what was done in the first term in *Life and Living*. Remind the learners that they have already investigated what plants need to grow. For this experiment, you can use a pot plant in the classroom, or you can choose a nearby tree to take the learners to.

INVESTIGATION: What happens to a plant that grows without light?

AIM (What do you want to find out?):

PREDICTION (What do you think will happen?):

APPARATUS (What you will need):

- a growing bean plant in a pot
- a small box with a lid that you can close.
- a bottle of water for the plant.

METHOD:

1. The bean plant must be growing well. Put the plant in a place where it gets light and where you can watch it every day.
2. Make a cut in the lid of the box and put the box over one branch with leaves. The box must be dark inside.
3. Give the plant a tablespoon of water every day and keep the plant healthy
4. After a week, open the box and look at the leaves that were growing inside.

5. Compare the leaves that grew in the dark with the leaves that grew in the light.

Put the small box over some leaves and make sure that light cannot reach those leaves

RESULTS (What you observed):

Draw two drawings of the plant. One drawing must be of the leaves that were covered in the box, the other drawing must be of the leaves that were exposed to the sunlight. Give your drawings a heading and labels.

CONCLUSION (What you learnt):

Write your conclusion from this investigation below.

How could you do this investigation better?

The light from the Sun helps plants on the Earth to grow. Look at the photo below here. All the leaves came from the same plant.

These leaves came from the same plant. The leaves on the top branch grew in light, but the leaves at the bottom branch grew without light.

QUESTIONS

1. What is the difference between the leaves on each branch? Write two sentences about the leaves. Begin like this "The leaves at the top of the picture are . . ."

   The leaves at the top of the picture are dark green and strong/healthy. The leaves at the bottom of the picture are pale green/light green and they look weak/sick. The learners are using the skills of observing and describing

2. Why do the leaves look different, do you think? Write one reason why the leaves look different.

   Here the learners must make a hypothesis. We do not know the answer but we can make a hypothesis that the pale green leaves grew in the dark. Another hypothesis could be: some insects were sucking juice from that branch so the leaves were weak. The second answer is not wrong and you should praise learners who think of more than one hypothesis. You are developing their skill in hypothesising. However, the first hypothesis is a better one than the second hypothesis.

ACTIVITY: Why do most plants stop growing in winter?

In winter and summer, the grass, trees and other plants around you look different.

INSTRUCTIONS:

1. Complete this table. The answers under the heading "summer" are done for you.

Questions	Summer	Autumn	Winter	Spring
In which months of the year do we have these seasons?	Late in November, December, January, February	*March, April, May*	*June, July August*	*September, October, early November*
Are most of the days cold, cool, warm or hot?	Most days are hot	*Days are warm or cool*	*Most days are cold*	*Most days are warm*
How high is the Sun at the middle of the day?	Almost over our heads.	*Not high and not low*	*Low down in the sky.*	*Not high and not low*
How long is the night? Short, long or medium?	Short	*Medium*	*Long*	*Medium*
What happens to plants during this season?	Plants grow well	*Plants stop growing*	*Many plants die or the leaves fall off*	*Plants begin growing again*
Draw a picture to show the season				

QUESTIONS:

1. In winter, plants stop growing. Plants lose their leaves or they die. Why does this happen, do you think?

   Ask the children to make hypotheses about why plants die. Ask them to look at the table they completed. When the Sun is low the nights are long and the air is cold.

2. In spring, plants begin to grow again. Why does this happen, do you think?

   The air becomes warmer because the Sun is in the sky for longer. The concept for teachers is that the Sun gives both light and heat to plants.

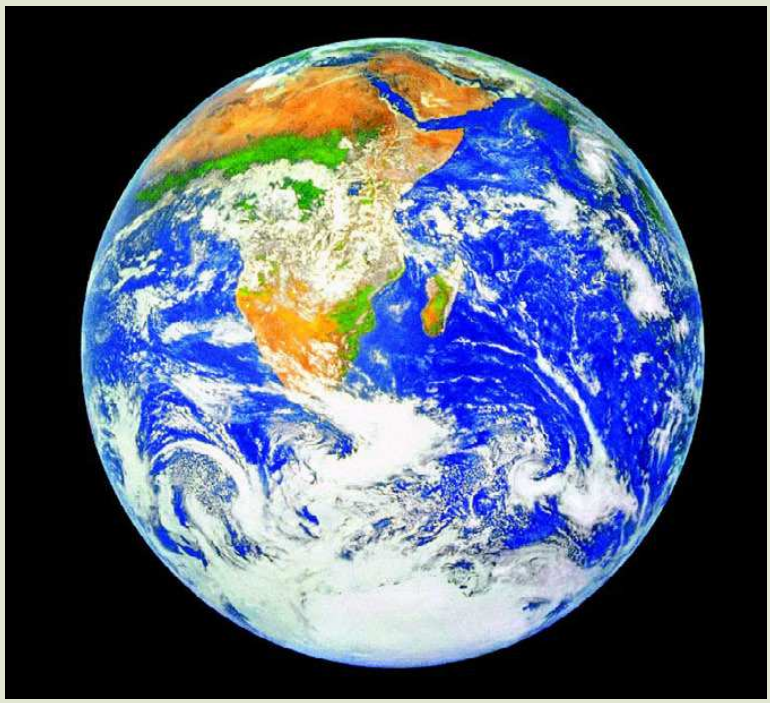
3. Do you remember learning in Term 1 about what a plant needs to grow? Write these down below.

   Light, heat or warmth, water, air

ACTIVITY: How is the Sun providing warmth and rain for South Africa?

INSTRUCTIONS:

1. Look at the photo of Earth below. You have seen it before in this book.
2. Answer the questions about this picture.



QUESTIONS:

1. Is it daytime or nighttime in South Africa?

   Day-time; we can see that all of Africa is in sunshine. Teach learners that they can interpret a photo.

2. Is the weather cloudy or sunny in South Africa?

   Most of South Africa is under cloud, in the photo

3. Where does the rain come from, to give water to the plants, animals and people? Write two or three sentences.

   Water evaporates from the sea ; The water vapour condenses into clouds; rain falls from the clouds. This is a link to Matter and Materials in Term 2 when the Water Cycle was done.

The Thunderbolt Kids had just learned about Earth and what the Sun provides Earth with. Sophie was sitting after class wondering if there are any other planets like Earth where people could also live.

VISIT

The search for life on other planets.
goo.gl/r8squ

QUESTIONS

Do you think people could live on other planets? Give a reason for your answer.

Learner dependent answer

Earth is the only planet in our solar system with the right temperature for us to live on; it is not too hot and not too cold. Earth is at exactly the right distance from the Sun to be the perfect temperature to support life.

QUESTIONS

1. Some of the planets are too close to the Sun and they are too hot for anything to live on. Two very hot planets are:

   Mercury and Venus

2. Most of the planets are so far from the Sun that they are very cold. They are so cold that people could not live on them. Five examples of cold planets are:

   Mars, Jupiter. Saturn, Uranus, Neptune

KEY CONCEPTS

- The Earth moves round the Sun
- The path of the Earth is called the orbit of the Earth.
- We have defined the time it takes the Earth to complete one orbit, a year.
- Some of the bright things we see at night in the sky are planets, and not stars.
- Earth is one of the eight planets in our solar system.
- Earth is the only planet that we could live on.

VISIT

NASA's kids site on the solar system.
goo.gl/t3v9Z

REVISION:

1. What is at the centre of our solar system?

   The sun

2. Name the 8 planets in our solar system.

   Mercury, Venus, Earth, Mars, Saturn, Jupiter, Neptune and Uranus.

3. What do plants get from the sun that they need to grow?

   light and heat

4. What is the shape of the Earth's path around the Sun?

   A circle, or very nearly a circle - an ellipse

5. What is the name of the Earth's path around the Sun?

   Its orbit

6. Why does the Earth move in a circle around the Sun?

   The force of gravity between the Sun and the Earth pulls the Earth towards the Sun; otherwise the Earth would go in a straight line into Space, and move far away from the Sun.

4 Rocket Systems

KEY QUESTIONS

- How can people travel in Space?
- How do I make my rocket go faster?
- How can I make my rocket go straight?

Teacher's Note

There is a strategic reason for placing the unit on rockets here: if we leave this unit to the last 2 weeks of the year, the children will probably not get the experience of doing a technology project. They may just make something in their own time, perhaps at home, and that is not technology. Technology is in the investigating, thinking and designing. You need time to guide them through all those processes.

The NCS pattern of technology projects is in here too. You can remind the learners of this:

I stands for investigating the problem which some people have, investigating existing products, and investigating concepts and skills that you will need to solve the problem.

D stands for Designing -- that means using what you learned from investigations to think of good ways to solve the problem

M stands for Making -- when you make your model, you use materials and tools, you make your model look good, and you show the teacher what you learned in your investigating. (Notice that most children design with their hands, not only with pencil and paper. As they work with materials they get more ideas, and their design improves. So we should think of designing and making as more or less the same stage of a project.)

E stands for Evaluating -- after you have made your model to solve the problem, you have to ask, does it work? Could we do a better

one?

C stands for Communicating -- you must show other people how you decided on your solution to the problem. You need to write and draw your ideas. (The learners should be drawing and writing all through the project. Don't leave the writing to the end, because they find it boring at that stage. When they are getting new ideas they often enjoy writing because they are writing about their own ideas; this is a great strength of technology in school. A technology project gives the children reasons for reading and reasons for writing. And so we can address the literacy problem through the subject of science and technology.)

4.1 The Thunderbolt Kids need a rocket

Jojo, Sophie, Farrah and Tom are watching a fireworks display at a music festival. Rockets shoot up into the dark night sky and then they explode and send out showers of sparks.

Fireworks at the music festival. [1]

VISIT

Watch this video on a space shuttle launching:
goo.gl/9EXTf

Jojo asks his friends, "Can one of those rockets go to the Moon?".

Tom replies, "No, the Moon is 384 000 kilometres away - that's too far!"

Farrah says, "I don't want any rockets on the Moon - it's so beautiful the way it is."

Sophie then confirms, "But people HAVE been there! They used a rocket to go there. They walked around and they brought back

some Moon rocks."

The Thunderbolts kids sit for awhile longer, gazing up at the beautiful fireworks with the moon in the background.

Farrah breaks the silence, "I saw a video of the astronauts on the Moon. They jumped around easily because they weighed less on the Moon."

Jojo then has a great idea, "Come on, let's make model rockets. We'll pretend we are sending someone to the Moon!"

Everyone agrees and Tom even says, "I want a little astronaut on my rocket - I'll write my name, Tom, on him!"

Now the Thunderbolt Kids want to design and make rockets. Their rockets will have a small model of a person on them. You must help them do this!

QUESTIONS

Write down two things you know about rockets.

They go up into the sky; they move themselves; they go fast; some rockets carry people; some rockets have gone to the Moon; gas or smoke comes out of the back of a rocket

We now need to write a design brieffor our project. A design brief tells what you are planning on doing and designing. It is normally quite short.

QUESTIONS

Write two sentences about what you are going to do. This is your design brief.

4.2 How do rockets work?

The Thunderbolt kids must find out some things before they can design a rocket. In this section, the Thunderbolt Kids are going to investigate rockets. In Technology, a designer must find out what people have already made, and find out how those things work. We use the word "investigate", which means find out.

Sophie is reading up about rockets that have been built in the past. She is investigating!

VISIT

Watch this video of when man landed on the moon for the first time.
goo.gl/vWKnF

Investigate rockets that went to the Moon

People have used rockets to go into space and to travel to the moon. In 1969, a rocket called the Apollo 11 took three men to the Moon for the first time. Turn to the page later in the book on "Moon facts"in the chapter on the Moon and find the pictures and read about the journey.

Teacher's Note

The task for the learners is to **find**the information they need. Do not give it to them; they must learn to search through text for information. Give them enough time to search Unit 5 and read the parts they need. You should put non-reading learners together with learners who can read.

QUESTIONS

1. Did the whole rocket go to the Moon?

   No

2. Which part of the rocket went to the Moon?

   Only the small spacecraft on the nose of the rocket

3. How far did the spacecraft have to travel to reach the Moon?

   384 000 kilometres. Actually it went further than this because it did not go in a straight line. Its path was curved because the moon was a moving target.

Investigate rocket systems

Once we leave the Earth's upper atmosphere, there is no air between there and the Moon. The wings of aeroplanes work only when they move through air.

QUESTIONS

Can an aeroplane fly to the Moon? Give a reason for your answer.

No, because their wings will not work in Space.

Rockets therefore cannot move in space the same way that aeroplanes move through the air on Earth. So rockets need to move in other ways. Let's have a look at making a simple model of a rocket to see how they move.

Teacher's Note

The next activity introduces the learners to the idea of the rocket using gas to propel forwards. The gas combusts and releases from the bottom, moving the foil in the other direction, much in the same way that a rocket does when launching and travelling in space. Explain this to the learners during the activity.

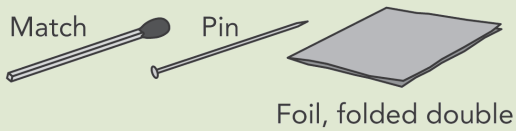
ACTIVITY: Make a rocket from a match

MATERIALS:

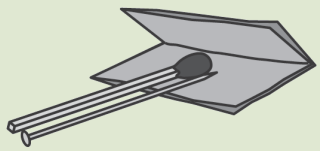
- a box of matches
- four rectangles of aluminium foil, 4 cm by 8 cm
- a pin
- a paperclip

INSTRUCTIONS:

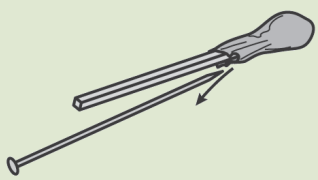
1. Put the match on the square of foil and put the pin next to the match.



2. Wrap the foil around the pin and head of the match.

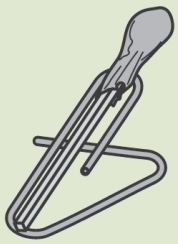


3. Pull out the pin. This leaves a tiny tube for gases to escape.

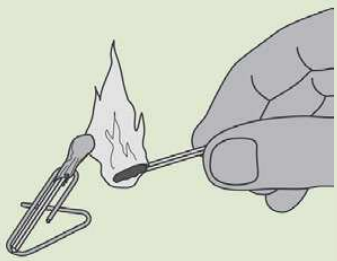


4. Now you have a rocket. It is almost ready to launch. All you still need is a launch structure.
5. Bend the paperclip to make a structure as you see in picture.

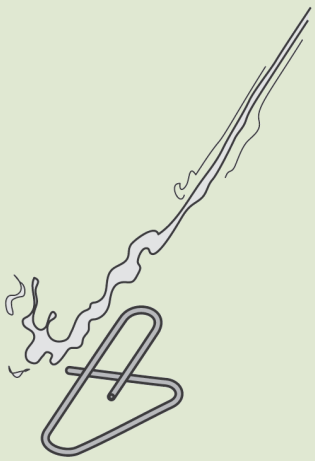
6. Put your match rocket in the launch structure. Make sure the rocket points away from people.



7. Strike the other match and heat the head of your rocket.



8. Watch what happens!



1. A rocket needs fuel. Fuel stores energy (Remember we learned about storing Energy in Term 3?) Where is the energy stored in this rocket?

   The energy is stored in the head of the match

So, what have we learned from this small model of a rocket using a match stick? When the match-head burns, it gives off hot gases. The hot gases try to expand upwards, sideways and downwards. To expand means to take up more space.

The gases that expands downwards escape from the nozzle at the back of the rocket. The hot gases shoot out from the nozzle and as a result, the rocket is pushed upwards.

QUESTIONS

Do a drawing of the rocket going up. Add these labels to your drawing: nose of the rocket; tail of the rocket, nozzle, hot gases coming out.

The rocket goes upwards because the hot gases shoot downwards out of the nozzle. The faster the gases go downwards, the faster the rocket goes upwards.

If the nozzle is very big, the gases get out too easily and so they do not shoot out fast. If the nozzle is too small, the gases cannot get out fast. So what is the best size for the nozzle? You can try different nozzle sizes for the match stick rocket to find out which one works the best.

QUESTIONS

What have you learned from this investigation?

Investigate balloon rockets

Have you ever blown up a balloon and then let it go. How did it fly? Did it go in a straight line? Probably not! It most likely flew all over the place! This is no good for a rocket. How do we make it fly straight?

I have an idea to make the balloon go straight! Have a look in the next activity.

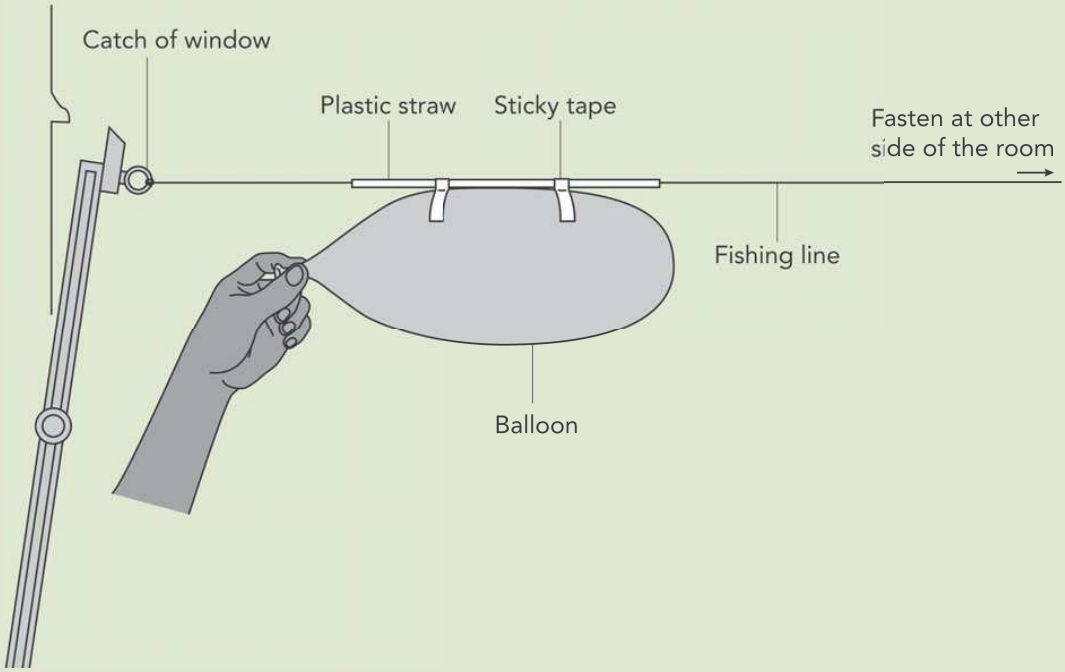
ACTIVITY: Help the balloon to fly straight

MATERIALS:

- 2 balloons
- fishing line, about 10 m long
- plastic straw
- sticky tape

INSTRUCTIONS:

1. Fasten the fishing line to something on one side of the room.
2. Put the other end of the fishing line through the plastic straw.
3. Now fasten the fishing line to the catch or handle of a window. Move the window so that the fishing line is tight and straight.
4. Blow up the balloon to the size of a loaf of bread and then use the sticky tape to fasten the balloon onto the straw. You see this in the diagram below.



Stretch the fishing line tight.

5. Let the balloon go! The balloon moves away straight along the fishing line.
6. Now blow up the balloon until it is as big as a soccer ball. Let it go.
7. Blown the balloon up to different sizes. You can use the number of breaths that you blow into the balloon as a variable, for example, 3 breaths, 5 breaths, 7 breaths. Each time release the balloon and measure with a ruler how long it goes along the fishing line. Record your results in the table below.

Size of balloon (number of breaths to blow up)	**Distance moved (cm)**

Use this information to now plot a line graph. The number of breaths that you blow the balloon up with is what you are

changing, so this goes along the bottom horizontal axis, called the x-axis. The distance moved by the balloon along the line depends on how many breaths you blew into the balloon. So this goes along the vertical axis, called the y-axis. Your teacher will help you and show you how to plot the first point. Use the space below to draw your graph.

QUESTIONS:

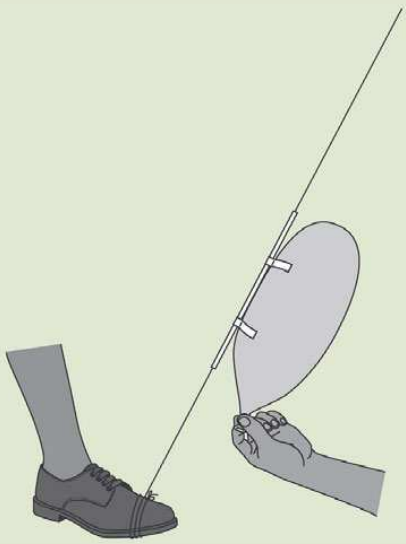
1. Does the balloon move differently when you blow it up to a small size and a big size?

   Yes. (In each case it will move along the fishing line, but at different speeds and for different distances)

2. What is the difference between the ways the balloon moves when it is blown small and blown big?

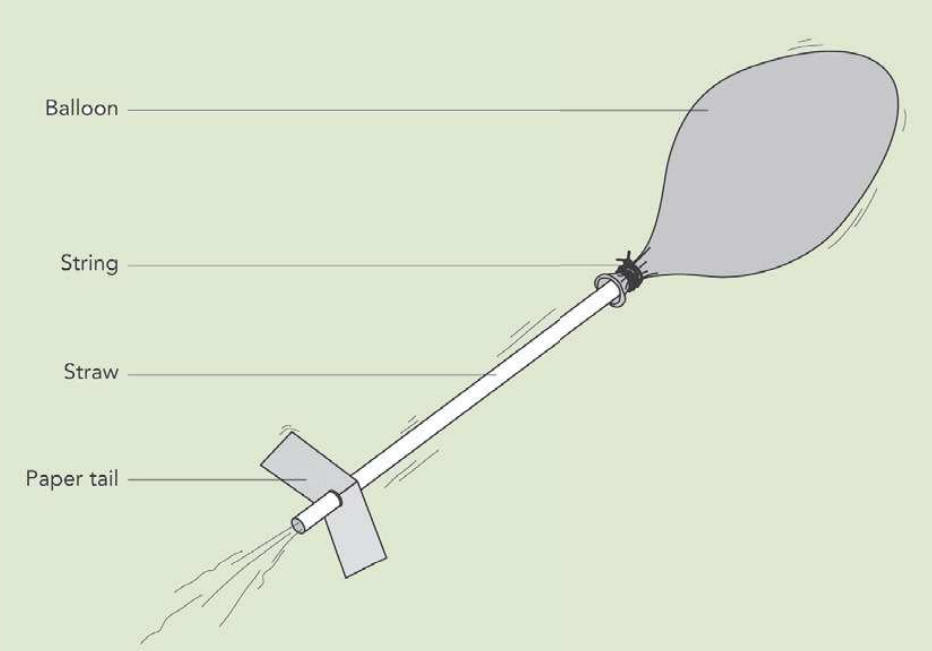
   When it is blown up big it moves much faster. the reason is that you have stored more energy in the balloon.

3. Rockets that take astronauts to the Moon go up, not sideways. Think of a way to make the rocket go up and straight. The picture below will give you some ideas.



How well does the balloon fly if you hold the fishing line like this?

4. The next image shows you another way to help the balloon go straight. Make a balloon rocket like that and see if it flies straight.



Will this system make the rocket go straight?

So far we have done some investigations into rockets and researched how they move and work. The last thing to do is to investigate a bit about the place we want to go - theMoon!

ACTIVITY: Investigate the Moon

INSTRUCTIONS:

1. You must find out about the Moon.
2. You can read Moon Facts in Chapter 5.
3. Answer the questions below.

QUESTIONS:

1. How far is the Moon from the Earth?

   384 000 kilometres

2. Does the Moon have air for you to breathe?

   No

3. Is there air between the Earth and the Moon?

   No

4. Could a bird fly from the Earth to the Moon? Give a reason for your answer.

   The bird needs air to breathe and it will have none in space. But also, a bird's wings work on the air, and again, there is no air in Space.

5. Can a big airliner fly to the Moon? Give a reason for your answer.

   The engines of an airliner need air to make the fuel burn, and its wings work only when they are rushing through air. There is no air in Space so neither the engines nor the wings would work.

4.3 Modelling a rocket

The Thunderbolt Kids are going to design and make rockets. To design means to use your knowledge and to think carefully about the thing you are going to make.

Teacher's Note

Remember that for primary school children, designing and making go together. They get ideas when they work with materials and they design with the their hands, not only with pencil and paper. As they work, they change their ideas. So we never force them to make something that looks like the first drawing they did. In industry, designers will make sketches and then make a prototype. A prototype is not the final design, they make it to check their design ideas. They will then improve the prototype. Throughout this chapter we have been going through an extended Design Process. In the beginning, we identified a need to design something as the Thunderbolt Kids wanted a rocket to go to the Moon. A short Design Brief was written. We then spent a lot of time doing the Investigation part and other activities formed part of this process. This also shows that science and technology go together and that science investigations can be used to make decisions about your design. Now that we have finished investigating, the next section will go into the Design, Make, Evaluate and Communicate parts of the Design Process.

ACTIVITY: Designing, making and evaluating a rocket

INVESTIGATE:

The first step is to always investigate. We have already done quite a few investigations leading up to this. Go back and revise what you have learned.

DESIGN:

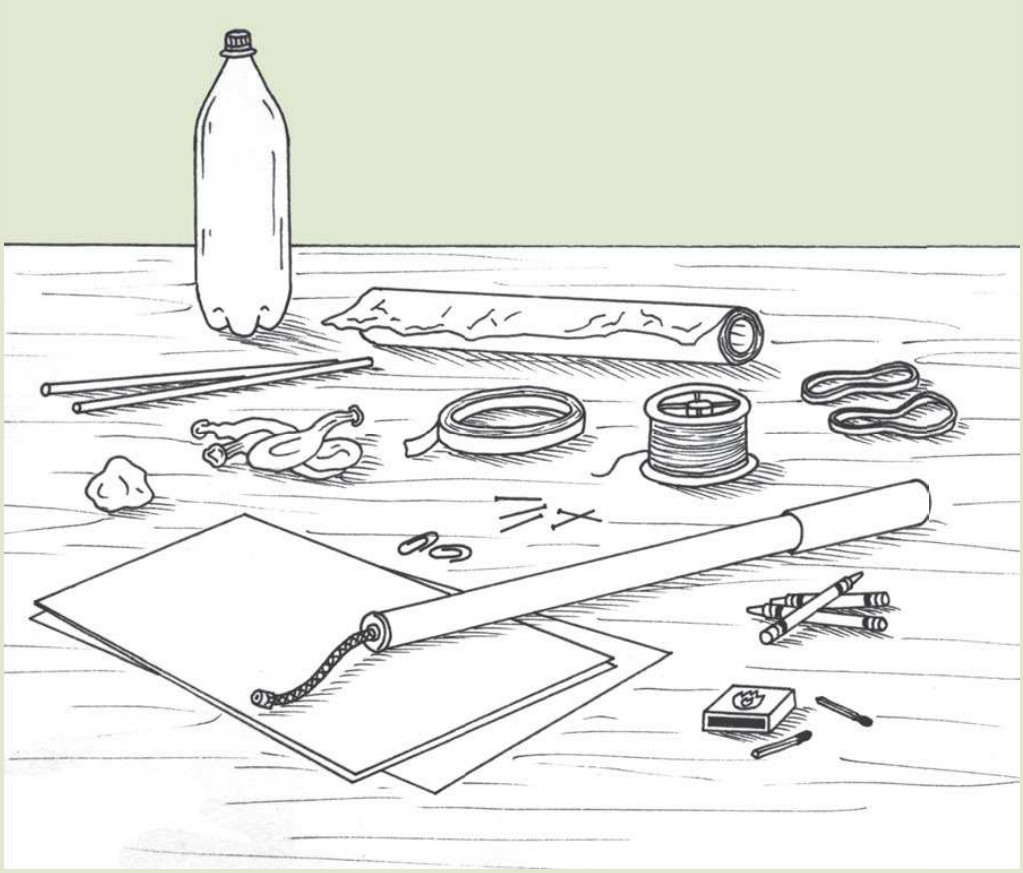
Now you need to use the information you have found out to come up with a design for your rocket.

Your rocket has the following specifications:

- your rocket must move by itself.
- your rocket must go further than 1 metre, upwards or sideways.
- your rocket must carry a small paper model of an astronaut.
- the astronaut must have the name of someone in the group.
- you must make your rocket in class, not at home.

Answer these questions:

1. What do you need to design?
2. What will the size and shape of your rocket be?
3. What materials are you going to use to build your rocket? Make a list of all the materials you will need. The image below shows some of the materials you can use. You do not need to use all of them and you can also use other things that are not in the picture.

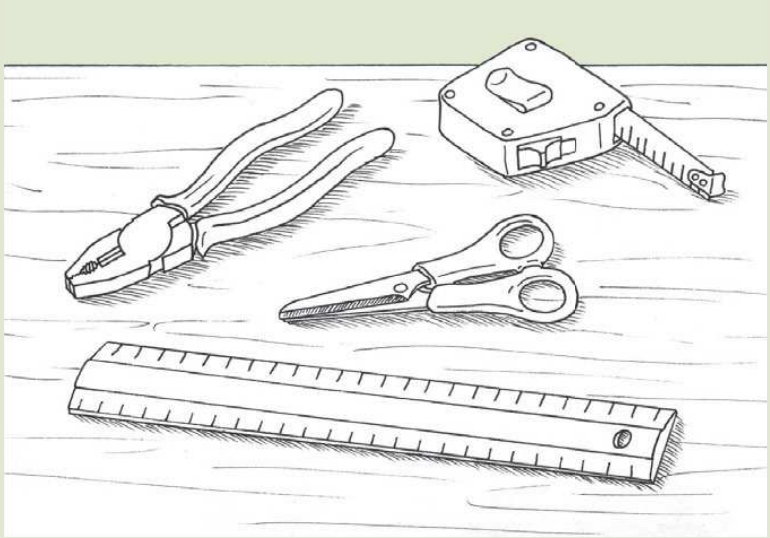


The things you can use to make your rocket.

Teacher's Note

Do not tell learners they may use only certain materials; remember, we want to encourage their creativity. When they get enthusiastic about their projects, they will find all kinds of materials to try. However, we should tell them that anything they bring must be used in class, because we need to assess their design-and-make abilities. Not the abilities of their parents!

4. What tools are you going to need to make your rocket?



These are some tools to use.

5. Are there any other specifications and constraints that you can think offor your rocket?

Now you need to draw some designs for your rocket. Use scrap pieces of paper to do your first designs. Once you are happy with your design, use the space below to draw your design. Label your drawing showing what materials you are going to use for the different parts.

When you are making your rocket you will get better ideas so come back afterwards and draw on the bottom half of the page; show what you really decided to make.

MAKE:

Now make your rocket in class! You have to make your rocket according to your sketch and using the materials you identified.

Once you have all finished making your rockets, test them to see if they go 1 m up into the air. Show the class how your rocket moves. The class will ask you how far it goes, and they will look for the little paper astronaut who rides on the rocket. Does anyone's rocket go higher than 1 m?

Teacher's Note

A lot of facilitation is needed at this point. Maybe only test one rocket at a time so that all learners see what the other have done and can learn from each other.

EVALUATE:

Answer the following question on the rocket that you have built after testing it.

1. Where did your rocket get its energy from to move?
2. How many centimetres did your rocket move?
3. Did your rocket move in a straight line?
4. What could you have done to make a better rocket?

COMMUNICATE:

Remember, the last part of the Design Process is to communicate what you found to others so they can learn from what you did.

I really want to know what you learned about designing rockets!

Write a paragraph below where you tell the Thunderbolt Kids about the rocket that you built, what worked and what did not work, so that they can also learn from what you did.

KEY CONCEPTS

- Aeroplanes cannot fly in Space because there is no air in Space
- Rockets can move in Space
- People have used rockets to go into space and to travel to the Moon
- Rockets use stored energy to move

REVISION:

1. We cannot fly to the Moon in an aeroplane. Give a reason why we cannot.

   In space there is no air. Aeroplane wings work only in air.

2. Explain how a rocket moves.

   Rockets work by pushing hot gases out of the nozzle in the back end. This propels them forward.

3. Give a reason why the nozzle at the back of the rocket must be small.

   The gases must come out very fast

4. What year did man first land on the Moon using a rocket?

   In the year 1969

5 The Moon

KEY QUESTIONS

- Why is the Moon bright on some nights?
- Why does the Moon change its shape?
- How can we find out what the surface of the moon is like?

5.1 Features of the moon

Remember when we looked at the features of the Earth. Now, let's take a look at the features of the moon. Let's go visit the Moon! You already built rockets in class. Now let's pretend that we are the astronauts on our rockets and we are going to explore the Moon.

The Moon is a ball of rock in Space

The Moon is very different to the Earth. The Moon is not a planet either! It is made of rock and it moves around the Earth in a circle. Remember how we spoke about the planets which orbit the Sun. The Moon does the same thing - it orbits around the Earth.

Full moon.

QUESTIONS

1. The moon has marks and shapes on it. What are those marks, do you think?

   Let the children discuss this and then write down their ideas. They are making hypotheses. A hypothesis is a good guess, using the knowledge one has.

2. How could you find out what the marks on the face of the moon are?

   We would have to go there and look at the surface of the moon. For the teacher: Tell the learners that we will be going there - at least, in our imagination we will go there. We will had to build a rocket to get there.

Moon facts

- The Moon is 384 000 kilometres from Earth
- The Moon is made of rock and the surface is rock and grey sand.
- The Moon has no air and no water
- The Moon is smaller than the Earth
- People weigh less on the Moon than on Earth because the force of gravity is less on the Moon.
- The Sun is much further away from Earth than the Moon.

Exploring the Moon

In 1969, the rocket you see in the picture carried three men to the Moon for the first time. The rocket and spacecraft were called Apollo 11.

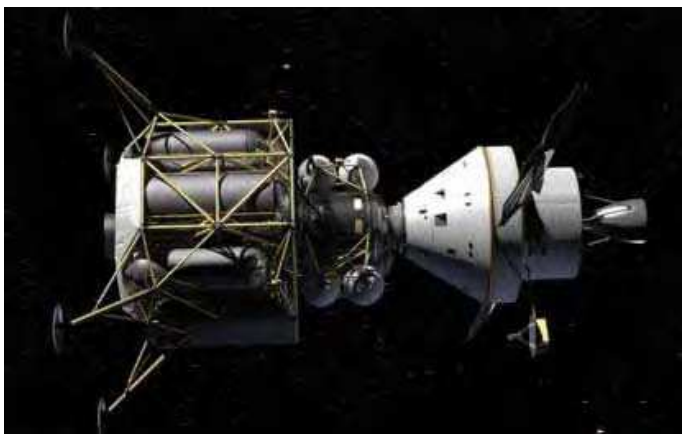
This picture shows the rocket blasting off and going up into Space. The rocket is as high as a 30-storey building.

VISIT

Watch this video of astronauts landing on the moon [2]

The flame at the back is the hot gases coming out of the nozzle. The clouds on the side of the picture are the gases that hit the ground and blow dust sideways. The three men were called astronauts. They were in a small spacecraft on the nose of the rocket.

The big rocket burned up all its fuel and fell back to Earth, and landed in the sea. But the small spacecraft went on by itself to the Moon, and the astronauts were inside the spacecraft.



This is the space-craft that went to the Moon and landed there.

Let us imagine that we are in that rocket!

We travel through Space at 5 800 kilometres in every hour. After three days' travel, we reach the Moon. We can see that the Moon is round, like a ball. We can see that the surface is rough, with mountains and many craters.

The surface is the outside of an object. You can rub your hand on the surface of your desk. A crater is a hole that was caused by something hitting a surface. If you throw a stone into sand, you make a crater in the sand.

Teacher's Note

First let the children try to read this story for themselves. You can prepare them like this:

Ask them to find these words and underline them:

surface (= the ground is the surface of the Earth)

helmet (= a structure that protects a person's head. Cyclists wear helmets.)

radio (= a system like a cellphone)

crater (= a hole in the ground)

protective glass (= glass that stops the Sun harming your eyes)

temperature (= how hot or cold something is).

Then explain the meaning of the words to the learners.

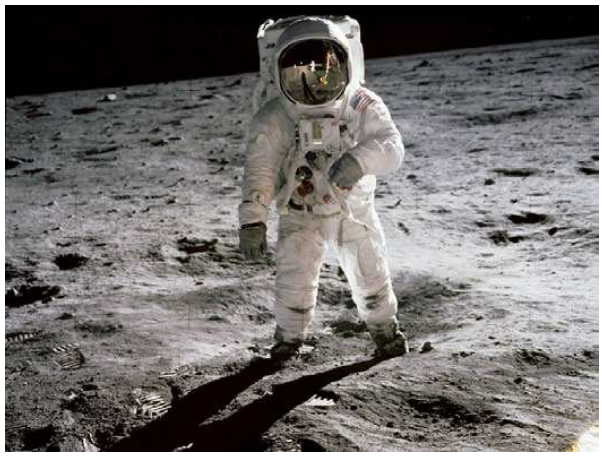
If you decide to read the story to the learners, then pause at each of these words, and ask the class to read the word aloud. This does two things: it helps them learn the new word in its context, and it lets you know that they are following in the text.

What do we find on the Moon?

Read this story, or listen while your teacher reads it aloud:

The spacecraft goes down slowly to the Moon's surface, blowing out a big cloud of dust. There is no air on the Moon, and so the dust quickly falls back to the ground. We put on our space suits.

We have air in tanks to breathe, radios to talk to each other and special glass helmets to protect our eyes from the Sun.



An astronaut in his space suit walking on the Moon.

The ground under our feet is grey sand, dust and small rocks.

The craters that we saw are big holes in the surface of the Moon. Rocks that travel very fast through Space sometimes smash into the Moon. In the places where the rocks hit, they make a hole and a ring of sand.

The sky is black, not blue. We can see the stars and the Sun at the same time. The Sun is bright, much brighter than on Earth, and we are glad we have protective glass in our helmets.

As we walk around on the Moon, the temperature of the ground is hotter than boiling water. But if we stop in the shade of a big rock or the spacecraft, the temperature is much colder than ice. The temperature changes so much because the Moon has no air. On Earth, the air keeps the Earth's surface from getting too hot or too cold.

ACTIVITY: I am an astronaut on the Moon

QUESTIONS:

1. Why is the astronaut in the picture wearing a glass mask that covers his whole face? Could he just wear dark glasses?

   No. The glass mask also keeps the air in his suit.

2. He is carrying the big pack on his back. Think of three things that are in the pack. You can work out the answers by discussing the story.

   Water, air, batteries, radio and a fridge system to keep him cool. Don't let the learners try guessing the answers; teach them to ***make inferences*** *from the story they just read.*

3. The sand on the Moon appears to have a light colour. Why does the Moon give us light at night?

   The sand does not make its own light. The Moon is like a grey wall with the Sun shining on it. The grey wall lights up a dark room.

4. Do a drawing of yourself on the Moon. Write a heading for your picture: This picture shows me on the Moon. Show the protective suit that you wear, and write labels for the parts of your protective suit.

This is the Earth seen from the surface of the Moon.

5.2 The phases of the Moon

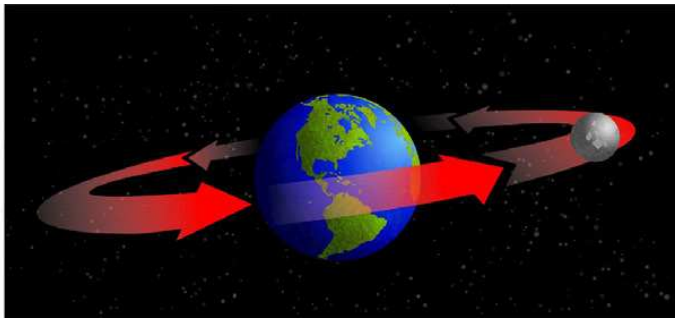
A phase is a period of time. For example, you are now in the Intermediate Phase at school. In Grade 7 you will be in the Senior Phase.

As the Moon orbits around the Earth it appears as though the Moon is changing its shape in the sky. The Moon changes from a thin crescent to a full circle or disk (full moon) and then it shrinks back to a thin crescent again. It is then not visible for a few days again. These changes in the Moon's shape are called the Moon's phases.

Look at the diagram showing all the phases of the Moon.

The Moon moves in an orbit around the Earth. The Moon takes about 29.5 days to go all the way around and come back to the same position. This length of time is almost one month and so it takes almost one month from a full Moon to the next full Moon.

The moon changes shape each night as the Earth is casting a shadow on the Moon. Depending on the position of the Moon, the Earth and the Sun, the Earth blocks the Sun's light from reaching the Moon and therefore casts a shadow. As the Moon moves around the Earth different shadows will be cast on the moon from the earth making it look like it is changing shape.



The Moon orbits the Earth once every 29 $\frac{1}{2}$ days.

Why does the Moon change shape during the month?

The Sun shines on the Moon but there is always a part of the Moon that the Sun cannot reach. We can see the part that has sunlight on it, but we cannot see the dark part that is in shadow.

Teacher's Note

If you don't do this activity outside, then set up a big mirror to shine sunlight into the classroom.

ACTIVITY: Make a model of the Earth, Sun and Moon

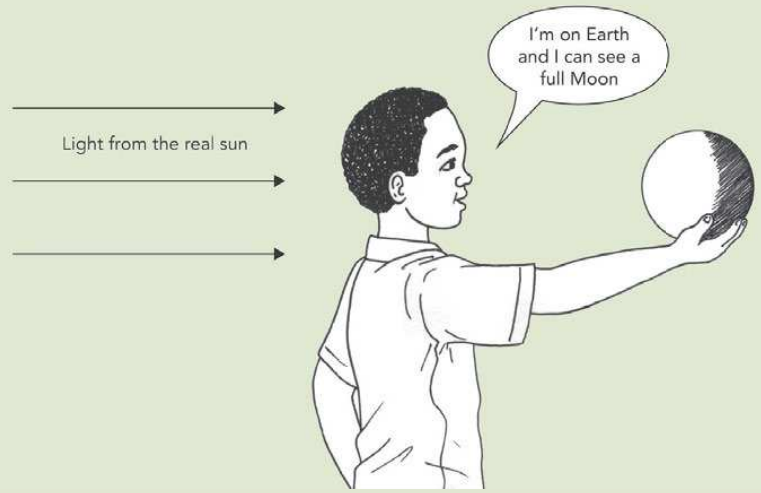
This model will help you understand why the Moon's shape changes during the month.

MATERIALS:

- a small ball to represent the moon
- a sunny day!

INSTRUCTIONS:

1. You must do this activity outside, early in the morning while the Sun is still low.
2. Begin with your back to the Sun.
3. Hold out your "Moon" in front of you, as you see in the picture.
4. Your head is the Earth and your nose is Africa. You are looking from Africa. Which phase of the model Moon do you see?



How to hold the "Moon" with the sun behind you.

5. Keep your arm stretched out and swing around until the model Moon is between you and the Sun. Now you see only the shadow side of your "Moon". You are seeing new Moon.
6. Keep your arm stretched out and move the "Moon" to your right until a little sunlight shines on the side of the "Moon".

Teacher's Note

In case you are wondering, the learners move the ball (the "Moon") to their right because they are in the southern hemisphere.

7. Which shape of the Moon do you have now? Point to the pictures in the table showing the moon phases.
8. Turn more to your right until half the Moon has light on it.
9. Which shape are you seeing now? Point to the pictures in the table.
10. Turn your back to the Sun, so that you see light all over the side of the Moon. This is like 14 days passing.
11. Which shape of the Moon do you have now? Point to the pictures in the table.
12. Turn further to your right. Show your teacher how you can get the shape in the table. This is like 21 days passing.

Teacher's Note

The Moon takes about $29^{1/2}$ days to go around the Earth and come around to the same position it was in before.

QUESTIONS:

1. If it were new Moon tonight, how many days will it take for the Moon to be full again?

   About 14 days

2. How many days will it take for the Moon to be a new Moon again?

   $29^{1/2}$ days from new Moon to next new Moon

Teacher's Note

Carry out the activity on the moon watch while continuing with other work as it will take 1 month to complete. You may want to give them other sheets to take home to observe the moon so that they do not have to take their workbooks home.

ACTIVITY: Observing the Moon's phases

MATERIALS:

- Pencil to draw
- Recording Sheet

INSTRUCTIONS:

1. Look at the Moon at the same time every night, for a month.
2. Write the date in the relevant block in the recording sheet below.
3. Make a drawing of the shape you see every night in the table below.

4. See if you can identify the name of the phase and write that in the block below your drawing.
5. If you cannot see the Moon due to bad weather, then write "Bad weather" in the block instead.

Recording sheet

Week 1	**Mon**	**Tues**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Moon shape							
Phase name							
Week 2	**Mon**	**Tues**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Moon shape							
Phase name							
Week 3	**Mon**	**Tues**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Moon shape							
Phase name							
Week 4	**Mon**	**Tues**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Moon shape							
Phase name							

5.3 Moon stories

Many cultures have different stories about the moon. These stories tell us about the importance of the moon in people's lives.

Here are some stories about the moon from different cultures.

The Moon and the Hare

The hare and the Moon met at a water-hole one night. The hare washed his face with water. The water became still, like a mirror. He saw himself in the water and then he saw that the Moon was more beautiful than he was.

So the hare took mud from the side of the pool and he threw it on the Moon's face. You can still see the mud on the face of the Moon, if you look at the Moon tonight.

QUESTIONS

1. What do you think the people who told this story were looking at on the Moon when they described the "mud" on the Moon's face?

   Possibly craters which appear darker.

2. Do you think it was right that the hare threw mud at the Moon?

3. What emotion was the hare experiencing?

   Jealousy

The Moon and the Sun

Teacher's Note

Encourage the learners to read this story for themselves. If they are not yet able to do this, do a pre-reading activity: ask them to find these words and underline them:
burnt; fond; jealous, angry; reason; eclipse. Explain what these words mean. Then read the story aloud, pausing when you come to one of the underlined words. The learners must say the word aloud, so that you can check that they are following the text.

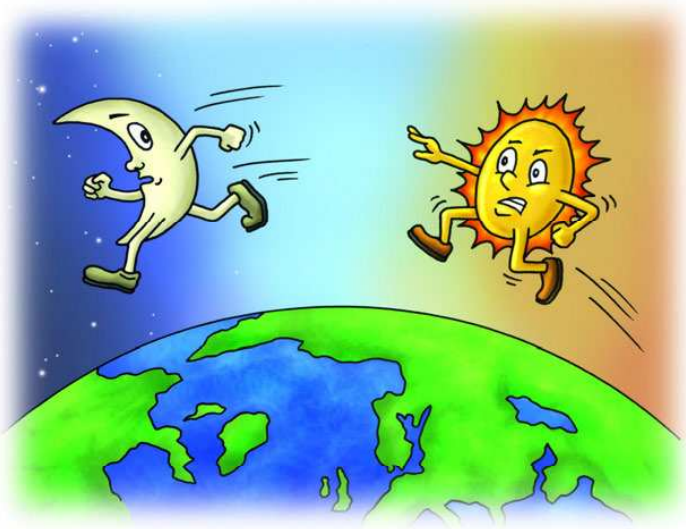
Once upon a time the Sun and the Moon were married and they had many children known as Stars.

The Sun was very fond of his children and he always wanted to hold them. But he was very hot and so the stars got burnt.

The stars did not like to be burnt and so they always ran away to hide when he came up into the sky. But the stars liked to be with their mother, the Moon, because she was the cool one. The Moon had markings on her face and she was beautiful.

This made the Sun very jealous, and he was angry with the Moon. So that is the reason why the Sun chases the Moon out of the sky. On some days you can see her in the daytime but the Sun almost never catches her.

There are times when the Moon comes between the Sun and the Earth, and we see the Sun go dark. These events are called eclipses of the Sun.



The sun chasing the moon across the sky.

QUESTIONS

1. In this story, who is the father, who is the mother, and who are the stars?

   The sun is the father, the moon the mother and the stars the children

2. In this story, what happens in the morning when the Sun comes up?

   The stars run away to hide in the morning

3. How do you know that this story is not true?

   The Sun and moon cannot get married; they cannot have children; the sun does not have feelings like jealousy and anger. ***For the teacher****: This story helps people remember what happens in the day and night sky, and people enjoy stories like this. But science tells a diff kind of story; science tries to explain things that happen by using information about the sun and stars.*

4. The story does help us remember some true facts. Name one of the true facts we get from the story.

   The sun and the moon move across the sky on almost the same paths; the full moon sets in the west when the sun comes up in the east; sometimes the sun does go dark when the moon passes in front ofit.

5. Why are the sun and the other stars hot?

   They are big balls of gas; one kind of gas is changing into another kind of gas and that is why they are so hot.

6. In the real sky, why do the stars disappear when the sun comes up?

   The sun is much brighter than the stars and so we cannot see the light from the stars, but they are still there in daytime.

7. In the real sky, can you ever see the moon in daytime?

   Yes, you can on some days.

KEY CONCEPTS

- The Moon is a ball of rock
- It moves through Space and goes around the Earth
- It reflects light from the Sun onto the Earth
- The Moon has phases due to its position in relation to the Sun and the Earth

REVISION:

1. What is the Moon made of?

   Rock

2. Why does the Moon give us light at night?

   Sunlight shines on the Moon and some of it bounces back to Earth

3. How many days must pass between a night when the Moon is full, and the next full Moon?

   29 1/2 days

4. When we see a half-Moon it looks like a letter D. Why can we see only half of the Moon?

   The other halfis not getting any light from the Sun and so no light comes from it to our eyes.

5. What do we call the changing pattern of shapes of the Moon during the month?

   Phases of the Moon.

6. Arrange the Earth, the sun and the moon in order from biggest to smallest.

   Sun, Earth, Moon

Chapter 1 Energy and Energy transfer

1. http://www.flickr.com/photos/porsche-linn/5056569434/

Chapter 2 Energy around us

1. http://www.flickr.com/photos/cote/66570391/
2. http://www.flickr.com/photos/alanvernon/5206522939/
3. http://www.flickr.com/photos/cote/66570391/
4. http://www.flickr.com/photos/satoru_kikuchi/4461604877/
5. http://www.flickr.com/photos/andybutkaj/1495901113/
6. http://www.flickr.com/photos/54400117@N03/5069103310/
7. http://www.flickr.com/photos/wonderlane/3134754840/
8. http://www.flickr.com/photos/39747297@N05/5229733311/

Chapter 3 Movement and energy in a system

1. http://www.flickr.com/photos/kretyen/6904463913/
2. http://www.flickr.com/photos/fitzharris/7592615270/

Chapter 4 Energy and Sound

1. http://www.flickr.com/photos/usfwsnortheast/6022721392/

Chapter 1 Planet Earth

1. http://www.flickr.com/photos/mauriceking/4784312233/
2. http://www.flickr.com/photos/rubenholthuijsen/7183769130/
3. http://www.flickr.com/photos/afgmatters/4205836196/
4. http://www.flickr.com/photos/nirak/644336486/
5. http://www.flickr.com/photos/40385177@N07/5135201063/
6. http://www.nasa.gov
7. http://www.nasa.gov/audience/forkids/kidsclub/flash/index.html

Chapter 2 The Sun

1. http://www.nasaimages.org/luna/servlet/detail/NVA2%7E34%7E34%7E80665%7E136130:Glittering-Metropolis#
2. http://www.nasaimages.org/luna/servlet/detail/NVA2%7E34%7E34%7E80665%7E136130:Glittering-Metropolis#
3. http://www.flickr.com/photos/wmshc_kiwitayro/3520297538/sizes/l/in/photostream/
4. http://www.flickr.com/photos/calliope/440681335/sizes/l/in/photostream/
5. http://www.flickr.com/photos/ell-r-brown/6949115457/
6. http://www.flickr.com/photos/sanderovski/4712725540/

Chapter 3 The Earth and the Sun

1. http://www.flickr.com/photos/foolstopzanet/3205760827/
2. http://www.flickr.com/photos/12684466@N06/4251142658/

Chapter 4 Rocket Systems

1. http://www.flickr.com/photos/bayasaa/2693171833/

Chapter 5 The Moon

1. http://www.sciencekids.co.nz/videos/space/moonlanding.html
2. http://www.sciencekids.co.nz/videos/space/moonlanding.html