Natural Sciences and Technology

Grade 4

Teacher Guide

The content of this textbook was formatted to combine the two original workbook volumes into a single textbook.

Natural Sciences Grade 4 Teacher Guide

This project is funded as an ongoing project of the Sasol Inzalo Foundation (SaIF), the Department of Basic Education (South Africa) and has been developed with the participation of Magic Moments Consulting and Services.

Cover design by www.topillustrator.com

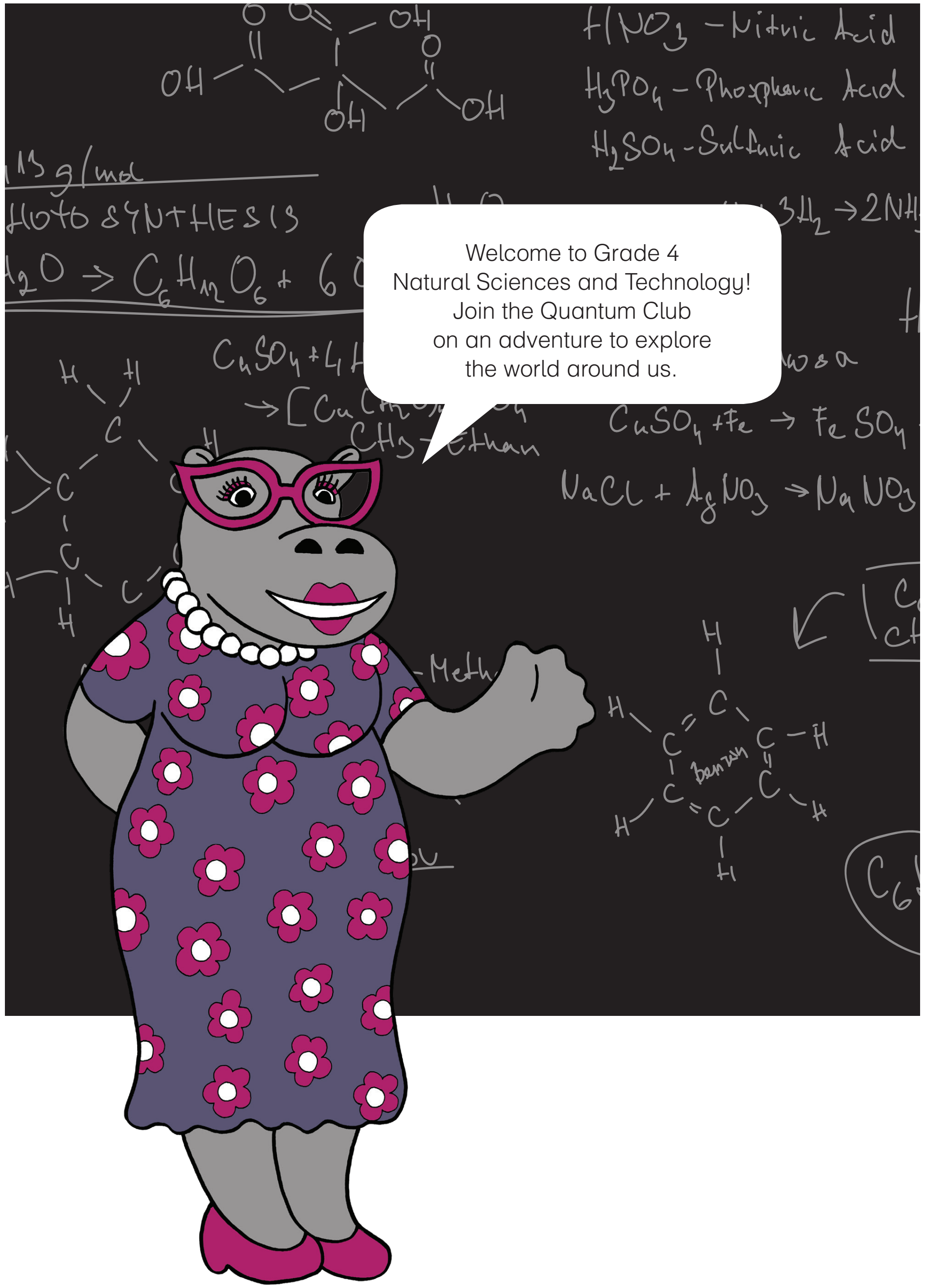
Original contributors: Ronald Arendse, Prof Ilsa Basson, Rudolph Basson, Mariaan Bester, Darryl Bimray, Brandt Botes, Novosti Buta, Michaela Carr, Kade Cloete, Julian Cowper, Dawn Crawford, Zorina Dharsey, Octave Dilles, Shamin Garib, Sanette Gildenhuys, Nicole Gillanders, Celestè Greyling, Martli Greyvenstein, 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

Layout and typesetting by Lebone Publishing Services

Proofreading by Maylani Louw

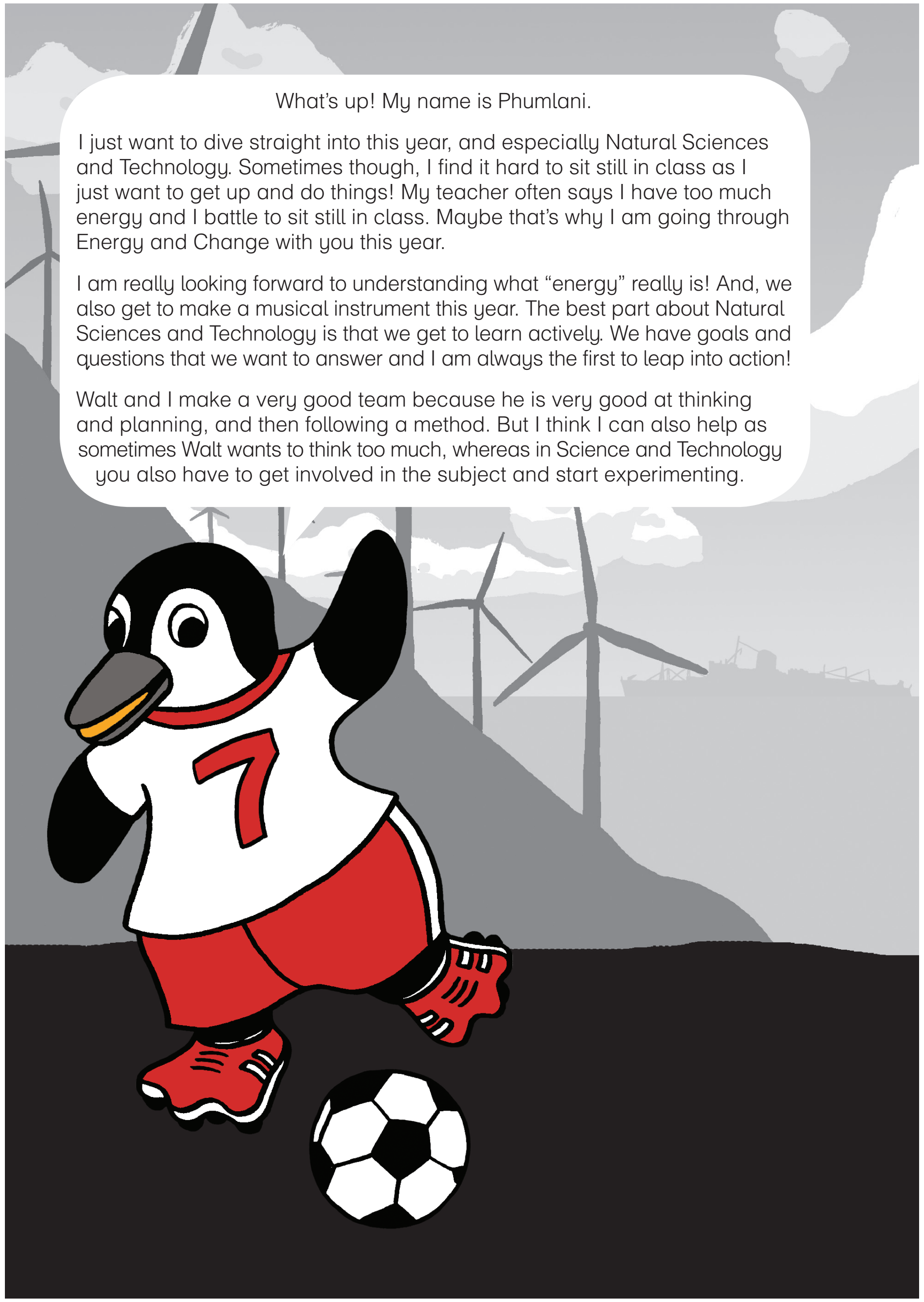
ISBN: 978-1-4315-2862-2

Image attribution: See notes at the end of the book.
Special thanks to Thekla Salmon for the photo of samp and beans on page 169 and the photo of breakfast eggs on page 186 (www.domesticgoddesses.co.za).




Hi there! My name is Mothusi.
My favourite subjects at school are where I get to be creative and imaginative. But, did you know, this is not only in the art or drama classroom? We can also be creative in the ways we do Science and Technology. This is especially true when thinking about new ways to answer a question with a Science investigation or drawing a design to solve a problem.
I also really love being outdoors in the natural world around me. This is why I am going to go through Life and Living with you. I think we are very lucky to live in such a beautiful place as South Africa, with so many colours and plants and animals. I am really excited to start learning more about the living world around us.
Felicity is my best friend and she teaches me how to think carefully and solve problems using logic, which is a very good skill to have in Science. Although we can get on each other's nerves, just like best friends do, we have so much fun together and learn a lot from each other.


Hey! My name is Walt.
I have two places where I am most happy! The first is in the Science lab because this is where we get to be inventive and tinker away with projects and experiments! My second favourite place is the junk yard! Do you know how many interesting objects you can find there? I use these objects in my latest inventions.
This is why I am really excited to be going through Matter and Materials with you. We are going to learn about all sorts of materials around us, and especially how to strengthen materials and make strong structures.
I also really enjoy Maths and thinking about how we can solve problems logically. Phumlani is one of my best mates, although he can be very messy at times! But, Phumlani helps me get involved with my whole body when trying to solve problems in our daily lives, and not just use my mind.


What's up! My name is Phumlani.
I just want to dive straight into this year, and especially Natural Sciences and Technology. Sometimes though, I find it hard to sit still in class as I just want to get up and do things! My teacher often says I have too much energy and I battle to sit still in class. Maybe that's why I am going through Energy and Change with you this year.
I am really looking forward to understanding what "energy" really is! And, we also get to make a musical instrument this year. The best part about Natural Sciences and Technology is that we get to learn actively. We have goals and questions that we want to answer and I am always the first to leap into action!
Walt and I make a very good team because he is very good at thinking and planning, and then following a method. But I think I can also help as sometimes Walt wants to think too much, whereas in Science and Technology you also have to get involved in the subject and start experimenting.
7


Hello! My name is Felicity.
One of my favourite places to be is in the school library. I love reading a new book – there is just so much to learn and discover about our world!
I am always asking questions. Often these questions do not yet have answers to them! This is fascinating as we then get to make a theory about what we think the answer might be. This is why I really enjoy learning about outer space as there is so much that we do not know. Throughout history people have been asking questions about space and our place in the universe. This is why I am going to go through Earth and Beyond and Systems and Control with you as we start to learn about our planet Earth and our solar system.
I also like expressing my opinion and debating about a topic. You have to give me a very good argument to convince me of your opinion! I love exploring with Mothusi, as she helps me to be more creative and imaginative in the way that I think. I can also be quite sceptical and do not believe everything I read. But, this is very important in Science as we must not always accept everything as fact.

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

NatSci&Tech_Gr4_TG_Book.indb 6 2018/05/17 11:37:34 AM

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

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

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)

Planet 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)

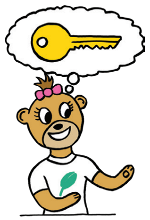
NatSci&Tech_Gr4_TG_Book.indb 7 2018/05/17 11:37:34 AM

Table of contents

NatSci&Tech_Gr4_TG_Book.indb 8 2018/05/17 11:37:34 AM


Life and living

1 Living and non-living things



New words
- process
- conditions
- oxygen gas
- carbon dioxide gas
- seedling
- excreting waste products
- transpiration
- sensing
- reproducing
- germinate
- fertilise
- dormant

KEY QUESTIONS
- What does it mean to be alive?
- What is a non-living thing? What does it mean to be non-living?
- A river seems to move, so is a river living?
- Are the plants that I eat from Gogo's garden living or non-living?
- How can I tell if the bean seeds from Gogo's garden are living or non-living?
- A chicken egg seems to be non-living, but then it can hatch into a chicken. Is the egg living or non-living?

1.1 Living things

There are many different kinds of living things. It is easy to see when some things are living or non-living. It is a bit trickier to decide with other things if they are living or not.

ACTIVITY 1.1: What is living and what is non-living?

INSTRUCTIONS (What you must do):

1. Look through the photos on page 5. Decide whether you think they are living or non-living.
2. Put a ✓ next to the living things and a ✗ next to the non-living things.
3. When you are done, discuss your choices with your class.

Teacher's Note

Introducing the topic

In this unit the learners will find out about what all living things have in common. The emphasis must not be on memorising facts or definitions but on activities that use process skills such as: **observing differences, sorting and classifying, describing and drawing.** As a teacher you need to build the language needed for talking about concepts. Even if the learners use the **correct word**, the **meanings** of that word may be different for each of them. It is especially important to introduce the formal scientific terms of the seven life processes correctly and to explain each process and word-meaning accurately.

Although more technical terms may be introduced incidentally, CAPS requires that the seven life processes are named as follows: moving, reproducing, sensing, feeding, breathing, excreting and growth. Learners need to understand the seven life processes and distinguishing between living and non-living things. It is suggested that teachers make a display with these words: cut coloured A4 pages lengthwise in half, write or print the process on each long strip and use prestik to attach it to the wall in a mind-map formation. In the centre of the mind-map write: The Seven Life Processes. As examples of each of these processes are studied in the class let the learners add illustrations or interesting facts and build the mind-map as you work through the section.

Flowers and plants

Water and waves[1]

A zebra

Clouds in the sky[2]

Chicken eggs in a nest[3]

A burning fire[4]

A tropical fish[5]

Mould growing on a lemon[6]

Teacher's Note

1. Introduce the unit with a class discussion. Encourage all learners to participate by calling on different learners for their opinions on what constitutes being living and non-living. Use the white or black board and write down the key concepts that are raised.
2. Ask the learners to name the living things around you and at home.
3. Discuss the difference in terminology between something that is non-living and something that is dead.
4. Suggested questions.
   - What does it mean to be alive?
   - Are all living things animals? What do plants and animals need to stay alive? (Water, food, air etc.)
   - Which seven things have all living things in common?

Let the learners examine the photos to identify the seven life processes. Let them explain each in their own words. Encourage learners to work out an acronym to remember the seven life processes. For example:

M = Moving
R = Reproducing
S = Sensing
B = Breathing
F = Feeding
E = Excreting
G = Growth

This spells? MRS B. Feg

Did you know?

It is ok if you do not agree with everyone else. It is important that you listen to everyone when they explain what they think it means to be living or non-living.

It is not always easy to say if something is living or non-living. Many times things that look as if they are non-living can become alive again. Other things like a river or soil, are non-living but people say the "soil is alive" or talk about "living waters". This is because there are so many living things that live in the soil or the water. This can be a bit confusing, don't you think?

Look carefully at the living things in the photos on page 5. Can you see what is the same in *all* of them? Something that they maybe all *do*?

Characteristics of living plants and animals

Although living things look different, they all carry out seven similar processes. We call these the seven life processes.

Let's take a look at each of these life processes.

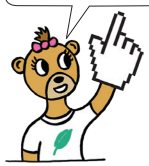
Moving

All living plants and animals move:

- Humans and animals use their bodies to move from one place to another.
- Some plants turn towards light or water. Roots mostly grow downwards. Many stems grow upwards.

Visit

This video shows how sunflowers follow the movement of the sun. goo.gl/amRQE



Sunflowers turn towards the sun.

Humans move all the time. These athletes are running.[7]

Reproducing

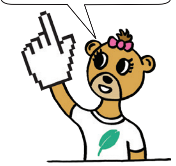
All living things make offspring (babies or seeds):
- Humans and animals have babies.
- Some new plants can grow from seeds.
- Other plants grow from cuttings or shoots.

A mother and father with their baby.

Sensing

All living things respond to any change that they sense:
- When you feel cold, you put on a jersey or jacket.
- When it becomes winter some animals hibernate.
- In autumn the leaves on some trees change colour.
- You can use an umbrella to protect you from the rain or from the harsh sun on a hot day.
- Reptiles lie and bask in the sun on cold days.

Visit
Video on hibernation.
goo.gl/dhT4X



This chameleon is basking on the wall in the winter sun.

The leaves on some trees respond to the change of the season and turn brown during autumn.

Breathing

All living things *breathe* gases in and out:

- Humans and animals use oxygen gas from the air that they breathe in. They release (give off) carbon dioxide gas when they breathe out.
- Plants take the gas carbon dioxide into their leaves. They use it to make food. They then release oxygen for animals and humans to use.

Feeding

All living animals and plants need food:

- Food gives all living things the energy they need.
- Green plants can make their own food for energy in their leaves and stems.
- Humans and animals eat plants to get energy.

These children are eating their lunch. [8]

Did you know?

When you sweat you are actually excreting waste from your skin!

Excreting

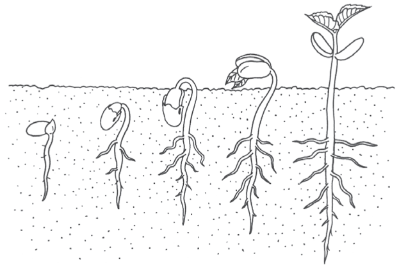
All living things have to get rid of waste products:

- Humans and animals have to get rid of waste products from their bodies.
- There are special organs in the body which help to get rid of waste, such as the lungs, kidneys and skin. Your kidneys take the waste out of your blood and produce urine.
- Plants get rid of waste water through the process of transpiration.

Do you see how shiny the horse looks?
It is sweating from all the running.[9]

Growing

All living things grow:
- Human and animal babies grow into adults.
- Seedlings grow into plants.



Growing seedling

Visit
Watch this time-lapse video of a plant growing.
goo.gl/ul33Y

All seven of the life processes must happen for something to be living. If something does not carry out all seven life processes then that thing is non-living. For example, if you think of a river, you may think it moves and grows, but a river does not sense, feed, excrete, breathe or reproduce. So it is non-living.

Teacher's Note

Presentation hints

1. Should teachers require further information kindly visit the site: 10-7 life processes
2. In the next activity learners are going to check their understanding of living and non-living things by doing the activity based on the seven life processes.
3. You could let them work in pairs. Every learner has to complete the activity in his/her workbook.
4. Go through the answers.

ACTIVITY 1.2: Understanding the seven life processes

The reason for doing this activity is to help you understand the seven life processes.

INSTRUCTIONS (What you must do):

1. Look carefully at each photo.
2. Next to each of the seven life processes make a ✓ if it applies to the object in that photo.
3. If a life process does not apply to the object in the photo, make a ✗ next to that life process.
4. Decide whether the object is living or non-living and write your answer in the last column.
5. The first one is done to show you what to do.

Object	Process	✓ or ✗	Living or non-living
 Children[10]	Moving	✓	Living
	Reproducing	✓	
	Sensing	✓	
	Feeding	✓	
	Breathing	✓	
	Excreting	✓	
	Growing	✓	
 Aeroplane[11]	Moving		
	Reproducing		
	Sensing		
	Feeding		
	Breathing		
	Excreting		
	Growing		

Object	Process	✓ or ✗	Living or non-living?
 Children[10]	Moving	✓	Living
	Reproducing	✓	
	Sensing	✓	
	Feeding	✓	
	Breathing	✓	
	Excreting	✓	
	Growing	✓	
 An aeroplane[11]	Moving	✓	Non-living
	Reproducing	✗	
	Sensing	✗	
	Feeding	✓	
	Breathing	✓	
	Excreting	✓	
	Growing	✗	

Teacher's Note

An aeroplane takes in fuel (feeding), gives out exhaust gases (excreting) and use air for combustion (breathing). You should accept either a tick or a cross for these three processes.

Object	Process	✓ or ✗	Living or non-living
 *Fish in the sea* [12]	Moving		
	Reproducing		
	Sensing		
	Feeding		
	Breathing		
	Excreting		
	Growing		
 *Plant* [13]	Moving		
	Reproducing		
	Sensing		
	Feeding		
	Breathing		
	Excreting		
	Growing		
 *Bouncing soccer ball* [14]	Moving		
	Reproducing		
	Sensing		
	Feeding		
	Breathing		
	Excreting		
	Growing		
 *Chicken eggs* [15]	Moving		
	Reproducing		
	Sensing		
	Feeding		
	Breathing		
	Excreting		
	Growing		

Object	Process	✓ or ✗	Living or non-living?
 *Fish in the sea* [12]	Moving	✓	Living
	Reproducing	✓	
	Sensing	✓	
	Feeding	✓	
	Breathing	✓	
	Excreting	✓	
	Growing	✓	
 *Plant* [13]	Moving	✓	Living
	Reproducing	✓	
	Sensing	✓	
	Feeding	✓	
	Breathing	✓	
	Excreting	✓	
	Growing	✓	
 *Bouncing soccer ball* [14]	Moving	✓	Non-living
	Reproducing	✗	
	Sensing	✗	
	Feeding	✗	
	Breathing	✗	
	Excreting	✗	
	Growing	✗	
 *Chicken eggs* [15]	Moving	✓	Living
	Reproducing	✓	
	Sensing	✓	
	Feeding	✓	
	Breathing	✓	
	Excreting	✓	
	Growing	✓	

Teacher's Note

The chicken egg can be revived later if it has been fertilized and so it is a living thing.

Some things seem to be non-living but are not

Mmm, this sounds interesting. I want to find out more!

Did you know?

In the Western Cape some fynbos seeds wait for many years in the soil. They only start growing after a fire has burnt their hard outer shell.

Some things seem to be non-living for a very long time. They wait until they sense the right conditions to revive again. This means that they have to wait for something special to happen before they can revive and show the characteristics of living things. We say they need the right conditions to revive and show the seven life processes. Look at the pictures below of seeds that seem to be non-living.

Seeds from a coral tree [16]

Have you ever eaten sunflower seeds? [17]

Teacher's Note

Informal assessment by teacher

- Learners mime (act without using words) the life processes.
- Learners write down the 7 life processes. (Use acronym: Mrs B Feg to support weak learners where necessary.)

Ask informal questions:

- How do the movement of plants and animals differ? **Expected answers:** Movement – animals can move from one place to another, while plants grow in the same place but can move towards the light or to/away from gravity.
- How many ways do you know of that plants can grow new plants? **Expected answers:** seeds, cuttings, perhaps a few might know of shoots, underground rhizomes (?) or spores?
- Are the vegetables you eat living or non-living? How do you determine this? **Expected answers:** A good way to explain this is to ask if they could plant the cooked vegetable and if new plants will grow from it. If they cannot then the item is no longer living.

Self-assessment by learners

Ask the learners to be very honest when they mark the checklist below. Check their responses and address problems.

QUESTIONS

Why do seeds seem to be non-living? How can we show that they are living?

We say the seeds are in a dormant state until they are given water, warmth, air, light and soil to germinate and start growing. There are other things too that seem to be non-living. Under the right conditions they can revive and carry on living.

A dove keeping her eggs warm to hatch them.

Fertilised eggs need to be kept warm or they will not hatch. This is why a mother bird will sit on her eggs to keep them warm after she has laid them.

Yeast causes bread dough or cake batter to rise. Yeast needs warmth to come alive and start raising the bread. Some people buy dry yeast for their baking. It also needs heat to start working (and sugar). That is why you will see bakers place their dough in a warm place (near the stove for example) to get it to rise.

QUESTIONS

Why do seeds seem to be non-living? How can we show that they are living?

Learners might think seeds are non-living as they do not appear to show any of the 7 life processes. But things can appear to be non-living when they are actually in a dormant state. You can germinate the seeds to show that they are living.

NatSci&Tech_Gr4_TG_Book.indb 11 2018/05/17 11:37:38 AM

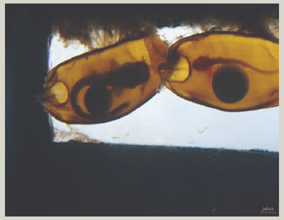
ACTIVITY 1.3: Can I revive living things that seem to be non-living?

INSTRUCTIONS:

Look at these photos carefully.

Chicken eggs hatching in an incubator.[18]

Frog eggs about to hatch into tadpoles.[19]



Shark eggs[20]

Snake eggs hatching in a nest.[21]

Did you know?

A shark egg often looks like a see-through packet. Some people find them washed up on the beach and call them mermaid's purses!

QUESTIONS:

1. Study the photo of the bird sitting on her nest on page 13. Can you explain why she needs to sit on her eggs?
2. In farms, the farmers often do not let the mother chickens sit on their eggs. Instead they put the eggs in an incubator, as you see in the picture above of the chicken eggs hatching. What does the incubator provide for the eggs?
3. A snake normally lays her eggs in a nest. Why does she not have to lie on top of them to hatch them?

QUESTIONS:

1. She needs to keep the eggs warm in order to hatch them.
2. It provides warmth.
3. The heat of the sun provides the warmth to hatch the eggs.

4. Have you ever caught tadpoles or kept silkworms in a box? Maybe someone in your class has some that they can bring to school. In what season can you normally find little tadpoles or silkworms, and why?

ACTIVITY 1.4: Germinating a seed

MATERIALS (What you need):

- Bean seeds
- Cotton wool
- Plastic lids (From empty peanut butter jars, for example.)

INSTRUCTIONS:

1. Place two layers of cotton wool in the plastic lid.
2. Place a few of your seeds between the two layers of cotton wool.
3. Drizzle water over the seeds. You need to water the cotton wool enough to wet it but not to drown the seeds. There should be no water running over the sides of the lid.
4. Place your seeds in a sunny place near a window.
5. Water your seeds whenever you feel the cotton wool is almost dry. Be careful not to drown your seeds.

QUESTIONS:

1. Before you water your seeds, describe how your seeds look and feel.
2. Draw your seeds between the cotton wool on the first day in your exercise books.
3. Keep watching your seeds every day. How long did it take them to germinate?
4. What do your seeds look like? Draw more pictures.
5. What do you think made your seeds revive and germinate?

4. Silkworms are typically available in Spring and early summer, and tadpoles can generally be found in pools and ponds from Spring to Autumn. The eggs need warmth to hatch. The adult animals lay their eggs in these seasons because the warmth of the sun will hatch the eggs.

Teacher's Note

Bean seeds are the most common to get hold of, but sometimes take a bit long to grow. Lentils or coriander seeds can sometimes grow quicker. Perhaps try a mixture of the seeds.

QUESTIONS:

1. Learners should refer to the hard & dry texture of the seeds and that it looks non-living.
4. Learners should refer to the outer layer of the seeds getting soft and moist and say that there is something growing out of the seeds.
5. The water that was poured over the cotton wool kept the seeds moist (as if it was lying in moist ground). Some might also remember that they put the seeds near the window so the heat from the sun might have also helped the seeds to sprout. This is discussed extensively in the later section so do not spend too much time on it.

ACTIVITY 1.5: Getting yeast to grow!

MATERIALS (What you need):

- Packet of dry yeast
- Sugar
- Warm water
- Empty yogurt tub

INSTRUCTIONS:

1. Place a teaspoon of sugar and a teaspoon of dry yeast in your yogurt tub. Mix with your spoon.
2. Add three teaspoons of warm water.
3. Stir your sugar and yeast mixture in the warm water to make sure it is well mixed.
4. Watch to see what will happen.

SAFETY WARNING! Do not use boiling water – it might burn you! You only need to use luke warm water.

QUESTIONS:

1. What did your yeast look and feel like before you mixed it with the sugar and water?
2. When you add the sugar to the yeast, does anything change in the yeast?
3. What happened to the yeast and sugar mixture when you added the warm water?
4. How did the yeast revive?

1.2 Non-living things

Non-living things are different from living things because they do not perform all of the seven life processes. Let's look at an example.

QUESTIONS:

1. The yeast feels like small round balls / grainy / dry / grey / non-living.
2. Not really – it stays the same.
3. It starts to bubble and smells 'strange'. The mixture bubbles up into the tub. There is a feint fizzy noise.
4. The yeast needed the warm water and the sugar to revive from a dormant state.

Teacher's Note

Extension activity. Encourage learners to think further than this simple activity. Perhaps someone might wonder what happens if there is no sugar in the mixture or if the water is cold... Teachers are urged to actively support and applaud such scientific inquiry! Encourage learners to experiment with the yeast and see if the same results are achieved if the sugar is left out, or very little or large quantities is included; also to experiment with the temperature of the water to see if this effects the outcome.

ACTIVITY 1.6: Do you think this car is living or non-living?

INSTRUCTIONS:

1. Let's look which of the seven life processes the car carries out. (Remember if it is not an egg or a seed. If there is even one life process that something cannot do then it is not living.)
2. Place a ✓ or a ✗ in the last column.

Car[22]

Movement	
Reproducing	
Sensing	
Feeding	
Breathing	
Excreting	
Growing	

QUESTIONS:

1. How many life processes does a car have?
2. Is it living or non-living?

Remember, non-living things cannot carry out *all* the seven life processes.

Changing from living to non-living

Living things can become non-living when they die. Look at the wood that your desk is made of. Where did the wood come from? What was once living?

QUESTIONS

Look around you in your class. Are there other things that were once living and that are now non-living or dead? Discuss these things in your class and write some of your answers from the discussion in your exercise books.

Movement	✓
Reproducing	✗
Sensing	✗ allow for discussion though, like if children comment that mom's car battles to start on cold mornings.
Feeding	✓ petrol / diesel
Breathing	✓ engine uses air to sustain combustion
Excreting	✓ exhaust fumes
Growing	✗

QUESTIONS:

1. It does four of the life processes.
2. 4 of the 7 so it is non-living.

Teacher's Note

Introducing the next activity.

1. Learners need to bring objects from home to identify whether these objects are living or non-living, if they are non-living and can become living or if they were once living but are not non-living.
2. Arrange with learners a few days before to bring in objects from home. Make suggestions that the objects can be pictures in newspapers or magazines showing living or non-living objects, toys, bones, yogurt, dried seeds as lentils, beans, flower bulbs, electric bulbs etc. Challenge learners to bring a variety of objects. Bring your own collection of objects to the class, in case some learners forget.
3. Divide the learners in groups before they engage in the activity below. Tell them that they have 10 minutes to complete the activity. Instruct them to work together, to follow the instructions and to complete the activity. Walk to each group and help the groups that are unsure.
4. Ask the group presenters to report back on what they learned. Groups must be quiet during the report session and listen to one another.

ACTIVITY 1.7: Distinguish between living and non-living things

The reason for doing this activity is to help you learn to distinguish between living and non-living things.

MATERIALS (What you need):

- Collect three to five different objects or pictures of things that are living or non-living, and bring these to school.
- Scrap paper or cardboard

INSTRUCTIONS:

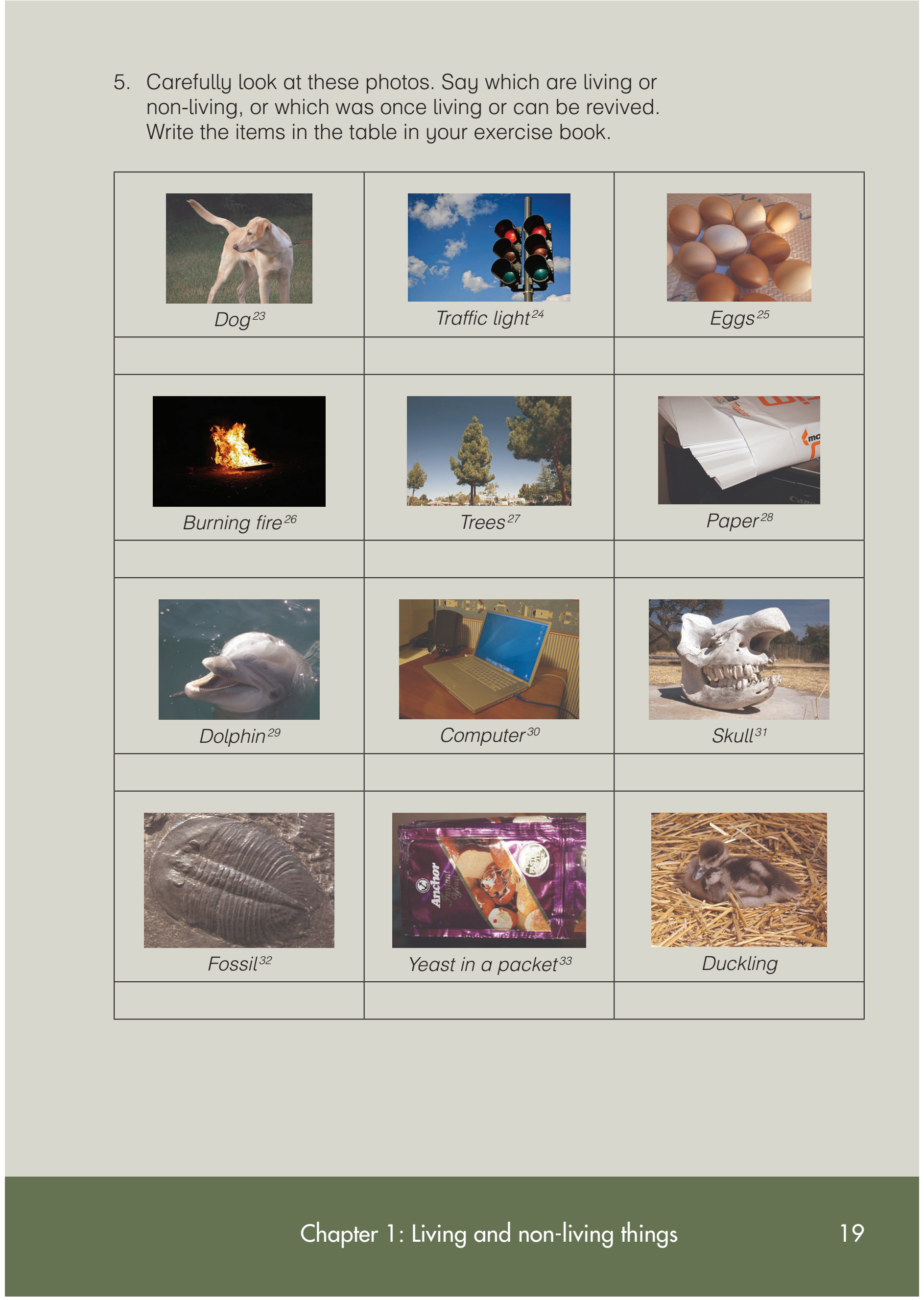
1. Divide into groups of three or four.
2. Use the scrap paper or cardboard to make four labels of these headings:
   - Living
   - Once lived
   - Seems to be non-living but can be revived
   - Never lived
3. Show the pictures or objects you brought to your group. Place each item or picture under one of the headings.
4. Now copy and complete the table below in your exercise books with the results. If there is time left over you can add in interesting objects from other groups into your table as well.

Living	Once lived	Can be revived	Never lived

5. Discuss a few examples and allocate time for learners to ask questions. Let every learner complete the table in his/her workbook using the objects their group brought to class. Encourage them to add a few more examples to their table.

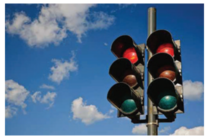
Teacher's Note

These answers will depend on the objects brought by the pupils.


5. Carefully look at these photos. Say which are living or non-living, or which was once living or can be revived. Write the items in the table in your exercise book.

Dog[23]	Traffic light[24]	Eggs[25]
Burning fire[26]	Trees[27]	Paper[28]
Dolphin[29]	Computer[30]	Skull[31]
Fossil[32]	Yeast in a packet[33]	Duckling

Chapter 1: Living and non-living things 19

 Dog[23]	 Traffic light[24]	 Eggs[25]
Living	Non-living	Can be revived
 Burning fire[26]	 Trees[27]	 Paper[28]
Once lived	Living	Once lived
 Dolphin[29]	 Computer[30]	 Skull[31]
Living	Non-living	Once lived
 Fossil[32]	 Yeast in a packet[33]	 Duckling
Once lived	Can be revived	Living

Teacher's Note

Presentation hints

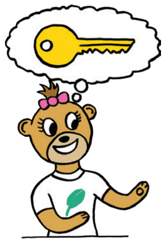
1. This is a consolidation activity. Each learner do the activity as classwork on their own.

QUESTIONS

Can you now distinguish between living and non-living things? How do you know when things are living and when they are not?

Distinguishing between living and non-living

Now you know that we can group almost everything in the world into two groups: living and non-living things. If something cannot carry out all the seven life processes then it is non-living. Some things were never living, like water and oxygen. Other things can be non-living now but were living before, like wood, fossils or oil.



KEY CONCEPTS

- We can group things on Earth as either living and non-living.
- There are seven life processes that all living things carry out.
- Non-living things cannot carry out all seven life processes.
- Living things can die.
- Some things like seeds or eggs seem to be non-living but they can revive again.

2. After completion, go through the table and let them mark their own work.
3. As an extension, you can practice drawing tables by asking learners to come up to the board and helping to draw a table to represent all these answers, similar to the table in question 4.

QUESTIONS

Can you now distinguish between living and non-living things? How do you know when things are living and when they are not?

Yes, learners should be able to distinguish by now. Things are living when they display all 7 life processes and they are non-living when they do not (except for seeds, eggs and yeast which can be revived again).

REVISION

Read the story and answer the questions that follow.

The Strelitzias

When the world was made the Strelitzia birds were among the finest! Their bright orange feathers and dark purple wings decorated the sky and all creation admired their beauty. They would fly for hours high in the sky and only came down to feed at the river bed, and to tell the other animals of the wonderful things they had seen.

Their nests were in the highest cliffs and they almost never sat in trees or walked on the ground among the other animals. However as time went by the Strelitzia birds became more and more proud and arrogant. They started to look down on the other animals. The birds teased them endlessly, telling the tall giraffe that her neck could never dream of the cool breezes they have felt. Or laughing at the tortoise who had to always stagger through the dust over rocks and sand. They laughed at the crocodile who had to stay in the water and at the monkeys for being stuck in trees all their lives.

Strelitzia flowers reaching up!

One day the Maker came to visit the animals and instead of the beautiful, joyous creation there was only sadness and tears. One by one the animals told of the Strelitzia birds' teasing and taunting till the Maker became very angry at these proud birds.

The Maker snatched them one by one from the sky and stuck their strong, slender legs deep into the soil. Their graceful long claws became roots and their feathers and wings turned into dull green leaves. Only their crowning feathers of orange and purple remained as a reminder of their beauty.

If you find a Strelitzia flower today, look carefully and you will see how they are always reaching for the sky, trying to free themselves from the soil and fly once more!

QUESTIONS:

1. Name five non-living things mentioned in the story.
2. Name all the things from the story that use oxygen.
3. What life process in living things uses oxygen?
4. Give an example from the story of:
   a. moving
   b. sensing
   c. feeding
   d. growing
5. The Strelitzia birds had nests high up on the cliffs. Why do you think birds like them like to build their nests high up on the cliffs?
6. What life process do we think of with the eggs in the nest?
7. Do you think this story is true or not? Explain your answer.

Now that we have learned about living and non-living things, let's move on and take a closer look at plants and animals!

QUESTIONS:

1. Any 5 of wind, cliff, rock, soil, dirt, dust, breeze, river bed, etc
2. Strelitzia, giraffe, tortoise, crocodile, monkey, trees, plants
3. Breathing
4. a. glide, stagger, fly , walk, snatch, stick
   b. joyous, sadness, tears
   c. roots, leaves, water hole, trees
   d. dull grey leaves
5. To protect their eggs and young
6. Reproduction

2 Structure of plants and animals

KEY QUESTIONS

- Are plants all made in the same way with the same parts?
- If I cannot see leaves on a cactus, is it still a plant?
- Is the moss that grows near the tap at the back of the house a plant? How can I tell if it is?
- So if a cactus, seaweed and a dandelion are all so different, how can you say they are all plants?
- Animals all look so different – how can we group different animals together?
- What makes animals different from each other?

We learnt that almost everything can be grouped into two groups – living and non-living. In the next section we are going to learn more about living plants and animals, how they look and what makes them special.

New words

- structures
- functions
- absorb
- nutrients
- veins
- compare
- parallel
- serrated edge

2.1 Structure of plants

Basic structures of plants

All plants have different parts that we call structures. In most plants you can identify the following structures:

- roots
- stems
- leaves
- flowers

Let's take a look at the different plant structures.

Roots

Plant roots are normally found underground. Roots have very important functions (jobs):

- Roots anchor or hold the plant in the ground.

Teacher's Note

Introducing this topic

- Learners need to identify different basic structures (parts) in plants.
- They need to explore VISIBLE differences between different plants.
- They can incidentally be introduced to the concept that plants make their own food; they don't eat other plants, but animals eat the food plants make which is stored in different parts of plants.
- At the start of this section it is suggested that you display propagation through cutting to compare to seedling propagation in a later activity. You can use a cut stem from a fig or rose plant.
- As an extension they may be introduced to the function of different structures.
- In this series of textbooks we will also place emphasis on the scientific method used to make and label drawings.

This section therefore starts with a study of plants and the different plant structures. Although CAPS does not directly require that the function of plant structures be studied, it is included to enrich the subsequent visual differentiation activities. Learners need to observe differences and find out more about the different types of plants in their environment. The differences can be the size of plants, the colour and form of the leaves and flowers, whether they have flowers or not, whether they loose their leaves or not – and many similar visible differences. We encourage teachers to ignite learners' curiosity and interest to find out how the natural world works. As young scientists they need to compare plants or animals and group them together.

Presentation hints

1. Always try to link learners' prior knowledge to what they are going to learn before you formally present the lesson.
2. Bring a plant or a clear poster showing the basic structures of flowering plants to the class.
3. Ask learners to identify different parts of the plant.
   Encourage them to think of the possible function(s) of each part.

- Roots absorb water and nutrients from the soil, which are then transported to the rest of the plant.
- Some plants store the food they make in their roots, like potatoes or carrots. Next year you will see how plants make their own food.

The roots of this tree go deep down into the soil.

A carrot is a root that stores food made by the plant.

Stems

Stems connect the roots to the rest of the plant. The stem has important functions:

- The stem supports the leaves, flowers and fruit by holding these parts upright.
- The stem carries nutrients and water from the roots to the other structures of the plant.
- Some plants store the food they produce in their stems, like sugar cane or asparagus.

A growing plant stem.[1]

A tomato plant stem.

Leaves

Although many plant leaves are green, leaves can have many other colours. Some leaves change colour during autumn.

24 Life and living

Many learners have the correct concepts but lack the linguistic proficiency to express their thoughts. Teachers are encouraged to help learners with language related problems by providing a vocabulary rich environment and to display key words in a prominent place while constantly referring to these words. This supports learners to learn new scientific vocabulary and use it to explain themselves.

4. Use questions to guide the class discussion regarding the basic structures of flowering plants. Why do plants need water? Which part of the plant can take up water? Give another word for “take up”(absorb). Which part of the plant connects the roots to the rest of the plant etc.
5. Explain new words clearly and carefully and make sure these words (and possibly their meanings) are displayed in a prominent place in the class.
6. Encourage learners to set up their own glossary with explanations of the meanings.

Leaves have very important functions:

- The leaves absorb the sunlight and use it to make food for the plant.
- Some plants use their leaves to store water (like a cactus) or food (like spinach or lettuce).
- Most leaves have veins that are like tiny pipes, which carry water and nutrients from the roots. The veins also carry the food the leaf makes to the rest of the plant.

Can you see the veins in these leaves?[2]

Flowers

Many plants have flowers. The flowers are very important to the plant:

- They make pollen to make seeds that will grow into new plants.
- The flowers attract birds and insects to spread their pollen and get pollen from other flowers.
- The flowers make fruit and seeds.
- There are different kinds of flowers.

QUESTIONS

1. Think of some of the flowers you know and write their names in your exercise books.
2. How many different colour flowers are in your school ground or your garden at home? Or do you see any flowers on your way to school? Next time look out for them and notice all the different colours!

Teacher's Note

This process is known as photosynthesis – learners are however not required to learn such specifics at this stage and will only learn about this in Grade 5.

Teacher's Note

Leaves have small openings (called stoma) underneath that allows the plant to pass out extra water as part of the process of transpiration.

QUESTIONS

1. Think of some of the flowers you know and write their names in your exercise books.

   Learner dependent answer

2. How many different colour flowers are in your school ground or your garden at home? Or do you see any flowers on your way to school? Next time look out for them and notice all the different colours!

   Learner dependent answer

Wow, flowers really make our lives more colourful,
and I love colour!

Visit
The structures of plants (video).
goo.gl/ADk8R

Seeds

Many plants make seeds and store their seeds in different ways:

- In their fruit like in peaches or oranges.
- In pods like in beans and peas.
- On a cob like a mielie or on an ear like wheat.

Plants grow their seeds from the plant's flower, like a dandelion or the acorns on an oak tree.

Seeds are very important to plants because new plants can grow from seeds.

Dandelion seeds are light.

The seeds on ears of wheat.

Pea seeds in a pod.

Peach seeds are inside the fruit.

ACTIVITY 2.1: Identifying the different parts of a flowering plant

The reason for doing this activity is to see whether you can identify the different parts of a plant.

MATERIALS:

- Drawing of a flowering plant
- Ruler, pencil and eraser

INSTRUCTIONS:

1. Look at the drawing on page 28. There are no labels added to the drawing. Scientists often need to label drawings and diagrams. This is a very important skill.
2. When we give labels for a drawing, there are some guidelines to follow:
   a. Draw a straight line with a pencil and ruler from the part that you want to label.

Teacher's Note

Presentation hints

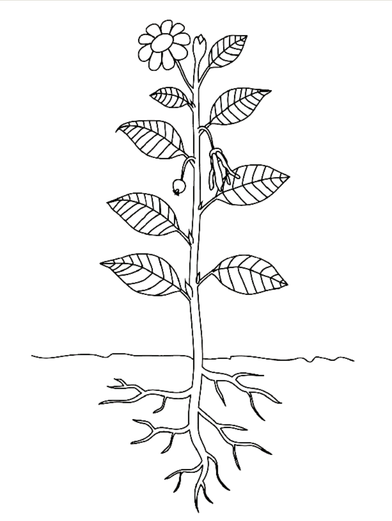
In the following activity learners will be required to label the drawing. This is the first time that the skill of labelling is being introduced in Grade 4. So, it is important that teachers actively teach learners this important skill step by step, waiting for everyone to finish one step correctly before moving onto the next step. Perhaps the following rules could be made into a poster to be displayed and referred to whenever learners are asked to make scientific drawings...

The guidelines for drawing and labelling:

- The drawing must have a heading (printed in pen).
- Labelling lines must be in pencil.
- Labelling lines must be drawn using a ruler.
- Label lines must be parallel to the top / bottom of the page.
- Label lines must touch the part of the drawing being labelled.
- Label lines must end the same distance from the drawing (i.e. the labels must be in a vertical line underneath each other).
- Labels must be written using print, and not cursive, and in pen.
- The correct labels must be used in the correct place.

b. Label lines must touch the part of the drawing being labelled.
c. The line must be parallel to the bottom of your page.
d. Write the names for each part neatly underneath each other.

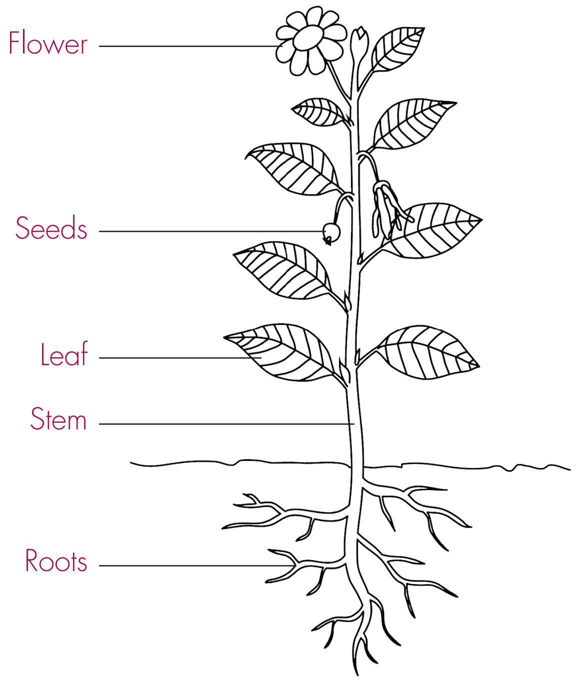
3. Draw the flowering plant below in your exercise books.
4. Label the drawing with the following labels: root, stem, leaf, flower, seed. Remember to follow the guidelines for labelling drawings.
5. When doing a scientific drawing, you need to give it a heading so that we know exactly what it is. Think of a heading for your drawing and write it in your exercise book.



QUESTIONS:

1. Can you briefly describe the basic structures of a plant?
2. Do you think one part of a plant is more important than another part? Explain your answer.

Answer:



QUESTIONS:

2. One part is not more important than another part because all parts are needed for the plant to function as a whole. All parts are equally important and needed for different reasons/roles.

Visible differences between plants

There are many different kinds of plants. If you look at different plants you can see many things that are different but also things that are the same. We know that most plants have stems, roots and leaves, and that many others have flowers, seeds and fruit. If we want to compare plants, we can compare these plant structures.

You can look at the different plant structures of plants and compare their:
- size
- colour
- shape

Or you can ask important questions about the plants:
- Does this plant make flowers?
- Does it lose its leaves in autumn?
- Can animals eat the plant or parts of the plant?
- Can humans eat the plant?

Perhaps you can think of other important questions that you could ask?

Did you know?
You can easily start your own vegetable garden at home or at school. Bring your different crops to school to compare the differences in the food we eat.

QUESTIONS

People have studied plants for thousands of years. Can you think of reasons why people need to study plants? Think of the reasons why people use plants and write them down.

People that study plants, like you are doing, start by looking at the plants and comparing what they see. They later move onto more complicated things to compare. We are going to compare different plants using our eyes as our guides.

Look at the photos of the banana palm and basil plant on page 30. How many differences can you see between these two plants?

Did you know?
All plants are grouped into two main groups – those with seeds and those without seeds.

Chapter 2: Structure of plants and animals 29

Teacher's Note

Presentation hints

In the following activity learners will be required to label the drawing. This is the first time that the skill of labelling is being introduced in Grade 4. So, it is important that teachers actively teach learners this important skill step by step, waiting for everyone to finish one step correctly before moving onto the next step. Perhaps the following rules could be made into a poster to be displayed and referred to whenever learners are asked to make scientific drawings...

This section on plants provides an opportunity and a necessity to practise agricultural science as a part of Natural Science. For example, while doing this section, encourage your learners to plant different kinds of crops (those that store food in stems, leaves, in roots, etc) and then ask them to bring them to school once they have grown to compare the visible differences and work with them fresh from the soil. If no one can grow their own vegetables, try to set up a vegetable garden at the school in some corner, or just buy some different vegetables from the shops and bring them to class so learners can see the real things and describe the differences. This aspect may not have been highlighted in the curriculum, but it is important for learners to know where food comes from. And also highlight the need for schools to have vegetable gardens!

QUESTIONS

People have studied plants for thousands of years. Can you think of reasons why people need to study plants? Think of the reasons why people use plants and write them down.

People need to find which plants are good to eat and which plants can be used to cure which diseases; some plants are good for making baskets or clothes, while others can be used to construct shelters and homes; plants can also be used to write on (papyrus and trees that make paper)or to make string etc. There are many more uses.

Banana palm[3]

Basil plant

QUESTIONS

Describe the differences you could list between the banana palm and basil plant.

When we compare plants, it is sometimes easier to use the different plant structures to compare the plants. We can look at the stem, for example, in the banana palm and the basil plant and compare this. The basil plant has a thin green stem while the banana palm has a thick brown woody bark covering its very thick trunk.

Did you know?
Basil is a very popular herb used in cooking. Especially in pasta and pizza dishes!

Look at the photo below of the edge of a river. There are two main types of plants growing: the waterlilies in the front and the reeds at the back. Both grow near or in water but they look completely different.

Waterlilies and reeds growing in water.

QUESTIONS

Describe the differences you could list between the banana palm and basil plant.

This question is specifically left open to the learners' interpretation and once everyone in the class had finished teachers should discuss differences and similarities the learners saw. It is hoped that some would use the stem, root and leaves to compare the two plants and teachers are encouraged to pick up on this and heap tremendous praise on these learners for thinking like Little Einsteins! This will pave the way towards the next activity.

ACTIVITY 2.2: Comparing plants

INSTRUCTIONS:

1. Work with a friend and study the photo on page 30. Compare the two plants (water lilies and reeds) using the plant structures.
2. When people compare different things using a set of items (like the plant structures we are using), they often use a table to write down their ideas.
3. Study the table below. Copy the table in your exercise books. Write down the differences and similarities between the plant structures of the waterlilies and the reeds.

Plant structure	Waterlilies	Reeds
Stems		
Roots		
Leaves		
Flowers and/or seeds		

QUESTION:

If you look at a plant and cannot see seeds, can you say that that plant falls into the group that does not make seeds? Why not?

Did you notice that it was slightly easier to compare plants if you know the different plant structures? In the next activity we are going compare the leaves of different plants. You need to collect three leaves from three different plants. It is important that you only bring leaves from plants that you or your parents know because you need to tell the class the name of the plant.

Did you know?
Some plants can hurt or poison you. Only collect leaves from plants that you know are safe to touch or even eat.

Teacher's Note

(It is hoped that many of the learners will be familiar with either reeds or waterlilies or both and that this will enrich this discussion.)

Plant structure	Waterlilies	Reeds
Stems	single straight thin stem, some might notice that they are not siff but can bend with the current as visible in one in photo	stems are segmented tall and woody, some might say the stems are hollow
Roots	Cannot comment – not visible	Cannot comment – not visible
Leaves	round flat leaves (to float on the water)	thin narrow long leaves
Flowers and/or seeds	beautiful flowers	seeds in the top parts to be dispersed by the wind

QUESTIONS:

1. NO – Just because you cannot see seeds does not mean the plant does not produce seeds sometime in its lifetime. Some plants only flower once in 10 – 15 years and then only produce seeds at this time. Teachers to emphasize that just because at a specific time a plant does not have flowers or seeds, learners should not assume that the plant does not produce these.

ACTIVITY 2.3: What do leaves of different plants look like?

The reason for doing this activity is to see the difference in leaves from various plants.

MATERIALS:

- Leaves from three different plants.
- The names of the plants you collected the leaves from.
- White paper and crayons

INSTRUCTIONS:

How to make leaf rubbings:

1. Take one leaf and put it on a flat hard surface.
2. Make sure the veins are facing up (leaf must be upside-down).
3. Place the white paper over the leaf.
4. Use the crayon on its side to gently colour on the paper over the leaf to trace the leaf.
5. Label the leaf with the name of the plant it came from.
6. Repeat this process with all the leaves.
7. Give your page a heading that describes what you did.
8. After you have made the leaf rubbings, study your different leaves. Describe the differences you have noticed in the leaves.

QUESTIONS:

1. Work with a friend and compare leaf rubbings.
   a. Can you see if different leaves have similar shapes?
   b. Can you see if different leaves have similar edges?
2. Copy the table below in your exercise books.
3. Draw the different shapes and edges of the leaves that you could see.

Different shapes of leaves	Different edges of leaves

Teacher's Note

Introducing the next activity.

1. Ask the learners before the next lesson to bring leaf samples of THREE different plants to the class. They need to know the names of the plants.
2. Tell learners to be respectful of plants and plant owners. If the plant does not belong to them they need to ask permission from its owner to collect a leaf. They also need to be careful not to ruin the plant when they cut the leaf off; use a pair of scissors or cutters.
3. Learners must also take care of themselves. Some plant are POISONOUS. Safety rules are:
   - Don't eat parts of unknown plants.
   - Don't rub your eyes while handling plants.
   - Wash your hands after handling plants.
4. Let the learners name edible leaves for example: lettuce, spinach, parsley, cabbage, coriander etc.
5. As teacher you need to contribute to the activity the learners are going to do by also bringing samples of leaves of different plants to the class to make sure that a variety of examples are available.
6. Let the learners study the activity. Make sure that they understand how to trace and label the leaves.
7. Explain key words as: smooth or serrated edge, large or small, hairy or smooth, thin or thick, etc.
8. Let the learners work in pairs. Each pair has to complete the table in the activity.
9. Give the learners enough time to complete the activity. Walk around the class and make sure that all the learners remain on task. Help the learners who are struggling.
10. Ask the learners for their answers and fill in the table on the board.
11. Ask the learners to complete the self-assessment.

4. Copy and complete the table in your exercise books.
   a. Fill in the name of each plant in the first column.
   b. Make a ✓ in the column(s) that describe how the leaf looks.
   c. One has been done using roses from Gogo's garden to show you what to do.

Gogo's beautiful roses

Name of plant	Round leaf	Long, thin leaf	Smooth edge	Serrated edge
Rose	✓			✓

2.2 Structure of animals

All living things can be grouped into two groups – plants and animals. Plants can be compared using the different plant structures to group them into different groups. We can use a similar method to compare animals. In this section we are going to learn how to identify different animal structures. Then we will use these animal structures to compare some animals you might already know.

New words
- classify
- vertebrate
- invertebrate
- mammal
- reptile
- amphibian
- limb
- sense organ
- predator
- prey

Learner dependent answers.

Teacher's Note

Introducing this topic

This unit deals with the basic structure of animals and thus their body plans. CAPS does not differentiate between vertebrate or invertebrate, between warm-blooded or cold-blooded or any other groupings. It requires that learners compare animals based on the basic structure of animals: head, tail, body, limbs and sense organs. Comparisons are based on these structural elements as well as size, shape, body covering and sense organs. Teachers are cautioned to stick to these specifications but encouraged to extend able learners by introducing such concepts as vertebrate and invertebrate, warm and cold blooded, etc.

Presentation hints

1. Introduce this unit with a class discussion. Ask the learners to think of different animals. They can whisper their animal's name in your ear before miming the animal to the class to guess which animal they are.

ACTIVITY 2.4: Comparing animals

INSTRUCTIONS:

1. Study the photos of the dogs and the jellyfish below. What differences and similarities can you see?
2. Copy the table in your exercise books and write down the differences and similarities.
3. Discuss your list of similarities and differences with your classmates and see how your lists are the same or different. Maybe you have some extra things to add to your list?

Differences	Similarities

Did you know?

Animals are classified (grouped) into those with a backbone (spine) and those without. Animals with a backbone are called vertebrates. Those without a backbone are called invertebrates.

A jack russel standing and a golden retriever lying down.

Jelly fish live in the sea.[4]

2. Discuss the concept that humans are also animals since all living things are either plants or animals. It is important to address language barriers and misconceptions at this point. If their mom for instance says that the big sister lives in a pig sty or that the big brother eats like a dog then this is a different way to use language. This point is perhaps an absurd example but it is important to be on the lookout for similar misconceptions where colloquial (or everyday) and scientific language use leads to misunderstanding of scientific principles.
3. **Presentation:** Revise the concept basic structure (how it is built up). Let learners name the basic structure of plants. Study the basic body structure of different animals. Use the 5 basic body structures as guidelines. (Many teachers chose to use the word body plan to describe the structure of the bodies of animals however this is not strictly in keeping with terminology used in the CAPS.)

Differences	Similarities
Learner-generated answers. This activity is purposefully left wide open to allow learners to think "out of the box". It will give teachers a good indication of the level of prior-knowledge of animals and animal structures that exists in among the learners.	It is not explicitly stated but learners are expected to use the 5 basic body structures to compare the dog and jellyfish. Teachers are encouraged to walk around the class and check as learners work at this activity how they compare these two animals. Point those who do not realise that they can use the body structures to compare in the right direction.

Teacher's Note

Some learners might have used the body structures of animals to compare the jellyfish and the dog. Others might have included different things – like whether the animal has a skeleton or not or perhaps where it lives or what covers its body. Encourage learners to exchange ideas and discuss their reasons for their answers either in small groups or as a class.

Basic structures in animals

Let's take a closer look at the body parts of animals.

Just like plants, animals also have a basic structure. The basic structures of an animal are:

- head
- tail
- body
- limbs
- sense organs

Did you know?

When we talk about animals or plants, we use words like "most animals" or "many plants" because there are always plants or animals that are not like the others.

Head

Animals all have a special part in their bodies called the head. Even the smallest animal has a part where its brain is. In most animals the head has these structures:

- A brain – no matter how small.
- Sensory organs like the eyes and ears.
- Feeding structures like the mouth and jaws.

Tail

Most animals have a tail at the back end of their body. Have you ever wondered where the tail of a starfish or octopus is? A tail is usually pointed but can have other shapes too.

ACTIVITY 2.5: The tails

INSTRUCTIONS:

1. Work in groups and look at the different tails of all the animals in the drawing on page 36.
2. Can you find similarities between the tails?
3. Discuss possible similarities between the different types of tails with your group and write your answers in your exercise books. Use some different words to describe some of the tails.
4. Tails do different jobs for animals. What does the whale in the picture use its tail for?

Teacher's Note

Presentation hints

Revise the concept basic structure. Let them discuss what they thing the basic structure of animals are – refer back to the jellyfish and the dog above. Discuss the body of different animals starting with themselves and then use the jellyfish and the dog as examples. Perhaps add other types of animals to reinforce the point that different animals' bodies are covered in different ways.

INSTRUCTIONS:

3. Dependent on how observant the group is. Some tails are long, some are short, some are bushy and covered in fur, others are covered in scales, some are very colourful and others are just one colour.
4. To swim.

5. Both the chameleon and the squirrel have tails and live mostly in trees and bushes. But their movements are very different. A chameleon moves slowly, while a squirrel jumps from branch to branch and climbs up and down tree trunks. What does each of these animals use their tails for?
6. The male peacock has a very brightly coloured tail. Why do you think this is so?

Let's look at some more functions (uses) of tails. Tails help animals to do different things:

- Move and swing in trees – monkeys for example.
- Balance – for example, kangaroos use their tails to balance while they jump.
- Kill their prey – crocodiles use their tails to spin them around when they need to drown their prey; scorpions often have poison in their tails.
- Pat down the earth – beavers use their powerful tails to pat the ground down hard and solid.
- Swim – almost all fish use their tails to swim.

5. The chameleon uses its tail to cling onto branches and balance. The squirrel mostly uses its tail for balance and to be agile when jumping from branch to branch.
6. He attracts a mate with his tail by lifting it up and displaying it.

- Steer their movement – fish, whales, dolphin, sharks and many others use their tails as rudders to steer their direction. Bird tails are very important rudders in flight too.
- Attract a mate – a peacock is a perfect example!
- Keep warm – a squirrel or fox wraps its tail around it like a blanket to keep warm.
- Get rid of flies – a cow or horse can swish their tail to get rid of flies.
- Warn others of possible dangers – some deer flash the white underside of their tails to other deer to warn them of possible danger.
- Communicate – dogs show their emotion in their tails. If they are happy to see you they wag their tails.
- Protect – an armadillo has an armoured tail to protect itself.
- Distract predators – if a lizard is attacked it will drop its tail and get away while the predator goes after the wriggling tail.

As you probably realised animals' tails are very important to them!

Body

Different animals need to cover their bodies in different ways.

QUESTIONS

Can you think of at least five different kinds of body coverings that animals have? Write them down it in your exercise books.

Just like animals, people use specific body coverings for special reasons. Let's think about reasons why people cover their bodies then we'll see how this compares to animals.

Teacher's Note

Presentation suggestion:

Collect soft toy of animals with as realistic body coverings as possible – a teddy, a feathery bird, a rough skinned crocodile, perhaps a tortoise, a whale, etc. Divide the animals in three groups and place them in thick black plastic bags that learners cannot see through. Choose volunteers to 'feel' what is inside the bag. They need to discuss what they felt the class.

ACTIVITY 2.6: Why do we cover our bodies?

INSTRUCTIONS:

1. Think of where or when someone will wear these types of clothes.
2. Copy the table in your exercise books and write your answers in.

Clothing	Where or when would people wear it?
a. Thick jacket, scarf and gloves	
b. Bright thin dress with thin straps over the shoulders	
c. A black suit with black pants and bow tie	
d. Grey skirt and white short sleeve blouse, black shoes and white socks	
e. A costume	

People wear different kinds of clothes in different environments. If they are cold people will wear warm clothes, and if they are hot most people will wear much fewer and thinner clothes.

Animals also have different body coverings, which most cannot change when the weather changes.

QUESTIONS

Why do you think a bird is covered in feathers and not scales? Why does a whale have smooth thick skin but an octopus has slimy slippery skin? Why is it that a cat has a soft furry skin but a crocodile's body is covered in hard bone-like scales?

Clothing	Where or when would people wear it?
Thick jacket, scarf and gloves	Winter or areas where it is very cold.
Bright thin dress with thin straps over the shoulders	Summer beach weather or going to a pool party.
A black suit with black pants and bow tie	Going to a ball or perhaps a wedding or a very formal dinner.
Grey skirt and white short sleeve blouse, black shoes and white socks	School clothes for summer for many South African learners.
A costume	Going for a swim at the beach, pool or dam.

Animals need to cover their bodies in special ways for a few reasons:

1. Body coverings need to protect the animals' organs, bones and muscles from their environment, UV rays, bumps and scratches, and from germs and bacteria that might cause infection. A warm furry body protects a polo bear in the arctic just like a scaly body protects the armadillo and crocodile.
2. They need to blend into their environment to hide from predators. Lions hide themselves in the veld grass to stop their prey from seeing them.
3. Males often use their body covering to attract female attention. A peacock has his beautiful tail feathers and a lion has his mane.

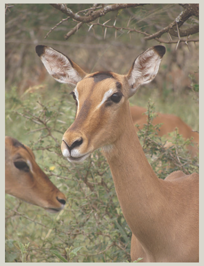
ACTIVITY 2.7: Compare animal body coverings

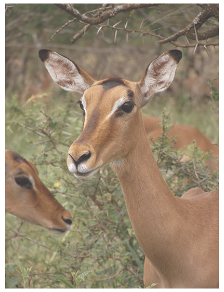
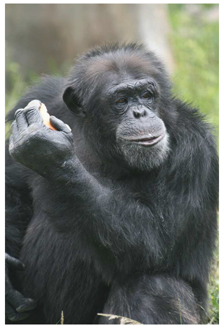
INSTRUCTIONS:

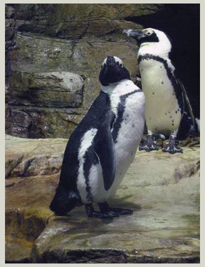
1. Carefully look at (examine) the body covering of each animal in the photos below.
2. Then think about where the animal lives.
3. Copy the table in your exercise books and answer these questions:
   - What does each animal's body covering do for it?
   - Where does this animal live?

Animal	Body covering	Where does it live?
1.  *Snail*[5]		

Animal	Body covering	Where does it live?
 *Snail*[5]	Shell and strong leathery body	Gardens, jungles, forests – lots of vegetation.

Animal	Body covering	Where does it live?
2.  *Impala*		
3.  *Tortoise*[6]		
4.  *Chimpanzee*		
5.  *Earthworm*[7]		

Animal	Body covering	Where does it live?
 *Impala*	Hide	Grasslands
 *Tortoise*[6]	Hard bony scales	Grasslands, deserts
 *Chimpanzee*	Fur	Trees, jungle, forest
 *Earthworm*[7]	Soft moist skin	Soil

Animal	Body covering	Where does it live?
6.  Goldfish[8]		
7.  Penguin[9]		
8.  Whale		
9.  Seal		

Limbs

Most animals use their limbs to move. They can walk, run, climb or swim using their limbs. Some animals like chimpanzees and squirrels can use their front or upper limbs to handle objects.

Animal	Body covering	Where does it live?
 Goldfish[8]	Leathery water-proof skin	Cold fresh water
 Penguin[9]	Thick warm water-proof feathers	In the sea in cold areas
 Whale	Soft slippery skin	Under sea
 Seal	Thick hairy skin	Shoreline / near the ocean and in sea

Look at the pictures of the different animals in the previous activity. How many different limbs can you see on these animals?

Animals can have wings, webbed feet, tentacles, fins, legs, arms, flippers and long slithery bodies with no limbs, such as the earthworm.

Sense organs

Animals can sense much more than humans can. Dogs, for example, can sense things and help humans with this.

Sniffer dogs help to find people who are trapped under building rubble, mudslides or snow and tell the rescue workers where the victims are. These dogs also smell drugs or bombs and alert the police.

Sniffer dogs at the airport.[10]

Did you know?
Blowflies have 3000 hairs in their feet that they use to taste with!

- Eagles, buzzards, hawks and other birds of prey have extremely sharp eyes as they have to see a small rodents from very far away.
- Elephants, cats and dogs can hear sounds that human ears cannot hear.
- Bats, dolphins and some whales use a special sense called eco-location. They send out special sound waves and can find prey or objects from quite far away.
- Butterflies, bees and earthworms have another special sense called chemoreceptors – they taste through their skin or feet.

Teacher's Note

Miming Animals' Movement: Write animal names on paper and put them in a container. Divide the class into two group that will compete with each other. Let learners pull a name from the container. They need to mime an animal's movement for their team to guess what it is. The winning team will have guessed the most animals at the end of the period.

- Animals like ants, cockroaches or crayfish have special sense receptors that can sense something moving from very far away!

Cats have very good hearing

QUESTIONS

Think back to the seven life processes and why we can say that an animal is alive. Look at the basic structure of an animal, at their head, limbs, body, tail and sense organs. How does the basic structure of animals help them carry out the seven life processes?

ACTIVITY 2.8: Label drawings of animals

When you were learning about plants, you also learnt how to label scientific drawings. In this activity you are going to practise your labelling skills.

INSTRUCTIONS:

1. Study each of the drawings of different animals on page 44.
2. Use your scientific labelling skills to label each animal with the five body structures of animals.

QUESTIONS

Think back to the seven life processes and why we can say that an animal is alive. Look at the basic structure of an animal, at their head, limbs, body, tail and sense organs. How does the basic structure of animals help them carry out the seven life processes?

Movement – limbs & tail

Reproducing – body

Sensing – sense organs

Breathing – body

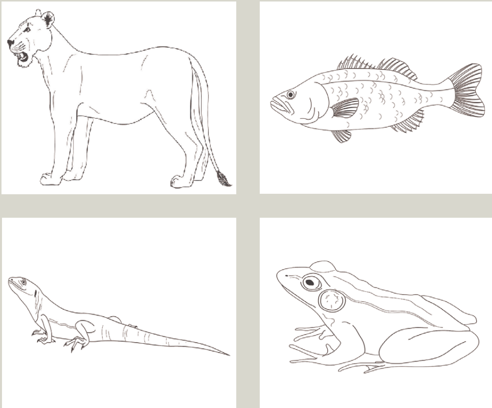
Feeding – limbs (catch food, hold food, break it open), head & sense organs

Excreting – body

Growth – body, limbs, tail, head, etc.

Teacher's Note

The relationship between the structure of an animal and the 7 life processes may not always be clear with some animals, but with most animals it is. For the above question, encourage learners to think of an easy animal such as a dog.



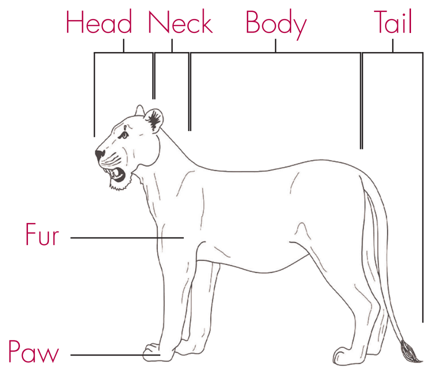
Animals all look very different. Some have long legs and others have short stubby claws, some have big eyes and others have thousands of tiny eyes together in one big eye. They come in all shapes and sizes!

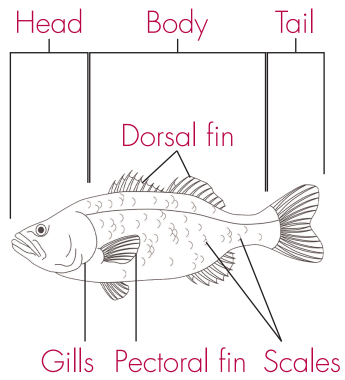
QUESTIONS

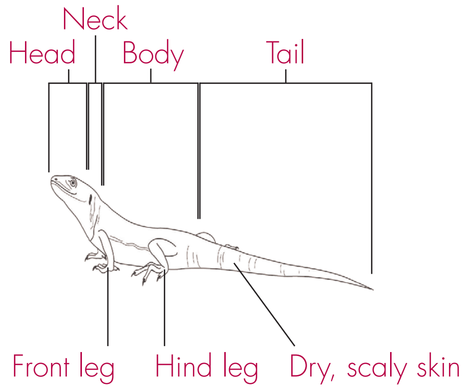
Have a look at pages 2 and 3 that introduces Life and Living at the beginning of the term. You can see the Quantum Club exploring the jungle. Can you see all the different shapes and sizes of the animals? How many different animals can you spot?

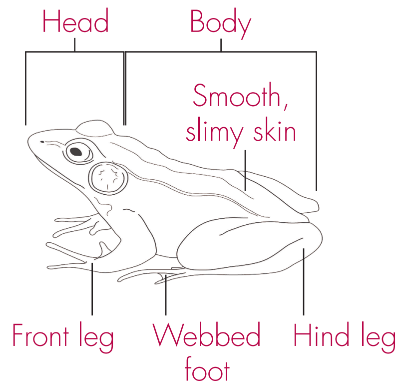
ACTIVITY 2.9: Small, medium, large or extra large?

Do you sometimes go shopping with your family? Have you seen that shops use the words small, medium, large and extra large when they compare things like pizzas, eggs or clothes? Sometimes people just use S, M, L and XL to show the size.









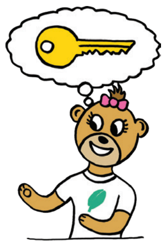
INSTRUCTIONS:

1. Let's use these letters to compare the basic body parts of the animals you labelled on page 44.
2. Copy the table and write S, M, L or XL to describe the size of the different body parts of the animals.

	Head	Body	Tail	Front limb	Back limb
Lion					
Fish					
Lizard					
Frog					

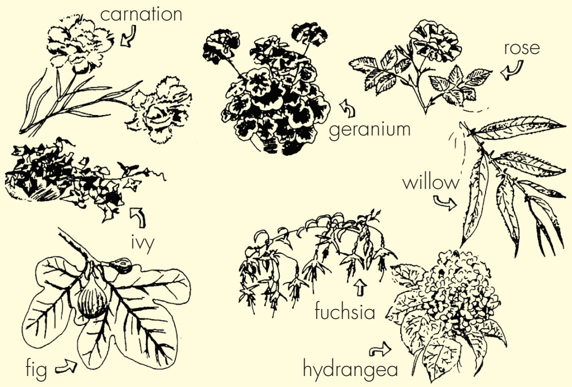
KEY CONCEPTS

- All plants have a basic structure of roots, stems and leaves.
- Flowering plants also have flowers, fruit and seeds.
- We can see how plants are different. We compare the size, shape and colour of roots, stems, leaves, flowers, fruits and seeds.
- All animals have a basic structure: head, tail, body, limbs and sense organs.
- Animals have different body coverings, shapes and sizes, and sense organs.
- We can compare the different things that we see in animals.



REVISION

1. Look at the picture below and answer the questions in your exercise books:



a. Describe the difference between the leaves of the fig tree and the willow tree.
b. Study the flowers. Which flowers would you group together?
c. Use these headings to write the answers in your exercise books:

Many flowers close together	Single (one) flowers on a long stem

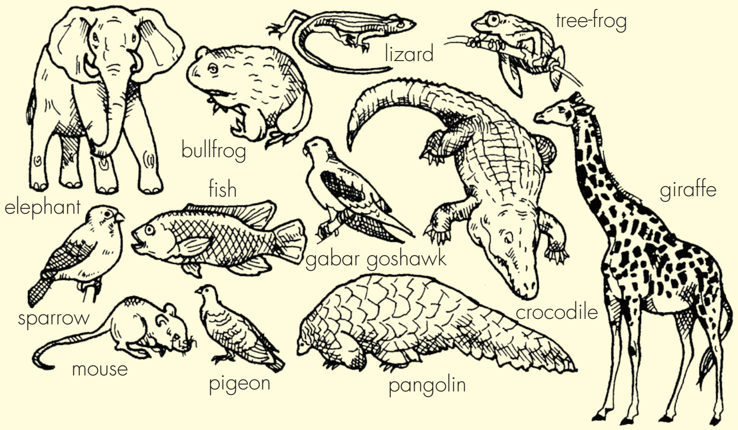
2. Think of three different plants that you know. They can be vegetables, fruit, flowers or trees. Each plant looks different, right?

Many flowers close together	Single (one) flowers on a long stem
geranium	carnation
hydrangea	rose

Copy the table in your exercise books and write down what you know about the different parts of each plant.

Plant's name	Stem	Leaves	Flowers

3. Carefully study the animals in the picture and answer the questions.



a. Find five examples of different body coverings.
b. Find three examples of different limbs.
c. Which animals have soft skins and need to live in or near water to keep their skin moist?
d. Which animal can drop its tail when it is in danger?
e. Which animal uses its tail when catching its prey to drown them in a death-roll?
f. Name the animal that can use its front limbs to handle objects or food?

3. a. feathers, fur, scales, hard horny scales, soft moist skin, leathery tough hide
   b. wings, fins, legs (claws)
   c. bullfrog and tree frog
   d. lizard
   e. crocodile
   f. mouse

g. One animal in this group specifically has very good hearing. Which one has better hearing than most?
h. Think how birds of prey hunt. Which animal in this group needs to have especially good sight to help it hunt?
i. Why does the pangolin have an armoured body?
j. Do you think the crocodile has a good body covering?
k. Would a crocodile be able to survive with the same scaly body covering as a fish? Why does it have the hard horny scales?

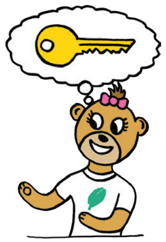
g. elephant
h. gabar goshawk
i. it wraps the hard horny scales to wrap around itself when predators come and then they cannot eat it.
k. A crocodile often catches large buffaloes or gazelle with sharp horns. If its body is not protected by a hard bony armour these animals' hooves or horns could damage the body of the crocodile. The crocodile also spends most of its life in water so if it had the same body covering as a fish it would probably survive.

NatSci&Tech_Gr4_TG_Book.indb 46 2018/05/17 11:37:44 AM

3 What plants need to grow

KEY QUESTIONS

- How can I grow my own plants?
- If I plant seeds, what must I do to make sure that they grow?
- What does a plant actually need to stay alive and grow?



3.1 Conditions for growth

What do plants need to grow?

Do you remember learning about living and non-living things? We said that almost all things on earth are either living or non-living. The plants and animals that are living need to carry out the seven life processes. Do you remember what they are?

Plants make all the food that all the animals on Earth need to stay alive. If all the plants were to suddenly vanish, life on Earth would be not be possible. We need to take care of the plants on our planet.

In this section we are going to learn about what makes plants grow and keeps them alive. We will also look at growing new plants. How can you make sure that as many of your seeds as possible sprout and grow into healthy plants?

New words

- sprout
- adapt
- dissolve
- fertile
- cuttings
- shoots

QUESTIONS

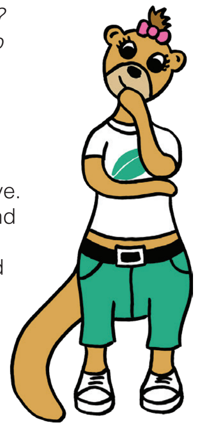
In Activity 1.4 on page 15 you planted a bean seed. How did your bean grow? Did it die or did it stay alive? Discuss what you think your bean plant will need to stay alive and continue growing.

QUESTIONS

In Activity 1.4 on page 15 you planted a bean seed. How did your bean grow? Did it die or did it stay alive? Discuss what you think your bean plant will need to stay alive and continue growing.

Plants need sunlight, water and air to grow.

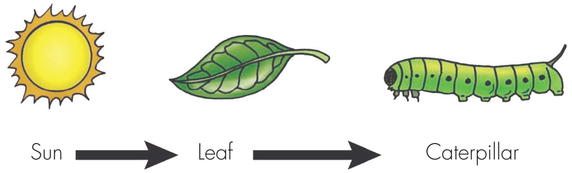
What do plants need to grow?
I am excited to find out and to
grow my own plant!



Visit
What plants need to grow (video).
goo.gl/dzDGr

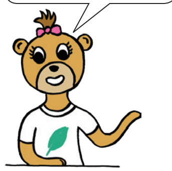
Sunlight

- Plants need sunlight to grow and live.
- Green plants use sunlight, water and carbon dioxide gas to make food.
- The plant can use some of this food to grow and develop.
- It stores the rest of the food for animals to eat.
- When animals and humans eat plants they get energy from the plant.



The plant leaf uses sunlight energy to make food and grow. The caterpillar eats the leaf.

Did you know?
The picture of the sun, leaf and caterpillar is an example of a food chain. You will learn more about food chains in Grade 5.



Air

Just like animals and people, plants also need air to live and grow. Plants use carbon dioxide to make food so that they can grow.

Water

Plants need water to grow and to make food. Some plants need more water than others. The amount of water a plant needs depends on the type of plant. If the plant does not get the amount of water it needs it will die. Some plants are able to grow in very dry areas, such as cacti in the desert. These plants have adapted (changed) over many, many years to be able to survive in these conditions.

In the photo below the raindrops are collecting on the leaves. They will then roll down and soak into the soil. The roots of the plant absorb water from the soil. This water carries nutrients from the soil to all the parts of the plant.

Raindrops collecting on leaves.[1]

Remember, a plant needs water, sunlight and carbon dioxide to make food.

Soil

Most plants grow well if they are planted in fertile soil:

- Plants are anchored in the soil by their roots.
- Their roots absorb the dissolved nutrients from the soil.
- To make sure plants get enough of these mineral nutrients we often add some fertiliser or compost to the soil. We say that soil that has a lot of nutrients is rich or fertile.

New plants growing in the soil.[2]

3.2 Growing new plants

Plants can generally be grown from seeds or cuttings.

- Seeds grow from flowers and are fertilised with pollen from another flower. Fertilised seeds can then germinate to start growing into a new plant.
- A cutting is made when a piece of a plant (usually the stem) is cut off and planted in new soil to start growing roots and form a new plant.
- Plants can also grow from shoots, which are little roots that shoot out of special places in the stem of some plants.

QUESTIONS

What three really important things do plants need to grow? Do you remember that one of the life processes is reproduction? How do plants make new plants?

What seeds need to germinate

You have learnt that seeds are important to grow new plants. A plant needs to germinate from the seed to start growing. This means that the seed has to develop into a new plant and grow all the necessary plant parts.

In Activity 1.4, we germinated a bean seed and saw that although it seemed to be non-living, it can be revived from its dormant state.

Have you ever wondered what seeds need to germinate and grow into new plants? Let's find out by doing a Science investigation!

New words
- aim
- prediction
- apparatus
- results
- observations
- control group
- conclusion
- data
- experiment
- legend

QUESTIONS

What three really important things do plants need to grow? Do you remember that one of the life processes is reproduction? How do plants make new plants?

Sunlight, water, air. They make seeds which then germinate to grow into a new plant.

Teacher's Note

How to introduce the topic

It is recommended to do this practical task over time at school while learners engage with the next section. Give the learners the opportunity to observe the wonder of a new plant becoming alive from a seed or cutting! Let them DO the investigations; observe and record observations over time.

Presentation hints

1. Experience of the teacher will assure success. Do the prescribed investigations **before** you ask learners to do them. Then you will be more able to guide the learners. Consider not to do this investigation in mid-winter low temperatures are usually not favourable for germination. Use different bean seeds and find out which germinate better. Apply the precautions as stated in the investigation in the text.
2. Start class discussion by asking learners why plants are important. Possible answers can be: For food, to provide oxygen, to protect the soil (plant on dunes), plants are beautiful etc. Do we need to make more plants? Why? How?
3. Check learners' understanding of the words: germinate – a seed develop into a new plant, cutting a stem, leaf or part of a plant that can be used to grow a new plant.
4. Tell the learners that they need to find out what seeds need to germinate and grow into new plants. Go through the materials and procedures in the text. Let them work in groups. Check that every learner has the required materials and knows what to do.
5. You must DAILY monitor how their investigations progress. Set aside at least five minutes per day.

INVESTIGATION 3.1: What does a seed need to germinate?

You will be working in groups to investigate different questions. The aim (purpose) and prediction will depend on the question you want to answer in your investigation.

AIM:

An aim in a science investigation is where we state what the purpose of the investigation is. What do you want to find out by doing this investigation?

PREDICTION:

A prediction is when you predict (make a guess) what the result of your investigation will be. But it is not just any guess. You must think about what you think will happen in your investigation. What do you think will happen to your seed and how will it change?

APPARATUS:

Apparatus is the scientific name for the equipment you will need:

- Bean seeds for each group
- Shallow containers for each group (saucers, jar lids or yoghurt tubs)
- Cotton wool (or strips of newspaper)
- Dark cupboard or box
- Fridge (perhaps there is one in the staffroom)
- Ruler

METHOD:

The method is the steps of what you must do. Each group will have a slightly different method, depending on what you are investigating. Follow the instructions for your group.

Group A – Control

Important! A control is where the bean seed is given everything that we think it needs to germinate. In the other investigations, one of these things will be left out.

6. Guide the learners on how to keep a diary. Learners have to write the date and record their observations under headings as: what is different today (root appeared) , measured root length, etc.
7. Revise / reinforce that drawings and labeling must be done scientifically. The:
   - drawing must have a heading (printed in pen)
   - drawing done with a sharp pencil
   - drawing done using solid lines
   - labeling lines must be in pencil
   - labeling lines must be drawn using a ruler
   - labeling lines must be parallel to the top / bottom of the page
   - labeling lines must touch the part of the drawing being labeled
   - labeling lines must end the same distance from the drawing (i.e. the labels must be in a vertical line underneath each other)
   - labels must be printed in pen

   The correct labels must be used in the correct place.
8. Assist the learners to make the following drawings:
   - the bean and the first root
   - the bean, root and first leave
   - its first root, a stem and its first leaf
   - bean plant after 2 weeks

Teacher's Note

This is the first time learners will be doing a science investigation. Emphasize the need for a proper science investigation to answer a question. Such as "Can a bean germinate in a dark place?", "Can a bean germinate in a very cold place?", "Can a bean germinate without water?", etc. Each group can answer a different question and their aim and prediction will depend on what question they are answering.

Answers:
AIM: Group dependent answer. For example: To find out whether a seed needs light to germinate and grow", or "To find out whether a seed needs warmth to germinate and grow"
PREDICTION: Group dependent answer

NatSci&Tech_Gr4_TG_Book.indb 51 2018/05/17 11:37:45 AM

1. Wrap your bean in cotton wool or newspaper.
2. Place it in the shallow container (saucer or lid).
3. Wet the cotton wool and be careful not to flood it!
4. Place the container with the wet cotton wool and bean in a sunny spot.
5. Water your cotton wool *daily* and make sure that it stays damp.
6. Regularly check your bean's progress.
7. Keep a diary during the next few weeks to write down what you see happening. This is called recording your observations.
8. Once the seeds germinate, measure the length of the stems each day and record your results. Your teacher will show you how to do this.

Group B – No water

1. Wrap your bean in cotton wool or newspaper.
2. Place it in the shallow container (saucer or lid).
3. *Do not* wet the cotton wool! You want to see if a plant needs water to germinate so you must not give it water.
4. Place the container with the cotton wool and bean in a sunny spot.
5. Regularly check your bean's progress.
6. Keep a diary during the next few weeks to write down what you see happening. This is called recording your observations.

Group C – No warmth

1. Wrap your bean in cotton wool or newspaper.
2. Place it in the shallow container (saucer or lid).
3. Wet the cotton wool and be careful not to flood it!
4. Place the container with the wet cotton wool and bean in the fridge.
5. Water your cotton wool *daily* and make sure that it stays damp.
6. Regularly check your bean's progress.
7. Keep a diary during the next few weeks to write down what you see happening. This is called recording your observations.

Teacher's Note

It is important to have a control to compare the other groups to. The control beans should germinate and grow the best and you can then use these plants to monitor further. Once they have germinated, show learners how to measure the lengths of the stems using a ruler. Possibly measure 3 stems and then calculate an average. Record these results on the board and then use them to draw a table and then a graph in the learner's book. Get all learners to make a drawing of the first beans that germinated, and again when a leaf appears. There is space later on to do these drawings.

Teacher's Note

For this section, collect all the results from all groups. A suggestion is to have "the diary" written up as a table on the board and each day you record the results for each group. The groups must look at all the different investigations taking place, otherwise some which are studying for example the beans with no water will have a boring time. The skills of observation are very important here. You can teach some of these skills about how to collect and record data. The plants in the control group should be measured each day once they have germinated so you can record the growth. Measure the length of three stems and calculate an average using, average = $\frac{\text{total length of 3 stems}}{3}$. You can then use these results to plot a graph to show growth over time.

RESULTS AND OBSERVATIONS (What you observed and found out):

1. Copy the table below in your exercise books and record the results or data from each groups' observations.

	Control	No water	No warmth
Was there a change on Day 1?			
Did the seeds germinate?			
When did the seeds first germinate?			
Did the new plants grow once they had germinated?			

2. Now let's focus on the data (results) we collected from the Control Group so we can see how the plants grew over time:
   a. When the first beans germinate, make a drawing of a bean that germinated and the first root that appeared.
   b. When the first plants start to grow further and produce leaves, make a drawing of a bean, the root and its first leaf.
3. Use your exercise books to draw a table where you record the data you collected from the Control Group and the length of the stems each day after they germinated. A table is very useful in Science investigations to record and present a lot of data. A table must also have a heading.
4. We are now going to draw a graph. Graphs are another way of presenting (showing) our results. They are often used by scientists to show their results. Drawing graphs is a very important skill! We will use the results from the table above to draw a graph. There are many different types of graphs, but we will draw a line graph. If this is the first time you are drawing a graph, do not worry! Your teacher will help you.

Teacher's Note

The drawing and labeling for question 2a must be done scientifically. The teacher must go through this / revise / reinforce this from the previous section on this:

- the drawing must have a heading (printed in pen)
- drawing done with a sharp pencil
- drawing done using solid lines
- labeling lines must be in pencil
- labeling lines must be drawn using a ruler
- labeling lines must be parallel to the top / bottom of the page
- labeling lines must touch the part of the drawing being labeled
- labeling lines must end the same distance from the drawing (i.e. the labels must be in a vertical line underneath each other)
- labels must be printed in pen

The correct labels must be used in the correct place

Same guidelines for question 2b as for previous drawing.

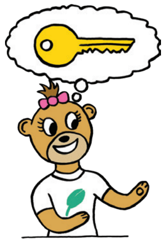
A possible outline of a table for question 3 is given below. Depending on how much the beans grew, use millimeters or centimeters and include the unit of measurement in the column heading. Remember to give the table a heading! Also explain to learners why you have not recorded all the lengths of the stems, but only an average. This may be difficult at this point but it is an important science concept for later. Averages are used as they give a better representation of the whole experiment (or population). if you only chose one plant to measure, that plant might have not grown much or grown much more than the other plants and so this would not be a true reflection of the results.

Date	Average length of stems (mm)

CONCLUSION (What we have learnt):

When we do a science investigation, we always have to write a conclusion at the end. This summarises what we have learnt from the results of our experiment.

For this Science investigation, write a conclusion where you state what you have learnt.



KEY CONCEPTS

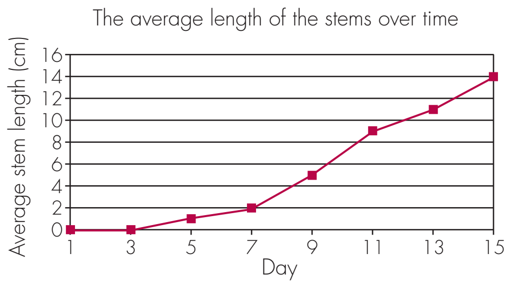
- Plants need light, water and air to grow.
- You can grow new plants from cuttings or seeds.
- A cutting is a stem, leaf or part of a plant that can be used to grow a new plant.
- Germination is when seeds revive from their dormant state and start to grow.
- Seeds need water, warmth and air to germinate and grow.

Teacher's Note

Take learners step by step through the process of drawing a line graph. Use the steps below and draw the graph on the board for learners to see what you are doing and then draw their own in their books.

First draw the axes – one is called the horizontal axis and the other is called the vertical axis.

- Next decide what will go on each axis. The horizontal axis is where the independent variable is plotted. This is confusing for learners, even in Grade 12! So the earlier we start showing them how to do it, the better. The date or day number will go along the horizontal axis. The dependent variable goes on the vertical axis. The height grown by the plants (stem length) is dependent on the day, so this goes on the vertical axis.
- Label the axes.
- Next decide on a scale for each – perhaps only record a measurement every two days if your seeds took a long time to grow.
- Next plot each point using the "pairs" from the table. In other words for Day 1, the height should be zero so plot a point for this first. Show learners how to first read on one axis, then the other, and where these two cross, you make the point.
- You can then draw a line between the points to link them up.
- Give the graph a heading
- A possible graph is given below to give an idea.



Conclusion:

Seeds need water and warmth to germinate (this should be the main conclusion from learners). Evaluate any other conclusions that they might have made depending on the experiment.

REVISION

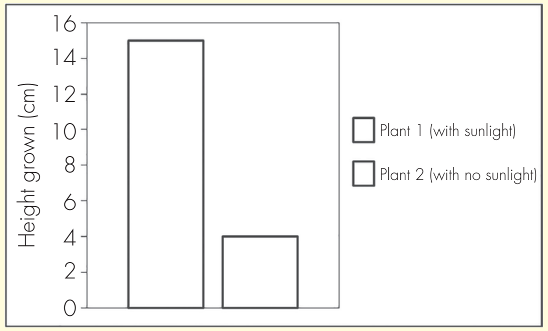
1. Explain what germination means.
2. What does a seed need to germinate?
3. What does a plant need to grow?
4. Two of the same plants were grown in different places. One plant got a lot of rain and was planted where there was sunshine. The other plant also got a lot of rain, but hardly any sunshine.

   After two weeks the following measurements were taken:

Plant	Length of plant
Plant 1	15 cm
Plant 2	4 cm

   Which plant do you think grew in the shadowy place? Why do you say so?

5. Complete the bar graph:
   a. Copy the bar graph below.
   b. Choose a different colour for each plant and colour in the bar for it.
   c. Also colour in the little boxes on the side that tell you which plant is which. This is called a legend.



REVISION

1. It means the seeds start growing and developing all the necessary parts
2. water and warmth, and air
3. water, food, air (and some plants need soil)
4. Plant 2; it did not grow so well

Teacher's Note

Presentation hints

The investigation on the following page provides a wonderful opportunity to revise the scientific investigative process.

- Back ground: You have noticed that the same vegetables grow different in different gardens, you wondered what are the reason.
- Question to be investigated: How does the amount of water influence the growth of a plant?
- Aim: I want to find out how much water a plant needs to grow fast.
- Predict: What will happen if the plant gets no water, a little water, plenty water.

Planning the investigation:

- Which conditions are you going to keep the same? (Same seedlings, same type and size of the container, some amount and kind of soil.
- Which materials are needed?
- How are you going to do the experiment? How many milliliters of water will you use for "a little water" and how many for "plenty of water"? Are you going to add the water daily or every second day?

Do the investigation:

- Follow procedures 1–5 in text.
- Collect and record your data 6,7. Draw a graph using the collected data.
- Write down what you find out.

INVESTIGATION: Extension: How the amount of water influences the growth of a plant

This can be done as an extension investigation if time permits in your class.

AIM (What you want to find out):
What do you want to find out by doing this investigation?
Learner dependent answer

PREDICTION (What you think will happen):
Can you already guess what will happen in your investigation? Write a prediction of what you think will happen.
Learner dependent answer

APPARATUS (Equipment you will need):
- Three of the bean plants that germinated in the previous investigation.
- Three containers of exactly the same size.
- Soil

METHOD (What you must do):
1. Fill the three containers with exactly the same amount of soil.
2. Plant the three seedlings in the three containers.
3. Place the three containers next to each other in a spot that gets enough sunlight during the day.
4. Label the three containers as follows:
   - 1 – No water
   - 2 – Little water
   - 3 – Plenty of water
5. Water the plants according to the labels.
6. Measure the three plants on the same day every week.
7. Copy the table below in your exercise books and use it to recording your findings. That means you need to write the lengths of each plant in the correct block on the table below.

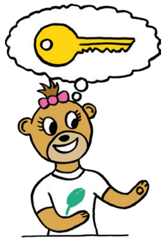
RESULTS (What happened?): (Answer dependent on classroom environment)

	1 – No water	2 – A little water	3 – Plenty of water
Week 1			
Week 2			
Week 3			
Week 4			
Week 5			

- Use in your exercise books to draw a bar graph of your findings.
- Fill in the scale for the vertical axis
- Draw in the bars for each plant for the final height it grew after week 5.

CONCLUSION (What we learnt):
What differences could you see between the three plants after the 5 weeks? Why do you think the plants differed so much after 5 weeks?
Learner dependent answer

4 Habitats of animals and plants



KEY QUESTIONS

- Why do you only find certain plants or animals in certain parts of the world?
- How do plants and animals choose where to live?
- Why do we have the galjoen, blue crane and springbok as our national animals?
- Why are proteas and the real yellowwood tree our national plants?

4.1 What is a habitat?

New words
- habitat
- organism

Animals tend to live naturally in specific areas. Different kinds of plants grow naturally in certain areas too. Plants and animals will choose where they live mostly because of the water, food and climate of a specific area. The place that a plant or animal lives in is called a habitat.

The physical environment also plays a part in an organism's choice of habitat (home). For example, plants prefer certain types of soil to grow in. You can easily see if a plant does not like to grow in a specific area/habitat. It will stay small and have few leaves. If a plant is in an area that it likes it will grow big and strong and have lots of leaves.

A pond is a natural habitat to many different animals, such as fish, birds, snakes, frogs and other small mammals.

A habitat is the physical area where the animal or plant lives. An organism's natural habitat has everything it needs to live.

QUESTIONS

Look at pages 2 and 3 where you can see the Quantum Club exploring a habitat! What type of habitat do you think this is? Name some of the plants and animals that live in this habitat.

4.2 Different habitats

There are many kinds of habitats that plants and animals like to live in.

New words
- desert
- forest
- grassland
- wetland
- indigenous

Some areas of the Karoo in South Africa are semi-desert areas where plants are adapted to grow in dry, hot habitats.[1]

- Some plants and animals choose to live in the hot, dry desert. These plants and animals do not need as much water as other types.
- Some animals and plants live in a forest or cave habitat because they prefer cooler, shady areas.
- In South Africa there are many forest habitats.

There used to be many wild elephants that lived in the Knysna forest in the in the Western Cape. But today there are hardly any left as many were killed by humans.

QUESTIONS

Look at pages 2 and 3 where you can see the Quantum Club exploring a habitat! What type of habitat do you think this is? Name some of the plants and animals which live in this habitat.

It is a forest habitat. Animals are: elephant, rabbit, butterfly, frog, monkey, purple loerie, owl, duiker, snake, caterpillar. Plants are trees, vines, ferns, grass, mushrooms, fungi (not actually a plant though).

Did you know?

When animals and plants are known to be found in a specific habitat, we say they are indigenous to the area.

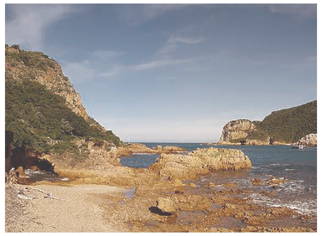
Their forest habitat has also become smaller because humans moved in and cut down the trees. So the number of elephants have decreased.

The plants growing on the forest floor like a shady, cooler habitat.[2]

- Other plants and animals choose to live along the shoreline where the water meets the land. This is because they prefer a wet environment, but they are also able to live on land. Animals that live along the shoreline need to have strong bodies to protect them against waves and seagulls. This is why many may have shells to cover their bodies.

QUESTIONS

Identify three animals that live at the shoreline and have shells or hard armour covering their bodies. If you have not been to the shoreline, choose another habitat close to your home and identify three animals from that habitat.



A rocky shoreline habitat in the Knysna lagoon.[3]

QUESTIONS

Identify three animals that live at the shoreline and have shells or hard armour covering their bodies. If you have not been to the shoreline, choose another habitat close to your home and identify three animals from that habitat.

crabs, crayfish, prawns, muscles, periwinkles, sea snails, sea stars, etc.

- Water plants like to grow in or very near to rivers, lagoons or wetlands. Some animals always live in the water, while others are only in the water sometimes.

QUESTIONS

Write down the names of two animals that are always in water and two that are only sometimes in water.

- There are even animals and plants that live in the very cold regions near the arctic poles or in very high mountains. Marion island is an island towards the South Pole and near South Africa. Scientists study animals that live on the island to learn more about them and how they adapt to their habitats.

ACTIVITY 4.1: Discovering habitats

In this activity you are going to find a habitat in your school, then draw and describe the habitat.

MATERIALS:

- Scrap paper and pencils
- Clipboard or something hard to press on when you draw
- Paper for final drawings
- Coloured pencils or crayons

INSTRUCTIONS:

1. Work in groups to find a habitat in your school where different plants and animals live.
2. Carefully look at your habitat without moving or changing anything in your habitat. Can you see any animals in your habitat?
3. Ask one person to turn over large rocks one at a time so you can see what is under the rock. Many insects and spiders live under the rocks. Also look under the bushes or shrubs for animals that might be hiding from you!

QUESTIONS

Write down the names of two animals that are always in water and two that are only sometimes in water.

Give learners scope to list their favourite underwater animals: fish, whales, dolphins, sharks, stingrays, seals etc. Animals that are only in water some of the time may be: crocodiles, hippos, frogs, seals, sea-lions, etc.

4. Make a drawing of the habitat you observe on scrap paper. This is your rough drawing. You will redraw your habitat when you get back to class. Add in only the plants and little animals that you can see in your habitat.
5. Carefully study the colours of the different plants in your habitat.
6. Once your whole group has finished their drawings, return to your class.
7. Redraw your habitat in class on new clean paper. Use colour pencils or other colouring in materials to add colour and detail to your drawing.
8. Give your drawing a heading and add labels to name the different plants and animals that you recognised. Display your drawings in the class.

QUESTIONS:

1. Explain where the habitat was that your group studied.
2. What kind of habitat did you study? Use some words to describe the habitat, such as shady, sandy and wet.
3. Name the different animals that you could see in your habitat.
4. Were there any plants that you recognised in the habitat? Name these plants.
5. If it started raining very heavily, how would the plants and animals in your habitat be affected?
6. How do you think your plants and animals are affected in winter? Will they be able to survive the cold conditions? Explain why you say so.
7. Is there any damage from people in your habitat? If so, how do you think you could prevent this damage?

4.3 Why do animals need a habitat?

Animals and plants need food, water and shelter in their habitat. Animals also need a safe place to have their young (babies) and to hide from predators and escape from other danger. Let's look at some more of the reasons why animals need a habitat.

New words
- camouflage
- national symbol

Camouflage in a habitat

Some animals rely on their habitat to escape danger or to hide from the food they are trying to catch! To help them do this they blend in with their surroundings. This is called camouflage.

Animals use camouflage for two reasons:
1. Some use it to hide from predators. In other words, their camouflage helps protect them from other animals that eat them.
2. Others use it to hide from their **prey**. When they are hunting it helps them sneak up on other animals without being seen.

Animals are camouflaged in different ways. Let's look at some animals and the way they use their habitats to escape danger!

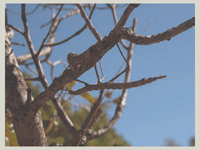
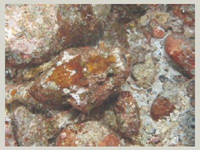
A chameleon can change its skin colour to blend in with its surroundings.[4]

The endangered western leopard toad uses its spots to blend into its surroundings and hide from predators.[5]

ACTIVITY 4.2: Finding hidden animals!

INSTRUCTIONS:

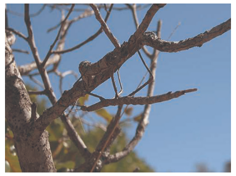
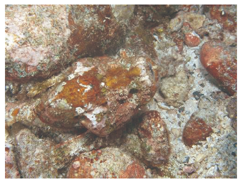
1. Some animals are really good at blending into their habitats. Look at the photos below of different animals and their camouflage.
2. Identify the animal in the photos.
3. How does each animal use its camouflage to blend into its surroundings? Write the answers in your exercise books.

Animal	Description of animal and camouflage	Animal	Description of animal and camouflage
1 		5 	
2 		6 	
3 		7 	
4 			

64 Life and living

Teacher's Note

As an extension you can also ask learners why they think the animals need to blend into their habitat – is it to escape danger, such as a predator, or is it to hide from prey?

Animal	Description of animal and camouflage	Animal	Description of animal and camouflage
1 	Lizzard – blended into the rock	5 	Cheetah – blends into the grass
2 	Stick insect – looks like a branch or stick	6 	Crabs – same coverings and textures as the rocks they live on.
3 	Fly – looks like the bark of the tree	7 	Insect/bug – same colour as the leaves it mostly lives on.
4 	Stone fish – looks like the rocks covered in coral		

*Wow! That was fun!
My pink ribbon is not
very camouflaged, is it?*

Habitats of indigenous animals in South Africa

South Africa is very well-known for its Big Five, as the lion, leopard, elephant, buffalo and rhino are known. Many tourists visit our country to see these animals. But how do they know where to find these African wild animals? Let's help them!

ACTIVITY 4.3: Understanding the habitats of indigenous South African animals

MATERIALS:

- A piece of A2 cardboard and A4 paper.
- Information about the Big Five.
- Pictures of the Big Five from old magazines, newspaper cuttings or photocopied images.
- Coloured pens and pencils.
- Scissors.
- Glue.

INSTRUCTIONS:

1. You are going to make a poster for tourists about the Big Five and where to find each animal.
2. Work in groups of five and assign one of the Big Five to each group member. Each person in your group will investigate one of the Big Five animals.

Teacher's Note

For the following activity, divide the class up the day before or two days before you plan on doing the activity. Then instruct pupils to find the relevant information before then. Some pupils will not bring to class and might not have access to the resources. in that case, they can draw the pictures of the animals, or you, the teacher, can source some old magazines, such as Getaway, for the pupils to cut up.

3. Each group member must bring information from home (or from the library) about their animal. This must include what the animal eats, where it lives, and how it reproduces.
4. Bring all your information and pictures to class. If you do not have any pictures, then use your pencils and crayons to draw some pictures of the Big Five.
5. In your group, plan the poster you are going to make about where to find each of the animals on the A4 paper.
6. Once you have finished your plan, use the bigger sheet of paper to make your real poster. (Remember to give your poster a heading.)
7. Present your poster to the class.

My favourite Big Five animal is the elephant. I love drawing the texture of their wrinkly skin!

QUESTIONS

What would you tell a tourist about where to find the Big Five animals in their natural habitat?

Teacher's Note

Decide how you want the learners to present their poster – perhaps each one can present about the animal that they investigated.

National symbols of South Africa

South Africa has five animals and plants as our national symbols. National symbols are used to identify a country.

National symbols are animals and plants that live in habitats found in our country and seas:

- National bird – blue crane
- National animal – springbok
- National fish – galjoen

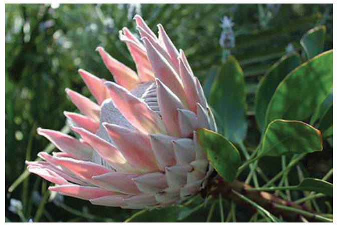
Blue crane in a river

Springbok grazing

QUESTIONS

Can you see the differences between the habitats of the Blue Crane and the Springbok? Write down some of the differences in your exercise books.

- National flower – king protea
- National tree – Real yellowwood



Protea[6]

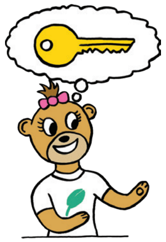
ACTIVITY 4.4: Research project on South Africa's national symbols

MATERIALS:

- Books and reading material about South Africa's national animals and plants
- Scrap paper for making notes
- Pencils for colouring and writing
- Cardboard to make a poster (for example from cereal boxes)

INSTRUCTIONS:

1. Work in pairs to find out as much as you can by reading in books or asking a family member about the plants and animals that are South Africa's national symbols.
2. Choose two of the animals and two of the plants.
3. Explain why they were chosen as national symbols.
4. Describe each one's habitat.
5. Explain why these animals and plants can survive in their habitats – how specifically are they suited to live there?
6. Identify ways that we can protect and look after these animals and plants.
7. Present your research as a poster.



KEY CONCEPTS

- Habitat is the place where a plant or animal mostly lives.
- There are different kinds of habitats, such as grassland, forest, river, sea and desert.
- Animals need a habitat for food, water, shelter, to reproduce, and also to escape from danger.

REVISION

1. List and describe two habitats that you learnt about in this chapter.
2. Explain in your own words what a habitat is.
3. Name three animals in South Africa and the habitats that they live in.
4. Look at the list of animals in the first column. Think carefully about the types of animals and what they would need in a specific habitat. Draw a line to connect the second column with the habitat in the first column.

Habitat	Animals and plants
a. Cape fynbos	1. lizards, snakes, spiders, scorpions, small birds, foxes, small buck, tortoises
b. Wetlands in St Lucia (vlei)	2. large buck and even elephants, bushpigs, some monkeys, many reptiles, big ferns, tall trees
c. Knysna forest	3. water birds, water snakes, small fish, frogs, terrapins
d. Karoo semi-desert	4. snakes, small tortoises, small frogs near little ponds, sugarbirds, many bees and butterflies, baboons, proteas and pincushions

5. Do you think a large bullfrog can live in the Karoo? Why do you say so?

REVISION

1. Learner dependent answers.
2. A habitat is a place where a plant or animal lives.
3. Some possible answers: lions, zebra, buck, etc in grassland; birds, fish, etc in wetlands, snakes, eagles, rodents, etc in semi-desert; buck, birds, small rodents in forest/woodland; ants, birds, mice, buck in fynbos.
4. A = 4; B = 3; C = 2; D = 1
5. It is not likely – A bullfrog needs to live in and near water as it breeds in the water and if there is not enough water it will not be able to reproduce and will die.

5 Structures for animal shelters

KEY QUESTIONS

- How does a little weaver bird or a swallow build such a complicated nest? I do not think I could even do it!
- What different kinds of animal structures do you get?
- How do I build an animal shelter?

5.1 Natural and human-made shelters

New words
- natural materials
- hive
- hexagon
- colony
- burrow
- network
- human-made

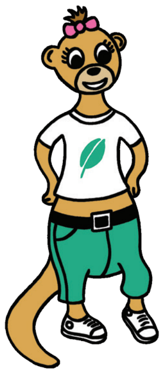
Natural shelters

Remember earlier you dealt with living and non-living things. Living things need some shelter to protect them from harsh weather conditions.

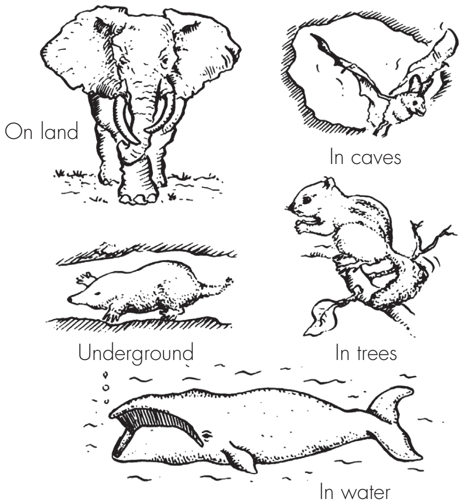
Some animals live in natural habitats for their homes. Other animals build their own homes. Some animals even live in other animal's homes. A natural shelter is a home that the animal has made for itself. Animals live in different kinds of homes:

- holes in the ground
- caves
- nests
- trees

Animals live in all sorts of places! Let's find out!



Look at the pictures of a few places where animals live.



Let's take a look at a few shelters that animals build and the materials they use.

Nests

Nests are built by birds and other animals in trees, on the ground and even in buildings. This is used as a home for them and especially for their eggs. Nests are usually bowl-shaped and made of twigs, leaves and grass held together by mud or saliva (spit).

Swallows build their nests from mud on the underside of roofs where they are protected from the rain.

Did you know?

Some people believe it is good luck if a swallow builds its nest at your home or school! The swallows will return year after year to their nest.

Did you know?

Ants build shelters to save their colonies from drowning. When water floods their nests they hold onto each other and can float like that for many weeks at a time.

Colonies

Bees live in very large colonies. The hive is made up of many six-sided cells (hexagons) stuck together. The queen bee lays all the eggs in a hive and each egg is put in a cell.

A natural bee hive in a tree.[1]

Meerkats burrow and dig huge networks of tunnels underground.[2]

Burrows

Small rodents such as squirrels, rabbits, mice and moles dig burrows in the ground, or under logs and rocks, to provide them with shelter. These burrows often form an underground network of tunnels in which these animals live.

Ants and earthworms also live in the ground.

Webs

Spiders spin webs from silk that they make in their bodies. The web isn't only a home for the spider, it also helps the spider to catch its prey.

A spider web between the twigs of a plant.

Human-made shelters

Other animals live in shelters that were built by humans. These shelters are normally for our pets or the animals that we farm.

QUESTIONS

Below are the names of three types of animals that we keep as pets or farm. We have to build shelters for them. In your exercise books, write down the name of the shelter next to each animal's name and describe it briefly.

- Dogs
- Bees
- Pigs

ACTIVITY 5.1: Describing human-made animal shelters

INSTRUCTIONS:

1. Look at the photos of human-made animal shelters.
2. Copy the table in your exercise books and complete it by filling in the answers.

	1  3	2  4	3  5
Animal that will live in this shelter			
Materials that the shelter is made of			
Why will it be a good shelter for this animal?			

QUESTIONS

Below are the names of three types of animals that we keep as pets or farm. We have to build shelters for them. In your exercise books, write down the name of the shelter next to each animal's name and describe it briefly.

- Dogs
- Bees
- Pigs

Kennel. A small house often made of wood with an entry way in the front.

Hive. A box, often made of wood, with layers for the bees to make their comb on.

Pig sty. An enclosure for pigs, often with an outside area with some mud and an inside, closed area where they sleep.

	1  3	2  4	3  5
Animal that will live in this shelter	bats or birds	cats or dogs	bees
Materials that the shelter is made of	wood	wood	wood
Why will it be a good shelter for this animal?	It is safely placed high up on a pole where predators can't get to the bat or bird; the box is dark inside so the bat can sleep during the day.	It is waterproof so rain cannot wet the cat; the cat can come and go as it wants to; the box inside probably has a lovely soft pillow for the cat.	It protects the bees from rain and wind; the bees can get in and out as they want to; the roof can be lifted off to get the honey out.

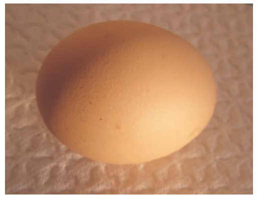
5.2 Structures and materials for animal shelters

New words
- construct
- joins
- members
- products
- technology process
- evaluate
- design brief
- specifications
- constraints

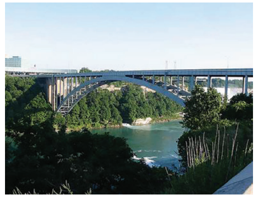
Structures are built by joining different parts together. Different materials are used to make structures. These structures come in different sizes and shapes.

Structures have four types of functions (jobs), they primarily serve to:
- protect
- contain
- support
- span a gap

Each of the structures shown in the photos below do one or more of the jobs or functions of structures. They are made from different materials. Carefully look at the different shapes that are used in the structures.



The shape of an egg shell is an example of a protective shell structure.[7]



A bridge is an example of a structure that spans a gap.[6]

A support structure holding up a water tower.[8]

A bird cage is an example of a structure that contains an object (the bird).[9]

The way structures are put together or constructed depends on the type of materials used.

ACTIVITY 5.2: Looking at structures

INSTRUCTIONS:

1. Work in pairs and look at the photos of structures on page 74.
2. Discuss each photograph with your partner.
3. Look at the shape and size of the structure, and the materials used to construct it. Use the S, M, L and XL to describe the size as you did in Activity 2.8 on page 44 for animals.
4. Record your findings in the table provided:

	Size of the structure	Shapes used in the structure	Materials used in the structure
Egg in a shell			
Bridge			
Water tower			
Bird cage			

Let's learn more about different kinds of structures.

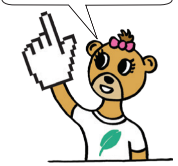
Shell and frame structures

Shell structures mainly contain and/or protect the contents. A bird's egg protects the little chick growing inside it. A car gives some protection to its passengers. A pot holds the food inside it.

A frame structure gives support. There is a frame structure inside your body – your skeleton supports your body! Your knees and elbows are places where the bones join.

A frame structure must carry a load in the right places without it collapsing or falling over.

Visit
Strength of an egg shell (video).
goo.gl/ZLl1d



	Size of the structure	Shapes used in the structure	Materials used in the structure
Egg in a shell	S	Oval	calcium deposits (learners are not required to know this, teacher help may be advisable)
Bridge	XL	Arch; triangles, columns	metal and concrete
Water tower	L	Triangles, rectangles	metal
Bird cage	M	Rectangles	metal & plastic base

Frames are made of members and joins. The members are the long parts and the joins are where the long parts come together. Sometimes longer tubes can be joined to make triangles. The tubes are called the members. Where the tubes come together that is called the join.

QUESTIONS

1. List three types of structures.
2. What is the difference between shell and frame structures?
3. What kinds of functions do shell and frame structures serve?
   a. Functions of shell structures:
   b. Functions of frame structures:

The Technology Process

When we design and make products and structures we use a special way to do this, called the technology process. The technology process helps you to design and make products.

The technology process has five steps:

1. Investigate
2. Design
3. Make
4. Evaluate
5. Communicate

We use the technology process to investigate a specific problem. We then use this information to design and make something to help us solve the problem. While we work on the design and make the product, we constantly evaluate it to see if it is working. Does it do what we meant for it to do? We can also talk to our friends working with us about what we plan to do. We explain how we want to design or make the product.

Teacher's Note

Learners need to research, design, and draw a shelter for an animal. This is the **first time** that learners are doing a Technology activity where they have to follow the Technology Design Process. However, they are not doing the whole process (ie. making and evaluating), as this would be quite demanding for the first time. Later on in the year in the other strands they will be taking the Technology Process further and actually making their products.

So, for each Technology project you are building up their skills and reinforcing the process and the steps to follow. It is probably best to let learners work in groups so that they can discuss how they are going to make the shelter, especially as this is their first time designing something.

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).

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?

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.

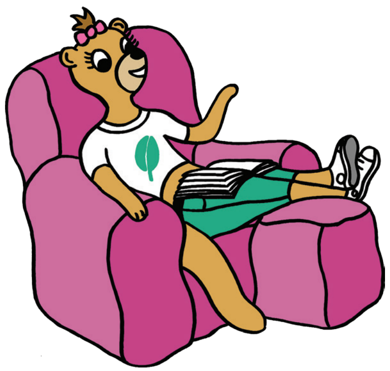
D stands for Designing – that means using what you learned from investigations to think of good ways to solve the problem.

Many people use the technology process every day. If you want to design and make something to solve a problem, you can also use it.

Whenever we do a technology project in Natural Sciences and Technology, we will be following these steps.

Designing an animal shelter

Let's use the technology process to help some birds in your area. Remember you need to start by first identifying the problem. Then you can start to design and make a shelter to solve the problem (solution).



This sounds like fun! I am excited to use the technology process to design and make something.

(For this project the Technology Process will stop after Designing and drawing, but you can tell the learners what would come next so that later in the year when you actually do these steps, they are already familiar)

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.

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. 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.

ACTIVITY 5.3: Design and make a shelter for wild birds

HELP! THE BIRDS NEED YOU!

Many of the trees in your town have been chopped down to make space for homes and other buildings. The birds that made nests in the trees now have nowhere to safely lay their eggs. There are many more rats, mice and other pests in the city because there are fewer birds to catch them. This is because many birds left to find safe places to build their nests and raise their chicks.

Some of the birds that stayed behind tried to make nests on rooftops but the people did not like the mess they made and destroyed the nests. Other birds tried to build their nests on tall radio and television towers. But then the people could not get their televisions or radios to work properly so they also broke their nests and scared the birds away. The people are complaining about all the pests that are in the city and the birds want to come back but do not have a safe place to build nests. They need your help!

In the previous section we learnt about animal shelters. We need to help these birds by making shelters or places for them to roost. We also have to make them look good for the people.

DESIGN BRIEF:

A design brief is a short description of what you plan to do. An example of a design brief for this project could be: "Design and make an animal shelter that can be used by wild birds."

INVESTIGATE:

The next step in the technology process is to investigate and do some research on the shelter that you are going to make. We have actually already done this in Activity 5.2 when we looked at different human-made animal shelters.

So let's get on to designing!

DESIGN:

We now need to design the animal shelter. In your groups, discuss the following questions. They will help guide your design and make you think about what your bird shelter should look like.

1. What is the purpose of the bird shelter?
2. What shape and size will the shelter be?
3. How will the birds get inside?
4. What are the best materials to make the shelter from?
5. Will there be a place to provide the birds with food and water?

When we design something there are some things that the product or structure you are making needs to do, or some things that it cannot do. We call these specifications (what it must do) and constraints (what it cannot do).

We need to show the specifications or things that your product must do or have before we start to design or make it. You have to make a list of all the specifications otherwise you might not make your product in the proper way.

When we list specifications and constraints, we answer certain questions. You answered some of these questions above.

Specifications

1. Purpose of the bird shelter
2. Size of the bird shelter
3. Materials used to make the bird shelter

Constraints

Some constraints for your bird shelter could be:

1. The materials used must be able to withstand the weather outside, such as wind and rain.
2. A constraint could even be that you have to design and make it in class.

Drawing the design for the bird shelter

In this step you draw what you want your bird shelter to look like. You might need to make many drawings until you decide which design you want to use. It is a good idea to use scrap paper for this. Label the different parts of your design and say what material each part is made of.

Teacher's Note

Teachers need to encourage learners to use recycled materials. An easy design is to make the bird shelter from a recycled 2 litre plastic juice bottle. They can push string through a hole in the lid and screw the lid onto the bottle to hang the bottle in the tree. Then they make holes in the sides to let a dowel sticks through for the birds to perch on. They also cut open a smallish flap to let birds leaving space at the bottom of the bottle for the bird to make a nest in. The flap should therefore be at least 15cm from the bottom. They can paint the bottles to blend into a tree habitat to hide the bottle from predators.

EVALUATE:

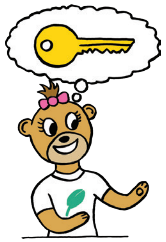
Once you have a design drawing that you are happy with, you would then make the shelter. We are not going to do this now. Later in the year you will get a chance to make some of the designs.

For now, let's evaluate the design that you did. This means you must decide whether your product will be able to solve the problem you identified at the beginning.

To do this you go back to the problem and ask the following questions:

1. Has my design solved the problem and how?
2. Did I stick to the specifications and constraints? (Ask this question of all your specifications separately.)
3. If you changed some of the specifications, such as the size or materials, why did you do so?
4. Is there any way to improve your design?

That was fun! I am going to try make my bird shelter at home and put it up outside our house.



KEY CONCEPTS

- Natural structures are made by animals, like nests and shells.
- Human-made structures are made by people.
- There are different kinds of structures, like frame and shell structures.
- Structures can have different shapes and sizes.
- Structures can be made from different materials.
- Humans can make shelters for animals, especially pets and birds.

Teacher's Note

Make it clear to learners that the drawing may be different from the actual product that you make in the end due to certain reasons, such as a material not working as well as was planned, or you get a better idea for something. This being the first opportunity for learners to design and make, they will chop and change a lot of things and learn in the process. So they should not be penalised for changing as this is part of the process. Perhaps use scrap paper for them to experiment on and draw many different designs. When they have a design they are happy with, they can draw it in the space provided.

Teacher's Note

If you have time in class you could make the bird shelters, or encourage learners to do it on the weekend at home if they want to. If someone makes a shelter, you could put it up in the school somewhere and see if birds use it do not worry if you do not have time to make the shelter in class as this is not specified in CAPS.

REVISION

1. Name four types of natural animal shelters.
2. Explain the difference between human-made and natural shelters.
3. Copy the table in your exercise books and use it to compare the shelters of rabbits, pigeons and tuna fish.

Criteria	Rabbits	Pigeons	Tuna fish
Where will I find the shelter?			
What is the shelter made of?			
Does the animal have to make the shelter?			
Does the animal use a naturally occurring shelter?			

4. Why do rabbits, pigeons and tuna fish have different habitats and shelters?
5. Do you think it is fair to keep a pet rabbit in a cage where it cannot burrow? Give a reason for your answer.

I loved learning about the plants and animals that we share our world with. I hope you did too?!

Next term, join Walt as you start to investigate the materials that make up the physical world around us.

REVISION

1. Nests, shells, hives, hollow trees, spider webs.
2. Natural shelters are when the animal makes the shelter itself out of materials that it finds in its habitat. A man-made shelter is not made by the animal, but it is used by the animal. Humans make man-made shelters for animals.
3.

Criteria	Rabbits	Pigeons	Tuna fish
Where will I find the shelter?	Under ground	In trees	In the sea
What is the shelter made of?	Soil	Sticks and grass	Water
Does the animal have to make the shelter?	Yes	Yes, ifit is a nest, otherwise it just perches in the trees	No
Does the animal use a naturally occurring shelter?	No	No, ifit has to make a nest	Yes

4. There are many reasons. The first is that it depends on what the animal is adapted to live in. Fish need to live in water and so cannot live anywhere else. The water is already there and so the fish does not have to make a shelter. Rabbits need to make shelters often to raise their young, sleep at night and hide from predators. They have to dig holes in the ground and these are not naturally occurring. Pigeons often sleep in trees which are naturally occurring, but they need a shelter when they lay eggs and have chicks so they have to make nests.
5. Learner dependent answer.


Matter and materials

6 Materials around us

KEY QUESTIONS

- What are solids, liquids and gases?
- How can water be a solid, a liquid and a gas?
- Why does my ice cream melt in the sun?
- Why does water start bubbling in the kettle when it gets hot?
- What changes take place when a substance melts?
- What changes take place when a substance evaporates?
- Why does the amount of water on the Earth remain the same?
- What is the water cycle?

New words

- matter
- mass
- solid
- liquid
- gas
- properties
- common properties
- diffuse
- states of matter
- substances

Everything around us is made up of matter. All solids, liquids and gases in the universe are matter. Matter takes up space and has mass, this means we can weigh matter. When we use one kind of matter to make something, such as a wooden or plastic chair, we say the material used was wood or plastic.

6.1 Solids, liquids and gases

Materials are all around us. Some materials are solids, some are liquids and some are gases. A material will always be one of these three things. But what exactly are solids, liquids and gases?

Let's investigate the material properties of solids, liquids and gases.

When is a material a solid?

The word "property" has different meanings. We say this house is the property of Mr Mabusa, he is the owner of the house. When we use the word "property" in Science

Teacher's Note

When you introduce the learners to the strand: Matter and Materials, explain to them that everything around us is built up of matter. When we use matter to make something we usually call it a material.

Introduce this section with a practical demonstration. Use examples of materials and substances to sort matter as solids, liquids and gases.

You will need the following materials: wood, stone, plastic, a glass of water, another different shaped container to pour the water in, juice, tea, air (in a two of three different shaped balloon or tyres), cooking oil, cooking gas, a boiling kettle etc.

Introduce the learners to the examples. Let them observe, feel, smell and touch the examples. Let the learners engage in the activity to identify solids, liquids and gases.

Teacher's Note

Explain to the learners the meaning of the word: property. Some learners know a "property" is a thing owned by someone as a piece of land or house. In science the word "property" describes a special quality or characteristic of something. Properties are common when the same qualities belong to most substances in the group studied.

Explain to the class what they have to do in the activity "Exploring the properties of solids". Let the learners work in pairs. They must **do** the activity and **write** down their findings. Assist them to draw a concept map. Follow-up with a class discussion to make sure that everyone knows what the common properties of solids are.

we look at what makes that kind of material special. How does it behave differently from other kinds of materials? For example when you shift a chair to another place, it will still have the same shape. This is because the chair is solid. So we can say that all solids keep their shape. We say that keeping its shape is a property of a solid. Let's look at some of the properties of solids.

A chair is made of solid materials.[1]

ACTIVITY 6.1: Exploring the properties of solids

MATERIALS:

- A stone
- Cloth
- Paper
- A table or chair
- A pen or any solids around you

INSTRUCTIONS:

1. Work in pairs and copy the table on page 86 in your exercise books. Use the questions below to investigate each solid:
   - Does it feel hard or soft?
   - Does it make a sound when you knock on it?

- Does it break easily? Can it break?
- Can you put your finger through it?
- Is your hand dry or wet after handling the object?
- Does it change its shape when you put it in something else?
- How will you describe the shape. Is it fixed, does it remain the same?

2. Fill in your answers about each of the objects on the table.
3. There are some empty rows at the bottom for you to fill in any other solid objects that you might have investigated.

Object	Your observations
Stone	
Cloth	
Paper	
A table or chair	
Pen	

QUESTIONS:

1. Which properties were the same (common) for all the solids you investigated?
2. List some other solid objects in your classroom. Give at least four examples.

We have learned that a material in a solid form will have a fixed shape and take up a definite space. Let's now look at liquids.

QUESTIONS:

1. Fixed shape, dry, hard
2. Table, door, ruler, pencil, rubber, desk, etc

What is a liquid?

There are liquids all around and you use them in your everyday lives. Some examples are water, paraffin, baby oil, fruit juice, petrol and methylated spirits. What are the common properties of liquids?

When scientists want to know more about something they ask questions. Then they try to answer the questions by doing experiments.

ACTIVITY 6.2: Exploring the properties of liquids

MATERIALS:

- Water
- Paraffin
- Baby oil
- Fruit juice
- Methylated spirits
- Five small pieces of cloth
- Containers for each of the liquids
- Five other clean and empty containers (glass, cooldrink bottle or tin)
- Five saucers or lids

INSTRUCTIONS:

1. Work in groups. Each group must test a different liquid.
2. Select someone in your group to collect a liquid in a container from the teacher. Each group must also collect another empty container and a saucer from your teacher.
3. Copy the table on page 88 in your exercise books. Give your table a heading.

   Important! Do not taste the liquid!
   - How does it smell?
   - Can you put your finger through it?
   - Is your hand dry or wet feeling the liquid?
   - Can you soak the liquid up with a cloth?
4. Answer these questions while you are studying your liquid.

Teacher's Note

What you have to do before presenting the lesson:
Collect the materials needed for the practical before you do the activity. You can ask the learners to bring some of the materials to school, but be prepared to supply the materials as learners sometimes do not have the resources or forget to bring them to school and then you are stuck. Take care that you have soap, water, a basin and paper towels for learners to wash their hands after doing the practical.

How to present the lesson:
Pour about 2 tablespoons of the suggested liquid in a container. Divide the class in 5 groups. Give each group a different liquid, a saucer and another container. Go through the activity with the learners and explain to them what they have to do. Discuss the safety rules and warn the learners NEVER to taste an unknown liquid – methylated spirits and paraffin is poisonous. Walk to each group and help the groups that are not sure what to do. Let the learners to wash their hands after doing the practical. Go through the concept maps of the groups in a class discussion to make sure that everyone knows how to draw a concept map. Let the learners on their own do the questions set in their workbooks. Go through answers with the class.

5. Put a small amount of the liquid in the saucer and leave it for a while in a warm place.
   - Was it easy to pour the liquid from one container to another?
   - Can the liquid flow or spread out on a saucer?
   - How will you describe the shape of the liquid, is it fixed or does it take the shape of the container?
   - Did the amount of the liquid stay the same after leaving it in a warm place?

   Important! Wash your hands after handling the liquid.

Observations	Answer
What did your liquid smell like?	
Was your hand dry or wet after touching the liquid?	
Did the shape of the liquid change when you poured it into another container?	
What happened to the liquid when you left it in a warm place?	

QUESTIONS:

1. Write down the safety rules for this investigation. Why are these safety rules taken?
2. Write down those properties that were the same (common) for all the liquids investigated.

After doing this activity where we investigated the properties of liquids, we can say that a liquid:
- can flow
- has no fixed shape
- takes the shape of the container that it is in.

This is different to a solid. Remember a solid has a fixed shape and you cannot pour a solid.

QUESTIONS:

1. Don't taste any unknown liquid, wash your hands after handling unknown liquid they can be poisonous.
2. Liquids: flow and can be poured, shape is not fixed they take the shape of the container.

What is a gas?

Visit

Video on gases.
goo.gl/sf9TG

Do you remember in the first term when we spoke about breathing as one of the seven life processes of living things? When we breathe, we are taking in and giving out gases. But we cannot see the gases!

Gases are a bit more difficult to understand as we usually cannot see gases. We can see places where gases are used and the containers that they are kept in.

Do you know any gases? What about the gas used in a stove to cook food? Have you seen the gas coming out of the exhaust of a car? In hospitals there are cylinders filled with oxygen gas for patients with breathing problems. The air you breathe in has oxygen gas. The air you breathe out has more carbon dioxide gas.

Look at the following pictures of where a gas is being used.

Cooking using a gas stove. The gas is in a cylinder and is burned to cook food.

A patient in hospital with an oxygen mask on. The oxygen is given to her in a tube attached to the mask.[2]

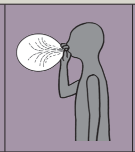
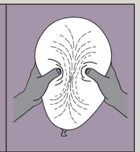
These balloons are filled with helium gas. You cannot see the gas but it is in there as the balloons are blown up and floating.[3]

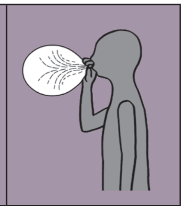
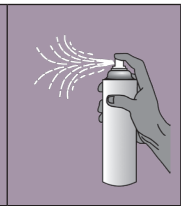
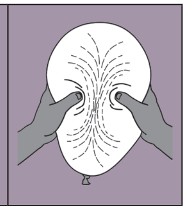
Scuba diver with an oxygen tank on his back to breathe underwater.[4]

ACTIVITY 6.3: Learning about gases from pictures

INSTRUCTIONS:

1. Study the pictures below. Each of the pictures shows a different property of a gas.
2. The properties are listed in the first column of the table. Copy the table below in your exercise books.
3. Give a tick to the picture showing the property. The first one has been done for you.

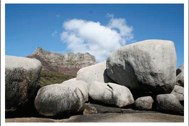
Property illustrated			
A gas moves without something pushing it – it diffuses through the air.		✓	
A gas has no definite shape and fills the container it is in.			
A gas can be pressed to fill a smaller space.			

Property illustrated			
A gas moves without something pushing it – it diffuses through the air.		✓	
A gas has no definite shape and fills the container it is in.	✓		
A gas can be pressed to fill a smaller space.			✓

Comparing solids, liquids and gases

The states of matter are solids, liquids and gases. We have carefully investigated these three states of matter.

Here is a summary:

Solids	Liquids	Gases
Have a definite shape	Have no definite shape	Have no definite shape
Takes up a definite space	Takes up a definite space	Takes up all the space available
Do not flow	Can flow	Can flow
 Big boulders of rock are solids.	 Milk and orange juice are liquids.	 These balloons are filled with helium gas.

Visit
A fun game on solids, liquids and gases.
goo.gl/9PcF6

QUESTIONS

Here is a tray with the Quantum Club's favourite refreshments. Identify what state of matter each refreshment is.

In the next activity, we are going to study examples of different substances (materials) and classify or sort them as solids, liquids or gases.

QUESTIONS

Here is a tray with the Quantum Club's favourite refreshments. Identify what state of matter each refreshment is.

Ice cream: solid

Tea in mug: liquid

Steam from tea: gas

Water in glass: liquid

Ice in water: solid

ACTIVITY 6.4: Identifying solids, liquids and gases

INSTRUCTIONS:

1. Work in pairs and look at the pictures of the different substances below.
2. Decide if they are solids, liquids or gases.
3. Copy the table in your exercise books and use it to classify the substances. Place a ✓ in the right column.

Visit

A song on solids, liquids and gases.
goo.gl/3fPv1

Substance	Solid	Liquid	Gas
Glass of water			
Ice blocks			
Steam from a kettle			
Ice cream			
Rock			
Lava from a volcano			
Gold bars			
Wind			

NatSci&Tech_Gr4_TG_Book.indb 90 2018/05/17 11:37:54 AM

6.2 Change of state

Remember that we spoke about the states of matter? These were solid, liquids and gases. A substance can change from one state to another. For example, a solid can change into a liquid.

Water can be a liquid in your glass or in the freezer water is ice. Ice is a solid. But what makes these substances change from one state to another?

New words
- melting
- solidify (freeze)
- change of state
- evaporating
- condensing
- water vapour
- temperature
- thermometer

What causes a change of state?

We know that matter can be in the solid, liquid or gas state. Let's use water as an example.

QUESTIONS

If you pour tap water into an ice tray and put it in the freezer, what will happen to the water? What happens to the ice cubes if you put them in the sun?

The difference between the freezer and the sun outside is that one is hot and the other is cold. So if we place the water in a place that is cold enough, it freezes. If we place the ice cubes in a hot place, they melt.

This is because the state of matter can be changed from one to another by adding or removing heat.

Let's read a story to try understand this a bit more.

QUESTIONS

If you pour tap water into an ice tray and put it in the freezer, what will happen to the water? What happens to the ice cubes if you put them in the sun?

The water freezes. The ice cubes melt.

ACTIVITY 6.5: The story of Mashadu

INSTRUCTIONS:

1. Read the story below about Mashadu.
2. Answer the questions that follow.

Mashadu and the Quantum Club

Mashadu is a boy in Grade 1 at a primary school in a small village, which gets very hot in summer. He loves to play soccer. After school he often goes over to The Quantum School of Learning to play with the Quantum Club. They really like having Mashadu over, even though he is a few years younger, because he is very talented, fun and caring. Mashadu especially likes Phumlani and they play well together as a team.

One day after school, Mashadu thought he would do something nice for his friends, the Quantum Club and surprise them with ice lollies for when they were finished playing. Mashadu bought five ice lollies, one for himself and one for each of the Quantum Club. He put the ice lollies in a bowl and put some ice blocks around them to keep them cool. Mashadu then ran off to join the others playing soccer.

After the game, Mashadu ran back to the bowl to get the ice lollies. But he got such a shock when he got there. They were all gone! He was so upset and started to cry. The Quantum Club saw that Mashadu was upset and ran over to see what was wrong.

"Hey Mashadu, what's wrong?! Did you hurt yourself while playing?" Phumlani asked.

"No, I didn't. I bought some ice lollies for all of you as a surprise and when I came back now to get them they were all gone! I think someone stole and ate them and just left the sticks! Look!" Mashadu cried out.

"Oh no, don't cry Mashadu! It's not your fault, and no one stole them or ate them either," Mothusi said, while rubbing Mashadu on the back.

Teacher's Note

For the next activity, the aim is to increase reading and writing skills in learners while still focusing on a science concept. The idea of a state change (melting) is explained using a story. The story can be read out by the teacher in the class and then learners can get together in groups and read the story again together and answer the questions that follow.

"Yes, Mashadu, actually we learned in class today about what happened to your ice lollies," said Felicity. "I can explain it to you too. Do you see that your bowl is actually not empty? There is a liquid in it. And it also has a red colour, which was the colour of your ice lollies."

"Yes, I see that," answered Mashadu, "but then how did that happen?"

Walt then answered, "Your ice lollies melted from the heat from the air around us. Even if the sun was not so hot, they would have melted! For something to stay frozen it needs to be at a very cold temperature, like in a freezer."

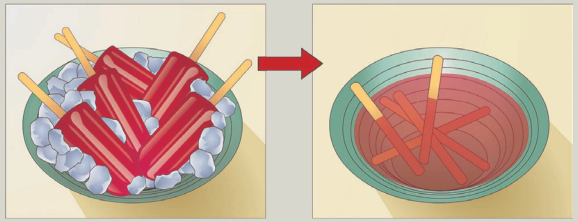
"Yes, melting is when heat causes the solid ice lollies to change into a liquid," Felicity replied, "So no one stole the ice lollies, they just melted."

"Oh ok, I see," said Mashadu, "I must be really silly not to know that!"

"No not at all Mashadu! We only learned about it today in class and we are in Grade 4!" laughed Mothusi.

"I know what we should do!" shouted Phumlani, "Let's go to the tuckshop right now. I have some extra change and we can buy some more frozen ice lollies!"

They all really liked this idea, especially Mashadu who was now laughing. So off they all went, the Quantum Club and Mashadu. They bought some more ice lollies and sat under the tree to eat them.



QUESTIONS:

1. What is the name of the main character in the story?
2. What grade is he in?
3. What grade are the Quantum Club in?
4. What game are they playing together after school?
5. When the ice lollies are frozen, are they a solid, liquid or a gas?
6. Explain in your own words what happened to the ice and the ice lollies while they were left in the sun.
7. What is the name given to this process?
8. Do you think you can reverse the process of melting? How would you do this?
9. What is your favourite type of ice cream or ice lolly?
10. If you wanted to do something nice for your friends, what would you do?

Melting and solidifying

So what have we learned from Mashadu's experience with the ice lollies? The ice lollies were frozen and cold. When they were placed in the sun, they started to warm up. This heat caused a change of state. The ice changed to a liquid. This is called melting.

When Mashadu and the Quantum Club went to get new ice lollies from the Tuckshop, these ice lollies were frozen, but they were made from a liquid. The liquid was poured into the shape of an ice lolly and then they were cooled until they froze. When a liquid changes to a solid, this is called solidifying.

Now that we have read about changes of state, let's do some activities to learn more.

Icebergs floating in the ocean are made of water that has frozen because it is so cold.[5]

QUESTIONS:

1. Mashadu
2. Grade 1
3. Grade 4
4. Soccer
5. Solid
6. Heat from the sun causes a state change and the ice lollies melt from a solid to a liquid.
7. Melting
8. Yes, you can freeze the liquid so that it becomes ice again, but it would not be in the same shape as the ice lollies.
9. Learner-dependent answer
10. Learner-dependent answer

ACTIVITY 6.6: Heating and cooling to cause a change of state

MATERIALS:

- Kettle
- Liquid water
- Glass or mirror
- Gloves or towel

INSTRUCTIONS:

Important! This activity can be dangerous, so your teacher will demonstrate it for you.

1. Boil the water in the kettle.
2. Put a glass or mirror 30 cm above the boiling kettle. **Important!** Wear thick gloves or use a towel to avoid burning your skin!
3. Your teacher will then let you come up to see what is taking place. Make sure you have a look at the mirror.

QUESTIONS:

1. What was the change of state when the water boiled and became steam?
2. You cannot actually see the steam. The steam is extremely hot and quickly cools and forms tiny droplets in the air. When the steam changes into tiny water droplets, what is this called?

Evaporating and condensing

Evaporation takes place when liquid is heated. It means the water changes from the liquid to the gas state.

We hang wet clothes out to dry in the sun. They dry as the water evaporates.[6]

Chapter 6: Materials around us 97

Teacher's Note

The following activity is to be done as a demonstration in the front of the class. Invite learners up to your desk in small groups to see the water boiling and to observe the steam as it hits the mirror and condenses. You need to explain both processes that are taking place. firstly, heat is added to the water and it boils, changing from a liquid to a gas. When the gas hits the mirror, which is cold, it cools down and condenses to form a liquid again on the mirror. This also shows that changes of state are reversible. Later on, refer back to this activity when dealing with reversible state changes.

Teacher's Note

There is often a misconception between boiling and evaporation. Water does not need to boil in order to evaporate. Even cold water can evaporate at room temperature. Be careful not to introduce this misconception in this activity. Rather, what it is showing is condensation. Even the steam is not visible coming out of the kettle. The steam is actually just at the spout when it first comes out and is extremely hot. The "cloud" that you see forming is actually when the steam has already started to cool and condense and form water, but in tiny droplets which are visible. This is not a gas but actually tiny droplets of water in the air. The use of the mirror is to help speed up the process of condensation and show what is happening. This activity shows boiling and condensation, not evaporation.

QUESTIONS:

1. Water to gas
2. Condensation

The steam that comes out of the kettle is extremely hot and you cannot see it. The steam quickly cools and forms tiny droplets in the air. These tiny droplets are visible and form the "cloud" that you see. When these tiny droplets hit the mirror they cool more and form the bigger droplets, which you see forming on the mirror. We say the steam condensed to form water. The change of state is from the gas state to the liquid state. Condensation takes place when heat is removed.

When you leave a glass filled with cold water on the table, small droplets form on the outside. This is because there is water vapour in the air which cools down when it is near the cold glass. The water vapour in the air around the glass condenses as it changes from a gas to a liquid and forms the tiny droplets you can see.

Water droplets on the outside of a cold glass.

Visit

Making ice cream in large quantities to sell in shops (video).
goo.gl/JQjEO

We now know that substances react to temperature changes around them. But where do we use what we learned in everyday life? Let us look at how milk reacts to low temperature.

Ice cream is frozen milk and cream.[7]

ACTIVITY 6.7: Let's make ice cream!

MATERIALS:

- An electric blender
- A 2 litre container with a lid
- Three ripe bananas
- Fresh cream (2 cups)
- Milk (2 cups)
- A teaspoon of vanilla essence
- Half a cup of sugar

INSTRUCTIONS:

1. Watch the video on how ice cream is made. If you do not have internet access, do not worry! We are going to make it ourselves now.
2. To make the ice cream, cut the three bananas into pieces.
3. Put the bananas into the electric blender.
4. Pour the fresh cream and the milk into the blender.
5. Add the vanilla essence and the sugar.
6. You can add any other flavours you may want into the ice cream, like chocolate pieces or strawberries.
7. Plug the blender in and turn it on. Don't forget to put the lid on! Blend for about a minute.
8. Pour the mixture into the 2 litre container and put the lid on.
9. Place the container in the freezer for the night.
10. Enjoy your ice cream the next day!

Visit

Make your own ice cream in a blender (video).
goo.gl/MzQAh

QUESTIONS:

1. The ingredients were in different states (solid or liquid) before and after making the ice cream. Copy the table in your exercise books and use it to record what state each ingredient was in before and after making the ice cream.

Teacher's Note

The following activity can be done using the video to watch how ice cream is made. If you do not have access to watch the video, then follow the instructions to make the ice cream. The teacher can make the ice cream in the front of the class and then put it in a freezer at the school for the night.

Ingredients	Before	After
Bananas		
Milk and cream		
Vanilla essence		
Sugar		

2. What do we call the process for when a liquid changes to a solid?
3. Which ingredients changed state during the process?

ACTIVITY 6.8: Melting and solidifying substances

MATERIALS (What each group needs):

- Butter, fat or margarine
- Chocolate or wax
- Ice blocks or ice cream
- Three containers which will not melt (empty tins)
- Six wooden pegs
- Candle and matches

INSTRUCTIONS (What you have to do in your group):

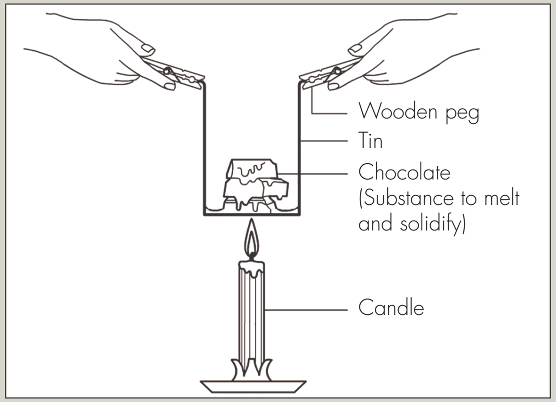
1. In your groups, plan how you are going to melt and solidify the substances.
2. Look at the diagram on page 101, which shows how you can do this.
3. Be careful not to burn yourself when working with the candle! In your group, discuss the safety rules that you are going to apply.
4. Test each different substance that you have by placing it in the tin and holding it over the candle.
5. Then remove the tin from the candle and leave it on the side to cool.

QUESTIONS:

2. Solidifying
3. Cream, milk and vanilla essence

Teacher's Note

For the following activity, either do it as a demonstration or allow learners to work in groups. Make sure that you walk around the class and pay special attention to when the learners are working with the candle so that they do not burn themselves.



Set up for the experiment

OBSERVATIONS:

What happens to each substance? Write your observations in the table.

Substance	Observation before heating	What happened after heating	What happened after cooling
Butter/margarine			
Chocolate/wax			
Ice blocks/ice cream			

QUESTIONS:

1. What happened when the solids were heated by the candle?
2. What happened to the substances when they cooled down again?
3. Did the ice cream solidify again or did it remain a liquid?

QUESTIONS:

1. They melted.
2. They solidified.
3. No, ice cream should not have solidified again if it was not placed back in the freezer.

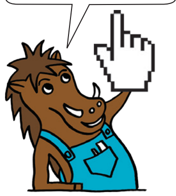
Teacher's Note

Explain to children that the ice cream needs to be at a colder temperature than the butter or chocolate in order to solidify. This is because it has a different freezing temperature.

We have seen that some solids that have melted can be solidified again. So the process can be reversed or turned around again by removing heat.

Let's revise what we have learned from the story of Mashadu and the activities. We have learned some new big words which may be quite confusing!

Visit
The science of chocolate:
goo.gl/BMB6g



Chocolate melting on a hot surface.[8]

Here is a summary of the different changes of state:

Change of state	Heating or cooling?	We call the process
Solid to a liquid	Heating	Melting
Liquid to a gas	Heating	Evaporating
Gas to a liquid	Cooling	Condensing
Liquid to a solid	Cooling	Freezing or solidifying

Temperature

In Activity 6.8, you saw that you were able to melt and solidify different substances. But some may have taken

Teacher's Note

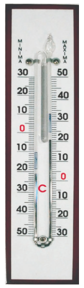
Reversibility is a difficult concept that even high school learners battle with. It is a process that can go in either direction depending on (in this case) whether energy is added or removed. But, energy is only done in term 3. So, at this stage it is only necessary for learners to know that the process can be turned around and one can explain that by saying heat is added and heat is removed. This should be in their frame of reference.

Teacher's Note

Freezing is actually only a type of solidification and requires specific conditions, zero degrees Celsius.

longer to melt than others. The ice cream probably melted very quickly, but the chocolate took longer.

Some substances melt very easily, while others need to be heated a while. Each substance starts melting at a certain temperature. This is called its melting point of a substance. Temperature is measured in degrees Celsius (°C) with an instrument called a thermometer.



A thermometer to measure the temperature of the air.

ACTIVITY 6.9: Drawing a bar graph

INSTRUCTIONS:

1. The table below shows the melting temperature of different substances.
2. You must draw a graph to show this information in your exercise books. Your teacher will help you and guide you through the steps.

Substance	Melting point in degrees Celsius (°C)
ice	0
chocolate	32
wax	62

QUESTIONS:

1. Look at your graph and decide which substance melts at the lowest temperature.
2. Which substance melts at the highest temperature?
3. What is the name of the process when solid wax turns into a liquid?
4. What do you need to do to change liquid gas into a solid again?
5. What process is the reverse (opposite) of melting?

Teacher's Note

Drawing graphs is a very important skill in science. This may be the first time that learners are learning about drawing graphs. You need to explain that graphs help to show information in a different way to plain text. They help to present a lot of data in an easy way to read. The next activity should be done as a class in a step by step way. Explain that the substance will go at the bottom (the x-axis) and the temperature will go on the left axis (y-axis). Possibly draw the graph on the board as a group activity and get the learners to copy it into their books. Choose an easy scale for the y-axis, such as 10.

QUESTIONS:

1. Ice
2. Wax
3. Melting
4. Cool it down.
5. Solidifying

6.3 The water cycle

New words
- water cycle
- precipitation model

People say Earth is the blue planet because most of its surface is covered in water. The land forms a small part.

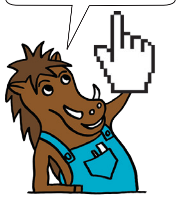
Did you know that the amount of water on Earth now is about the same as when the dinosaurs lived on our planet? How is that possible?

The answer is that invisible water vapour in the air cools and condenses to form drops of water. The reverse process takes place when water evaporates. When the water evaporates, it cannot be seen any more as it has become a gas called water vapour. This process of water always changing from a liquid to a gas and back again is an ongoing process. It is called the water cycle. This is why the amount of water on Earth stays the same.

In a cycle, a set of events (things that happen) keep on repeating in the same order.

Visit

PhET simulations.
goo.gl/r3xkV
goo.gl/4vZcV



The Earth as seen from space.[9]

What is the water cycle?

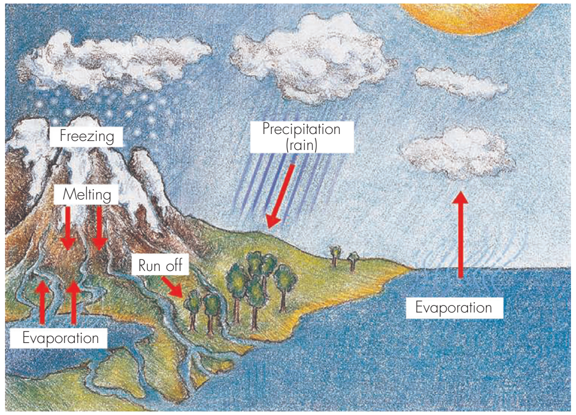
The water cycle shows how water changes from one state to another in a cycle. It takes place all over our whole world.

Teacher's Note

Get your learners to first discuss the picture below showing the water cycle before the facts are given.

Let's look at the stages in the water cycle:

- The sun's heat causes water to evaporate from the seas, streams, rivers and lakes.
- The water vapour rises into the air.
- Higher up where the air is cooler, water vapour condenses into millions of water droplets, which form clouds.
- When the water droplets in the clouds get bigger and heavier, some of the water falls as rain. The Science word for rain is precipitation.
- In other clouds that become really cold, the water vapour freezes and forms snow or hail. The snow falls down to the ground and melts.
- Some runoff water that falls to the ground flows down into the rivers and to the seas.
- And this water will evaporate again forming part of the water cycle.



The water cycle

Look at the image again that shows the water cycle. Use the picture to explain the water cycle to your partner. Do you understand all the steps in the process?

Let's make a model to help explain the water cycle. Models are very important in Science as they help to show an important process in real life. A model is something we build to explain what happens in real life.

Visit
The water cycle (video)
goo.gl/LY6rG

Did you know?
Clouds are not actually soft and fluffy! Clouds are made of water vapour that has condensed.

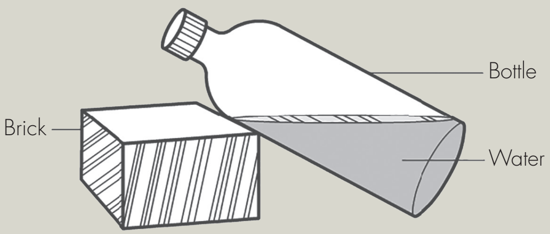
ACTIVITY 6.10: Making a model of a water cycle

MATERIALS:

- Big plastic bottle (2 litre Coke bottle)
- Water
- Brick

INSTRUCTIONS:

1. Put about a cup of water in a big plastic bottle and put the lid back on.
2. Rest the upper part of the bottle on a brick as shown in the diagram.
3. Leave the bottle in the sun for 20 minutes.
4. Watch what happens and write down your observations.



Set up for the model of the water cycle

QUESTIONS:

1. Which part of the model is like the sea?
2. Which part is like rain falling?
3. Which part is like the river flowing back to the sea?
4. What do we call it when water turns into a water vapour (a gas)?
5. Can you see how the water in the bottle is going through a cycle?

Now that we have seen a model of the water cycle, let's try drawing it.

Teacher's Note

The following activity involves making a model of the water cycle. Models are very important in science as they help to demonstrate a concept or process. Explain to the learners that different parts of the model will represent actual things in real life. For example, the water in the bottom of the bottle will represent the ocean. At the end of the activity the learners will need to answer what each part of the model represents so make sure to give hints and suggestions as you are making the model. It would be best to do this as a group activity. Make sure that it is a hot day and that you leave the bottles in the sun for long enough that there is evaporation and condensation in the bottle. An idea is to leave the bottle outside whilst carrying on with the rest of the lesson.

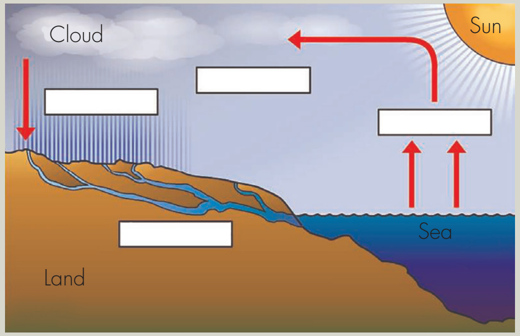
QUESTIONS:

1. The water in the bottom.
2. The water condensing on the side of the bottle.
3. The droplets running back down to the water along the side of the bottle.
4. Evaporation.
5. Water as a liquid – evaporation – condensation – water as a liquid

ACTIVITY 6.11: Drawing the water cycle

INSTRUCTIONS:

1. Draw and complete the water cycle in your exercise books by filling in the missing labels.



2. Use the water cycle to explain in your own words how rain is formed. Write your answer in your exercise books.

KEY CONCEPTS

- Matter is everything around us.
- Materials are matter used to make something.
- Solids are matter that has a fixed shape.
- Liquids are matter that flows, pours, and takes the shape of the container.
- Gases are mostly invisible, takes the shape of the container and spreading out in the available space.
- A change of state is brought about by heating and cooling matter.
- Adding heat to matter causes solids to change to liquids and liquids to change to gases.
- Removing heat from matter causes gases to change to liquids and liquids to change to solids.
- Water evaporates, condenses, freezes and melts in the water cycle.

NatSci&Tech_Gr4_TG_Book.indb 105 2018/05/17 11:37:56 AM

REVISION

1. List the three states of matter.
2. Describe what happens to solid ice when it is heated.
3. Below are descriptions of each of the three states of matter. Match the descriptions to the states of matter.

a. Liquid	1. Has a definite shape and takes up a definite space on the surface
b. Solid	2. Has no definite shape and spreads in the space
c. Gas	3. Has no definite shape and takes the shape of a container

4. What will happen to the water in a saucer if we leave it in the sun on a very hot day?
5. Explain why water droplets form on the outside of a cold cooldrink can?
6. A block of ice, a brick and a marshmallow are left in the sun next to each other on a hot day. What changes would you see in the objects after three hours?
7. What is the reverse of freezing?
8. Do you think ice or chocolate will melt quicker if they are both left outside in the sun?

REVISION

1. Solid, liquid, gas
2. The temperature rises causing the solid to melt.
3. They are placed in the wrong order. Match the right letter to the number and draw a line from one to the next.

   Answers:
   1. B. Solid
   2. C. Gas
   3. A: Liquid
4. It will evaporate.
5. The water vapour in the air touches the side of the cold cool drink and also cools down. This causes it to condense on the side of the can and form water droplets.
6. The block of ice will melt and become a liquid very quickly. The brick will warm up but will not melt. The marsh mellow will probably begin to melt, but not as quickly as the ice.
7. Melting
8. Ice

7 Solid materials

KEY QUESTIONS

- What kinds of materials are solid objects made from?
- What is the difference between raw and manufactured materials?
- Where do raw materials come from?
- Is glass really made from sand?

In chapter 6, we looked at materials all around us and how they can be either a solid, a liquid or a gas. Now we are going to look more closely at solid materials.

New words
- object

7.1 Solid materials all around us

Almost everything around us is made of materials. The shoes you wear, the pen you write with, the glass you drink out of, cellphones, a soccer ball, all your toys, the chair you sit on – they are all made of materials.

ACTIVITY 7.1: Investigating materials objects are made of

INSTRUCTIONS:

Study the object and answer the questions that follow.

Teacher's Note

In CAPS, this section has been allocated 2 weeks (7 hours), however, more time might be needed, possibly 3 weeks. The next chapter on "Strengthening Materials" could possibly take a shorter amount of time than 2 weeks, possibly 1 week. So, a suggestion is to spend more time of this chapter and a bit less time on the next chapter on strengthening materials. There are also some activities in this chapter on flexibility which could be repetitive and so if you do not have time to do all of them, then just choose one.

QUESTIONS:

1. What is this object called and what is it used for?
2. What material is the object made of?
3. Do you think this is a good material for this object? Give a reason for your answer.
4. Can you suggest another type of material that can be used to make this object? Do you think this material will work better? Give a reason for your answer.
5. The object has a zip. What is the function of the zip?
6. What material is the zip made from? Do you think this is a good choice of material? Give a reason for your answer.

In Activity 7.1 you learnt about making objects.

- We use materials to make useful objects.
- We choose materials for a specific purpose when we make the object.

We are now going to see how some materials are used to make new objects. We are also going to look at why some materials are better to use for making certain objects.

New words

- raw material
- natural resource
- manufactured material
- ceramics
- species
- plantation
- wood and plant fibre
- pulp
- recycle
- industry

7.2 Raw and manufactured materials

Every day we use different products made from different materials. The chair you are sitting on is made of a material called wood or plastic. Wood is from a tree. Wood comes from a natural resource. It can be used as a raw material by humans to make furniture.

What does raw and manufactured mean?

Where have you heard the word "raw" before? Perhaps it was when someone was talking about your food and they said the meat or vegetables were still raw as they had not been cooked yet. When we talk about raw food, it means the food has not been processed by cooking. When we process something we do something to it to turn it into something else with different properties.

QUESTIONS:

1. A pencil bag is used for keeping your stationery in.
2. Fabric
3. Learner dependent answer – check their ability to provide a viable reason to justify their answer.
4. Learner dependent answer – a possible material to make it from is plastic, which might be stronger for example.
5. To open and close the bag.
6. The zip is made of metal. It is a good choice of material as metal is strong and will not break when you are constantly opening and closing the zip. Assess what the learners says and if they provide any other reasons.

We can also talk about raw materials. This is when the material is in its natural state. It has not been processed yet. We find raw materials in the environment around us, such as the trees in a forest, or coal and oil underground. But, when this raw material has been processed, meaning humans have changed it, then we call it a manufactured material.

Examples of raw materials are wood and plant fibre. Once wood and fibre have been processed, humans make it into paper. Paper is a manufactured material.

Wood is a raw material.[1]

Paper is a manufactured material made from wood and plant fibre.

QUESTIONS

Sheep are farmed for their wool. Wool is a raw material, but it is processed to make a manufactured material. What things are made from wool?

Raw materials in our environment are used to make other materials that are very useful. Let's look at some.

Examples of raw materials used to make other materials

- Animal skin is a raw material that is processed into leather to make shoes, handbags and belts.
- Animal wool is used to make clothes, such as jerseys and scarves

QUESTIONS

Sheep are farmed for their wool. Wool is a raw material, but it is processed to make a manufactured material. What things are made from wool?

Fabric, jerseys, scarves, socks, beanies, gloves, etc

- Sand is a natural, raw material. Sand is heated to extremely high temperatures and melted to make glass.
- Clay is moulded and baked to make ceramics like teacups, teapots and vases.
- Coal and oil are used to make plastics, paints and fabrics.
- Wood and plant fibres are used to make paper.

Look at the pictures in Activity 7.2 below. They show the raw material and the manufactured material that is made from each. Raw and manufactured materials have different properties.

ACTIVITY 7.2: Describing the properties of raw and manufactured materials

INSTRUCTIONS:

1. Study the photos of raw materials and the manufactured products that are made from them.
2. Compare the properties of the raw material and the manufactured material after it has been processed.

Raw materials	Manufactured materials
 Animal skin (hide) is used to make leather.	 Boots made from leather.
Describe the properties of the cow hide:	Describe the properties of the leather:

Teacher's Note

Photos are provided but it would be best if you could bring some of the actual materials into class, such as wet clay and a fired pot.

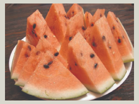
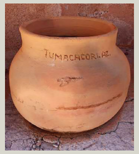
 Wool from sheep is used to make to make clothes.	 Wool is spun to make strings and dyed different colours. It will be made into clothes by knitting.
Describe the properties of the sheep wool:	Describe the properties of the processed wool:
 Clay being moulded into a pot.[2]	 A pot made from clay that has been painted.
Describe the properties of the clay:	Describe the properties of the ceramic pot:
 Sand is used to make glass.[3]	 Glass is made from 70% sand, which has been heated to very high temperatures.
Describe the properties of sand:	Describe the properties of the glass:

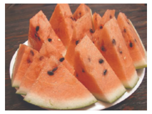
We know that materials are used to make different objects. You have now learned that some materials are called raw or natural materials and some are called manufactured or human-made materials. We can group materials and matter according to how it is used. This grouping of materials is called classifying.

ACTIVITY 7.3: Classifying materials into raw or manufactured

INSTRUCTIONS:

1. Look at the photos in the table below. How can we tell whether something is a raw or manufactured material?
2. Classify the objects into raw or manufactured material by placing a ✓ in the right column.

Object	Raw material	Manufactured material	Object	Raw material	Manufactured material
 *Watermelon*[4]			 *Plastic bag*		
 *Glass*			 *Pot made of clay*[5]		
 *Feathers*			 *Wood*[6]		

Object	Raw material	Manufactured material	Object	Raw material	Manufactured material
 *Water-melon*[4]	✓		 *Plastic bag*		✓
 *Glass*		✓	 *Pot made of clay*[5]		✓
 *Feathers*	✓		 *Wood*[6]		✓

Object	Raw material	Manufactured material	Object	Raw material	Manufactured material
 *Coins*			 *Diamond*		

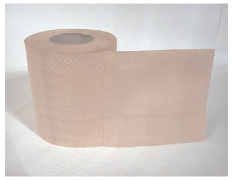
The paper story

Can you imagine a world without paper? There would be no books, newspapers, magazines or even a sheet of music when you want to play piano. No paper means no more paper food labels or paper packaging. Not even toilet paper or kitchen wipes.

Did you know?

In 2011 Sappi, one of South Africa's leading papermaking companies planted 37 million trees in Southern Africa!

Books are made from paper.



Toilet paper is made from paper.[7]

Paper is a very important material in our lives today. Let's find out how paper is made.

Paper is made from the wood and plant fibre from trees growing in plantations all over the world.

A tree being planted.[8]

A plantation of trees for making paper.[9]

Object	Raw material	Manufactured material	Object	Raw material	Manufactured material
 *Coins*		✓	 *Diamond*	✓ (tricky as this diamond has been polished and cut to look like this, but diamond does occur naturally)	

Teacher's Note

Introduce the topic by highlighting the role paper plays in everyday life. Let the learners list objects made of paper. How do they feel about framed photos of loved ones? Ask them where paper comes from. Let them read the story below and then answer the questions.

QUESTIONS

What raw material is used to make paper?

A field trip with the Quantum Club!

The Quantum Club had just been learning about paper in their class. Walt wanted to know more about how plant fibres from trees are actually made into paper. So the Quantum Club decided to visit a paper mill to learn more about the life cycle of making paper.

They were each given a diagram to help explain the papermaking process. You have also been given a copy of the diagram on page 117. The processes that take place at each stage were explained to the Quantum Club at the mill and Walt wrote down his notes. You will see his notes below for each stage – make sure you read these too!

Walt's notes:

1. **Plantation**
- Trees are planted in well-managed forests. These are called plantations.
- The trees are allowed to grow for several years before being cut down.
- The main types of trees used to make paper are eucalyptus (gum trees) and pine trees.

2. **Harvest**
- Once the trees reach a certain height they are cut down. This is called harvest.
- The logs are cut into smaller pieces so that they can be transported.

3. **Transport**
- The logs are all loaded onto big trucks.
- They are then transported to the pulp mill.

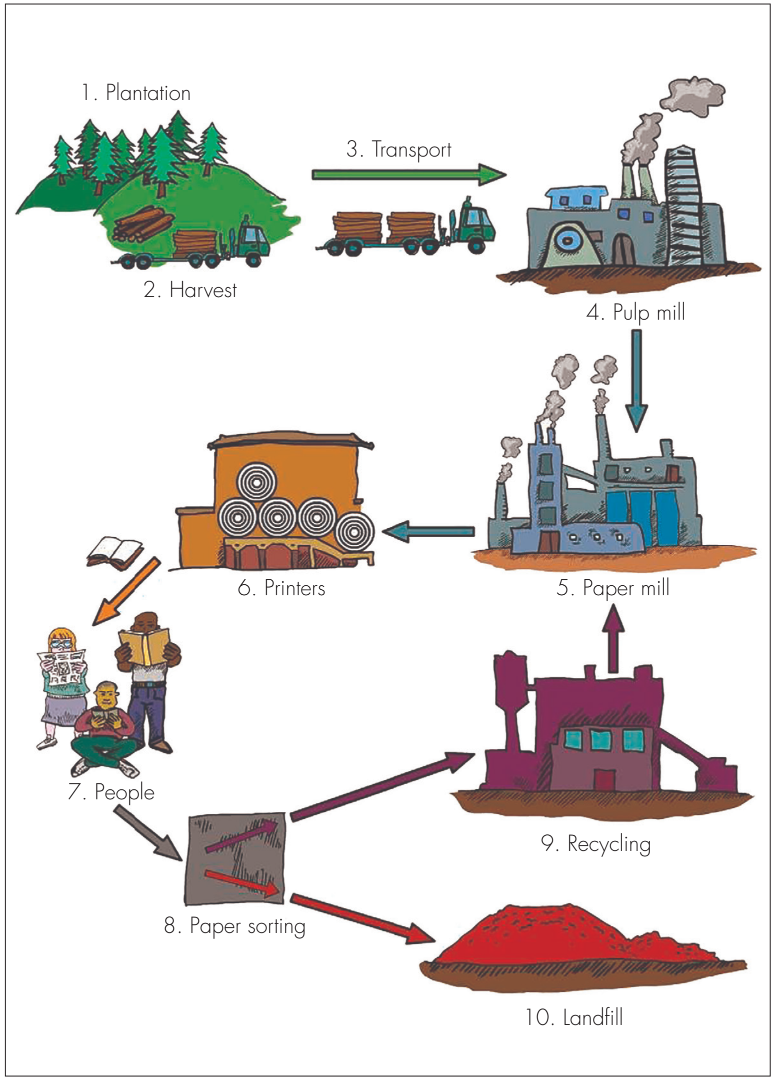
QUESTIONS

What raw material is used to make paper?

Plant fibre.

Teacher's Note

You can supplement the following activity with other resources from paper mills such as Sappi and Mondi.



Chapter 7: Solid materials 117

Teacher's Note

Learners generally struggle with a flow diagram – the concept that one thing happens after the other. Teachers really need to explain this concept carefully and show learners that a flow diagram lays out all the steps in a process in the order that they happen in. Perhaps first just get learners to look at the flow diagram whilst you go through the accompanying notes, and then they can read the notes themselves and match each note to the picture it is describing.

4. Pulp mill

- The logs are first debarked (all the bark is taken off) and then chopped up into smaller pieces, called chips.
- The chips are mixed with water and other chemicals to make a soft pulp.
- Pulp consists of wood fibres and water.

Visit

How to make your own paper (video).
goo.gl/4xDiO

5. Paper mill

- The pulp then flows to the paper mill.
- At this mill the pulp is washed, bleached and cleaned before the paper is made.
- The pulp is pressed and dried and then rolled or cut into sheets of paper.

6. Printers

- The paper is transported to other buyers and printers in big rolls.
- These printers make the paper into other products such as books, magazines and newspapers.

7. People

- The finished products are transported to shops where people buy the products.
- When people are finished using the paper products, such as reading a newspaper, they throw it away in the dustbin or recycle it.

8. Paper sorting

- All the rubbish paper is collected after it has been thrown away and it is sorted.
- Some paper can be recycled but some cannot, so the paper is sorted into two different groups.

9. Recycling

- Used paper can be collected and used again. This is called recycling.
- The paper that can be recycled is converted into other paper products.
- Or it is made into recycled fibre which can then be used at the paper mill again.

10. Landfill

- Paper which cannot be recycled is taken to the landfill sites where it is dumped.
- Landfill sites have a negative impact on the environment. So it is best to try hard to reduce the amount of waste, which ends up at landfill sites, by recycling.

After the field trip, Felicity was really interested in how she could set up recycling at their school to help reduce their impact on the environment. Mothusi showed her arty side when she made some earrings and a cover for her notebook from recycled paper. Phumlani was just happy that he had his favourite sports magazine to read, which is made from paper. Walt was really happy that he got to learn more about the papermaking process!

ACTIVITY 7.4: The papermaking process

INSTRUCTIONS:

1. Read through the diagram again that the Quantum Club were given at the paper mill and the notes that Walt wrote down.
2. Answer the questions below.

QUESTIONS:

1. What are some of the final products that paper can be made into?
2. Which trees are mostly used to make paper?
3. What is pulp made of?
4. What does "debarked" mean?
5. What is a landfill site?
6. Arrange the processes in papermaking in the correct way.
   a. Chips go into the pulp mill
   b. Wood logs are transported by trucks
   c. Pulp flows to the paper mill
   d. Paper is transported to buyers who make other paper products

QUESTIONS:

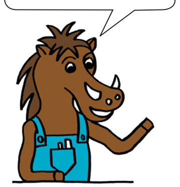
1. Books, newspapers, magazines, billboards, toilet paper
2. Eucalyptus (gum trees) and Pine trees
3. Plant fibre and water
4. It means the bark is removed from the logs.
5. It is where the rubbish is dumped in big areas.
6. F, B, A, C, G, E, D

Did you know?
It takes 40% less energy to make paper using recycled paper than to use new wood fibres

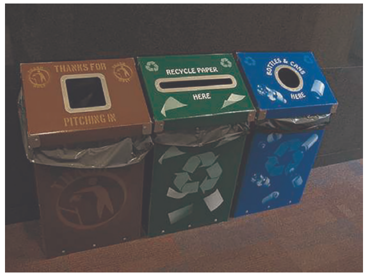
e. Pressed and dried pulp is rolled or cut into sheets of paper
f. Wood is harvested from trees growing in a plantation
g. Pulp is washed, bleached, cleaned and dried

7. Talk to a partner about the section of the papermaking process that interested you most. Explain why you find it interesting.
8. Do you think many people work in the papermaking industry? Explain your answer.
9. Do you think the papermaking process is a long or a short process. Give a reason for your answer.
10. Name two of the major papermaking companies in South Africa that you know of.

Did you know?
The idea of recycling isn't new. Humans have been recycling materials for a thousand years!



We mentioned recycling as a part of the papermaking process. Recycling is a very important process as it allows us to reduce our waste and use things over again. Not only paper can be recycled. You can also recycle glass, tin and plastic.



Bins for recycling. Watch out for these types of bins in your area! [10]

QUESTIONS

Is there a paper recycling project in your school or community? Why do you think we need to recycle paper?

7. Learner dependent answer
8. Many people are employed. There are job opportunities for workers in the forests at the paper mills to transporting products etc.
9. It is a long process as there are many steps involved which all take time, especially the growing of the plantations as the trees take several years to grow to the right height.
10. Sappi and Mondi

QUESTIONS

Is there a paper recycling project in your school or community? Why do you think we need to recycle paper?

Yes/no. Energy is saved to make new paper products when using recycled paper. Reduce the waste at the landfill sites which have a big environmental impact and destroy natural habitats.

7.3 Properties of materials

Raw and manufactured materials have specific properties. We already looked at some of the properties of raw and manufactured materials by describing them. The properties of a material help determine (decide) how it is used. For example, plastic is waterproof so some rain jackets are made of plastic to keep you dry. A rain jacket made from wool or fibre would not be waterproof and you would be soaked! This is because the wool is an absorbent material (it absorbs water).

New words

- waterproof
- absorbent
- hardness
- toughness
- compression
- tension
- flexible
- force
- fragile
- X-axis
- Y-axis
- scale
- vertical

Hard or soft?

A material is described as hard when you cannot scratch it, you cannot cut it and you cannot dent it. Hardness measures how difficult or easy it is to change the shape of the material, either by denting, cutting or scratching it. A diamond is an example of a hard material as diamond cannot be scratched by other objects. In fact, diamond is so hard it is used on drill bits to drill through rocks and many other materials.

A diamond is a very hard material.[11]

The opposite of hard is soft! Think of wet, raw clay, which is soft and can therefore be moulded into a new shape.

ACTIVITY 7.5: Exploring the hardness of materials

MATERIALS:

- Sharp steel nail
- Wax candle
- Metal coin
- Plastic spoon or wooden pencil

INSTRUCTIONS:

1. First make a prediction about whether you think you can scratch or dent each object with the nail.
2. Copy the table below in your exercise books and fill in your predictions.

Material	Prediction – can you scratch or dent the material?	Scraping observations	Denting observations
Wax candle			
Metal coin			
Plastic spoon			

3. Scrape the point of the steel nail across the surface of the wax, the metal and the plastic.
4. Try to indent (make a hollow in) each of the objects by pushing the point of the steel nail into it.
5. Fill your observations in on the table.
6. Now answer the questions.

QUESTIONS:

1. Which of the three materials is the hardest?
2. Which of the three materials is the softest?

QUESTIONS:

1. Metal coin
2. Wax candle

Tough or fragile?

A material is tough if it is hard to break. Kevlar is used to make the bulletproof vests worn by police officers. This material will not let bullets go through.

Kevlar is an example of a tough material.

If you hit a metal coin with a hammer, there will be no or little damage. If you hit a piece of chalk with a hammer it will break into tiny pieces. The metal coin is tough compared to the chalk. The chalk is very fragile.

Toughness measures how much energy is needed to break a material. We will test some everyday materials to decide which material is the toughest.

INVESTIGATION 7.1: How tough are some materials?

AIM: To investigate how tough different materials are.

APPARATUS (Each group will need):

- Container with a wide round opening (large jam tin or yoghurt container)
- A square sheet (20 cm by 20 cm) of each of the following materials:
  - newspaper
  - photocopy paper
  - tin foil
  - wax paper
  - plastic wrap

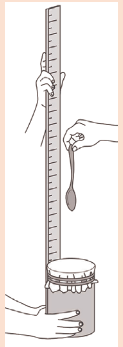
Chapter 7: Solid materials 123

Teacher's Note

You could use this science investigation to answer the question that you write on the board, learners then come up with a hypothesis, and you then present them with the apparatus and they try come up with the method themselves to test their hypothesis. Do not work from the workbooks. Then once learners have had a chance to design their own investigation, you can come back to the workbook.

- Two thick elastic bands to fit around the container
- Metre stick or tape measure
- Metal teaspoon

METHOD: (Each group will have to):



Set up

1. Each group must choose a material to test.
2. Place the material over the top of the container and hold the material in place using the elastic band. Make sure that the material is flat and secure.
3. Hold the covered container next to the metre stick.
4. Hold the teaspoon by the handle 10 cm above the top of the container.
5. Drop the teaspoon straight down onto the material.
6. Copy the table below in your exercise books and record your observations. Did the material dent or tear?
7. If the material did not break repeat the experiment by dropping the teaspoon from 20 cm above the material. Record your observations.
8. Keep increasing the height from which you drop the teaspoon by 10 cm until the material breaks.
9. Remove the broken material and replace with a different material.
10. Repeat the experiment.

RESULTS AND OBSERVATIONS:

In your exercise books, record your measurements and observations in the following table:

Material	Final drop height (cm)	Observations
newspaper		
photocopy paper		
tinfoil		
wax paper		
plastic wrap		

CONCLUSION (What you learned):

The energy of the teaspoon when it hits the material depends on the height from which you dropped the teaspoon. The greater the height, the greater the energy. The toughest material only broke with the teaspoon at the greatest energy.

1. Which material broke first and which material broke last?
2. Which material needed the least amount of energy to break?
3. Which material took in (absorbed) the most energy before breaking?
4. Which material was the toughest?

Stiff or flexible?

Stiffness and flexibility are ways of describing how an object behaves when a force is applied to it. A stiff material will not bend when you apply a force (push on it). But a flexible material will bend. When builders choose materials for building structures, sometimes they need flexible materials and other times they need stiff materials.

QUESTIONS

Copy the table below in your exercise books and fill in your ideas about stiff or flexible materials and where they could be used. Look around your classroom or home and find three more materials to add and also classify.

Material	Stiff or flexible	Where would material be useful?
rubber		
glass		
wood		
plastic material		

Teacher's Note

Energy will only be dealt with in Term 3, and these questions require learners to connect height when it breaks with energy. But this can be picked up again next term and provides a nice extension.

Teacher's Note

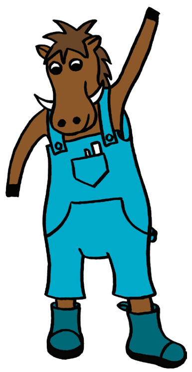
When doing science investigations it is **VERY IMPORTANT** to not simply state the steps in the scientific method as learners will then just want to memorize the steps. Also, asking learners in a test to simply write down the steps in the scientific method does not add to their understanding of why we need them. They are simply recalling. Understanding why each step is needed and the logic of the steps comes with time and more practice.

Case study: The flexibility of rulers

The Quantum Club use rulers a lot in class. Their teacher likes them to use rulers to draw straight lines so that their work is neat. Walt needed a ruler as his was broken. Walt noticed that his was broken and so was Mothusi's, but Felicity's and Phumlani's rulers were not broken. Walt also observed that each of them had rulers made of different materials, either wood, plastic or metal. Walt thought that maybe the type of material that the ruler was made of might influence whether it would break or not. He asked his teacher if the material of the ruler made a difference to whether the ruler would break or not. Their teacher suggested that the whole class do an experiment to test the flexibility of the different rulers. Science investigations or experiments are used to answer questions!

QUESTIONS

1. What did Walt observe?
2. What was the question he wanted to answer?
3. Why did the class do the experiment? This is the aim of the experiment.
4. What do you think the answer is to the question in number 2?



Let us now try answer the question by doing a Science investigation!

Teacher's Note

What we want learners to be able to do is **ASK TESTABLE QUESTIONS, HYPOTHESISE and then DESIGN and CONDUCT EXPERIMENTS to test their hypotheses and thereby answer the question.** The following questions will help learners come up with the question, hypothesis and prediction for the ruler investigation. You need not only use investigations which are outlined in these books, but actually **TEACH** learners how to go about doing an investigation. The procedures outlined in these workbooks will help, but rather do not use the book to follow a step by step procedure. Use it to guide your teaching in class while the learners' books are packed away and the learners have to come up with their own design and see how they can best conduct the experiment using the apparatus available.

Refer to the books later to consolidate the investigation and record results. Each time you teach a different investigation you can also focus on a different aspect, such as asking the right investigative question, OR formulating a hypothesis, OR learning what variables are, OR representing data. Each of these skills will be emphasized in different ways in the different investigations, but only choose ONE to focus on at a time. This also will not all take place in one year, but the skills will be built up gradually over the years at school.

QUESTIONS

1. What did Walt observe?
2. What was the question he wanted to answer?
3. Why did the class do the experiment? This is the aim of the experiment.
4. What do you think the answer is to the question in number 2?

1. Most learners had broken rulers.
2. Which ruler is most flexible, a ruler made of wood, plastic or metal?
3. To find out which ruler is most flexible.
4. Dependent on learner.

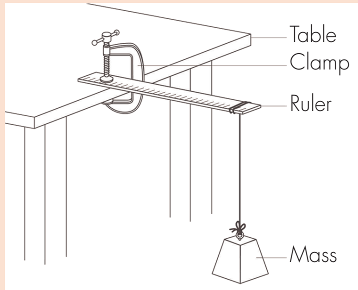
INVESTIGATION 7.2: Which material is the most flexible for a ruler?

APPARATUS (What you will need):

- 30 cm plastic ruler
- 30 cm wooden ruler
- 30 cm metal ruler
- 500 g mass
- String
- Clamp

METHOD (What you must do):

1. Set up the apparatus as shown. The ruler must be clamped onto the end of a table.
2. Measure how far the mass pulls the end of the ruler down and record the distance in the given table in your exercise books.
3. Clamp the next ruler in exactly the same position and measure how far the mass pulls the end of the ruler down.
4. Repeat with the last ruler.



RESULTS:

Record what you observed and found out:

Type of ruler	Distance moved down by the end (cm)
a.	
b.	
c.	

Teacher's Note

It is probably best to test the experiment yourself first to see if the 500g mass is sufficient to cause the rulers to bend. If not, you might need a bigger or smaller mass. Also, if you do not have a clamp, an alternative could be to rest a very heavy object on the end of the rulers such as some books or a pot plant.

1. Which type of ruler allowed the mass to move the most distance?
2. Which type of ruler allowed the mass to move the least distance?
3. If the mass is able to move down, then it means the ruler has to bend. We have said that the measure of how much something can bend is its flexibility. Which ruler do you think is the most flexible and why?

CONCLUSION (What you learned):

What did you learn from the results of this investigation? Provide an answer to your original question.

From your own conclusion, explain to Walt how you decided which ruler is most flexible.

The class was so excited after doing the experiment that they did another experiment to test how the most flexible ruler behaves with different masses.

INVESTIGATION 7.3: Investigating the flexibility of a ruler

APPARATUS (What you will need):

- 30 cm flexible ruler
- Clamp
- String
- Any ruler
- Six 100 g mass pieces
- Graph paper

METHOD (What you have to do):

1. Use the most flexible ruler and set up the apparatus as in the previous experiment.
2. Hang a 100 g mass piece on the end of the ruler. Use any other ruler to measure how far the end drops down.
3. Copy the table in your exercise books and record the distance dropped.

Teacher's Note

Investigation 7.3 follows on from the previous one. This shows how when you conduct a science investigation, more questions can come from it which you can then attempt to answer again with another science investigation. if time does not permit you to do this investigation as well you could leave it out, or possibly rather have a class discussion about how to design an experiment to answer this next question of how flexible one ruler is. However, this next investigation provides an opportunity to plot a graph so the focus of this investigation is to teach learners how to draw graphs.

4. Add another 100 g mass piece and record the total distance the end drops down.
5. Repeat until 600 g are hanging from the end of the ruler.

Mass (g)	Distance dropped from start (cm)
100	
200	
300	
400	
500	
600	

RESULTS (What you observed):

Use the results from your table to plot points on graph paper.

We decided to change the mass hanging to the end of the ruler. With each mass the distance it dropped changed. When plotting a graph the quantity we chose to change (in this experiment the mass) is plotted on the x-axis.

1. Draw the x-axis, label it and choose the scale.
2. Draw the y-axis, label it and choose the scale.
3. Give your graph a heading.
4. Draw a line graph using your plotted points to guide you.

CONCLUSION (What you learned):

1. Which mass piece made the ruler bend the most?
2. Which mass piece made the ruler bend the least?
3. What can you conclude about the distance the ruler moves (bends) and the mass that is hung from the end?

Teacher's Note

Do not join the plotted points with a ruler. A smooth line drawn freehand through all the points is important.

CONCLUSION:

1. The heaviest
2. The lightest
3. The heavier the mass the more the ruler will bend.

Extension: Strength in compression and tension

Some situations need materials that are strong in compression (be able to withstand pushing forces). Other situations are where materials need to be strong in tension (be able to withstand pulling forces).

The vertical (upright) steel poles of the water tower that are supporting a great weight have to be strong in compression in order to hold up the weight of the water tank.

An example of being strong in compression.[12]

The rope supporting the bungee jumper needs to be strong in tension. This is to ensure that the rope does not break and that the jumper survives his experience!

An example of being strong in tension.[13]

Teacher's Note

Further activities to investigate the properties of solid materials, such as light or heavy and waterproof or absorbent is to bring some of these materials to school and let learners experiment with them in class. For example, bring some polystyrene balls and some marbles and some metal ball bearings which are all roughly the same size. let learners hold and play with them to see how they are very different in their weight although they may be similar sizes. You can put a bowl of water in front of the class and ask learners which balls they think will float and which will sink and then do the demonstration. (The polystyrene balls should float and the other two will sink). To investigate waterproof and absorbent, bring some sheets of these different materials to class, such as a dish cloth, a scarf, a piece of plastic (black bag or shopping bag), a piece of canvas, a piece of waterproof material to make jackets (if possible). Set up a demonstration in front of the class again and ask learners whether they think the piece of material will let a cup of water run through it (or if it will be able to soak up or dry some water on a saucer. Once they have answered you, do the demonstration to see if they are correct. You could get two learners to hold the piece of the material so that it makes a kind of cup or container and then you pour the water in. The rest of the class watches to see if any water comes out of the bottom and how much or how quickly. These kinds of activities will reinforce the idea of first asking a question, making a prediction and then testing it to see if your prediction was correct.

Teacher's Note

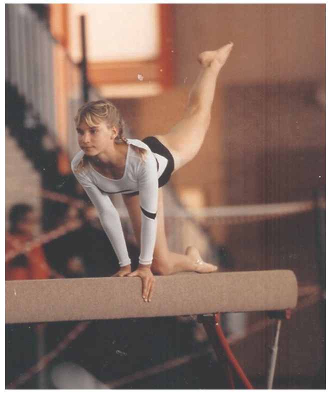
This is an EXTENSION and can be done if time permits or if you have some learners who are further along than others.

ACTIVITY 7.6: Identifying materials that are strong in tension

INSTRUCTIONS:

1. In each of the following scenes, identify the material that is strong in tension (pulling forces).

Scene	Material that is strong in tension
1. A person carrying a plastic shopping bag full of groceries[14] 	
2. A gymnast on a beam 	

Scene	Material that is strong in tension
1. A person carrying a plastic shopping bag full of groceries[14] 	plastic
2. A gymnast on a beam 	wood or metal

Scene	Material that is strong in tension
3. A child on a swing[15] 	
4. The cable car on its way to the top of Table Mountain 	
5. A parachutist falling under a parachute 	

When deciding which material to use, it is important to consider the type of material, the size of the material, the shape of the material and the forces the material will experience.

Scene	Material that is strong in tension
3. A child on a swing[15] 	steel chains
4. The cable car on its way to the top of Table Mountain 	reinforced steel cable
5. A parachutist falling under a parachute 	synthetic rope

7.4 Different materials for the same object

The use of the object determines the type of material it should be made of. Imagine a bicycle with wooden wheels. Do you think the wheels will turn and work as well as steel and rubber? Materials are chosen and used for the properties they have.

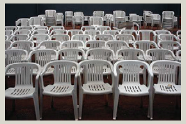
ACTIVITY 7.7: Identifying different materials

INSTRUCTIONS:

1. Look at the photos of different chairs below. Even chairs can be made from many different materials like plastic, wood, metal or canvas, or a mixture of more than one material.
2. Identify the types of materials that each chair is made from.
3. Write down where that material comes from.

Chair	Main materials used	Where the material comes from
 16		
 17		

Chair	Main materials used	Where the material comes from
 16	Wood	From trees
 17	Fabric	From cotton

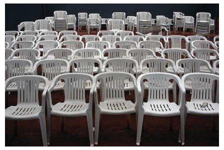
Chair	Main materials used	Where the material comes from
 18		
 19		
 20		

Similar objects, such as balls used in sport, can be made from very different materials, depending on what the object is used for. Let's have a look in the next activity.

ACTIVITY 7.8: Linking different materials with the purpose of the object

INSTRUCTIONS:

1. Work with a partner to study the photos of the balls and then answer the questions.
2. If you have some of these balls, study each one by rubbing it, pressing it and feeling the texture.

Chair	Main materials used	Where the material comes from
 18	Plastic	From coal and oil
 19	Metal	From metal which has been mined and processed
 20	Fabric and wood	From trees cotton

Teacher's Note

For Activity 7.8, photos are supplied of the two balls, but it would be ideal for learners to touch and feel each ball. So, if you can obtain some of these balls, then bring them to your class. The underlying skill of this activity is to describe what you see, in other words, making observations and being able to write them down.

Ball A	Ball B
	

QUESTIONS:

1. What sports are these balls used for?
2. Each ball is made from a different material. What are these materials?
3. Observe and then describe the properties of the material, which is used in each ball.
4. Why do you think the material was chosen for each ball?

KEY CONCEPTS

- Raw materials are those which have not been processed and they come directly from natural products.
- Manufactured materials have been made from raw materials.
- Raw and manufactured materials have specific properties.
- If a material is hard, it is strong and tough to scratch or break.
- If a material is stiff, it is firm and does not bend easily. Stiff is the opposite of flexible.
- Other properties to describe materials are strong, weak, light, heavy, waterproof and absorbent.

QUESTIONS:

1. A: Tennis, B: Cricket
2. A: Tennis ball is hollow made from a layer of rubber on the inside and surrounding it is a softer felt-like material.
   B: The cricket ball has a solid cork centre surrounded by hard leather and stitched with string.
3. Tennis ball – soft, "furry"/rough, can dent it (the rubber is flexible), light. Cricket ball – hard, heavier, smooth, shiny.
4. The tennis ball needs to be soft and to be able to bounce as it is hit across the tennis court. So the materials help it to do this. The red cricket ball is harder. The leather is smooth and hard and helps the ball to go fast and be hit far.

REVISION

1. Match the raw material and the manufactured material that it is made into:

Raw material	Manufactured material
a. Sand	1. Ceramics
b. Clay	2. Leather
c. Coal and oil	3. Glass
d. Animal wool	4. Paper
e. Wood and plant fibre	5. Plastic
f. Animal hide	6. Fabric

2. What is the term used for a material that is not flexible?
3. What is the term used for a material that is not waterproof?
4. Choose three materials that you would use to build a chicken run.
   a. State at least two properties of each material.
   b. How would those properties help in making your chicken run safe from animals and weather elements?
   c. Draw a table for your answers in your exercise books.

REVISION

1. a: 3
   b: 1
   c: 5
   d: 6
   e: 4
   f: 2
2. Stiff
3. Absorbent
4.

Materials	Properties
Wire mesh	Flexibility, toughness
Wooden poles	Stiffness, strength in tension
Zinc roof metal-sheets	Hardness, toughness

8 Strengthening materials

KEY QUESTIONS

- Which shape of pillar is the strongest?
- Which ways are used to strengthen the materials used in buildings?
- What is the purpose of folding and tubing in the building structures?
- How can triangles strengthen structures?
- Where in everyday life do we find examples of folding, tubing and braces?
- What is a strut and where is it used?

New words
- folding
- tubing
- corrugated
- strut

8.1 Ways to strengthen materials

There are different ways to strengthen materials to make a stronger structure. We can do this by changing the shape of the material. You may think that the shape may not make that much of a difference, but let's have a look.

Which shape is stronger?

ACTIVITY 8.1: Explore different ways to strengthen paper

MATERIALS:

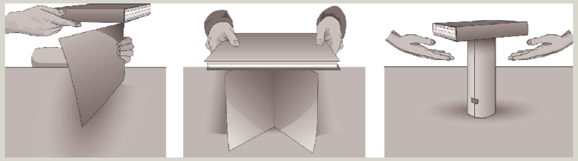
- Up to five sheets of A4 paper for each group
- Pieces of sticky tape
- Identical or similar size books for each group

INSTRUCTIONS:

1. In groups, investigate different ways of using your paper sheets to balance a book.
2. Look at the pictures on page 138 for some ideas.

Visit
Different shapes for structures.
goo.gl/Q9XLd

3. Use a piece of sticky tape if you need it.
4. How many different ways can you find of balancing a book more than 10 cm above the desk or floor, using only one sheet of A4 paper? You can try this on your own or in a small group.
5. Once you think that you have found all the ways you can do it, choose a member of your group to report back to the rest of the class.
6. With your teacher's help, show each different method side-by-side on a table or on the floor at the front of the class.



QUESTIONS:

1. Could you balance a book on just a single flat piece of paper?
2. Which shape of piece of paper is the strongest? Why do you think so?

What did we learn from doing this activity? Materials can be made stronger by changing their shape. An example is rolling the paper into pillars. Pillars can be circular, triangular or square. Which one do you think is the strongest?

Walt has a pile of books next to his bed at home. He wants to make a stand for these books so that his room looks a bit neater. He thought about making a stand using materials he can easily get hold of, such as paper. His idea is to make four pillars and then place a cardboard sheet on top on which to place his books. But, Walt does not know which type of pillar would be the strongest – triangular, circular, or square.

Teacher's Note

This can be done numerous ways, by rolling the paper into a tube and balancing the book on top of the tube, or by folding the sheet of paper into various shapes with different cross-sections. Allow the children to explore and grapple with it, and when they report back, display an example of each different method at the front of the class.

QUESTIONS:

1. No
2. The investigation should show that the strongest shape that the paper can be folded or rolled into to support a weight would be a round tube.

NatSci&Tech_Gr4_TG_Book.indb 136 2018/05/17 11:38:02 AM

Let's help Walt and do an investigation to find out which shape of pillar is the strongest for him to make a book stand.

INVESTIGATION 8.1: Which pillar is the strongest?

AIM:

The aim is what you want to find out.

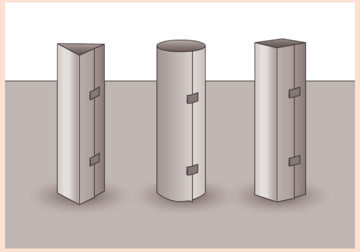
Write down what you think the aim is for the experiment.

APPARATUS:

- Four sheets of A4 paper
- Scissors
- Sticky tape
- Piece of cardboard to form a platform (or the lid of a box)
- A number of the same type and size of books

METHOD:

1. Each group will make and test a different pillar, either circular, triangular or square. Look at the image below to see how to make the different shaped pillars



Triangular, round and square paper pillars.

2. In your group, make four of the same pillars out of the sheets of paper (one sheet per pillar).
3. You can use sticky tape if needed. Check the amount with other groups so that you all use the same amount, otherwise it would not be a fair test.

Teacher's Note

For this investigation the class can divided into three groups. Each group folds the paper to form a different shaped pillar.

Group 1: Circular pillars
Group 2: Triangular pillars
Group 3: Square pillars.
Each group will investigate only the strength of their pillar.

The conclusion will be made when the results of all groups are put together.

To make the investigation a fair test, each group must use the same:

- size and type of paper
- identical books
- platform
- amount of sticky tape

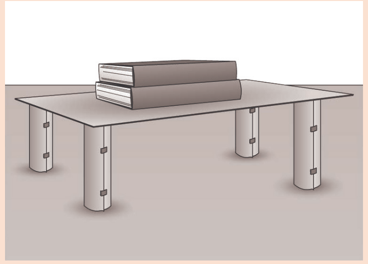
Explain this to the learners while doing the experiment – it would not be a fair test if each group used different paper and different weights of books. In the experimental design stage, encourage learners to ask questions such as "How will we know it is strong?", "What should we do to check it is strong?", etc. This will help learners to see that by placing books on top with increasing weight, you can test how strong the pillars are. Do not give them these answers outright, rather ask them the questions first and encourage them to think.

AIM:

To investigate which type of pillar is the strongest: a triangular, circular, or square.

NatSci&Tech_Gr4_TG_Book.indb 137 2018/05/17 11:38:02 AM

4. Put a platform of cardboard on the folded pillars as in the picture below.



A platform for the books using four circular paper pillars

5. Now go round to each group as a class and test the structures.
6. Add books (one-by-one) onto the platform. Use the same books for each group and place the books on in the same order each time.
7. Copy the table below in your exercise books and record the number of books that each structure can hold before collapsing.

RESULTS:

Groups	Number of books
Circular pillars	
Triangular pillars	
Square pillars	

Now draw a bar graph of your results. A bar graph is used to represent your results in a different way. Your teacher will guide you through the process.

CONCLUSION:

What is your conclusion from this experiment? Which shape of pillar is the strongest?

Teacher's Note

On x-axis: three types of support. Circular, triangular and square

On y-axis: number of books

Heading: The graph shows the number of books supported by pillars of different shapes

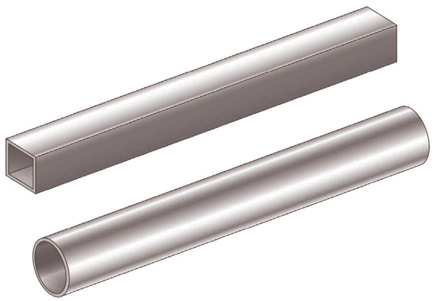
QUESTIONS:

1. Which shape pillar would you tell Walt to use for his book stand?
2. How did all the groups make sure that the experiment is a fair test? In other words, what did you make sure was the same in all the groups?

Tubing and folding

Materials are strengthened by shaping them into a tube (tubing). Tubing is often used to make frames and for supporting weight.

The tube can be in a number of shapes, as we saw in the investigation. It can be circular, square, triangular or even in a U-shape.



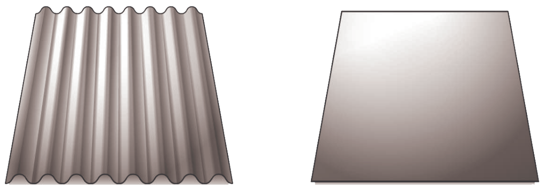
Square and round tubing

When exploring different ways to strengthen paper, you discovered folding the paper also helped to strengthen it. Corrugated cardboard and bubble wrap plastic are examples of strengthened folded materials.

Corrugated iron is another example of how folding makes a material stronger. Look at the picture on page 142 of a sheet of corrugated iron and a flat sheet. Corrugated iron is much stronger which is why it is used for the roofs of houses.

QUESTIONS:

1. Dependent on experiment. It should however be the round pillar.
2. The type of paper used, the number of columns (4), the type and size of cardboard for the platform, the number and size of the books, the amount of selotape used were all the same for each group.



Corrugated iron and a flat sheet of iron

Struts and braces

Struts are used to strengthen or support structures. Braces across the corner joints in structures increase their rigidity and strength.

ACTIVITY 8.2: What is my school made of?

The Quantum Club need to investigate the uses of different materials in different schools. They have asked your help with your school.

INSTRUCTIONS:

1. In groups investigate the different materials used in the buildings and structures in and around your school.
2. Look particularly for materials which have been tubed or folded, and for the use of struts and braces.
3. Record your observations in the table below in your exercise books. An example has been provided:

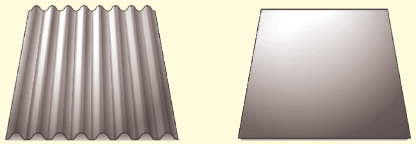
Structure	Material	Ways to strengthen (Folding, tubing, triangulation)
Roof	Corrugated iron	Folding

KEY CONCEPTS

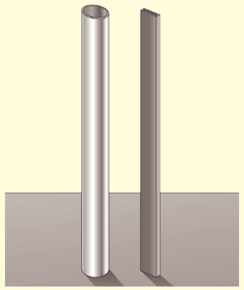
- The strength of structures can be increased by changing their shape, by using methods like tubing and folding.
- Shapes of structures can be circular, triangular or square.
- Braces across corner joints in structures increase their rigidity and strength.
- Struts are used to strengthen or support structures.

REVISION

1. Name some ways to strengthen paper to make a stronger structure.
2. Choose which piece of metal below would be better to use for a roof, and explain why.



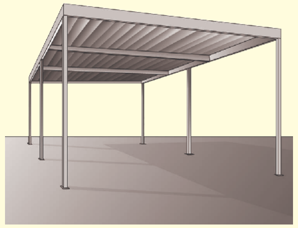
3. Which piece of steel shown in the picture below would you use as the stand for a basketball hoop? The flat piece of steel or the circular tube? Why?



REVISION

1. Folding, making into a tube, placing more pieces together.
2. Corrugated metal sheet – it is stronger and will not bend as easily
3. The flat bar would bend too easily when weighted – rather use round tube which is stronger.

4. The upright poles of the carport shown in the picture are made of square tubing. Give two good reasons why they are not just made of solid steel the same size?



Now that we have investigated ways to strengthen materials, let's move on to see how to make a strong structure!

4. Solid steel would be very heavy, and very expensive.

9 Strong frame structures

KEY QUESTIONS

- What are structures and what are their purposes?
- What is a strut? Where are struts used?
- How are struts used in building traditional homes?
- Which materials are used to construct traditional homes?
- Which materials are used to construct modern homes or buildings?
- Where do we find struts in the human body?

9.1 Struts and frame structures

In Chapter 8 we saw how to strengthen a material to build a strong structure, such as folding and tubing. Now we want to look at how we can strengthen a structure. A structure is something that is made or arranged in a specific way and consists of different parts. A jungle gym is an example of a structure. It has many different parts such as beams, ropes and bars.

A jungle gym is a type of structure.[1]

New words

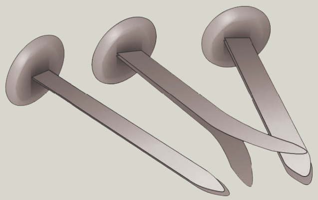
- diagonally
- stable
- rigid
- tie
- guy
- brace
- gusset
- scaffolding
- pylon
- crane
- bibliography
- research

A structure is made of different parts. The way we put these parts together can make a structure strong or weak. Let's have a look at ways to join parts together.

ACTIVITY 9.1: Exploring ways to make a strong structure

MATERIALS:

- Seven cardboard strips, all the same length
- Paper fasteners (10–12 split pins)
- Hole punch



This is what split pins look like.

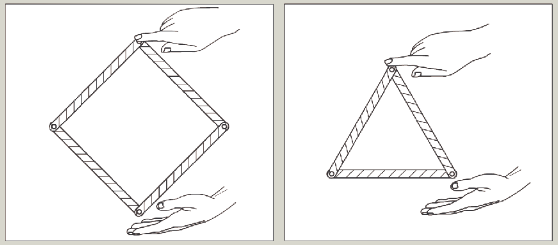
INSTRUCTIONS:

1. You are going to make different structures using the pieces of cardboard.
2. Make holes at both ends of each strip.
3. Join the strips into a square and a triangle. Use the paper fasteners (split pins) to join the strips together at the corners.
4. Now test each of the shapes by pressing two corners together as in the picture on page 147 (don't force them). Watch what happens. Which shape is easy to "squash"?
5. Cut a longer strip of cardboard, which will reach from one corner of the square to the opposite corner. Punch holes in it in the correct places, and add it onto the square.
6. Now press two corners together and see what happens.

Teacher's Note

Activity 9.1 is an investigation which will lead into the subsequent content. This activity will introduce what struts are. Make sure that the learners experience a triangle as a strong structure and a square as a weak structure.

The cardboard strips can be made from cardboard boxes such as paper boxes and kept for future years. This can also be done with straws and pins, or with toothpicks and jelly-tots, or with uncooked spaghetti sticks and marshmallows.



Press on the square and triangle shapes as shown here.

QUESTIONS:

1. Which shape lost its shape (collapsed) when you pressed on the corner?
2. How can we strengthen the shape that collapsed?
3. How many shapes are formed when the shape is strengthened with the extra piece of card?
4. What is the name of this shape?
5. Which shape do you think is the strongest?

We saw in the last activity that you can make a shape stronger by putting an extra piece in. For example, the square was much stronger after you placed an extra piece of card diagonally from one corner to the opposite. This extra diagonal piece is called a strut. The other pieces are also called struts and together they all make up a strong frame.

A roof in an airport where the structure is made stronger by using triangle shapes.

How struts make a rigid frame

The frame is the structure that supports the other parts. The struts strengthen the frame structure when joined in particular, stable shapes.

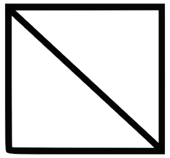
A frame is a rigid support structure that gives shape and forms support for its parts. The word rigid means stiff, not bending or changing shape. Every building, vehicle and piece of furniture has a frame structure.

QUESTIONS:

1. Square
2. Use one strip to brace diagonally opposite corners
3. 2 shapes
4. Triangle
5. Triangle

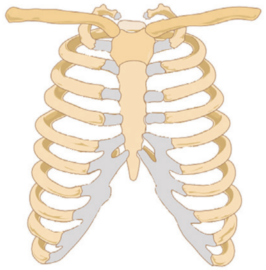
QUESTIONS

There are five struts making up this frame. Label all five.



Human frame structure

Did you know humans also have a frame structure? It is our skeleton! Your skeleton consists of bones, which make up the frame to support all our muscles and organs. Look at the picture below of the rib cage. It is a perfect example of a frame structure. The frame structure of the rib cage protects all the organs inside, such as the heart and lungs.

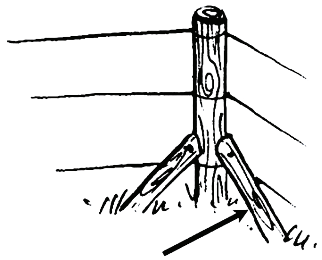


The rib cage is a frame structure.

How struts withstand compression

A strut is a part of structure that supports or holds another strut in place. It can be a rod or a bar. A strut is designed to withstand compression. The picture on page 149 shows how wooden struts are used to prevent the fence from collapsing.

QUESTIONS

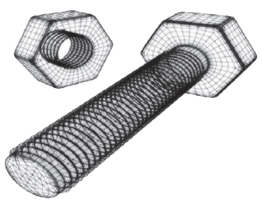


The struts in this fence must be strong and solid to give the fence stability.

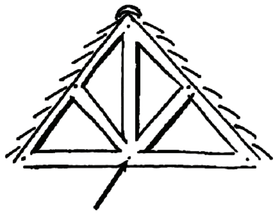
Study the picture of the struts in the fence. What properties do you think the struts need to have to do its job? For example can the strut be made of something soft? Can the struts be flexible?

Ties, guys and braces

A tie is a connector that is designed to withstand tension, for example a nut and bolt.



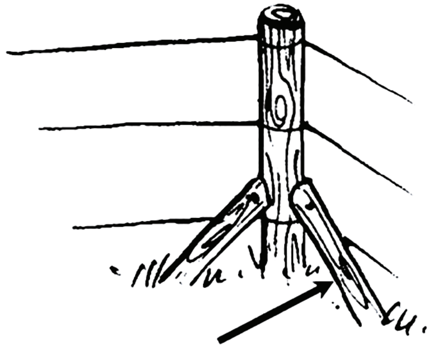
Nuts and bolts are ties that connect two parts together.



The arrow shows the bolt connecting the struts together.

A guy is designed to withstand tension. A guy can be a rope, chain or a single wire. For example, when you put up a tent you use guy ropes to hold down the tent.

QUESTIONS

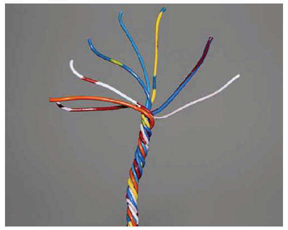


The strut in this fence must be strong and solid to give the fence stability.

Study the picture of the struts in the fence. What properties do you think the struts need to have to do its job? For example can the strut be made of something soft? Can the struts be flexible?

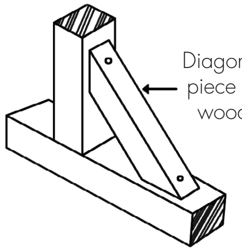
No, it cannot be made of something soft. The strut must be strong and hard to support the force from the fence. No, the strut must be stiff and not flexible as it must not bend.

A chain is an example of a guy.[2]

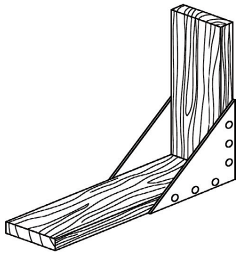


Twisting many wires together to make a guy even stronger.[3, 4]

Corners of rectangles are often weak points in structures, where the structure can bend and collapse like the square in Activity 9.1. Triangles are strong shapes, which do not collapse easily. By putting another support (called a brace) across a rectangle's corner to make a triangle, the corner is made much stronger.



A diagonal brace on a corner where two pieces of wood meet.



Another way of strengthening a corner so it can't collapse, called a gusset.

Examples of strengthened frame structures

We are mostly going to look at the parts of frame structures used in building something.

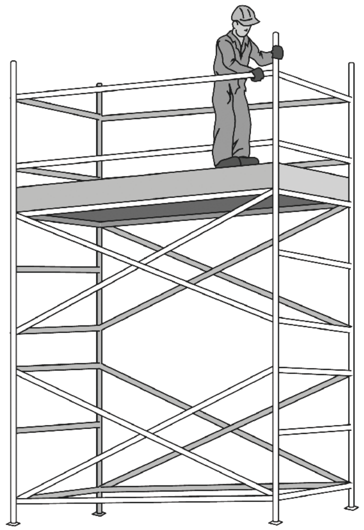
Scaffolding and roof trusses

When builders need to work high above the ground, they often use a frame called scaffolding. If this didn't have

Teacher's Note

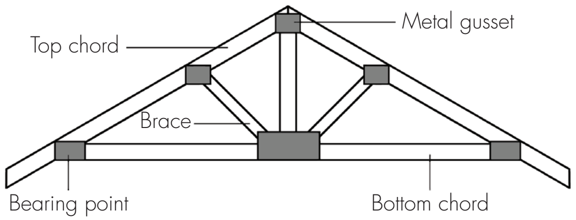
The following pages of pictures do not contain many exercises. But, the main objective is to expose the learners to different structures which have been strengthened using struts. Makes sure to go through each picture and identify the struts. Ask learners to point out the struts in the pictures and explain why they think the frame structures need to be strong and rigid.

any braces across it which make triangles, it could easily collapse.



Construction workers use scaffolding.

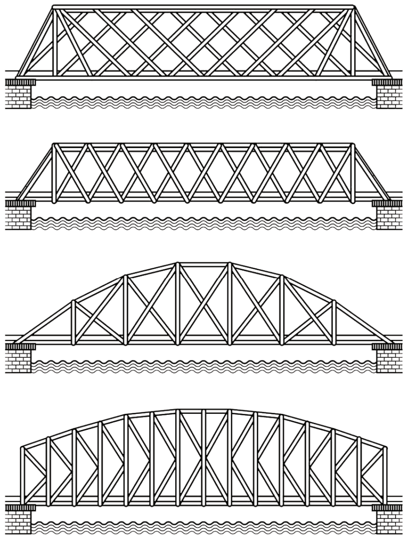
The next picture shows a roof truss. A roof truss is used to help carry the weight of the roof of a house. All of the triangles in it help make it strong.



A roof truss. You don't need to know all these names of the parts.

Bridges

Bridges also make use of struts to make the frame stronger. The diagrams below show the use of triangles to make bridges stronger:



All the triangles in these bridges make them strong.

QUESTIONS

Why do you think bridges need to be so strong?

Pylons and cranes

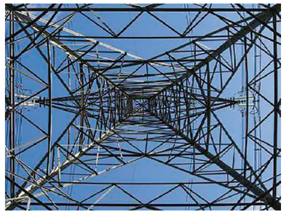
Some structures are really big and carry a lot of weight. These structures include pylons and cranes. They must have very strong frames, so they use struts to make them stronger. Look at the photos on page 153. Can you see all the diagonal struts which strengthen the frames of the pylons?

QUESTIONS

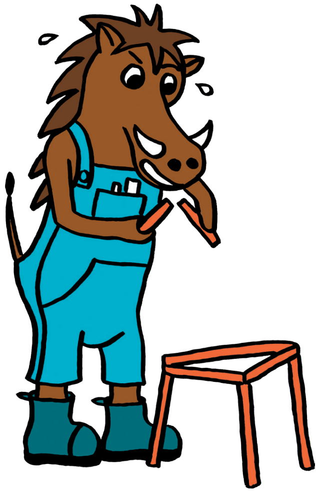
Why do you think bridges need to be so strong?

They need to be strong to carry all the weight of cars, trucks, trains driving over them.

A pylon is the structure that supports electricity lines.[5]

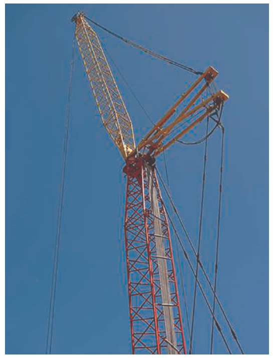


This is what you would see standing under a pylon and looking up![6]



Walt is trying to build his own pylon, but these are very complicated structures!

Cranes need to lift very heavy objects, but they also need to be able to move around. So they must be as light as possible, but still very strong. A frame structure with struts is the best way to do this.



Crane[7]

QUESTIONS

Look at pages 82 and 83. How many cranes are there helping to build the city?

Designing a strong structure

The Quantum Club went for a walk in the forest near their school after class. Mothusi wanted to find interesting objects from nature to draw. So she asked the others to come with her for a walk.

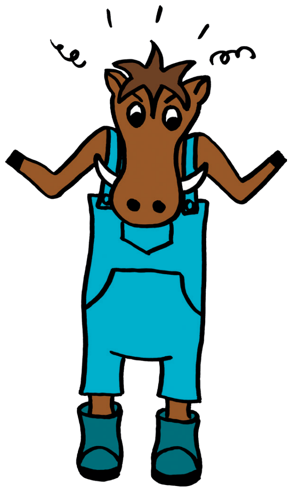
While they were running through the forest, picking flowers and climbing trees, they came to a river. The river was quite wide and they could not cross. Felicity suggested they turn around and go back. But Walt hates giving up and he felt he could solve this problem.

Phumlani was running from one tree to the next to see how fast he could do it, Felicity was inspecting a small pond where some tadpoles were swimming around, and Mothusi had sat down with her sketch book to draw a caterpillar crawling along a branch. Walt sat down next to the river to see if he could solve this problem of getting to the other side of the river.

QUESTIONS

Look at pages 82 and 83. How many cranes are there helping to build the city?

7 (seven)



There must be a way to solve this problem!

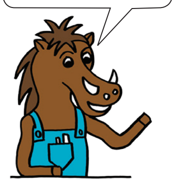
Walt remembered that in class that week, they had been looking at ways to strengthen materials, making them stronger to hold a heavier load. He remembered that folding and rolling paper into a tube made it stronger. He also thought about the struts used in frame structures to make them stronger, more rigid and stable.

The next day in class Walt asked his teacher if they could design a model of a bridge to cross the river near the school. The teacher thought this was an excellent idea and decided to set it up as a class competition: To design and make a model of a bridge to span 1m between two desks and then test whose bridge could hold the most weight.

Let's also take part in the competition in your class and help Walt come up with the best design for a bridge to cross the river.

Did you know?

A bibliography is the list of information sources that you used when investigating or researching. Remember to write a bibliography for your research.



Do you remember the technology process? We are going to follow these steps when designing the bridge:

1. Investigate
2. Design
3. Make
4. Evaluate
5. Communicate

Do you remember last term when you designed a shelter for birds? In that project on page 77, we only designed the shelter, made drawings, and then evaluated the design. Now, we are going to take this process further and actually make the bridge and then evaluate the products that we made!

If you do not want to do this design project of making a bridge, there are other options that also use struts to create a strong structure, such as designing a model of a tower, pylon or chair. This activity will use a bridge as an example.

ACTIVITY 9.2: Designing and making a bridge

INVESTIGATE:

The first step is to investigate and do some research around how to build a bridge. In earlier chapters we looked at ways to strengthen materials and create strong structures using struts. Remember this when you are investigating and designing your bridge!

You also now need to investigate ways of building bridges. You can use books and the internet. Write down some of your findings from your research in your exercise books.

DESIGN:

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

Teacher's Note

This project builds on the Design Process from Life and Living in Term 1. The learners are now required to go through the whole design process. as with the scientific method, the steps of the Design Process should not be enforced and learners should not be made to memorize the steps. Rather, TEACH them the necessity for each step and that they are not set in stone. For example, if you find your design is not working when you are actually making the product, you might go right back to the beginning and do some more investigating, and then come up with a modified or completely new design. It is a flexible process. This Design project can be done as individuals or as groups, preferable small groups of 3 or 4.

The aim is for learners to research different ways of building bridges, also drawing on the knowledge for this strand about ways to strengthen materials. They then have to come up with a design and make the structure in class. The aim is to make a bridge that can span a length of 1m between 2 desks. After all the bridges have been built, hold a competition to see whose bridge can hold the most weight before collapsing. Start off with coins and then small books, and then heavier books. You do not want to break a bridge with the first object that you place on it, otherwise this will destroy confidence in the children. So start off with light object and progress to heavier ones, in the same order for each bridge. When you do not think the bridge can hold any more weight, stop placing objects on it. Discuss as a class how it could have been made stronger. This will be used by the learners when they have to evaluate their designs and suggest possible ways of improving the design.

Your bridge has the following specifications and constraints:

- It must span a minimum length of 1m.
- It must be able to support a load (bags of coins or books).
- It must be built in class.

Answer these questions to formulate your design brief:

1. What do you need to design?
2. What will the size and shape of your bridge be? Remember that your bridge must span a gap of 1m between two desks.
3. What materials are you going to use to build your bridge? Make a list of all the materials you will need.
4. What tools are you going to need to make your bridge?
5. Are there any other specifications and constraints that you can think of for your bridge?

Did you know?
When making your bridge, you may come up with a better design! So, leave some space for a second drawing at the bottom.

Now you need to draw some designs for your bridge. Use scrap pieces of paper to do your first designs. Once you are happy with your design, draw your final design in your exercise books. Label your drawing showing the materials you are going to use for the different parts.

MAKE:

Now comes the fun part! You have to make your bridge according to your design sketch, and using the materials you identified. Do this in class.

Once you have all finished making your bridges, set them up between two desks that are 1m apart. Now, let's have some fun to test whose bridge can hold the most weight! We will only test one bridge at a time and use the same objects (bags of coins or books) to place on each bridge, adding one object at a time. This will ensure it is a fair test.

EVALUATE:

Answer the following question on the bridge that you have built after testing it:

Teacher's Note

If learners are battling, suggest some materials to use: drinking straws, toothpicks, Popsicle sticks, masking tape, thread, scissors, paperclips, straight pins, prestik, clay, paper or cardboard as well as rulers, weights and books for the testing phase.

Teacher's Note

A lot of facilitation is needed at this point. Only test one bridge at a time so that all learners see what the other have done and can learn from each other. You do not want to make hard work break! This might also be demoralizing for the learners who spent so much time making it. So perhaps place objects on until you think it will not take anymore.

1. Did your bridge work? How many objects did you place on it?
2. Did your bridge fulfill all the requirements in the specifications given to you?
3. If you ever had to build this bridge again, what would you do differently?

COMMUNICATE:

An important part of the technology process is to communicate what you found to others so they can learn from what you did.

Write a paragraph in your exercise books where you tell Walt about the bridge that you built, what worked and what did not work, so that he can also learn from what you did.

9.2 Indigenous structures

New words
- indigenous structures
- exotic
- traditional
- rural
- hut
- rontabile (rondawel)
- matjieshuis

When we say something is "indigenous" we mean that it occurs naturally in a place. Something that is not indigenous is exotic. We can say certain plants and animals are indigenous to South Africa, such as the lion, the elephant and the baobab tree.

We can also talk about indigenous people and indigenous knowledge. This is when we are talking about ideas and knowledge that a community of local people have developed over time, and that is specific to the area that they live in.

Now, we are going to talk about indigenous structures. This means structures for houses, which are built in South Africa by the people that live here.

Types of traditional homes

In South Africa we have a rich tradition of building homes from the materials available in our environment. Traditional homes have been built the same way for a long time.

Today these homes are mainly seen in rural areas. The building materials used are indigenous (grown locally) and the people collect the materials in their environment. Other cultures, such as the Inuit, also build traditional homes. Their indigenous material is blocks of ice.

In South Africa, we have the traditional homes of the Zulu hut (*uguqa*), the Xhosa *rontabile* and *ungqu-phantsi* and the Nama *matjiehuis*.

Types of traditional houses. The igloo is a traditional house to the Inuit.

ACTIVITY 9.3: Identifying materials used in traditional homes

INSTRUCTIONS:

1. In the above pictures of indigenous and traditional homes, each home has been constructed out of specific materials.
2. In your exercise books, copy and complete the table on page 160 for the materials used in each home. Then state whether it is a strut, beam or column.

Traditional homes	Materials used	Strut/beam/ column
Zulu hut		
Xhosa rontabile		
Nama matjieshuis		
Igloo		

3. Identify the shape of each of these traditional homes:

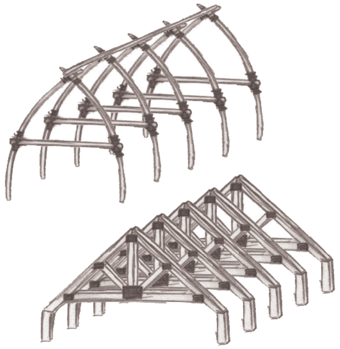
Traditional homes	Shape
Zulu hut	
Xhosa rontabile	
Nama matjieshuis	
Igloo	

4. The materials used in each hut has specific properties to make it suitable for its use. Copy the table below in your exercise books and list the materials for the huts again. Then select the appropriate property of the material in the given boxes (by ticking).

Traditional homes	Materials	Hard	Tough	Stiff	Flexible	Strength
Zulu hut						
Xhosa rontabile						
Nama matjieshuis						
Igloo						

Traditional and modern structures

Today we also have very modern homes. Sometimes the structures of modern homes are based on what was used to build traditional homes. Look at the two structures below. The first ones uses reeds and branches which are bent to make the framework for the house. This is a traditional structure.



Traditional and modern structures

In the second picture, you can see the roof trusses for a modern home. Can you see the similarities between the two? For example, the shape and how the structures are made stronger with struts. There are also some differences. In the traditional house, the reeds and branches are tied together with rope. But in the modern house, the roof trusses are strengthened with gussets.

Traditional hut [8]

Modern home [9]

ACTIVITY 9.4: Comparing modern and traditional structures and materials

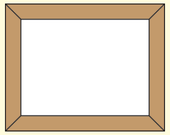
1. Work in pairs to study the frameworks and photos of the houses on page 161.
2. Discuss and compare the roofs of the traditional and modern house. Where are the differences? Are there similarities?
3. Discuss and compare the similarities and differences between traditional and modern structures and materials with your partner.
4. Discuss the advantages and disadvantages of the modern structure.
5. Discuss the advantages and disadvantages of a traditional structure.
6. In your exercise books, draw tables to show some points from your discussions:
   a. The similarities and differences in roofs
   b. The advantages and disadvantages of the modern structure
   c. The advantages and disadvantages of a traditional structure

KEY CONCEPTS

- Frame structures can be made stronger by using struts.
- A strut is a solid bar joined into a structure to make it more stable.
- Struts are used in roof trusses, bridges, cranes and pylons.
- Skeletons are frame structures made of a system of struts. The bones are the struts.
- An indigenous structure is a structure used in a traditional home.
- Indigenous materials come from living plants in the environment.
- Traditional homes of the Xhosa, Nama and Zulu make use of a framework of struts.

REVISION

1. Give four examples of structures that make use of struts to strengthen the framework.
2. Why do you think the human rib cage can be considered a frame structure?
3. Copy the frame below and draw a brace or braces onto the wooden frame to make it a much stronger structure.



4. Give three examples of traditional homes in South Africa.
5. What are some of the indigenous materials that traditional homes are made out of?

I enjoyed that!

REVISION

1. Bridge, pylon, crane, scaffolding, roof trusses
2. This is because it is a frame of ribs, which are like struts, and they protect the internal organs.
3. Either 4 small corner brace, or 1 or 2 cross-braces from corner to corner.
4. Zulu hut, Xhosa rontabile and ungqu-phantsi and Nama matjiehuis.
5. Reeds, branches, straw, rope

Energy and change

and systems and control

10 Energy and energy transfer

KEY QUESTIONS

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

10.1 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 10.1: Energy is the ability to do work

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.

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.

NatSci&Tech_Gr4_TG_Book.indb 163 2018/05/17 11:38:07 AM

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 seeker's 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 Thandi!" (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 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 in your exercise books.

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.

We saw that we got tired from running and playing a game in Activity 10.1. We use energy for everything we do.

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

Did you know?
The word energy comes from the Greek word *energeia*. Energy is the ability to do work.

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

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?

NatSci&Tech_Gr4_TG_Book.indd 164 2018/05/17 11:38:07 AM

ACTIVITY 10.2: Energy is all around us

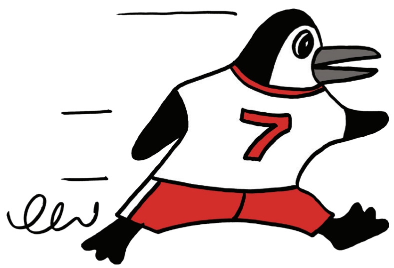
INSTRUCTIONS:

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 every day.
2. Write down five things that you have thought about that you could not do without 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 seven life processes that are carried out by all living organisms.



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.

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.

QUESTIONS

Write down the seven life processes that are carried out by all living organisms.

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

NatSci&Tech_Gr4_TG_Book.indb 165 2018/05/17 11:38:07 AM

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]

10.2 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 10.3: Word search

INSTRUCTIONS:

1. Complete the word search by finding the words listed below. Your teacher will give a copy of the word search. Do not write in the textbook.
2. Circle them with a coloured pen or pencil.
3. Once you have found all the words, discuss with your partner what the words mean to you.

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	H	B	T	Z	L	Q	K	N
H	E	X	A	W	N	H	E	E	D	B	T
E	Q	I	C	T	R	A	N	S	F	E	R
A	N	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

New words

- solar energy
- energy chain or food chain
- reflect
- transfer
- fossil fuels

Words to find:

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

Chapter 10: Energy and energy transfer 169

INSTRUCTIONS:

1. Complete the word search by finding the words listed below. Your teacher will give a copy of the word search. Do not write in the textbook.
2. Circle them with a coloured pen or pencil.
3. Once you have found all the words, discuss with your partner what the words mean to you.

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	H	B	T	Z	L	Q	K	N
H	E	X	A	W	N	H	E	E	D	B	T
E	Q	I	C	T	R	A	N	S	F	E	R
A	N	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

Words to find:

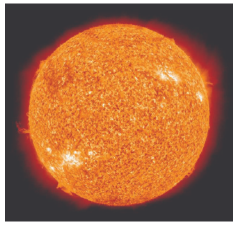
food, work, movement, sun, energy, change, light, heat, absorb, reflect, transfer, chain

Answers:

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	H	B	T	Z	L	Q	K	N
H	E	X	A	W	N	H	E	E	D	B	T
E	Q	I	C	T	R	A	N	S	F	E	R
A	N	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

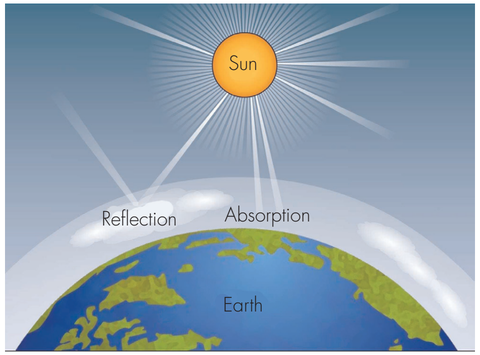
Solar energy

We get almost all of our energy on Earth from the sun. We call this energy solar energy. *Sol* means sun. Next term we will learn a lot more about the sun!



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 the Earth.

QUESTIONS

Use your dictionary to write down definitions for:

1. reflect
2. absorb

ACTIVITY 10.4: 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:

- Four thermometers
- Black paper and white paper

INSTRUCTIONS:

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 ten minutes?
5. Wait for ten minutes. Then copy the table below in your exercise books and write down the temperature reading on each thermometer.

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

QUESTIONS

Use your dictionary to write down definitions for:

1. reflect
2. absorb

1. To bounce back from a surface eg light is reflected back from a shiny surface
2. To take something in eg a sponge absorbs water, the earth absorbs heat

6. Which thermometer had the lowest temperature?
7. a. Which of the two thermometers, black or white had the highest temperature after 10 minutes?
   b. Explain your answer in a. above.

Uses of solar energy

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 use heat from the sun to dry clothes and generate electricity.

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 Grades 5 and 6!

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

172 Energy and change and systems and control

INSTRUCTIONS:

6. The thermometer in the shade.
7. a. The thermometer with the black paper covering.
   b. 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.

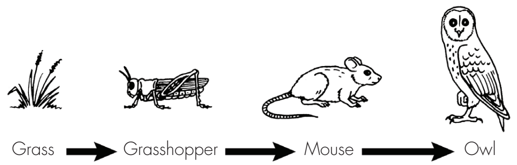
Animals eat plants to grow
The energy stored in the plants is used by the animals for life processes.

These cows are eating grass to get their energy.

Transfer of energy

The transfer of energy from the sun to plants, to animals, 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

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.

Teacher's Note

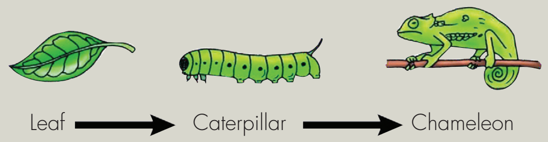
Before reading or going through the next paragraph, or when you are explaining this concept to learners, first ask the question "What sort of energy does the Sun give off?" The answer is light and heat energy. You can then go on to explain how the light energy given off the Sun is used by the grass to 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.

ACTIVITY 10.5: Describing the transfer of energy from the sun

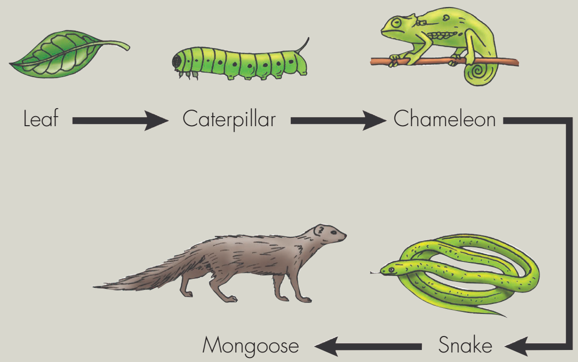
INSTRUCTIONS:

Look at the following food chain.

1. In your exercise books, describe the transfer of energy from one organism to the next.



2. 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.



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

174 Energy and change and systems and control

INSTRUCTIONS:

1. 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. The snake.

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.

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

Did you know?

Some people have solar panels on their roofs which traps and stores the sun's energy directly. It can then be used to light up their houses and heat water.

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

- Solar energy is the energy from the sun.
- 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?
2. Explain how animals get energy for 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.
4. List three fossil fuels.
5. Where do fossil fuels come from?
6. a. Show an energy chain of the following organisms: Snake, Mouse, Plants, and Eagle.
   b. Explain in details how energy is transferred from one organism to another.

I never knew that all our energy comes from the sun. That is really interesting!

Let's now move on and find out about the different types of energy all around us!

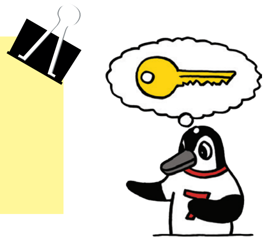
REVISION

1. It is energy from the Sun.
2. 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. sun → grass and shrubs (plants) → impala → lion
4. Some fossil fuels are coal, natural gas, oil.
5. 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. a. Plants → Mouse → Snake → Eagle
   b. Plants get energy from the sun to grow and absorb nutrients from the soil. When the mouse eats the plants, the mouse's body absorbs energy and nutrients from the plant. That enables the mouse to run around and do things. When the snake gets hungry, the snake catches and eats the mouse. The energy and nutrients in the mouse's body gets transfered to the snake and the snake can slither around. When the eagle catches the snake, the nutrients and energy that the snake's body has stored gets absorbed by the eagle's body.

11 Energy around us

KEY QUESTIONS

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

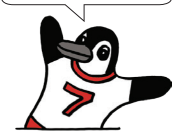


11.1 Forms of energy

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

New words
- ultraviolet rays
- infrared rays
- thermal energy
- vibrate

Let's find out how energy can be all around us!



ACTIVITY 11.1: Identifying energy all around us

INSTRUCTIONS:

1. Look at the picture on the next page.

1.1 Identify all places where energy is being used.

177

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:

1.1 Virtually everywhere in picture

QUESTION:

1.2 Write down five of the activities that you identified.

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.

QUESTION:

1.2 Airplane flying, candle that burns, fire in fireplace that causes smoke to come out of the chimney, warm water for shower, hair dryer, kite, people bustling around, electric devices that work (including street lights, traffic lights and the cell phone), vehicles that are running (car, motorcycle, bicycle), sausage barbecue, person carrying boxes.

Living things need light energy from the sun to survive.

Did you know?
The moon may seem like a source of light, but it does not provide light like the sun. It only reflects the light from the sun to us.

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 11.2: 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
- Torch

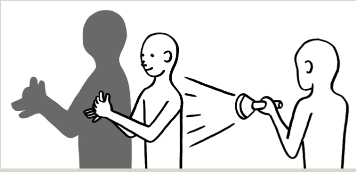
INSTRUCTIONS:

1. Work in pairs and find some objects around the classroom.

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.

2. Once you all have some objects, ask your teacher to turn the lights off and close the curtains in your classroom.
3. Stand with your partner near a wall.
4. 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.
5. Your partner must guess which object it is from the shadow. Do not peak at the actual object!
6. 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?
2. How can you make the shape of the shadow smaller?

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.

QUESTIONS:

1. Hold hands/object closer to the light source.
2. Hold hands/object further away from the light source.

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 11.3: Sources of heat energy

INSTRUCTIONS:

1. Look at the photos of some sources of heat energy below.
2. Can you recognise the source of heat energy in each photo?
3. Copy the table below in your exercise books and 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 and draw a picture.

INSTRUCTIONS:

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

Candle	Wood fire	Sun
		

ACTIVITY 11.4: Extend your thinking

INSTRUCTIONS:

1. Look at the photo of the boy below.
2. Answer the questions below.

QUESTIONS:

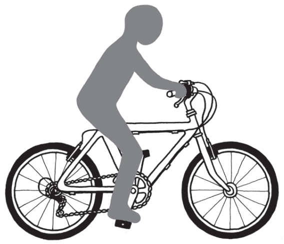
1. How does the blanket help him to stay warm?
2. Do you think a blanket should be included in the table in Activity 11.3 showing the sources of heat energy? In your exercise books, copy and complete the sentence below, writing down the option you want. Then write an explanation for your choice:
   a. *Yes I think it* ***IS*** *a source of heat energy because ...*
   b. *No, I think it is* ***NOT*** *a source of heat energy because ...*

Movement

When objects are moving they have movement energy. The faster the object is moving the more movement energy it has. Look at the examples of movement on page 183.

QUESTIONS:

1. It stops the heat from his body leaving.
2. 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.



While you are riding your bicycle, you have movement energy.

A race car that is travelling has lots of movement energy.

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

When I am dancing I have movement energy!

QUESTIONS

Look at the first two pages for Energy and Change on pages 164 and 165.

1. Identify the two Quantum Club members who have movement energy – who are they?
2. Why do they have Movement energy?

QUESTIONS

Look at the first two pages for Energy and Change on pages 164 and 165.

1. Identify the two Quantum Club members who have movement energy – who are they?
2. Why do they have Movement energy??

1. Phumlani and Mothusi
2. They have movement energy as they are dancing to the music.

Sound energy

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

ACTIVITY 11.5: 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 the vibration of substances.

QUESTIONS

Use your dictionary to write down a definition for "vibration".

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 11.6: Use a ruler to make sound

MATERIALS:

- Ruler
- The edge of a desk

INSTRUCTIONS:

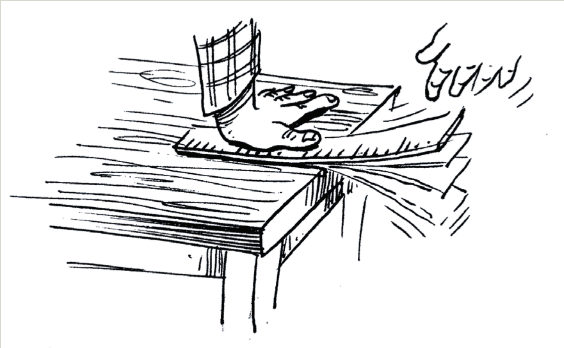
1. Put the ruler on the desk so that it sticks out over the edge.
2. Push the ruler down.

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.

3. Pluck the ruler and hear the sound.



QUESTION:

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

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 that 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 which 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.

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!

Energy is stored in food.

Burning coal releases the stored energy as heat.

Natural gas releases stored energy when it burns.

When the cars' ignition turns on, 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.

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 at least five examples of objects that need electricity to work.

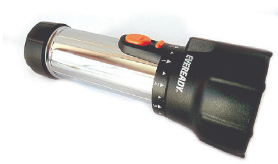
QUESTIONS

Write at least five examples of objects that need electricity to work.

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

Look at this photo 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.



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

Did you know?

Fireflies produce light using chemical energy from their food! The light they give off is actually more efficient than that of a light bulb.

Have you ever used a torch before? How do you think the bulb lights up in the torch? The battery is the source of energy in the torch. When the torch is turned on, the energy is transferred from the battery 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 battery of the torch as being the input energy, and the light energy that is given off by the bulb as the output energy.

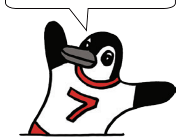
11.2 Input and output energy

Examples of input/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.

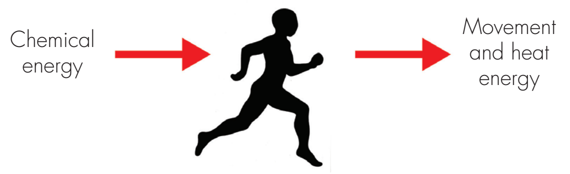
New words

- input energy
- output energy
- transferred



Let's look at some examples.

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

Chemical energy →  → Movement and heat energy

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 energy 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 11.7: Investigating input/output energy of appliances

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 photo 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!

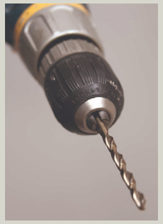
Appliance	Output energy transferred to surroundings	Appliance	Output energy transferred to surroundings
 *Stove*		 *Vacuum cleaner*	
 *Kettle*[1]		 *Electric fan*[2]	

Teacher's Note

After going through Activity 11.7 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.

Appliance	Output energy transferred to surroundings	Appliance	Output energy transferred to surroundings
 *Stove*	Heat energy	 *Vacuum cleaner*	Sound and movement (air) energy

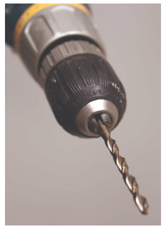
Appliance	Output energy transferred to surroundings	Appliance	Output energy transferred to surroundings
 *Lamp*		 *Drill*[3]	
 *Hairdryer*			

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

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

KEY CONCEPTS

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

Appliance	Output energy transferred to surroundings	Appliance	Output energy transferred to surroundings
 *Kettle*[1]	Heat energy (and movement energy of the water)	 *Electric fan*[2]	Movement energy and sound energy
 *Lamp*	Heat and light energy	 *Drill*[3]	Movement and sound energy, and heat energy (the motor and drill bit gets hot)
 *Hairdryer*	Heat and sound and movement energy		

REVISION

1. Copy the table below and fill in examples of different sources of energy.

Light energy source	Heat energy source	Sound energy source	Stored energy source
			food

2. Which sense organ do you use to detect sound?
3. A hearing-impaired person cannot hear music. How do you think someone who is hearing impaired could still dance to the music?
4. Which sense organ do you use to detect light?
5. For each of the following appliances, decide what is the input energy and identify the output energy.

Appliance	Input energy	Output energy
Radio		
Hairdryer		
Car moving		
Riding a bicycle		
Playing drums		
Lights in your home		

6. What does "energy is transferred" mean?
7. List three substances that contain stored energy that we can use.

REVISION

1.

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. You use your ears.
3. They can feel the vibrations through their feet or hands. They can feel the music.
4. You use your eyes.
5.

Appliance	Input energy	Output energy
Radio	chemical or electrical	sound
Hairdryer	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. Energy is changed from one form to another.
7. Three substances could be food, wood, oil, petrol, coal.

NatSci&Tech_Gr4_TG_Book.indb 188 2018/05/17 11:38:12 AM

12 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?

12.1 Movement and musical instruments

New words
- sound wave
- amplified

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. [1]

Let's make some music!

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.

ACTIVITY 12.1: The joy of sound – making a body band

INSTRUCTIONS:

1. Work in groups to make music with your body.
2. 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 (one 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!

12.2 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.[2]

Visit
Zulu drums.
goo.gl/WK7sM

A drum has a thin membrane or skin, which 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.[3]

The trumpet player blows through closed lips into the trumpet. This makes a buzzing sound that 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 waves.

12.3 Indigenous musical instruments in South Africa

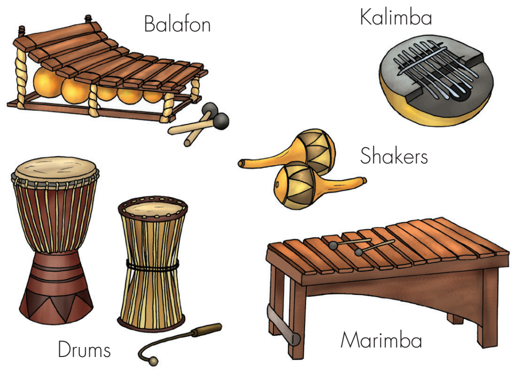
Music and musical instruments are very important in many cultures and societies. Different cultures have different musical instruments, which are part of their traditions. The instruments which were developed by a group of people and are used in a particular area, are called indigenous instruments. Indigenous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

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

Visit
Harpist playing (video).
goo.gl/ZTwug

Examples of musical instruments

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



QUESTIONS

Look at the front cover for Energy and Change on pages 164 and 165. One of the Quantum Club is playing an instrument on the beach! Who is playing it and what instrument is it?

QUESTIONS

Look at the front cover for Energy and Change on pages 164 and 165. One of the Quantum Club is playing an instrument on the beach! Who is playing it and what instrument is it?

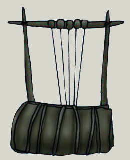
Mothusi is playing a shaker.
Walt plays a saxophone.
Felicity plays drums.
Phumlani plays guitar.

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 12.2: Comparing instruments from different cultures

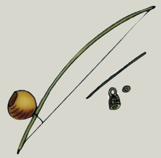
INSTRUCTIONS:

1. Study the examples of musical instruments shown in the table below.
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*

Teacher's Note

The idea of Activity 12.2 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 Activity 12.2.

Western culture	African culture
 *Violin*	 *Traditional music bow*

QUESTIONS:

Copy the table below in your exercise books and compare the instruments by completing it.

Instrument	How it is played?	What is it made from?
Flute		
Kwela flute		
French horn		
Kudu horn		
Harp		
Krar		
Violin		
Traditional musical bow		

QUESTIONS

Remember when we spoke about input and output energy in Chapter 11? What do you think is the input energy and output energy for most musical instruments?

QUESTIONS:

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 in Chapter 11? 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 12.3: Design and make your own musical instrument

The Quantum Club 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 handmade.

The Quantum Club want a variety of different instruments. Felicity can play the flute so she would like an instrument which she can play by blowing, like a whistle or pan pipes. Walt likes to play his electric guitar, but he can't use this as the instruments need to be traditional and handmade. So Walt needs an instrument which he can play by plucking strings. Phumlani loves playing the drums and Mothusi likes to dance with a shaker!

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

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 Quantum Club 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).

The problem is, none of the Quantum Club 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 Quantum Club. Write a design brief where you say who you are going to help, and what type of instrument you are going to make.

Assessment tool for design brief

Criteria: The learner is able to:	Maximum marks
Write a design brief	3
Draw and label a suitable design	5
List suitable tools, equipment and material	2
List logical steps for making	2
Make a model accurately, neatly and safely	6
List improvements	2
TOTAL	**20**

INVESTIGATE:

The next step in the technology process is to investigate. 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, 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?

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.)

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 these 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 this constraint: 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, draw your design in your exercise books. 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 more to 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!

EVALUATE:

Answer these questions on your musical instrument. Do it after you have finished making it and testing to see if it can be played.

1. Does your musical instrument look like your initial design?
2. How do you play your instrument?

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.

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 Quantum Club design and make musical instruments for their local Arts Festival!

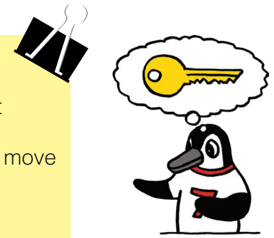
Write a paragraph in your exercise books where you tell who you decided to help about the musical instrument that you made.

Tell them what worked and what did not work. This is so they can also learn from what you did, and make a great instrument to play in their band!

Wow, thank you for helping us out with our band! We could not have done it without you!

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.



Assessment tool for design brief (page 196)

Criteria: The learner is able to:	**Maximum marks**	**Allocate marks as follows**
Write a design brief	3	Allocate two ✓✓ marks for 2 facts listed and one ✓ mark if written as a full sentence.
Draw and label a suitable design	5	Allocate marks for: • The name of the object looks like the musical instrument ✓ • Parts are labelled and identifiable ✓✓ • Measurements are suitable ✓ • Material and joints are appropriate ✓
List suitable tools, equipment and material	2	A maximum of two marks for correct selection of tools, ✓ equipment and material. ✓
List logical steps for making	2	Maximum of two marks for a minimum of four logical steps ✓✓
Make a model accurately, neatly and safely	6	Allocate marks for: • Model looks like the musical instrument ✓✓ • Measurements are appro-priate ✓ • Model stands on its own ✓ • Neatness ✓✓
List improvements.	2	Maximum of two marks for any two improvements ✓✓
TOTAL	**20**	

REVISION

1. What do most musical instruments have in common that allow them to make music?
2. Sound is caused by vibrations. What is a vibration?
3. a. How do you make sound on a guitar?
   b. How does the shape of the guitar help to make the sound louder?
4. What does the word “indigenous” mean?
5. What is your favourite musical instrument?
   a. Explain how it looks.
   b. How would you play it?
   c. Why do you like it so much?

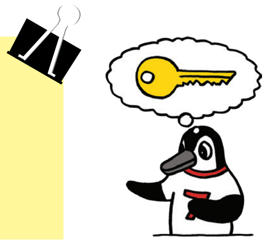
REVISION

1. A moving part that causes vibrations.
2. A vibration is a very quick movement (to-and-fro) of an object or its parts in the same place.
3. a. You make sound by plucking the strings.
   b. The sound is amplified (made louder) by the air vibrating in the hollow inside of the guitar.
4. Originating and characteristic of a particular place or people.

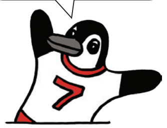
13 Energy and sound

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?



New words
- vocal chords
- medium
- vacuum
- acoustics
- eardrum
- air particle



13.1 Vibrations and sound

We have seen that musical instruments make sounds through vibrations. In Chapter 12 you learned that if you pluck the strings on some instruments the strings vibrate and make sound.

We can hear and feel vibrations

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

ACTIVITY 13.1: Observing vibrations

MATERIALS:

- Deep glass dish or bowl
- Cling film
- Rice grains (or any other small, dry particles)

INSTRUCTIONS:

Part A:

1. Cover the bowl with the cling film. Make sure it is tightly covered, but not too tight to start tearing.

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.

2. Put the rice grains between the middle and the edge of the cling film.
3. Tap the cling film lightly. Do this away from where you put the rice grains.
4. Now tap it harder. Do you see that your rice grains are moving or jumping up and down?

Set up for sound experiment

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

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. Sound must make the rice jump, not your breath.

QUESTIONS:

1. What happens to the rice grains when you tap the cling film?
2. When you hum, the cling film vibrates. Explain why there is a vibration.

QUESTIONS:

1. The rice jumps when the cling film moves.
2. 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!

Did you know?
The scientific study of sound is known as acoustics.

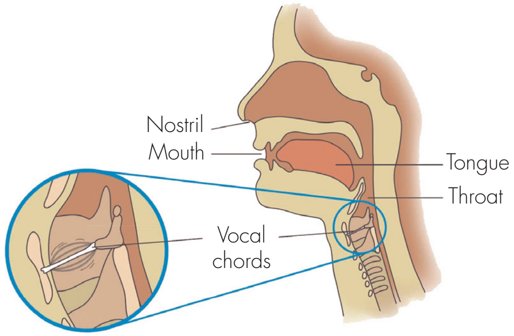
ACTIVITY 13.2: How do we make sound when we talk or sing?

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?

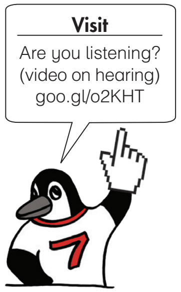
The human voice and hearing

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, shout or sing.



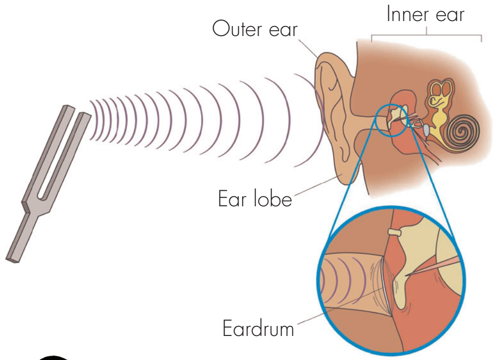
Can you see the vocal chords that vibrate to make a sound when we talk or sing?

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 diagram on page 205. The vocal chords are almost like the layer of cling film over the bowl in Activity 13.1 that vibrates.



So we make sounds when our vocal chords vibrate, but how do we *hear* sounds? In your ears you have eardrums. Eardrums help us to hear the sound. Your eardrums act like the cling film. They 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 that 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!

That's right Phumlani, 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 13.3: How does sound travel through air?

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 each end 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.

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.

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 13.4: Making a telephone

MATERIALS:

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

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.

INSTRUCTIONS:

1. Work in pairs. Ask your teacher to make a small hole at the bottom of each of the tins.
2. 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 in 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. Take turns speaking into the tin and listening to your friend speak to you.

QUESTION:

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

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

ACTIVITY 13.5: Secret code through a wall

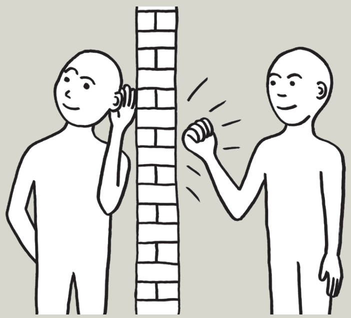
INSTRUCTIONS:

1. Work in pairs and make up a secret tap code: Maybe three quick taps means "hello". You can make up words using taps.
2. Sit on opposite sides of a wall with your partner.

Teacher's Note

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.

3. Put your ears to the wall and talk with your tap code through the wall.
4. 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 summarise 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.

Did you know?
After an earthquake people may be trapped under broken buildings. Survivors are sometimes found days after an earthquake. They make tapping noises against the walls which are then heard with sensitive equipment.

QUESTIONS

1. Why does sound travel well through solids?
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.

QUESTIONS

1. Why does sound travel well through solids?
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.

1. 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. 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.

NatSci&Tech_Gr4_TG_Book.indb 206 2018/05/17 11:38:16 AM

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?!

QUESTIONS

Can sound travel from the moon to Earth? Why?

New words
- volume
- pitch
- echo
- megaphone

Making sounds

Sometimes you need to speak softly when you whisper a secret to a friend. 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 13.6: Let's make sounds with an elastic band

MATERIALS:

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

INSTRUCTIONS:

1. Work in pairs and cut your elastic band in one place to make one long elastic strip.
2. One partner must hold the elastic at both ends.
3. The other partner plucks the elastic to make it move.
4. Try to make loud and soft sounds with your elastic.
5. 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.)

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.

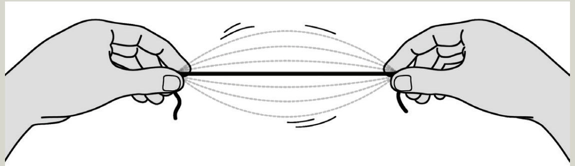
QUESTIONS

Can sound travel from the moon to Earth? Why?

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

Teacher's Note

Activity 13.6 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.



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.

In Activity 13.6 we have seen that movement causes vibration, which 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 are 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 are further apart, the sound has a higher pitch. Did you see the elastic move faster?

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

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.

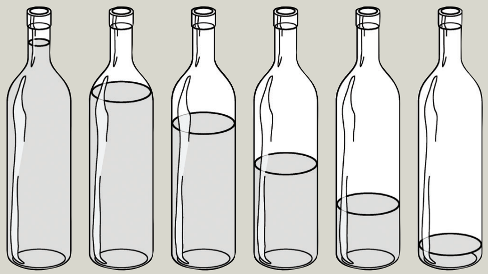
ACTIVITY 13.7: Making a water marimba

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 below.
4. Arrange the bottles from the fullest to the emptiest, like in the picture below.



Water marimba

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.

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.

212 Energy and change and systems and control

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.

QUESTIONS:

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

What did we learn from our water marimba?

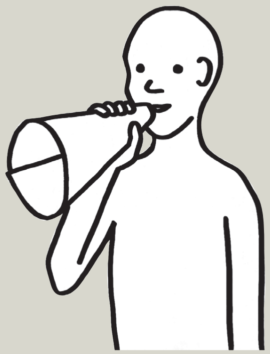
- The height of water in the bottle changes the pitch of the sound made.
- When you tap a bottle gently or hard, you change the volume of the sound.

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 13.8: Making a megaphone

MATERIALS:

- Thin cardboard or stiff paper
- Sticky tape
- Pair of scissors



Speak into your megaphone like this.

INSTRUCTIONS:

1. Roll the card or paper into a funnel shape. There must be a hole at the narrow end (about 5 cm 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.

Teacher's Note

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

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 in loudness if you speak normally or into the megaphone.

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

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 13.9: Making sound louder with a box

MATERIALS:

- Cardboard shoebox or plastic box (margarine tub or lunch box will work well)
- Elastic (rubber) band

INSTRUCTIONS:

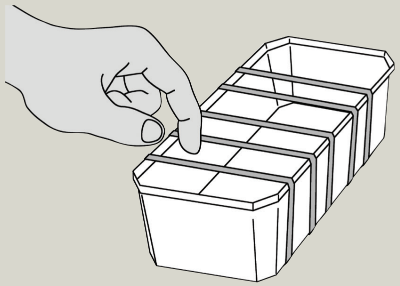
1. Stretch the elastic between your hands and ask a friend to pluck it.
2. Now pull the elastic band over the box. The elastic must be tight. If it is not tight use a smaller elastic or a bigger box.
3. Pluck the elastic.
4. Feel the sides of the box as the elastic vibrates. Can you feel that the box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

QUESTIONS:

1. 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. The funnel makes your voice seem louder.

Teacher's Note

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



The box makes the sounds louder.

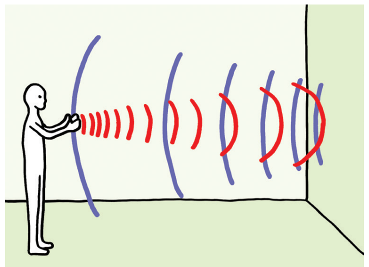
Did you know?

Dogs can hear very high sounds. These sounds are too high for us to hear. Elephants can hear sounds that are too low for us to hear.

Let's summarise 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 again. 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?

13.2 Noise pollution

There are many kinds of pollution. Sadly we all know about litter lying in the streets and rubbish in our rivers and dams. This is ground and water pollution.

New words
- pollution
- compromise
- hearing-impaired

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 smoky? This is called smog.

There are other types of pollution too, 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.

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.

ACTIVITY 13.10: 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.
2. Look at the picture of a very noisy environment below. Identify all the sources of noise pollution.

A very noisy environment!

3. List some sounds that are sometimes not noisy, but can be noisy at other times.
4. Are there any noises at school that distract (disrupt or disturb) you during class? This is also noise pollution.
5. Think of some ways you could minimise the noise pollution in your class.

QUESTIONS:

1. 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. Noise from the ambulance, the jackhammer on the road, the helicopter in the sky, the hooter from the blue car, the music blasting from the stereos in the furniture shop.
3. Music from other cars/neighbours, children playing, sports games, car driving, barking dog.
4. 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 of lesson time (ie. in the afternoon).

ACTIVITY 13.11: Role play about noise pollution

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 where both of you are happy? This is called 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.

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.

NatSci&Tech_Gr4_TG_Book.indb 215 2018/05/17 11:38:17 AM

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 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 use hearing aids to help them hear better.

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.

Visit

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

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?

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?
2. You built a “telephone” with a string joining two tins. Explain how your telephone works.
3. If a sound is made on the moon, it cannot be heard even on the moon. Explain why.

QUESTIONS

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

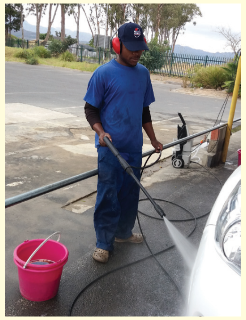
This protects the race horse from noise pollution from the crowd and stadium so that it does not get distracted when racing.

REVISION

1. communication, entertainment
2. 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. 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?
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.
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?
7. What makes some sounds pleasant, while other sounds are unpleasant?
8. List three jobs where there is loud noise.
9. The people doing these jobs, are in danger of damaging their hearing. Give them some advice on how to protect their ears.
10. Why is the man in the picture below wearing ear muffs over his ears?

A doctor using a stethoscope.



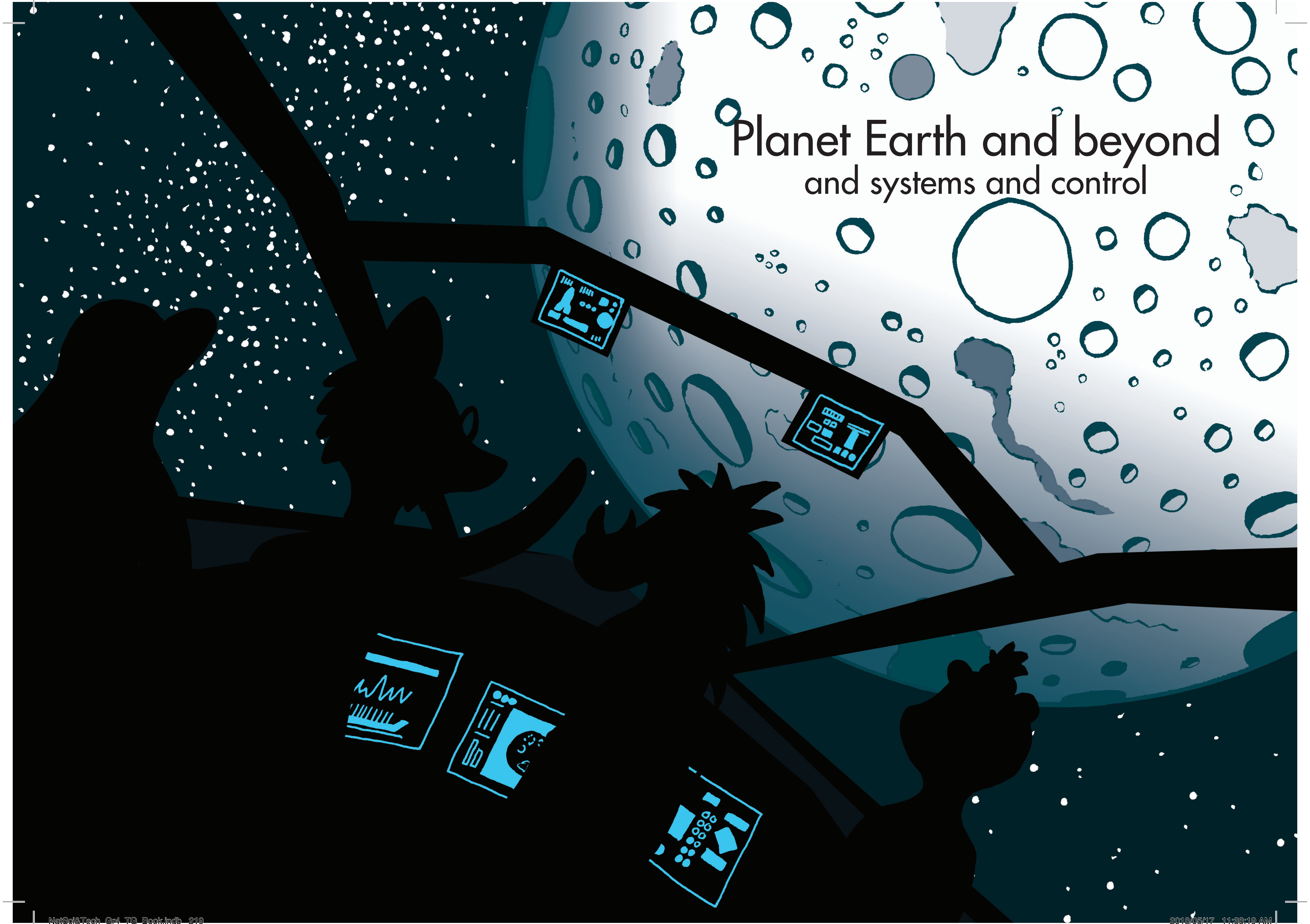
A man wearing ear muffs.

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

4. Close together as the sound can travel far.
5. 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. Vibrations increase in size.
7. Pitch, volume and personal preference.
8. Jackhammer operator, ground crew for an aeroplane, working in a steel mill, anything sensible.
9. Wear earplugs.
10. 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. It damages your ears and affects your hearing forever.

NatSci&Tech_Gr4_TG_Book.indb 218 2018/05/17 11:38:18 AM

Planet Earth and beyond
and systems and control



14 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?

14.1 Features of the Earth

New words
- feature
- erode
- atmosphere
- surface
- ocean
- continent
- island

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 photos showing the different features of Earth's surface.

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.

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.

NatSci&Tech_Gr4_TG_Book.indb 220 2018/05/17 11:38:19 AM

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]

Did you know?

The longest river in the world is the Nile River. It is 6 650 km long.

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 14.1: Habitats on Earth

INSTRUCTIONS:

1. Look at the photos on page 225 again that show different features of the Earth's surface.
2. Answer the questions below.

QUESTIONS:

1. Name some of the living things you can find on Earth.
2. In the photos, where do the birds live?
3. In the photos, where do fish live?
4. Where can cattle live?
5. What kind of animals can live in deserts? A desert is a place with almost no water.
6. What kinds of animals live in forests?
7. A habitat is a place where animals can find food, water, shelter and have their babies. Habitats have unique features. For example, the rocky shore habitat has crashing waves and big rocks. Name four habitats that you have seen in the photos.
8. Name four non-living things you can see in the photos.

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 that make up the mountains and hills. Or the water that makes up the rivers, seas and lakes.

QUESTIONS

Is there air high up in the sky? Give a reason for your answer. Are clouds all equally high?

QUESTIONS:

1. 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 of living things here, because you will have to teach how the sun provides light and warmth for them.
2. In the trees, on the beach and river-banks, some float on the water and dive for fish.
3. In the river and in the sea.
4. Along the banks of the river, on the grasslands.
5. Snakes, bats, meerkats, jackals are examples.
6. Buffaloes, elephants, bushpigs, monkeys, are examples.
7. Rivers, seas, grasslands, forests, mountains.
8. 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.

QUESTIONS

Is there air high up in the sky? Give a reason for your answer. Are clouds all equally high?

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. Some clouds 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 nearer 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 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 14.2: What do things look like from above?

MATERIALS:

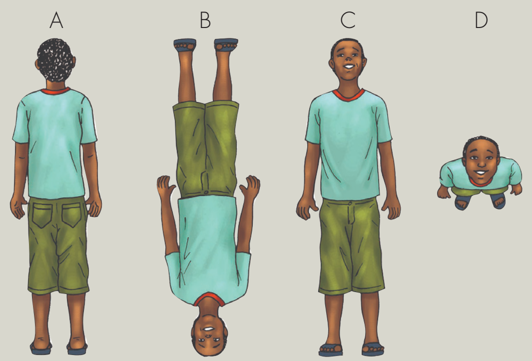
- Pencil
- Coloured pencils
- Rubber

INSTRUCTIONS:

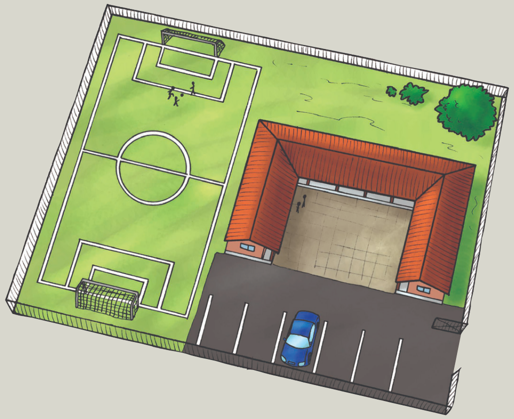
1. Let's look at what a bird sees when he flies over a boy. Can you see the bird flying over the boy in the picture?
2. Answer the questions that follow.

QUESTIONS:

1. When the bird looks down, what does it see? Choose the right picture.



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 in your exercise books. 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.
3. The next picture shows you a school as it looks from a bird's eye view.



The school as seen by a bird.

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.

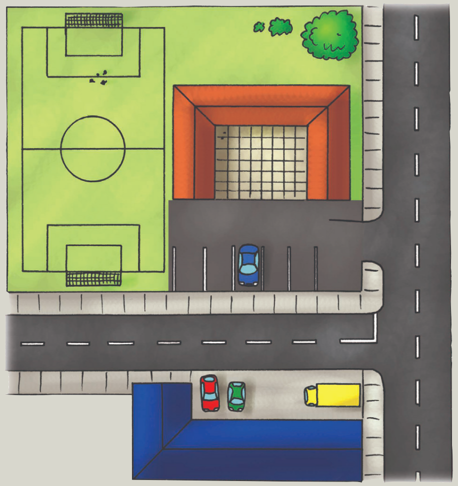
Teacher's Note

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.

Find these objects in the picture:

a. Gate
b. Roof of the school
c. Soccer field
d. 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 as seen by people in a low-flying aeroplane.

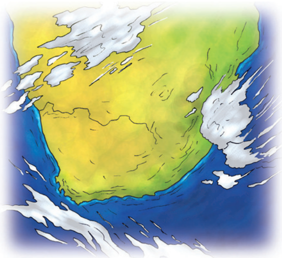
5. Find the soccer field now. Why is the soccer field much smaller than in the picture where the bird is flying over the school?
6. Find the shop. It is across the road from the school. What do you see outside the shop?
7. The aeroplane now flies higher up into the sky. You can now see what the town looks like to people in the aeroplane. Find the river, a road and a farm.

QUESTIONS:

5. We are much higher now, so things look smaller.
6. Answer is cars. The learners have to make an inference that the other building is a shop.
7. The learners must make an inference that it is a river, road, farm. It is not labelled. Making inferences from pictures and text is a process skill.

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

What we have seen in this activity is that as you go higher and higher up, the objects appear smaller and smaller. So, when photos 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 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 14.3: Looking at Earth from space

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

Planet Earth. This is how the Earth looks from a spacecraft in space.

QUESTIONS:

1. What shape is the Earth?
2. Find Africa in the photo. Point to it with your finger.
3. What are the blue parts of the photo?
4. What are the white things in the photo?
5. Where is Earth's air (atmosphere), in the photo?
6. Is there more sea or more dry land on the surface of the Earth? Look at the photo and work out your answer.

Continents and islands

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

The Earth has seven continents:

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

Visit

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

QUESTIONS:

1. It is round like a ball. Ask them what else they have seen in the sky, that looks round. (Answer is the Moon)
3. The oceans, also called the seas.
4. Clouds
5. 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. There is more sea than land on the surface of the Earth.

QUESTION

Which continent do we live on?

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.

ACTIVITY 14.4: Finding the continents on a globe

MATERIALS:

- Globe (or world map)

INSTRUCTIONS:

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

QUESTIONS

Which continent do we live on?

Africa

Teacher's Note

For Activity 14.4, 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.

Teacher's Note

The class just needs one globe.

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 this flat map.

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

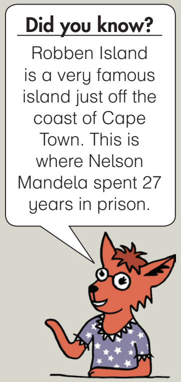
ACTIVITY 14.5: Islands

MATERIALS:

- Atlas, globe or map
- Information on an island of your choice
- Pictures of this island
- Colour pencils
- Scissors

INSTRUCTIONS:

1. 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 or why not?
g. Why is this island important?
h. Why is it an island and not a continent?

4. Make an information brochure about the island in your exercise books.

QUESTIONS

What is the difference between a continent and an island?

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 14.6: Finding the oceans and seas

MATERIALS:

- Globe or world map

INSTRUCTIONS:

1. Find these oceans:
   a. Indian Ocean
   b. Atlantic Ocean
   c. Pacific Ocean
2. Is there more dry land or more water on the surface of the Earth?
3. Find these seas near Africa on the map:
   a. Mediterranean Sea
   b. Red Sea

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

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.

INSTRUCTIONS:

2. There is much more water than dry land.

Did you know?
71% of Earth's surface is covered in water.

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.

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.

Did you know?
The Mariana Trench is the deepest point in the world's oceans. It is in the Pacific Ocean.

14.2 The Earth in space

The Earth is a planet in space. From 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. It is a vacuum.

I have lots of big questions about space. You probably do too!

New words
- sphere
- astronomy
- gravity

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 www.nasa.gov and the website aimed at kids, where there are fun games and activities is www.nasa.gov/kidsclub.

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

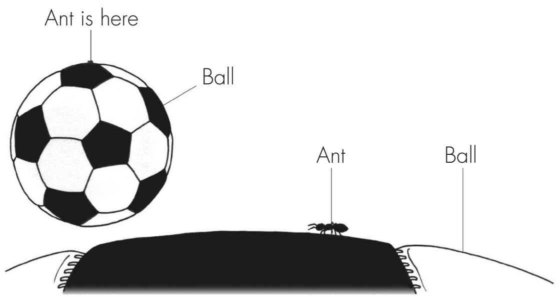
The Earth is shaped like a ball

Did you know?
The study of space has a special name called astronomy.

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. An astronaut in space can see the shape of Earth when looking out the window of the spaceship.

But if we look out of the classroom window, the Earth looks flat, not ball-shaped. Long ago people 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 surface 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.



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

Visit
A fun site about astronomy
goo.gl/NQZdF

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 photos of the earth taken from space!

Teacher's Note

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

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 it is a ball?

ACTIVITY 14.7: Which way is up and down on Earth?

MATERIALS:

- Classroom globe (photos or a ball)
- Pencil
- Rubber

INSTRUCTIONS:

1. Read this paragraph and answer the questions.

When a pencil falls off your table, it falls because the Earth pulls the pencil 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 on page 238 shows you how gravity pulls on things and keeps them from floating away.

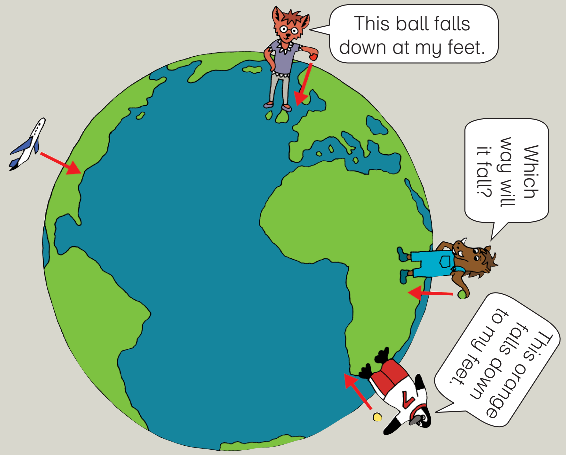
QUESTIONS

Why don't we fall down off the Earth, if it 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.

Teacher's Note

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



Phumlani, Felicity and Walt are all standing straight up on the Earth.

2. Look at the globe again. Find South Africa and the United Kingdom (UK) on the globe.
3. Now look at the picture; it shows Phumlani standing in South Africa; when he drops the orange it falls towards his feet and he says that direction is the downwards direction.
4. Now look at Felicity in the UK. When she drops a ball, 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:

Find the Democratic Republic of the Congo on the globe in Africa. Then look at the picture above. Walt is standing in the Congo. Which direction will the ball fall from Walt's hand?

QUESTION:

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 that pulls objects onto the Earth called gravity. We are pulled towards the centre of the Earth because of gravity.

KEY CONCEPTS

- 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 or atmosphere.
- Very big areas of land 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 organisms.
- If we go up high above the Earth, everything looks different to the way it does when we are on the ground.
- The Earth is a planet in space. Planets are spheres in shape.
- There is a force that pulls objects onto the Earth called gravity.

REVISION

1. A person's nose and eyes and mouth are features of his or her face. Name four features of the Earth.
2. The Earth is shaped like a ball. People do not fall down off the ball. What is the reason for this?
3. List the seven continents of the Earth.
4. Name an island near South Africa.
5. If we look up into the sky during the day, we can see objects up there. At night, we can see different objects in the sky. Copy and complete the table below in your exercise books. The first two answers are there already.

Things I can see in the day	Things I can see at night
Birds	Stars

6. a. Which object is closer to the ground?
   b. Which object is the furthest from the ground?
   c. Write these objects in order of the distance from the ground (i.e. write the object that is nearest the ground first, and write the one that is highest last).
7. Copy and complete these sentences. Write out the whole sentence each time. Use the words in the box below to complete your sentences.

- country
- water
- continent
- Blue Planet
- one part
- clouds

REVISION

1. Land (mountains, hills, valleys), water (oceans, seas, rivers, lakes), air (clouds)
2. The down direction is the direction that points to the centre of the Earth. Gravity pulls everyone towards the centre of the Earth.
3. Africa, Antarctica, Asia, Europe, North America, South America, Australia
4. Madagascar. Robben island. Dassen island. Seal island. Mauritius

5.

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 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. You are teaching the learners the concept of sequence or ordering: the moon, 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.

a. The planet Earth looks blue and white from space. It is called the __________ because it is covered with __________ and __________.
b. A continent is a large piece of land. For example, Africa is a __________ and South Africa is a __________ of Africa.

Now that we have learnt about our planet, Earth, let's move out into space and learn more about the sun!

7. a. Blue planet; water; clouds
   b. Continent; one part
   Learners need practice in writing long sentences.

15 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?

New words
- hydrogen gas
- helium gas
- diameter
- sundial

15.1 What is the sun?

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 (dawn) when it rises.

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

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.

Instruction to the teacher (Activity 15.1)

Scale Model of the sun and the Earth

About this Activity

This activity explores the relative size of sun and Earth as well as the distance between them.

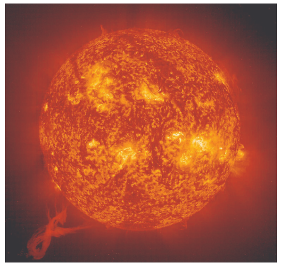
Preparation

Measure 20 meters (the distance between sun and Earth in the scale of our model) from where you will be doing this activity and mark the distance for later reference. If you do not have a fixed location, we find it helpful to have a piece of string cut to exactly 20m in length for you to use as a reference during the activity. If you want your learners to guess the size of the Earth, you might want to keep the image of Earth out of sight by cutting off the top of the hand-out page along the dash line.

The sun is a huge ball of burning gas

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

The temperature of the sun is about 5 500°C on the surface. That is hot enough to melt rocks!



The sun looks like this through a special camera.

Visit

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

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 above, you can see that the sun throws out huge streams of hot gas. Can you see this in the bottom left of the picture?

Did you know?

The sun is over 300 000 times bigger than Earth!

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 far away. The sun is far bigger than the Earth.

ACTIVITY 15.1: Exploring the relative size of the sun and the Earth, as well as the distance between them

MATERIALS:

- Copies of the sun and Earth handout sheet
- Measuring tape
- A large room or a long hallway where you will be able to walk 20m in a straight line without many obstacles
- Scissors

INSTRUCTIONS:

1. Cut out the images of the sun and the Earth.
2. To demonstrate the distance between the sun and the Earth at this scale, separate the images 20 meters apart. This distance represents approximately 150 million kilometres.

To Do and Notice

1. Show learners the image of the sun. (This is a good opportunity to notice what the sun's surface look like and to point out that the sun is not as featureless and uniformly bright as it might look to our eyes.) Ask learners to guess how big the Earth would be if the sun is the size of this image.
2. Reveal the answer by showing the image of Earth. (Optional: you might want to let the learners cut out the Earth and the disc of the sun instead of using the 2 sections of the handout sheet.) Ask learners to guess how far the model Earth should be from the model sun. We suggest allowing learners to walk to where they think the distance should be. We find it helpful to tape the model sun to a spot around eye-level at the starting point and have the teacher walk with the learners. The model Earth should be 20m away from the model sun. Use the marker you placed earlier (or the cut piece of string) to guide you.
3. (Optional) At 20m away, look back towards the model sun. Notice how big it looks to you at this distance. At this scale, the model sun should be about the same size as the actual sun would appear to us here on Earth. (It is always a good idea to remind learners not to look directly at the sun.) Since this part requires a basic understanding of ratio and scale model, it might not be appropriate for all learners.

Activity Notes

"Why does the sun I see in the sky look different from this picture?" is a common question. The sun image here was taken by a telescope that is mounted on a satellite in space (the TRACE mission to be exact). Besides being able to see farther than we can and without the clouds and Earth's atmosphere in the way, this telescope also looks at a different kind of light. The sun gives off different kinds of energy, only part of that is in the form of visible light which we can see. The telescope that took this picture looks at the extreme ultraviolet (EUV) light coming from the sun.

QUESTION:

Because the sun is so very far away.

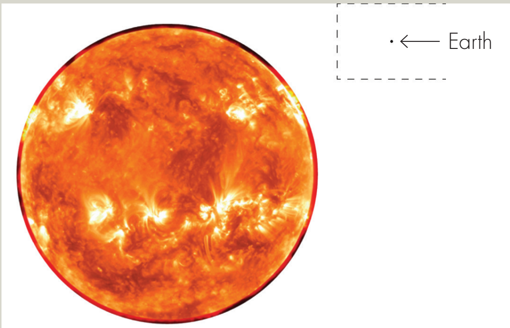


Figure 1: Scale Model of Sun: http://sunearthday.nasa.gov/ *Figure 2: Scale Model of Earth: http://sunearthday.nasa.gov/*

QUESTION:

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

The Earth is actually very far from the sun. It is 150 million km from the Earth. That is 150 000 000 kilometres!

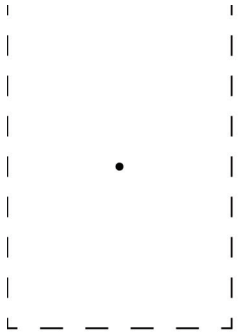
It is a really long way from the Earth to the sun. If you went in a car at highway speed of 120 km/h, you would have to travel for 146 years to reach the sun. So, the sun is far away and it is very big and very hot.

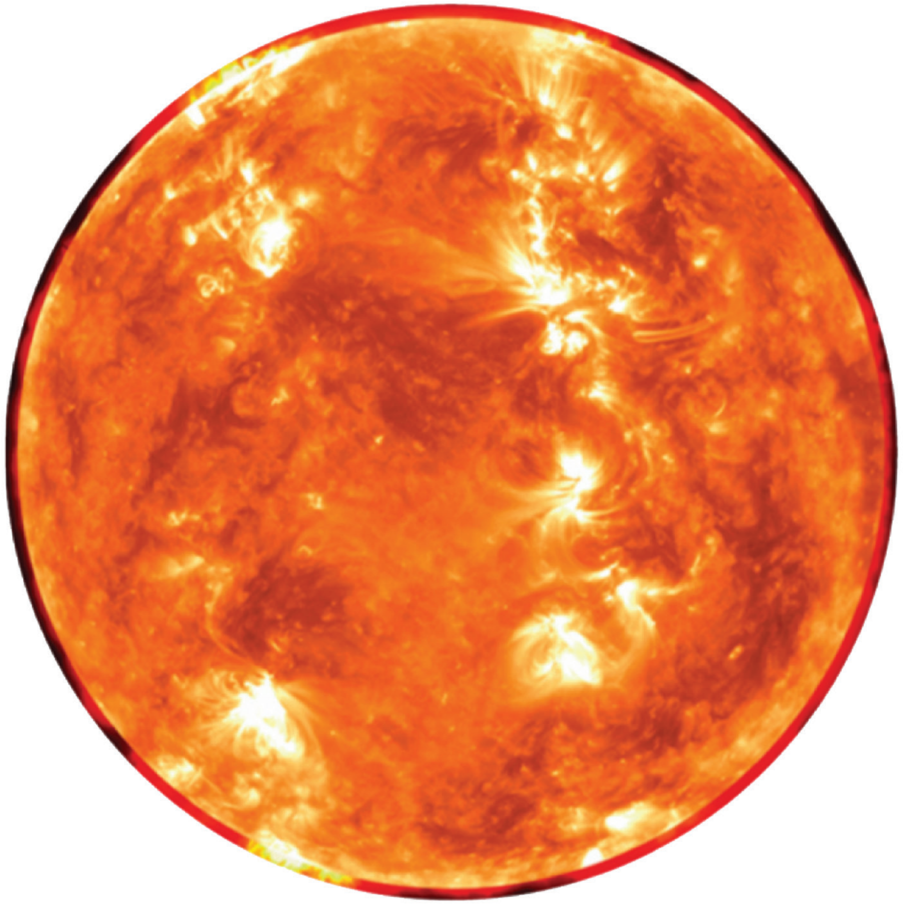
If the sun is so far away, why does it look as big as it does? The sun is so big that it is difficult for us to understand how big it really is. A model can help us to understand.

ACTIVITY 15.2: Showing how far Earth is from the sun

MATERIALS:

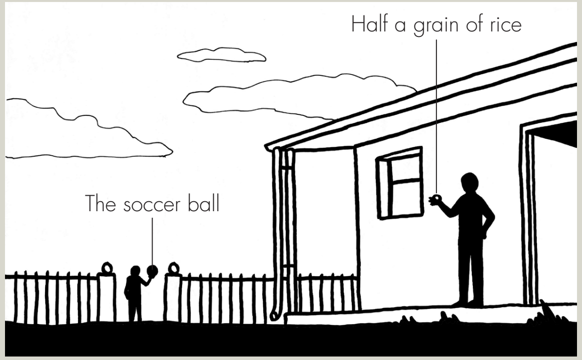
- A grain of rice (broken in half)
- Soccer ball
- Space to move (playground or soccer field)





INSTRUCTIONS:

1. Look at the picture on page 245.
2. One learner stands in a place where there is a lot of room all around them. This learner holds the soccer ball. The ball represents the sun.
3. Another learner stands next to her or him 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 or she can make. That distance is about 24 metres. The 24 metres represents the distance from the sun to the Earth.



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

5. Now the learner carrying the half-grain of rice starts walking to the right. He or she must always stay 24 m from the soccer ball. If you do this you will walk in a large circle around the soccer ball.

This model shows us that the tiny Earth moves in a circle around the big sun.

QUESTIONS:

1. Stand 24 m 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?
2. Why does the ball look as big as your nail?

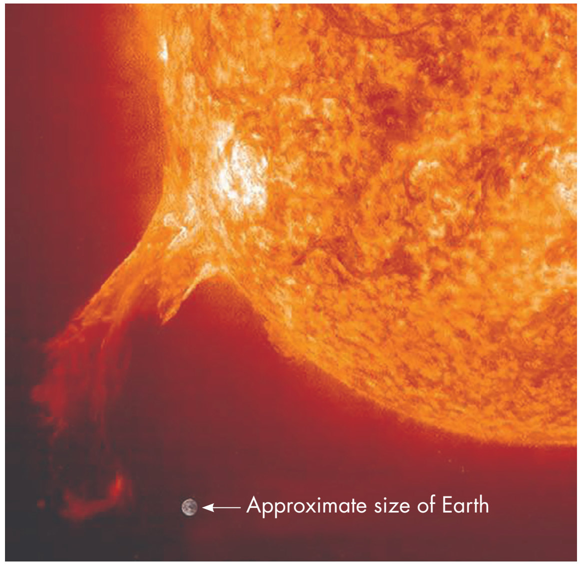
Teacher's Note

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.

QUESTIONS:

1. No
2. 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 below 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.

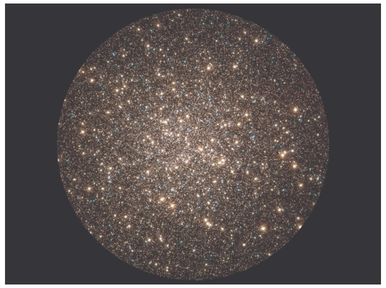
Did you know?

Galileo Galilei, the Italian scientist, developed the telescope.

15.2 The sun is the closest star

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 lets 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!



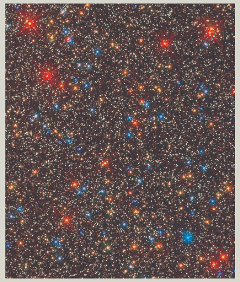
Hundreds of thousands of stars seen through the Hubble telescope.[1,2]

Star colour and temperature

ACTIVITY 15.3: The colours of stars tell us about their temperatures

INSTRUCTIONS:

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



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 do you think are the hottest?
3. What colour star is the sun?

QUESTIONS:

2. The blue stars
3. Yellow

Stars that look orange-reddish are not as hot as the sun. Stars that look blue-white are much hotter than the sun.

The sun is the nearest star to Earth. The second-nearest star is called Proxima Centauri. Light from the sun takes eight minutes to reach your eyes, but light from Proxima Centauri takes over four 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 km every second! If Voyager were to travel to Proxima Centauri it would take more than 73 000 years to arrive!

Did you know?

Many early cultures saw the sun as a deity or god because of how important it is on Earth. For example, ancient Egyptians had a sun god called Ra.

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, life became possible.

The sun sends out heat and light to the Earth. Earth only gets 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 sundial like this one.[4]

QUESTIONS

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

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 sun's heat energy to heat water.

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 rain water, drought can occur.[6, 7]

Too much sun can damage your skin.

KEY CONCEPTS

- The sun is a star. It is a very big ball of burning gas.
- It is more than a million times bigger than the Earth!
- Earth is 150 million km from the sun.
- The sun is so hot it gives Earth all the light and heat we need for life.
- The nearest other star is so far away it looks like a dot made with a pin on paper.

REVISION

Write out these sentences and complete them. Use the words in the box below to complete the sentences. Write out the whole sentence. (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 ____________.
2. The sun gives ____________ and ____________ to the Earth. All ____________ need light and heat.
3. The sun is not burning like a wood fire. The sun is hot because ____________ is changing into ____________.

REVISION

1. sun; half a grain of rice
2. light; heat; plants
3. hydrogen gas; helium gas

16 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?

16.1 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 in a cycle.

New words
- orbit
- leap year
- solar system
- dwarf planet
- asteroid belt

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 as clouds.

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.

QUESTIONS

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

Teacher's Note

The learners do not have to know about the tilt of the Earth's axis. The axis is tilted at 23,5 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.

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

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

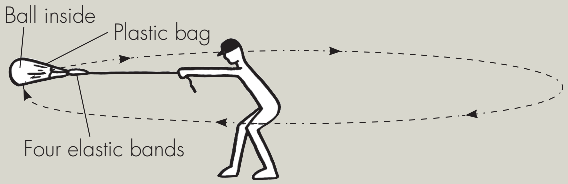
ACTIVITY 16.1: Making a model of the Earth's orbit moving around the sun

MATERIALS:

- Strong string about 5 m long
- 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 on the end of the string around as fast as you can. The rest of the class must watch the plastic bag carefully to see whether the rubber bands stretch.
4. The learner swinging the ball around 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.



The ball orbits in a circle path around the learner.

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.

5. Take turns to swing the ball; feel how hard you need to pull on the bag to keep it going around.

QUESTIONS:

1. What do you feel as you swing the ball?
2. If the ball in its bag could feel, what would it feel?
3. If the string breaks, in what direction will the ball carry on travelling? Point with your hand to show your answer.
4. Why can you not see a circle in the picture on page 252? Does the ball really move in a circle when you swing it?
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?

Visit

Play a game to make the Earth orbit the sun: goo.gl/qJo4i

The planet Earth orbits around the sun in 365 and $\frac{1}{4}$ 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 km 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 km! Like the string, gravity force keeps the Earth moving in its orbit around the sun, year after year.

Did you know?

Every four years we have a leap year. This is when there is an extra day in the year on 29 February. If previous year was in 2016 then next leap year will be in 2020.

16.2 The Earth and other planets

Some of the bright things we see in the sky at night are not stars, they are planets. Venus (the Evening Star) 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*.

QUESTIONS:

1. You will feel the string pulling on your hand.
2. The ball will feel an equal force of the string pulling on it.
3. 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 the string go.
4. 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. One year

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 16.2: The differences between stars and planets

INSTRUCTIONS:

1. Copy and complete the table on page 255, in your exercise books.
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 seven 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.	
We can see thousands of millions of stars with a telescope.	
Stars are very, very far away from us.	
Stars do not 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.

What are the names of the planets in our solar system?

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

Visit
A song about the planets.
goo.gl/lzUM9

We used to call Pluto a planet, but not anymore. Now it has been decided that Pluto is not a planet. Pluto is now what is known as a dwarf planet. The decision to reclassify Pluto came after 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. Pluto also does not have a regular orbit around the sun.

Did you know?
The solar system formed around 4.6 billion years ago!

Here is a tip! To remember the names of the planets in order from closest to the sun, say this rhyme:

My **V**ery **E**ager **M**om **J**ust **S**erved **U**s **N**achos.

INSTRUCTIONS:

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.

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

Did you know?

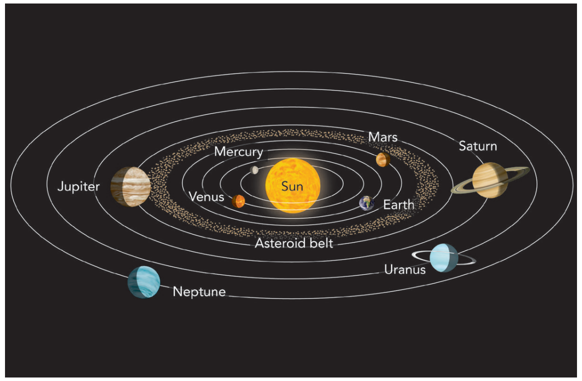
The word "solar" comes from an old word, "sol", which means "Sun".

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

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

Visit

A song about the solar system. goo.gl/3yE7T



The planets of our solar system orbiting around the sun. The planets are much further away than you see here.

NatSci&Tech_Gr4_TG_Book.indb 252 2018/05/17 11:38:26 AM

ACTIVITY 16.3: The planets of the solar system

INSTRUCTIONS:

1. Look at diagram of the solar system on page 256 again.
2. Answer the questions.

QUESTIONS:

1. Why do the planets all keep on moving in orbits around the sun?
2. Which planet is the closest to the sun?
3. Is Venus or Earth closer to the sun?
4. Write the names of the planets in order, beginning from the one that is closest to the sun.
5. Which planet do you think is the coldest?
6. What is the reason that this planet is the coldest?

16.3 The sun and life

New words
- aliens
- creatures

There are eight planets in the solar system. People often wonder if the other planets have creatures called aliens living on them. Have you 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.

INVESTIGATION 16.1: What happens to a plant that grows without light?

AIM:
What do you want to find out? Write it down.

PREDICTION:
What do you think will happen?

APPARATUS:
- Growing bean plant in a pot
- Small box with a lid that you can close
- Bottle of water for the plant

QUESTIONS:

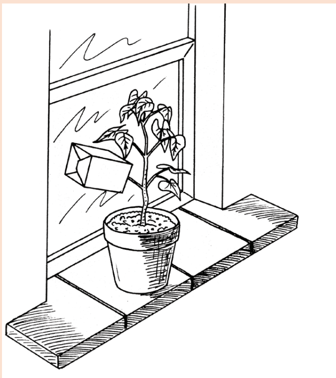
1. The gravity force between the sun and each planet keeps them moving in their orbits. The sun is so big and heavy that it can cause a gravity force that pulls even the furthest planet, Neptune, into its orbit.
2. Mercury
3. Venus
4. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
5. Neptune
6. It is the furthest from the sun.

Teacher's Note

Investigation 16.1 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.

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 did you observe? 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 have 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.

The leaves on the top branch grew in light, but the leaves on 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 on the top branch in the picture are . . ."
2. Why do you think the leaves look different? Write one reason.

ACTIVITY 16.4: Why do most plants stop growing in winter?

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

INSTRUCTIONS:

1. Copy and complete the table on page 260 in your exercise books. The answers under the heading "Summer" are done for you as examples.

QUESTIONS

1. What is the difference between the leaves on each branch? Write two sentences about the leaves. Begin like this "The leaves on the top branch in the picture are . . ."
2. Why do you think the leaves look different? Write one reason.

1. 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. 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.

Questions	Summer	Autumn	Winter	Spring
In which months of the year do we have these seasons?	December, January, February			
Are most of the days cold, cool, warm or hot?	Most days are hot			
How high is the sun at the middle of the day?	Almost over our heads			
How long is the night? Short, long or medium?	Short			
What happens to plants during this season?	Plants grow well			
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?
2. In spring, plants begin to grow again. Why does this happen?
3. Do you remember learning in Term 1 about what a plant needs to grow? Write these down.

Questions	Summer	Autumn	Winter	Spring
In which months of the year do we have these seasons?	December, January, February	March, April, May	June, July, August	September, October, 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	Some plants stop growing	Many plants die or the leaves fall off	Plants begin to grow again
Draw a picture to show the season.	Learners own drawings	Learners own drawings	Learners own drawings	Learners own drawings

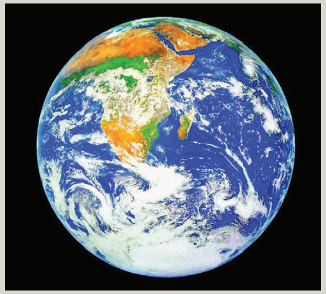
QUESTIONS:

1. 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. 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. Light, heat or warmth, water, air

ACTIVITY 16.5: 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.



This is the planet Earth; this photo was taken from a spacecraft far away from Earth.

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

QUESTIONS:

1. Is it daytime or night time in South Africa?
2. Is the weather cloudy or sunny in South Africa?
3. Where does the rain come from, to give water to the plants, animals and people? Write two or three sentences.

The Quantum Club had just learned about Earth and what the sun provides Earth with. Felicity was sitting after class wondering if there are any other planets like Earth where people could live.

QUESTIONS:

1. Day-time; we can see that all of Africa is in sunshine. Teach learners that they can interpret a photo.
2. Most of South Africa is under cloud, in the photo.
3. 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.

QUESTIONS

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

Which two planets are too close to the sun and too hot for anything to live there? Most of the planets are so far from the sun that they are very cold. People could not live on them. Give five examples of cold planets.

KEY CONCEPTS

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

QUESTIONS

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

Learner dependent answer

QUESTIONS

Which two planets are too close to the sun and too hot for anything to live there? Most of the planets are so far from the sun that they are very cold. People could not live on them. Give five examples of cold planets.

Mercury and Venus are too hot to live on. Mars, Jupiter, Saturn, Uranus and Neptune are too cold.

REVISION

1. What is at the centre of our solar system?
2. Name the eight planets in our solar system.
3. What do plants get from the sun that they need to grow?
4. What is the shape of the Earth's path around the sun?
5. What is the name of the Earth's path around the sun?
6. Why does the Earth and planets move in circles around the sun?

Visit

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

REVISION

1. The sun
2. Mercury, Venus, Earth, Mars, Saturn, Jupiter, Neptune and Uranus.
3. Light and heat
4. A circle, or very nearly a circle – an ellipse
5. Its orbit
6. 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.

17 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?

17.1 The Quantum Club needs a rocket

New words
- rocket

Phumlani, Felicity, Mothusi and Walt 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

264

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.)

Phumlani asks his friends, “Can one of those rockets go to the moon?”

Walt replies, “No, the moon is 384 000 kilometres away – that’s too far!”

Mothusi says, “I don’t want any rockets on the moon – it’s so beautiful the way it is.”

Felicity disagrees, “But people *have* been there! They used a rocket to go there. They walked around and they brought back some moon rocks.”

The Quantum Club sit for a while longer, gazing up at the beautiful fireworks with the moon in the background.

Mothusi breaks the silence, “I saw a video of the astronauts on the moon. They jumped around easily because they weighed less on the moon.”

Phumlani 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 Walt even says, “I want a little astronaut on my rocket – I’ll write my name, Walt, on him!”

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

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

QUESTIONS

Write down two things you know about rockets. Then write two sentences about what you are going to do. This is your design brief.

QUESTIONS

Write down two things you know about rockets. Then write two sentences about what you are going to do. This is your design brief.

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.

17.2 How do rockets work?

New words
- launch structure
- expand
- nozzle
- horizontal

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

Felicity 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 page 280 for moon facts in Chapter 18. Look at the pictures and read about the journey.

QUESTIONS

1. Did the whole rocket go to the moon?
2. Which part of the rocket went to the moon?
3. How far did the spacecraft have to travel to reach the moon?

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?
2. Which part of the rocket went to the moon?
3. How far did the spacecraft have to travel to reach the moon?

1. No
2. Only the small spacecraft on the nose of the rocket.
3. 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.

Rockets 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 make a simple model of a rocket to see how they move.

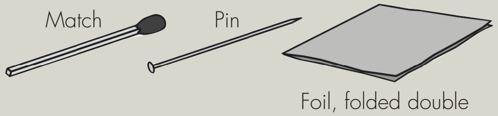
ACTIVITY 17.1: Making a rocket from a match

MATERIALS:

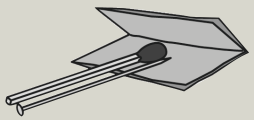
- Box of matches
- Four rectangles of aluminium foil (4 cm by 8 cm)
- Pin
- Paperclip

INSTRUCTIONS:

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



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



QUESTIONS

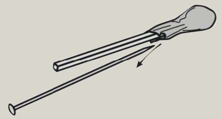
Can an aeroplane fly to the moon? Give a reason for your answer.

No, because their wings will not work in space.

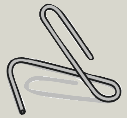
Teacher's Note

Activity 17.1 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.

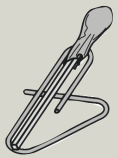
3. Pull out the pin. This leaves a tiny tube for gases to escape.



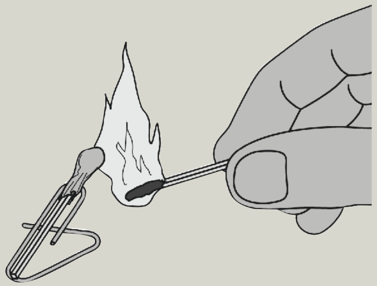
4. Now you have a rocket. It is almost ready to launch. All you still need is a launch structure.
5. Bend the paperclip to make a structure as you see in picture below.



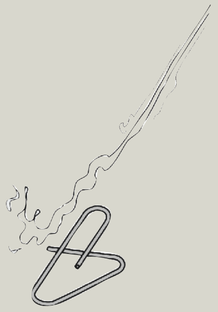
6. Put your match rocket in the launch structure. Make sure the rocket points away from people.



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



8. Watch what happens!



QUESTIONS:

1. A rocket needs fuel. Fuel stores energy. Do you remember what we learned about storing energy in Term 3?
2. Where is the energy stored in this rocket?

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 expand escape downwards 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.

QUESTIONS:

2. The energy is stored in the head of the match.

Did you know?

When you test something over and over again, and change it each time to find the best solution, this is called testing by "trial and error".

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.

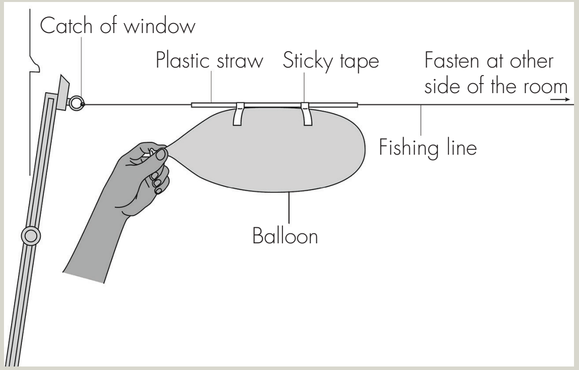
ACTIVITY 17.2: Help the balloon to fly straight

MATERIALS:

- Tube balloon
- 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. Then use the sticky tape to fasten the balloon onto the straw. You can 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. Blow the balloon up to different sizes. You can use the number of breaths that you blow into the balloon, for example, three breaths, five breaths, seven breaths. Each time release the balloon and measure with a ruler how long it goes along the fishing line. Copy and record your results in the table below in your exercise books.

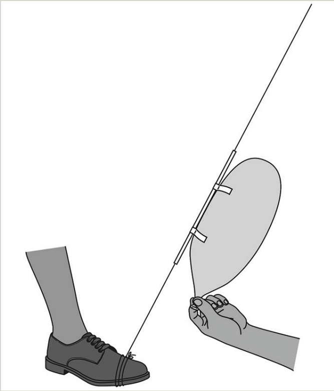
Size of balloon (number of breaths to blow up)	Distance moved (cm)

QUESTIONS:

1. Does the balloon move differently when you blow it up to a small size or a big size?
2. What is the difference between the ways the balloon moves when it is blown small and blown big?
3. Rockets that take astronauts to the moon go up, not sideways. Think of a way to make the rocket fly up.

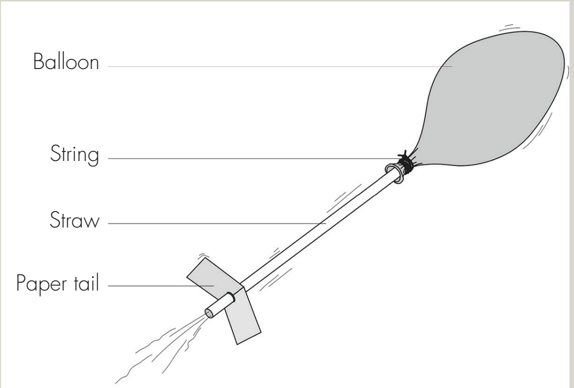
QUESTIONS:

1. Yes. (In each case it will move along the fishing line, but at different speeds and for different distances)
2. When it is blown up big it moves much faster. the reason is that you have stored more energy in the balloon.



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 this and see if it flies straight.



Will this system make the rocket go straight?

So far we have done some research into rockets on how they move and work. The last thing to do is to investigate a bit about the place we want to go – the moon!

ACTIVITY 17.3: Investigate the moon

INSTRUCTIONS:

1. You must find out about the moon.
2. You can read Moon Facts in Chapter 18.
3. Answer the questions below.

QUESTIONS:

1. How far is the moon from the Earth?
2. Does the moon have air for you to breathe?
3. Is there air between the Earth and the moon?
4. Could a bird fly from the Earth to the moon? Give a reason for your answer.
5. Can a big airliner fly to the moon? Give a reason for your answer.

17.3 Modelling a rocket

The Quantum Club is 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.

ACTIVITY 17.4: 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:

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

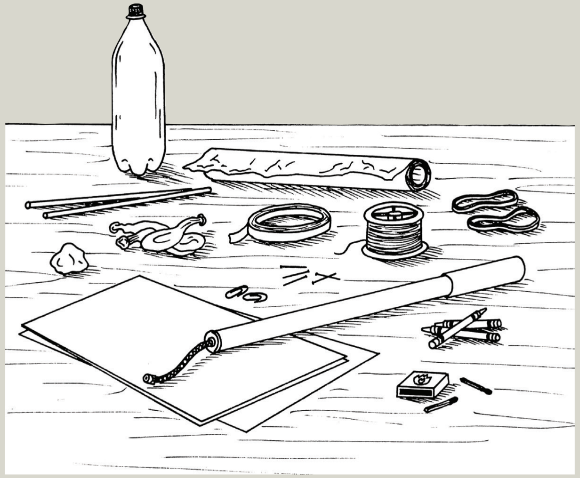
QUESTIONS:

1. 384 000 kilometres
2. No
3. No
4. 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. 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.

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 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 Quantum Club 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.

2. Your rocket has the following specifications and constraints:
   - Your rocket must move by itself.
   - Your rocket must go further than 1 m, 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.
3. Answer these questions:
   a. What do you need to design?
   b. What will the size and shape of your rocket be?
   c. What materials are you going to use to build your rocket? Make a list of all the materials you will need. The picture 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.

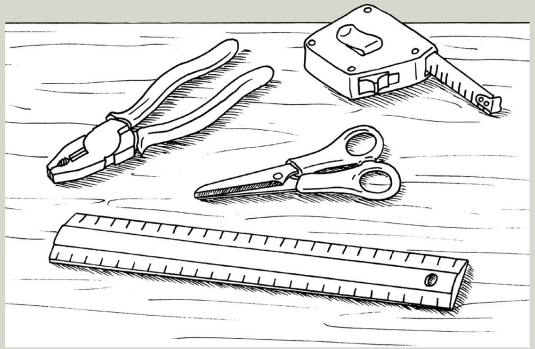


The things you can use to make your rocket.

4. What tools are you going to need 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!



These are some of the tools to use.

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

6. 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, draw your final design in your exercise books. 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 show what you really decided to make.

MAKE:

Now make your rocket in class. Make your rocket according to your sketch and use 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 technology process is to communicate what you found to others so they can learn from what you did.

Write a paragraph in your exercise books, where you tell the Quantum Club about the rocket you built, what worked and what did not work.

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

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.
2. Explain how a rocket moves.
3. Give a reason why the nozzle at the back of the rocket must be small.
4. In which year did the first man land on the moon?

REVISION

1. In space there is no air. Aeroplane wings work only in air.
2. Rockets work by pushing hot gases out of the nozzle in the back end. This propels them forward.
3. The gases must come out very fast.
4. In the year 1969.

18 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?

18.1 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 rocket 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

The moon has marks and shapes on it. What do you think those marks are? How could you find out what the marks on the face of the moon are?

Moon facts:

- The moon is 384 000 kilometres from Earth.
- The moon is made of rock and the surface is rock and grey sand.
- There is no air and no water on the moon.
- 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 photo below carried three men to the moon for the first time. The rocket and spacecraft were called Apollo 11.

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

QUESTIONS

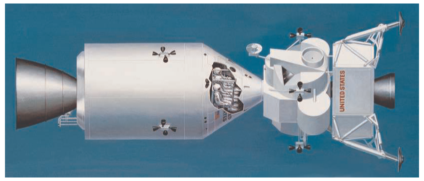
The moon has marks and shapes on it. What do you think those marks are? How could you find out what the marks on the face of the moon are?

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. 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.

NatSci&Tech_Gr4_TG_Book.indb 276 2018/05/17 11:38:31 AM

The flame at the bottom is the hot gases coming out of the nozzle. Clouds on the side of the photo are the gases that hit the ground and blow dust everywhere. The three astronauts were in a small spacecraft on the nose of the rocket.

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



This is the spacecraft that went to the moon and landed there.

Let us imagine that we are in that rocket!

We travel through Space at 5 800 km per 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.

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. 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 with, and special glass helmets to protect our eyes from the sun.

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)

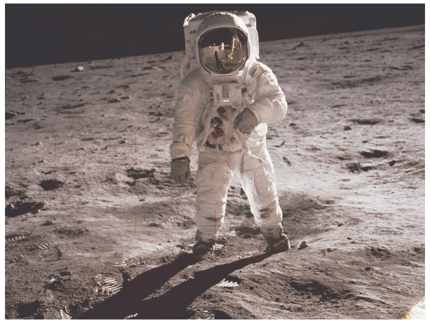
crater (= a hole in the ground)

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.



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 see 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 18.1: 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 normal glasses? Explain your answer.

QUESTIONS:

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

2. He is carrying a big pack on his back. Think of three things that are in the pack. You can work out the answers by discussing the story.
3. The sand on the moon appears to have a light colour. Why does the moon give us light at night?
4. Make 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.

18.2 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.

New words
- phase
- crescent
- waxing
- waning
- eclipse

2. 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 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.

Why are there phases of the moon?

From Earth we only see one side of the moon. If you were to stand on the moon and look at the Earth you would see our planet in the same position every time. This is why many people think that the moon does not rotate. The moon rotates on its own axis in the same amount of time it takes to orbit the Earth once. It takes the moon about 28 days to complete one rotation and revolve around the Earth.

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. This makes it look like it is changing shape.

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.

ACTIVITY 18.2: Make a model of the Earth, sun and moon

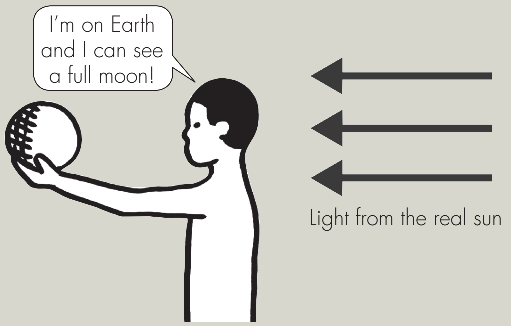
This model will help you understand why the moon's shape changes during the month.

MATERIALS:

- 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

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

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 picture on page 284 showing the moon phases.
8. Turn more to your right until half the moon has light on it. Which shape are you seeing now?
9. Turn your back to the sun, so that you see light all over the side of the moon. This is like 14 days passing. Which shape of the moon do you have now?
10. Turn further to your right. Which phase is this? This is like 21 days passing.

QUESTIONS:

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

ACTIVITY 18.3: 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. Copy the recording sheet on page 287 in your exercise books. Write the date in the relevant block for the week in the recording sheet.
3. Make a drawing of the shape you see every night.
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.

Teacher's Note

The moon takes about 29,5 days to go around the Earth and come around to the same position it was in before.

QUESTIONS:

1. About 14 days
2. 29,5 days from new moon to next new moon

Teacher's Note

Carry out Activity 18.3 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.

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							

18.3 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?
2. Do you think it was right that the hare threw mud at the moon?
3. What emotion was the hare experiencing?

The moon and the sun

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.

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?
2. Do you think it was right that the hare threw mud at the moon?
3. What emotion was the hare experiencing?

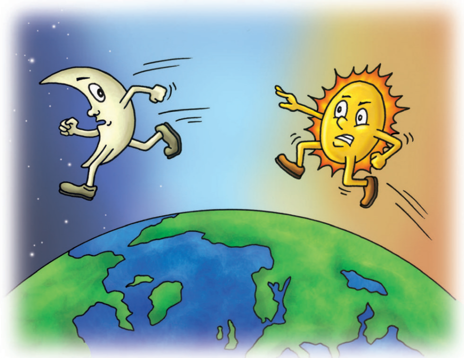
1. Possibly craters which appear darker.
3. Jealousy

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.

NatSci&Tech_Gr4_TG_Book.indb 284 2018/05/17 11:38:32 AM

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.



The sun chasing the moon across the sky.

Did you know?

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.

QUESTIONS

1. In this story, who is the father, who is the mother, and who are the stars?
2. In this story, what happens in the morning when the sun comes up?
3. How do you know that this story is not true?
4. The story does help us remember some true facts. Name one of the true facts we get from the story.
5. Why are the sun and the other stars hot?
6. In the real sky, why do the stars disappear when the sun comes up?
7. In the real sky, can you ever see the moon in daytime?

QUESTIONS

1. In this story, who is the father, who is the mother, and who are the stars?
2. In this story, what happens in the morning when the sun comes up?
3. How do you know that this story is not true?
4. The story does help us remember some true facts. Name one of the true facts we get from the story.
5. Why are the sun and the other stars hot?
6. In the real sky, why do the stars disappear when the sun comes up?
7. In the real sky, can you ever see the moon in daytime?

1. The sun is the father, the moon the mother and the stars the children
2. The stars run away to hide in the morning
3. 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 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 of it.
5. 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. 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. 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?
2. Why does the moon give us light at night?
3. How many days must pass between a night when the moon is full and the next full moon?
4. When we see a half-moon it looks like a letter D. Why can we see only half of the moon?
5. What do we call the changing pattern of shapes of the moon during the month?
6. Arrange the Earth, the sun and the moon in order from biggest to smallest.

REVISION

1. Rock
2. Sunlight shines on the moon and some of it bounces back to Earth.
3. 29,5 days
4. The other half is not getting any light from the sun and so no light comes from it to our eyes.
5. Phases of the moon.
6. Sun, Earth, moon

NatSci&Tech_Gr4_TG_Book.indb 287 2018/05/17 11:38:32 AM

Appendix

Science Lab/Investigation Report Rubric

Name: ______________________________

	Excellent (6-7)	**Good (4-5)**	**Satisfactory (2-3)**	**Needs Improvement (0-1)**
Components of the Report	All required elements are present and additional elements that add to the report (e.g., thoughtful comments, graphics) have been added.	All required elements are present.	One required element is missing, but additional elements that add to the report (e.g., thoughtful comments, graphics) have been added.	Several required elements are missing.
Journal / Notebook	Clear, accurate, dated notes are taken regularly.	Dated, clear, accurate notes are taken occasionally.	Dated, notes are taken occasionally, but accuracy of notes might be questionable.	Notes rarely taken or of little use.
Investigation question	The purpose of the lab or the question to be answered is clearly identified and stated.	The purpose of the lab or the question to be answered is identified, but is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is partially identified, and is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is erroneous or irrelevant.
Experimental Hypothesis	Hypothesized relationship between the variables and the predicted results is clear and reasonable based on what has been studied.	Hypothesized relationship between the variables and the predicted results is reasonable based on general knowledge and observations.	Hypothesized relationship between the variables and the predicted results has been stated, but appears to be based on flawed logic.	No hypothesis has been stated.
Materials and apparautus	All materials and setup used in the experiment are clearly and accurately described.	Almost all materials and the setup used in the experiment are clearly and accurately described.	Most of the materials and the setup used in the experiment are accurately described.	Many materials are described inaccurately OR are not described at all.
Experimental Design & Procedures	Experimental design is a well-constructed test of the stated hypothesis. Procedures are listed in clear steps. Each step is numbered and is a complete sentence.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions. Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences.	Experimental design is relevant to the hypothesis, but is not a complete test. Procedures are listed but are not in a logical order or are difficult to follow.	Experimental design is not relevant to the hypothesis. Procedures do not accurately list the steps of the experiment.
Variables	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends or predictions are made based on the data.	The relationship between the variables is not discussed.
Data	Neat looking and accurate representation of the data written, and in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in written form, but no graphs or tables is presented.	Data are not shown OR are inaccurate.

Drawings	Clear, accurate diagrams are included and make the experiment easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.
Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.
Summary	Summary describes the skills learned, the information learned and some future applications to real life situations.	Summary describes the information learned and a possible application to a real life situation.	Summary describes the information learned.	No summary is written.
Calculations	All calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results labeled appropriately.	No calculations are shown OR results are inaccurate or mislabeled.
Safety	Lab is carried out with full attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual.	Lab is generally carried out with attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but one safety procedure needs to be reviewed.	Lab is carried out with some attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but several safety procedures need to be reviewed.	Safety procedures were ignored and/or some aspect of the experiment posed a threat to the safety of the student or others.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab.	Report illustrates an accurate understanding of most scientific concepts underlying the lab.	Report illustrates a limited understanding of scientific concepts underlying the lab.	Report illustrates inaccurate understanding of scientific concepts underlying the lab.
Spelling, Punctuation, Grammar	One or fewer errors in spelling, punctuation and grammar in the report.	Two or three errors in spelling, punctuation and grammar in the report.	Four errors in spelling, punctuation and grammar in the report.	More than four errors in spelling, punctuation and grammar in the report.
TOTAL POINTS ________ /60 = ________%				
COMMENTS:				

Notes

Chapter 1 Living and non-living things

1. http://www.f1icr.icm/phctco/petercam1noc1/325590008/
2. http://www.f1icr.icm/phctco/8720628@N04/2217496745/
3. http://www.f1icr.icm/phctco/br1ttgcw/4781540407/
4. http://www.f1icr.icm/phctco/benwatto/4087289013/
5. http://www.f1icr.icm/phctco/37873897@N06/7225883680/
6. http://www.f1icr.icm/phctco/l1zjcneo/310415897/
7. http://www.f1icr.icm/phctco/uoaghumphreyo/3952303284/
8. http://www.f1icr.icm/phctco/72906133@N00/6590383249/
9. http://www.f1icr.icm/phctco/8374568@N07/3451503721/
10. http://www.f1icr.icm/phctco/ajturner/2919343853/
11. http://www.f1icr.icm/phctco/otevepj2009/3333523138/
12. http://www.f1icr.icm/phctco/t1mpearielcogatco/4366159576/
13. http://www.f1icr.icm/phctco//xtreme/295250582/
14. http://www.f1icr.icm/phctco/oihwuc/160754346/
15. http://www.f1icr.icm/phctco/waod1n/2395014850/
16. http://www.f1icr.icm/phctco/tgeruo/4662650273/
17. http://www.f1icr.icm/phctco/dcm1n1iop1io/5343849351/
18. http://icmmcno.w1c1med1a.crg/w1c1/F1le:Pclluelc_rcmp1endc_el_iaoiar%C3%B3n_01.jpg
19. http://icmmcno.w1c1med1a.crg/w1c1/F1le:Frcg_eggo.jpg
20. http://www.f1icr.icm/phctco/jecert/3892393732/
21. http://www.f1icr.icm/phctco/er1cpaterocn/4848567659/
22. http://www.f1icr.icm/phctco/dcughay/6238714929/
23. http://www.f1icr.icm/phctco/tcnamel/537819971/
24. http://www.f1icr.icm/phctco/hcr1avarlan/4747872021/
25. http://www.f1icr.icm/phctco//reeeotcic/4900327096/
26. http://www.f1icr.icm/phctco/31485433@N08/6307414140/
27. http://www.f1icr.icm/phctco/araowam1/1475225158/
28. http://www.f1icr.icm/phctco/oteelmcre/98391847/
29. http://www.f1icr.icm/phctco/arbrcn/56216585/
30. http://www.f1icr.icm/phctco/nam1bnat/4948647949/
31. http://www.f1icr.icm/phctco/1vanwaloh/4187244332/
32. http://www.f1icr.icm/phctco/1vanwaloh/4187244332/
33. http://www.f1icr.icm/phctco/m1ceba1rd/7108200389/

Chapter 2 Structure of plants and animals

1. http://www.f1icr.icm/oearih/?l=icmmder1v&mt=all&adv=1&w=all&q=plant+otem&m=text
2. http://www.f1icr.icm/phctco/irabih1ic/5809576233/
3. http://www.f1icr.icm/phctco/jcrgebraz1l/4983656659/
4. http://www.f1icr.icm/phctco/49164267@N04/4885206411/
5. http://www.f1icr.icm/phctco/7147684@N03/1037533775/
6. http://www.f1icr.icm/phctco/1mag1nextra/4609807052/
7. http://www.f1icr.icm/phctco/63048706@N06/6049015615/
8. http://www.f1icr.icm/phctco/24710622@N05/3230447522/
9. http://www.f1icr.icm/phctco/tyr1an123/479211584/
10. http://www.f1icr.icm/phctco/9009139@N08/1188915198/

Chapter 3 What plants need to grow

1. http://www.f1icr.icm/phctco/ocenmy/504840320/
2. http://www.f1icr.icm/phctco/ie/e1da/360929468/

Chapter 4 Habitats of animals and plants

1. http://www.f1icr.icm/phctco/mdpett1tt/2517630341/
2. http://www.f1icr.icm/phctco//rameoc/m1nd/4875066923/
3. http://www.f1icr.icm/phctco/garyrcbocn/520722754/
4. http://www.f1icr.icm/phctco/icda/530101796/
5. http://www.f1icr.icm/phctco/wwarby/3895166303/
6. http://www.f1icr.icm/phctco/iarclune/4278801507/
7. http://www.f1icr.icm/phctco/ex/crdy/2967158255/
8. http://www.f1icr.icm/phctco/m1oteree/3052754176/
9. http://www.f1icr.icm/phctco/icl_and_taoha/5648975768/

Chapter 5 Structures for animal shelters

1. http://www.f1icr.icm/phctco/h1ogett/5873506408/
2. http://www.f1icr.icm/phctco/m1n1iccper93402/4903577782/
3. http://www.f1icr.icm/phctco//reedcmeotud1co/6587449041/
4. http://www.f1icr.icm/phctco/m1ceba1rd/3885633425/
5. http:///arm5.otat1if1icr.icm/4006/4449854125_3bd74d012b.jpg
6. http:///arm5.otat1if1icr.icm/4135/4849263348_ebd8eedd6a.jpg
7. http://www.f1icr.icm/phctco/ellere brcwn/5970399027/
8. http://www.f1icr.icm/phctco//reeeotcic/4900327148/
9. http://www.f1icr.icm/phctco/wcuterpcotma/335640248/
10. http://www.f1icr.icm/phctco/80651083@N00/1814803669/
11. http://www.f1icr.icm/phctco//rcgbelly/1316829110/

Chapter 6 Materials around us

1. http://www.f1icr.icm/phctco/epoco/6018530849/
2. http://www.f1icr.icm/phctco/dcnhcmer/4037179901/
3. http://www.f1icr.icm/phctco/92833011@N00/1160780781/
4. http://www.f1icr.icm/phctco/87241965@N00/371591593/
5. http://www.f1icr.icm/phctco/38315261@N00/419844319
6.
7. http://www.f1icr.icm/phctco/preppybyday/5076899310/

8. http://www.f1icr.icm/phctco/jaynellcyd/6782664355/
9. http://www.naoa1mageo.crg/luna/oervlet/deta1l/NVA2%7E62%7E62%7E78737%7E135593:WhcleeEarth#

Chapter 7 Solid materials

1. http://www.f1icr.icm/phctco/prcphet1i_blcgger/7194377506/
2. http://www.f1icr.icm/phctco/cell1nahandbaocet/2183799236/
3. http://www.f1icr.icm/phctco/orccwn/797820971/
4. http://www.f1icr.icm/phctco/jetalcne/201784099/
5. http://www.f1icr.icm/phctco/alcha75/6086355519/
6. http://www.f1icr.icm/phctco/tuihcd1/5040332553/
7. http://www.f1icr.icm/phctco/belv1oc/5931888942/
8. http://www.f1icr.icm/phctco/uo/oreg1cn5/3598029211/
9. http://www.f1icr.icm/phctco/oc1loi1enie/5097236984/
10. http://www.f1icr.icm/phctco/un1vero1tyc/oirantcnl1brary/4768936904/
11. http://www.f1icr.icm/phctco/jurvetocn/156830367/
12. http://www.f1icr.icm/phctco/80651083@N00/1814803669/
13. http://www.f1icr.icm/phctco/lp1ep1cra/1015285438/
14. http://www.f1icr.icm/phctco/ycurdcn/4364551103/
15. http://www.f1icr.icm/phctco/d1g1t1zedihaco/4898296156/
16. http://www.f1icr.icm/phctco/toacohaug/3795649157/
17. http://www.f1icr.icm/phctco/54400117@N03/5069063990/
18. http://www.f1icr.icm/phctco/occpercuh/2862622326/
19. http://www.f1icr.icm/phctco/iarbcnnyi/536232897/
20. http://www.f1icr.icm/phctco/36910487@N07/4694629756/

Chapter 9 Strong frame structures

1. http://www.f1icr.icm/phctco/la y4c/93484023/
2. http://www.f1icr.icm/phctco/pratant1/5359581911/
3. http://www.f1icr.icm/phctco/cocay/4662288939/
4. http://www.f1icr.icm/phctco/cocay/4662288939/
5. http://www.f1icr.icm/phctco/c1ngdavera/2269448455/
6. http://www.f1icr.icm/phctco/nu/c1n/2321665314/
7. http://www.f1icr.icm/phctco/zcetnet/4769465268/
8. http://www.f1icr.icm/phctco/gbacu/1588615030/
9. http://www.f1icr.icm/phctco/jwthcmpocn2/139445633/

Chapter 10 Energy and energy transfer

1. ptt/://www.f1ick.iho//phtho//hkoipe-/1ii/3036369434/
2. http://www.flickr.com/photos/porsche-linn/5056569434/

Chapter 11 Energy around us

1. ptt/://www.f1ick.iho//phtho/ihte/66370391/
2. ptt/://www.f1ick.iho//phtho/a/aivekihi/3S063SS939/
3. ptt/://www.f1ick.iho//phtho/34400117@N03/3069103310/

Chapter 12 Movement and energy in a system

1. By Staff Sgt. Ryan Crane – https://www.dvidshub.net/image/1399451, Public Domain, https://commons.wikimedia.org/w/index.php?curid=39365608
2. ptt/://www.f1ick.iho//phtho/cketaei/6904463913/
3. ptt/://www.f1ick.iho//phtho/ tipakk1o/739S613S70/

Chapter 13 Energy and sound

1. ptt/://www.f1ick.iho//phtho/rofwoihktpeaot/60SS7S139S/

Chapter 14 Planet Earth

1. ptt/://www.f1ick.iho//phtho/oark1iec1ig/478431SS33/
2. ptt/://www.f1ick.iho//phtho/krueiph/tpr1joei/7183769130/
3. ptt/://www.f1ick.iho//phtho/afgoatteko/4S03836196/
4. ptt/://www.f1ick.iho//phtho/i1kac/644336486/
5. ptt/://www.f1ick.iho//phtho/40383177@N07/3133S01063/

Chapter 15 The sun

1. ptt/://www.iaoa1oageo.hkg//ria/oekv/et/deta1//NVAS%7E34%7E34%7E80663%7E136130: G/1ttek1ig- Metkh/h/1o#
2. ptt/://www.iaoa1oageo.hkg//ria/oekv/et/deta1//NVAS%7E34%7E34%7E80663%7E136130: G/1ttek1ig- Metkh/h/1o#
3. ptt/://www.f1ick.iho//phtho/woopicc1w1taakh/33S0S97338/o1ieo///1i//phthotkeao/
4. ptt/://www.f1ick.iho//phtho/ia//1h/e/440681333/o1ieo///1i//phthotkeao/
5. ptt/://www.f1ick.iho//phtho/e//-k- ukhwi/6949113437/
6. ptt/://www.f1ick.iho//phtho/oaidekhvoc1/471S7S3340/

Chapter 16 The Earth and the sun

1. ptt/://www.f1ick.iho//phtho/fhh/oth/iaiet/3S037608S7/
2. ptt/://www.f1ick.iho//phtho/1S684466@N06/4S3114S638/

Chapter 17 Rocket systems

1. ptt/://www.f1ick.iho//phtho/uaaaoaa/S693171833/

Chapter 18 The moon

1. ptt/://www.oi1eiiec1do.ih.ii/v1deho/o/aie/ohhi/aid1ig.pto/
2. ptt/://www.oi1eiiec1do.ih.ii/v1deho/o/aie/ohhi/aid1ig.pto/

Glossary

Absorb To take in or soak up a liquid, energy or other substance by chemical or physical action.

Absorbent A material that is able to soak up liquid easily.

Acoustics The branch of Science that studies the properties of sound.

Adapt To become adjusted to new conditions.

Aim The purpose or reason for doing a Science investigation.

Air particle Microscopic solid or liquid matter suspended in the Earth's atmosphere.

Aliens The name given to beings from other worlds, which are also called extraterrestrials. None have visited our planet yet but some people claim to have seen them.

Amphibian Cold-blooded vertebrate animals, like frogs, that have a aquatic gill-breathing larval stage, usually followed by a terrestrial lung-breathing adult stage.

Amplify To increase the volume (loudness) of sound.

Apparatus The equipment you will need to carry out a Science investigation or experiment.

Asteroid belt Asteroids, which are solid, rocky irregular bodies, orbit our sun between the orbits of Mars and Jupiter.

Astronomy The branch of Science that deals with space, objects in space (celestial) and the physical universe as a whole.

Atmosphere The envelope of gases surrounding the Earth or another planet.

Beehive The nest made by bees that has an internal structure called a honeycomb, which is made of hexagon prism shapes. The bees use it to store food (honey and pollen) and to house the brood (eggs, larvae and pupae).

Bibliography The list of books or websites used or referred to in a scholarly work, which usually appears at the end.

Brace Support placed across a rectangle's corner to make a strong triangle shape. They are used across a corner joint in structures to increase rigidity and strength.

Burrow A hole or tunnel dug by a small animal, especially a rabbit, as a dwelling.

Camouflage Colouration of animals to let them blend in with their surroundings so that they can hide from predators and prey.

Carbon dioxide gas A natural element released by people and animals into the air when they breathe out. Plants use the carbon dioxide gas to make food and then release oxygen gas.

Ceramics Pots and other articles made from clay hardened by heat.

Change of state When temperature changes, matter can undergo a change of state, shifting from one form to another, such as melting, solidifying, freezing, evaporating or condensing.

Classify To group or arrange things in classes or categories according to shared qualities or characteristics.

Colony Collective noun for a group of animals living together, such as ants, bats and bees.

Common properties General properties or physical properties that can be observed or measured without chemically changing the material or substance.

Compare To look at and note how things are the same or different.

Compression An external force (stress) that tends to crush a material, or push down on the material and squeeze its particles closer.

Compromise An agreement or settlement of a dispute (argument) that is reached by each side making concessions (agreeing to some demands).

Conclusion Summary of what was learnt from the results of a Science investigation.

Condensing The change of the physical state of matter from a gaseous state into a liquid state. It is the reverse of evaporating.

Conditions Set prior requirements on (something) before it can occur or be done.

Constraints A description of the limitations or restrictions for the design of a product. They describe the things that the product or structure you are making cannot do.

Construct To build, make or erect a shelter or building.

Continent Any of the world's main continuous expanses of land (Europe, Asia, Africa, North and South America, Australia, Antarctica).

Control group Group in an experiment where what is being tested is not applied. It is then used as a benchmark to measure how the other groups do.

Corrugated Material shaped into a series of parallel ridges and grooves so as to give added rigidity and strength.

Crane Strong but light construction machinery used to lift and move very heavy objects, which is why they have a frame structure with struts.

Crater A large bowl-shaped cavity in the ground or on the moon caused by the impact of a meteorite.

Crescent	The curved sickle shape of the waxing or waning moon.
Cuttings	Pieces of the stem or root of a plant that is used to grow a new plant.
Data	Facts and information collected during a Science experiment.
Desert	Barren area of landscape where little rain occurs and living conditions are hostile for plant and animal life.
Design brief	Description of what you plan to do to meet the specifications and constraints for designing the product.
Diagonally	A straight line or object joining two opposite corners of a square, rectangle or other straight-sided shape.
Diameter	A straight line passing from side to side through the centre of a body or figure, especially a circle or sphere.
Diffuse	To spread over a wide area. When gas moves through the air without something pushing it.
Dissolve	When solid material becomes combined with a liquid so as to form a solution.
Dormant	Alive but not actively growing.
Dwarf planet	A celestial body that resembles a small planet but lacks certain technical criteria that are required for it to be classified as such.
Eardrum	Membrane of the middle ear that vibrates in response to sound waves.
Echo	Sound caused by the reflection of sound waves from a surface back to the listener.
Eclipse	An obscuring of the light from one celestial body by the passage of another between it and the observer or between it and its source of light.
Energy chain (food chain)	A series of organisms each dependent on the next as a source of food and energy.
Erode	The gradually wearing away of soil, rock or land by wind, water or other natural agents.
Evaluate	To decide how successful the product design and construction was in solving the problem identified or meeting its specifications.
Evaporating	The process of a substance in a liquid state changing to a gaseous state due to an increase in temperature and/or pressure.
Excreting waste products	Animals rid themselves of waste materials through organs such as the lungs, kidneys and skin. Plants excrete oxygen gas and water.
Exotic	The opposite of indigenous, when something does not occur naturally in a place.
Experiment	Scientific procedure done to test a prediction, answer a question or prove a known fact.
Feature	A distinctive attribute, aspect or characteristic of something.
Fertile	Describes soil or land that produces or is capable of producing abundant vegetation or crops. Describes animals or plants able to have young or produce seed.
Fertilise	To cause an egg, female animal or plant to develop a new individual by introducing male reproductive material.
Flexible	The property of a material where it is capable of bending easily without breaking.
Folding	One of the ways to strengthen materials is by folding. Corrugated cardboard and bubble wrap plastic are examples of strengthened folded materials.
Force	A push or pull on an object caused by the object's interaction with another object.
Forest	Large area covered chiefly with trees and undergrowth.
Fossil fuels	Sources of energy that have developed within the earth over millions of years, such as oil, natural gas and coal. Because they take so long to form, they are considered non-renewable.
Fragile	The property of a material where it can be easily broken or damaged.
Functions	Activities that are natural to or the purpose of a person or thing.
Gas	Substances that take up all the available space to fill the container they are in or diffuse through the air. So they can flow, have no definite shape and can be pressed to fill a smaller space.
Germinate	When a plant seed begins to grow under the right conditions.
Grassland	Large open area of countryside covered with veld grass.
Gravitational force	Gravity is the force that attracts two objects toward each other. The force that causes apples to fall toward the ground and the planets to orbit the sun.
Gusset	Triangular shaped bracket that strengthens the angle of a structure.
Guy	A rope, chain or a single wire that is designed to withstand tension, like the guy ropes that hold down a tent.
Habitat	The natural home or environment of an animal, plant or other organism.
Hardness	The property a material has of being hard.
Hearing-impaired	To be partially or completely deaf (having hearing loss).
Helium gas	After hydrogen, helium (He) is the second lightest and second most abundant element in the universe. It makes up 24% of the burning gas in the sun.

Hexagon	Shape with six straight sides and angles.
Horizontal	Parallel to the plane of the horizon or at right angles to the vertical.
Human-made	Made by, built by or caused by human beings (opposite of occurring or being made naturally).
Hut	Small, simple, single-storey house or shelter built from materials found nearby.
Hydrogen gas	Hydrogen (H) is a chemical element and hydrogen gas is colourless, odourless, tasteless and non-toxic. While hydrogen fills stars and gas planets, here on Earth it's bonded to other elements. For example, when combined with oxygen, it forms water (H_20).
Indigenous	Coming from or originally occurring naturally in a particular place.
Industry	Economic activity concerned with the processing of raw materials and manufacture of goods in factories.
Infrared rays	Invisible radiation from the sun found in sunlight. Infrared rays are thermal so people can feel it as heat or warmth from sunlight.
Input and output energy	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.
Invertebrate	Animals like spiders and worms that are grouped by if they do not have a backbone or spinal bones.
Island	A piece of land surrounded by water.
Joins	Points or joints at which parts of a human-made (artificial) structure are joined together.
Launch structure	An above-ground platform from which a rocket-powered missile or space vehicle is vertically launched.
Leap year	A calendar year that has one additional day added to keep the calendar year aligned with the Earth's revolutions around the sun (seasonal year).
Legend	Short explanation of the symbols used in a graph, map or diagram.
Limb	An arm or leg of a person or four-legged animal, or a bird's wing.
Liquid	Substances that have no fixed shape, that can flow and will take the shape of the container they are in.
Mammal	Warm-blooded vertebrate animals grouped by having hair or fur, with females that secrete milk for feeding the young, which are born live.
Manufactured material	The result when raw materials have been processed, meaning humans have changed it.
Mass	The kilogram is used to measure how much matter an object has in it. The more matter there is, the more something will weigh.
Materials	The matter from which a thing can or is made.
Matjieshuis	A traditional beehive-shape hut made with a frame of bent branches and covered with woven reed mats.
Matter	Any physical substance that has mass and takes up space, including atoms and anything made up of these. It does not include other energy forms or waves like light or sound.
Medium	Material that sound vibrations travel through in order to be heard. Sound vibrations travel through the medium of air to your ears.
Megaphone	Large funnel-shaped device for amplifying and directing the voice.
Melting	A physical process that occurs when a material is heated and changes form from a solid to a liquid.
Members	The long pieces of a frame structure that are load-bearing.
Method	Systematic procedure or steps for doing something, like carrying out a Science investigation.
Model	Explaining an idea or process in Science by using something else to represent it, making it easier to understand.
National symbol	Animals and plants used to identify the country of South Africa.
Natural	Existing in or from nature and not made or caused by humans.
Natural resources	Materials or substances occurring in nature which can be exploited for economic gain.
Network	An arrangement of intersecting horizontal and vertical tunnels.
Nozzle	A cylindrical or round spout at the end of a pipe, hose, or tube used to control a jet of gas or liquid.
Nutrients	Soil substances that provide nourishment essential for the plants to live and grow. The three main nutrients are nitrogen, phosphorus and potassium.
Object	A material thing that can be seen and touched.
Observations	What you observe or see during or after the investigations. Observations are usually recorded or written down.
Ocean	A very large expanse of sea, in particular each of the main areas into which the sea is divided geographically.
Orbit	The regularly repeated elliptical course of a moon around a planet or planet around a star.
Organism	An animal, plant or single-celled life form.

Oxygen gas Oxygen gas is a natural element found in the atmosphere and water. It makes up 21% of the air animals and humans breathe and is essential for life. Plants make and release oxygen gas when they make food.

Parallel Lines or areas side by side and having the same distance continuously between them.

Phase Distinct period or stage in a process of change or forming part of something's development.

Pitch Quality of a sound governed by the rate of vibrations producing it; the degree of highness or lowness of a tone.

Plantation An estate on which crops such as trees, coffee, sugar, and tobacco are grown.

Pollution The presence in, or introduction into, the environment of a substance which has harmful or poisonous effects.

Precipitation Water released from clouds in the form of rain, sleet, snow or hail.

Predator An animal that naturally hunts and eats other animals.

Prediction When you make a good guess what the result of an investigation or experiment will be.

Prey An animal that is hunted and killed by another animal for food.

Process A series of actions or steps taken in order to achieve a particular end.

Products Articles that are manufactured from raw materials or added to so that they can be sold.

Properties The traits or attributes of a substance or material, which are used to to describe it and understand how it behaves in different situations.

Pulp A soft, wet, shapeless mass of material.

Pylon Steel structure that supports electricity lines and consists of various struts and triangular shapes.

Raw material The basic unprocessed material from which a product is made. This material in its natural state.

Recycle To convert waste products into reusable material.

Reflect To throw back heat, light, or sound energy without absorbing it.

Reproducing Living organisms make copies or offspring of themselves through sexual reproduction (male and female) or by splitting.

Reptile Cold-blooded vertebrate animals grouped by having dry skin covered with scales or bony plates and usually laying soft-shelled eggs on land.

Research Step-by-step investigation into and study of materials and sources in order to establish facts and reach new conclusions.

Results What you found out, in other words the outcome of a Science investigation or experiment.

Rigid Unable to bend or be forced out of shape and not flexible.

Rocket A cylindrical projectile that can be propelled to a great height or distance by the combustion of its contents, used typically as a firework or signal.

Rontabile (rondawel) A round home made with local raw materials. The walls can be constructed from sand, clay and cow dung or stones. The floor can be finished with a dung mixture to make it hard and smooth and the roof is traditionally a grass thatch.

Rural The opposite of urban in that it relates to or is characteristic of the countryside rather than the town.

Scaffolding Frame structure used by construction workers on building sites, which is a strong, stable structure because of the triangular design.

Scale What you mark on the axes of a graph, which shows the relation between the units you're using and their representation on the graph.

Seedling Young plant developing out of a seed after it has germinated or started to grow under the right conditions.

Sense organ Part or structure of the body that responds to external stimuli by sending impulses to the sensory nervous system.

Sensing Ability of living organisms to detect change in their environment.

Serrated edge Having a jagged edge like a saw.

Solar energy Radiant light and heat from the sun that can be used to power equipment.

Solar system The collection of eight planets and their moons in orbit round the sun.

Solid Materials that keep their shape in a fixed form and take up a definite space.

Solidify A physical process that occurs when a material is cooled and changes form from a liquid or gas to a solid.

Sound wave The pattern of disturbance caused by the movement of energy traveling through a medium, such as air, water, or any other liquid or solid matter.

Species A kind or sort of animal or plant (classification).

Specifications A detailed description of the design and materials used to make something. They describe the things that the product or structure you are making needs to do.

Sphere A round solid figure, or its surface, with every point on its surface being an equal distance from its centre.

Sprout When a seed, cutting or root puts out shoots.

Stable	When an object or structure is not likely to give way or overturn and is firmly fixed.
States of matter	The different forms that matter takes on with the main difference being the structures of each state or the density of the particles.
Structures	Plants have different parts called plant structures, like roots, stems and leaves. Like plants animals can be grouped according to their different structures.
Structures	Buildings or other objects built by joining several parts of different materials together. Their functions are to protect, contain, support or span a gap.
Strut	Part of a structure that will support or hold another part in place to withstand compression. It can be an extra diagonal piece on the corners of a frame structure to add strength.
Substances	Matter that has a specific composition and specific properties. Salt water is not a substance but a mixture of two substances, water and sodium chloride.
Sundial	A device that tells the time of day by the apparent position of the sun in the sky.
Surface	The outside part or uppermost layer of the Earth.
Technology process	The process followed in designing and making products and structures.
Telescope	An optical instrument that with curved mirrors and lenses makes distant objects appear nearer. Rays of light are collected and focused, which magnifies the image.
Temperature	A measure of the warmth or coldness of an object or substance.
Tension	The state of being stretched tight.
Thermal energy	Energy that comes from heat, which is generated by the movement of tiny particles within an object. The faster these particles move, the more heat is generated.
Thermometer	Instrument used to measure temperature in degrees Celsius (°C).
Tie	Connector like a bolt that is designed to withstand tension.
Toughness	The property a material has of being strong enough to withstand adverse conditions or rough handling.
Traditional	When something is part of a particular culture and has been done the same way for a long time.
Transfer	The act of moving energy from one place to another place.
Transpiration	Water is carried through the plant from the roots to small pores on the underside of leaves, where it changes to water vapour and is released to the atmosphere.
Tubing	Materials for supporting weight can be strengthened by shaping them into a tube, which may be circular, square, triangular or even in a U-shape.
Ultraviolet rays	Invisible radiation from the sun found in sunlight. UV rays are shorter than visible light but longer than X-rays and make up 10% of the total light output of the sun.
Vacuum	A space entirely devoid of matter so without a medium sound will not travel.
Veins	Vessels that support the leaf structure; and transport water and nutrients to the leaf and plant food from the leaf to the rest of the plant.
Vertebrate	Animals like mammals and snakes that are grouped by if they have a backbone or spinal column.
Vertical	Describes a line or area that rises straight up, such as a telephone pole or a tree.
Vibrate	To move back and forth or from side to side with very short, quick movements.
Vocal chords	Membranes stretched horizontally, from back to front, across the larynx, which vibrate and change the flow of air being expelled from the lungs during speaking.
Volume	Perception of loudness from the intensity of a sound wave, which means the higher the intensity of a sound, the louder it is perceived in our ears, and the higher volume it has.
Waning	Waning is the opposite of waxing, which is the term for the moon decreasing after a full moon.
Water cycle	Continuous cycle of water evaporating from the Earth's surface, rising into the atmosphere, cooling and condensing into clouds, and falling again to the surface as precipitation.
Water vapour	Water in its gaseous invisible state-instead of liquid or solid (ice).
Waterproof	A material that keeps out water.
Waxing	This term means the moon is getting larger in the sky, moving from the new moon towards the full moon.
Wetland	Land consisting of marshes or swamps and water saturated land.
Wood and plant fibre	Raw material in the form of fibre obtained from trees, and used especially in the manufacturing of paper.
X-axis	The line on a graph that runs horizontally (left-right) from zero on the bottom.
Y-axis	The line on a graph that runs vertically (bottom-up) on the left.