Natural Sciences and Technology

Grade 5

Teacher Guide

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Natural Sciences Grade 5 Teacher Guide

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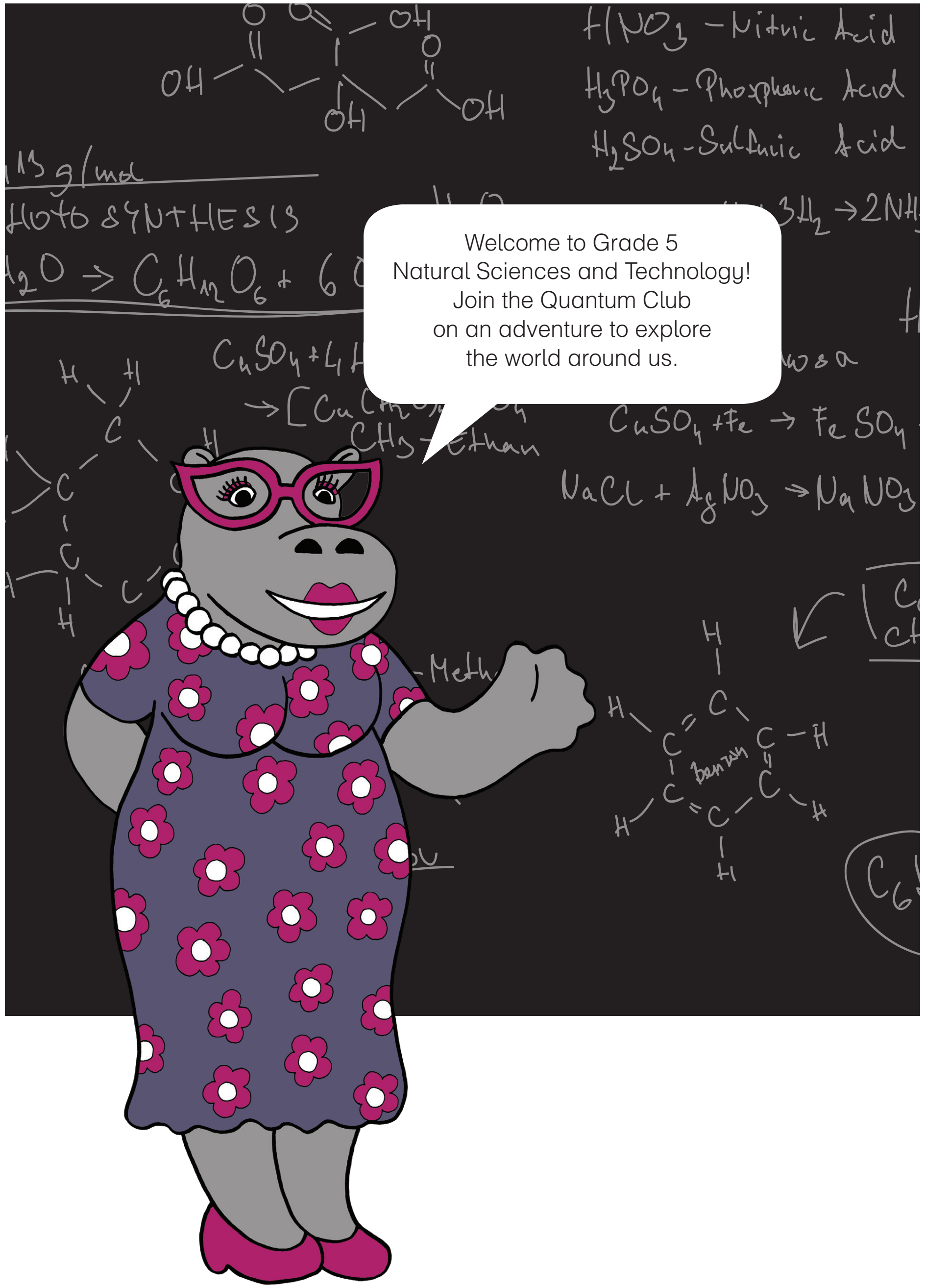
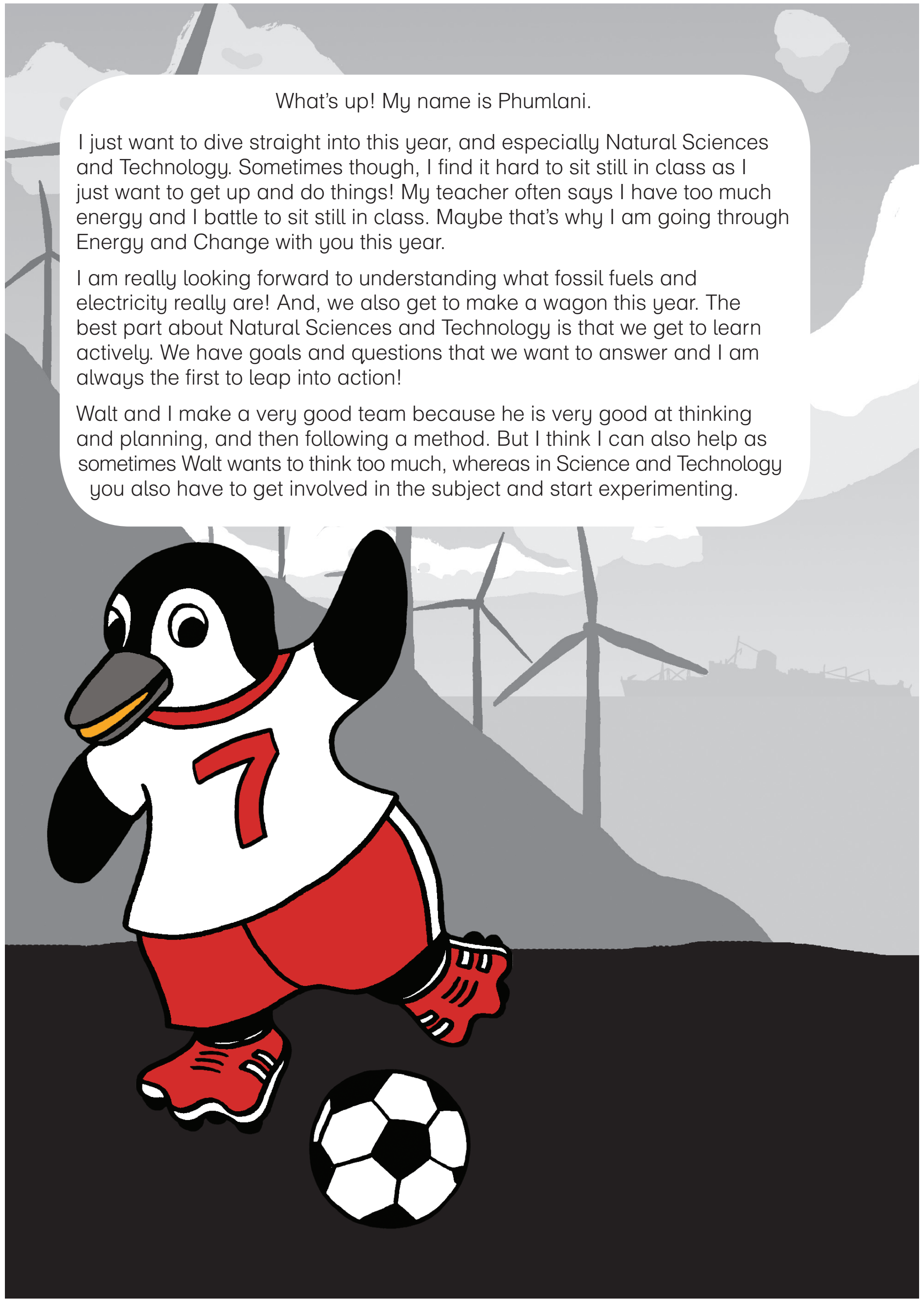



Hi there! My name is Mothusi.
My favourite subjects at school are where I get to be creative and imaginative. But, did you know, this is not only in the art or drama classroom? We can also be creative in the ways we do Science and Technology. This is especially true when thinking about new ways to answer 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 kitchen! Do you know how many interesting substances you can find there? I use these substances in my experiments.
This is why I am really excited to be going through Matter and Materials and Processing with you. We are going to learn about all sorts of materials around us. Especially about metals and processing materials and non-metals.
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 fossil fuels and electricity really are! And, we also get to make a wagon 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.
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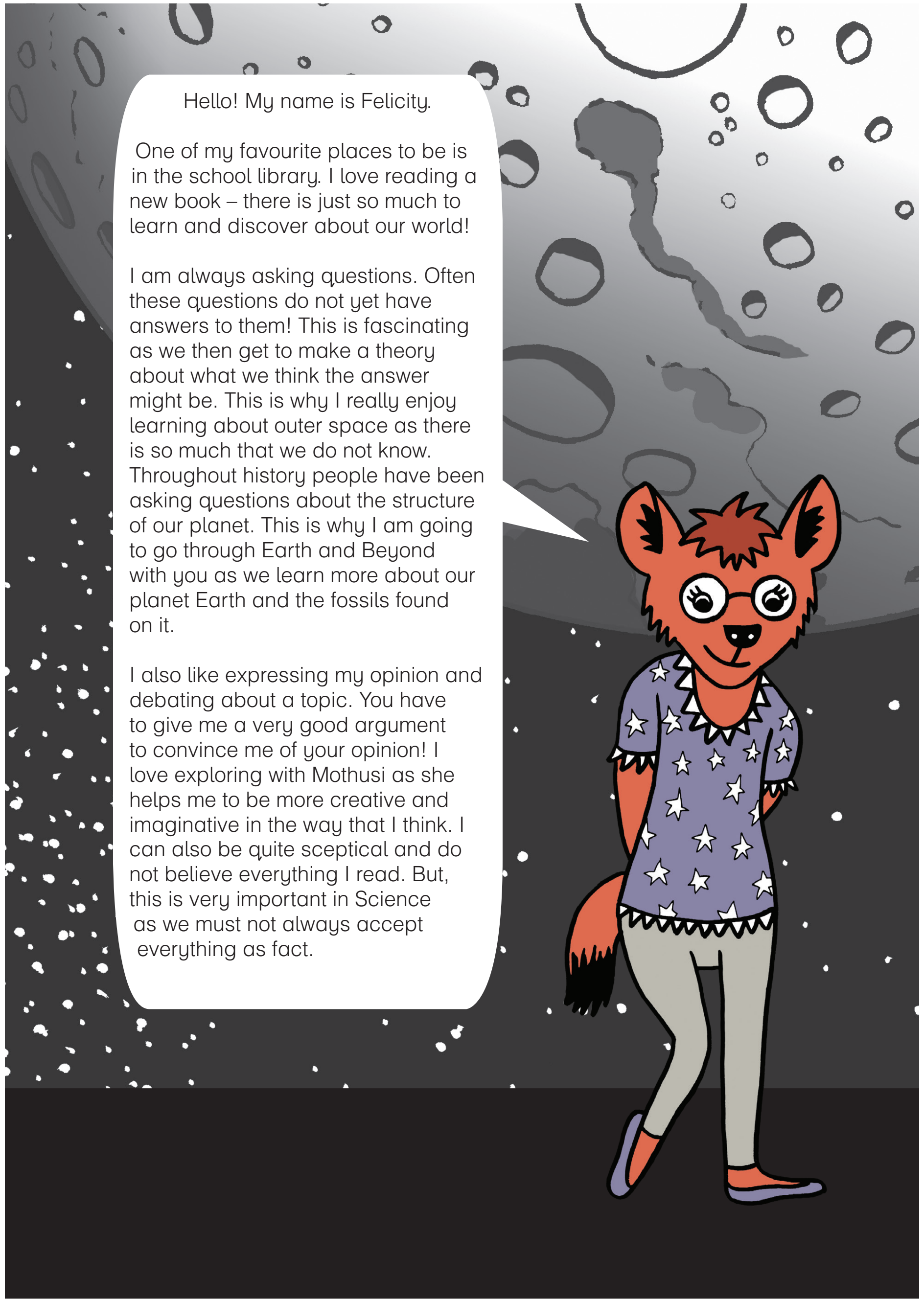
Hello! My name is Felicity.
One of my favourite places to be is in the school library. I love reading a new book – there is just so much to learn and discover about our world!
I am always asking questions. Often these questions do not yet have answers to them! This is fascinating as we then get to make 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 the structure of our planet. This is why I am going to go through Earth and Beyond with you as we learn more about our planet Earth and the fossils found on it.
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

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. Plants and animals on Earth	2.5 weeks (8.75 hours)
2. Animal skeletons	1.5 weeks (5.25 hours)
3. Skeletons as structures	2.5 weeks (8.75 hours)
4. Food chains	1.5 weeks (5.25hours)
5. Life cycles	2 weeks (7 hours)

Matter and materials and processing

Chapter	Time allocation
1. Metals and non-metals	2 weeks (7 hours)
2. Uses of metals	2.5 weeks (8.75 hours)
3. Processing materials	3.5 weeks (12.25 hours)
4. Processed materials	2 weeks (7 hours)

Energy and change and systems and control

Chapter	Time allocation
1. Stored energy in fuels	3 weeks (10.5 hours)
2. Energy and electricity	3 weeks (10 hours)
3. Energy and movement	1 week (3.5 hours)
4. Systems for moving things	3 weeks (10.5 hours)

Planet Earth and beyond and systems and control

Chapter	Time allocation
1. Planet Earth	1 week (3.5 hours)
2. Surface of the Earth	2.5 weeks (8.75 hours)
3. Sedimentary rock	2 weeks (7 hours)
4. Fossils	2.5 weeks (8.75 hours)

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Life and living

1 Plants and animals on Earth

KEY QUESTIONS

- What is the coldest place where animals live?
- How deep is the sea? Are there animals and plants down there?
- Where is the highest mountain on earth? Do plants and animals live up there?
- Do you get living things in the desert?
- What are vertebrates and invertebrates?

Did you know?

Plants and animals need water to live. Scientists search for water on other planets because they hope that if they find water they might find life forms there as well!

You might have heard that people say our planet Earth is the Blue Planet. If astronauts in space look down on Earth, the water that covers more than two thirds of the planet makes it look as if the planet is blue. Thousands of plants and animals can live on Earth because there is water.

The many plants and animals that live on Earth choose special places to live. The place where a plant or animal lives is called its habitat.

There is a special word we use to talk about all the animals and plants in their different habitats. This word is biodiversity. When you study the biodiversity of a specific area, you look at all the different kinds of habitats in that area, including its animals and plants.

QUESTIONS

Discuss this in class: Why is it important to study the biodiversity of our planet? Then write down some of the main points from your class discussion.

Teacher's note

1. We recommend that teachers visit this website: goo.gl/zxGPk – there are many videos and powerpoint presentations, graphics and hand-outs for teachers and students to use!
2. Consider labeling S different areas in your class with large signs for each of the different types of habitats. As you work through the section on each habitat, you can put key words and phrases up under these headings.
3. ***Become an Expert:*** Make enough labels for all the learners in your class. Write the S different habitats on each label and put the labels in a "hat" for learners to pick out of the "hat". Whichever habitat they choose they will have to ***Become an Expert*** of that habitat and know what plants and animals live there. After you have discussed the different types of habitats from the textbook, they will be required to make a display of the animals and plants within their specific habitat. They will put up their display at the area (where you stuck the heading) that you placed in the class and will have to use the words that you displayed in their work.
4. If you want to / can combine this with Home Language they can present their habitat as an Oral to the class.
5. After the oral presentation teachers are encouraged to hold a class quiz as a plenary activity. Divide the class in two groups with teachers asking questions about each habitat. The teacher calls on learners from each group to answer a question for 3 points. If said learner could not answer then the other group can have a chance for 2 points. If that group's learner gets it wrong a learner from the first group can answer the question – if correct they can get 1 point. It is crucial that absolute silence reigns while you ask and while learners answer the question to prevent other group members helping the learner whose turn it is. Teacher can deduct marks from a group if there are learners who shout out or behave in an unruly manner.

1.1 Many different plants and animals

The Earth is home to the most amazing diversity of animals and plants. Each animal and plant naturally chooses where it wants to live, its habitat.

We can identify different types of habitats on earth:

- Aquatic (water)
- Desert
- Grassland
- Forest

Within each habitat there are animals and plants that have adapted to live specifically in that environment. Let's take a look at some of the most common plants and animals that live in each of these habitats.

New words
- biodiversity
- aquatic
- breeding ground
- estuary
- extinct
- succulents

Water habitat

Many thousands of different animals and plants live in or near water in aquatic habitats. There are two main kinds of aquatic habitats – salty, marine habitats and freshwater habitats. The plants and animals that live in these habitats are adapted to either live in salt water or in fresh water.

In South Africa there are examples of both kinds of aquatic habitats.

Our country has a long coastline with different habitats, where a variety of animals and plants live. Many animals live in and around the rock pools. They can withstand the harsh sun and the constant pounding of the waves.

Did you know?
"Aqua" means "water" in Latin. A word with "aqua-" normally has something to do with water, like aquatic or aquarium.

Seagulls resting on the shore.

Starfish are found in rock pools along the coast.

QUESTIONS

Discuss this in class: Why is it important to study the biodiversity of our planet? Then write down some of the main points from your class discussion.

Teachers are encouraged to use this opportunity to introduce and/or raise environmental concerns and to emphasise that the more we know about the biodiversity of our planet the more we know how to protect it. It is also suggested that teachers discuss the importance of people valuing the diversity of plants and animals on earth. If we value diversity we are able to see that each plant and animal that gets driven to extinction is a tremendous loss for the whole earth. Perhaps point out that a plant or animal that went extinct might have held the key to curing terrible diseases or teaching us how to combat problems such as soil erosion.

Teacher's note

Teachers can use the following activity to gauge each individual learner's geographical understanding of places in our country. Many would not have been exposed to maps and might not know where they live. Use this opportunity as a teaching activity to give learners a brief overview of South Africa's map. Also emphasise where North is!

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Did you know?

South Africa is the only place on Earth where the great white sharks have learnt to jump out of the water when they catch seals (off Seal Island in False Bay).

A rocky coastline with rock pools.

Our seas are also filled with animals of all shapes and sizes. Large mammals like whales and dolphins swim in our seas.

Dolphins playing in the waves.[1]

A southern right whale with her calf off the coast of Hermanus, a popular breeding ground for whales in September.[2]

Did you know?

Female dolphins are called cows, males are called bulls and young dolphins are called calves.

The sea is also home to many schools of fish. The coral reefs off the South African coast, especially on the east coast such as Sodwana Bay, are very rich in fish and animal species.

Where a river runs into the sea a special area called an estuary develops. The fresh water from the river mixes with the salty sea water. You can often find mudskippers here – fish that can hop onto land and into trees!

Mudskippers live in estuaries, but they can hop onto land and into low branches.[3]

ACTIVITY 1.1: Identifying marine animals and plants

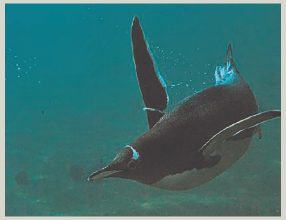
INSTRUCTIONS:

1. Carefully study the photos of different marine animals and plants off South Africa's coast.
2. Then answer the questions about these pictures.

Crab[4]

School of fish[5]

A crayfish in the shallow water.[6]



A penguin diving down under the water.[7]

Did you know?

The waters off South Africa's coast is home to a rare fish – the coelacanth! Scientists thought this prehistoric fish was extinct until they found living coelacanths in South Africa's waters.

The stars in the speech bubble indicate that an activity needs to be performed.

Green seaweed flowing in the water.[8]

Mussels growing on the rocks.[9]

Sharks[10]

Jellyfish[11]

Kelp seaweed[12]

Turtles[13]

QUESTIONS:

1. Can you imagine how difficult it must be to live on rocks being pounded by waves all day and all night long? Which animals in these photos live on or near the rocks?
2. Describe at least three different ways that animals protect themselves against the pounding waves.
3. Carefully study all the animals in the picture and find things that some animals have in common. Classify the animals into groups based on these similarities.

QUESTIONS:

1. Crabs, crayfish, seaweed, mussels
2. Some have a hard shell like mussels and clams. Other animals hide under rocks during high tide and only come out in low tide when the sea is calmer. Some organisms, such as snails and seaweed, have very strong suckers to stick to rocks and withstand the pounding of the sea.
3. This revises Gr 4 work where learners had to classify and compare animals based on visual differences. Encourage learners to be as creative in their thinking and classifying as possible. Also encourage them to use visual clues.

4. Many eco-tourists like to visit our country and see the sights. Some tourists like to go on tours where they go into a cage that is lowered into the sea. The tour operators often chuck small pieces of meat into the water to attract sharks, which then swim around the cage. Do you think shark cage diving is appropriate? Explain why you think so.

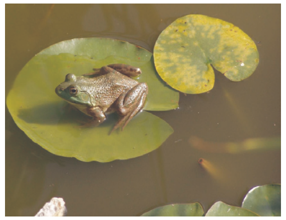
Let's now look at the plants and animals that live in freshwater, such as dams, ponds, streams and rivers.

Many animals live in or near freshwater ponds, dams and lakes, or rivers and streams. Small insects, snails, clams, crabs, frogs and fish live in or near water. Larger animals like turtles, snakes, ducks and large fish, as well as hippos and crocodiles also live in or near water.

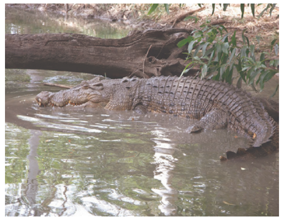
Did you know?
Sharks have amazing hearing. They can hear a fish moving in the water from as far as 500 metres away!

Ducks raise their chicks near plants where there is lots of food for their young in between the reeds and water plants.

Hippopotamus' live near to and in freshwater.



Can you see how this frog is resting on the lily pad?

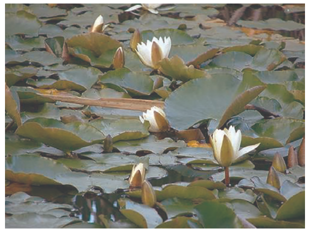


A crocodile lies by the side of a river.

4. Give learners scope (and permission) to differ from each other. Invite learners before they answer this question to discuss differing points of view on this topic. Some might be in favour of shark cage diving as it gives opportunities for research and study and makes people appreciate the sharks more. Others might agree with the minister and say that tourists might scare sharks out of their natural habitat and teach them not to fear humans and then they are easier to catch by other humans.

Did you know?
Waterblommetjie bredie is made from water lilies. Have you ever eaten it?

Some water plants have roots, for example water lilies and reeds. Water plants make oxygen for the animals to breathe and provide food for many of the animals.



Water lilies floating on the water.[14]

In South Africa we also have large wetlands where rivers slow down and the water stands still or flows very slowly. Wetlands provide food and shelter as a natural habitat for an incredible amount of animals: frogs, reptiles, birds (like ducks and waders) and fish are only a few of these!

ACTIVITY 1.2: Studying an aquatic habitat

MATERIALS:

- Pencil
- Paper
- Clipboard
- Sunblock and a hat

INSTRUCTIONS:

1. Work in groups and visit an aquatic habitat near your school. A stream or river, pond or dam, or perhaps a rockpool if you are near the sea.
2. Find examples of three different animals and three different plants that live in that environment.
3. Carefully study where they live and how you think the animals and plants are suited to their habitat. For example, answer these questions:
   a. Are the stems of the plants rigid or flexible?
   b. Do the plants grow inside the water or just outside?

c. What do the animals eat?
d. How do the animals breathe?

4. If possible, take some pictures of the plants and animals you observe. Or draw a diagram.
5. Report this information back to your class.

Deserts and semi-desert habitat

Deserts are areas that have a very low rainfall each year – in some deserts it only rains once every ten years!

The Namibian desert

The deserts may look dry, but there are many different plants and animals that are suited to living in these areas. Plants that can survive without much water in the desert are grasses, acacias, aloes, cactii and other succulents. Succulents are plants that can store their water in their leaves and stems, and survive well in dry climates.

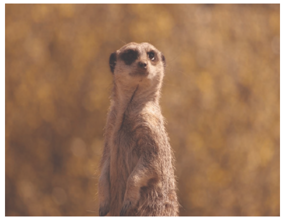
Can you see the thick leaves for storing water in this succulent plant?

Many animals live in deserts, such as the Kalahari. Some of these animals are:

- Predators such as lions, cheetahs and leopards, as well as hyenas and jackals.
- Large and small mammals, such as meerkats, giraffes, warthogs and porcupines.
- Antelope like eland, gemsbok, springbok, hartebeest, steenbok, kudu and duiker.
- Many species of birds including falcons, ravens, eagles, buzzards, hawks and turtle doves. The social weavers are small weaver birds that build family nests where hundreds of weaver families can live!
- Many different reptiles like puffadders, cobras, lizards, geckos and iguanas.
- A great many insects also live in the desert, such as bees and butterflies, grasshoppers and many more!

Did you know?

Elephants can change a forest area into a grassland in a matter of months! They pull branches from trees, eat the bark, smash the trunks, and eat the leaves and twigs.



An alert meerkat looking to spot danger.

A huge nest for social weaver birds.[15]

An eland.

A jackal looking for food.

Puffadder snake

Two warthogs looking for food.

Grassland habitat

Grasslands are covered in grasses and have very few trees. As soon as the first rains fall the grasses grow incredibly fast and new plants sprout all over the black earth. This is also the time when many animal babies are born as the new grass feeds the mothers to provide plenty of milk for the young.

QUESTIONS

List some of the animals that you think live in grasslands in your exercise books.

Forest habitat

A forest is a large area that is mostly covered in trees. Forests are extremely important for life on earth. The many trees clean the air and provide oxygen for the animals on earth to breathe. They also provide people with fuel, food, shelter, medicine and employment. Many animals live in forests, from large elephants and bears to smaller monkeys, squirrels, owls and woodpeckers.

We need to conserve (look after) our forests and stop people who want to chop down naturally growing trees. It is very important though to also conserve the many animals that pollinate trees and spread their seeds over large areas. Without these animals the trees would not be able to reproduce and will become extinct.

QUESTIONS

List some of the animals that you think live in grasslands in your exercise books.

Kudu, nyala, impala, zebra, buffalo, lions, leopards, other small mammals, many birds, etc

Inside the Knysna forest, one of South Africa's few indigenous forests.

An elephant in the Knysna forest elephant park.

I never realised South Africa has so many plants and animals. We have a really diverse country!

ACTIVITY 1.3: Counting plants and animals

MATERIALS:

- Something to mark out an area (such as stones or sticks to make the corners, and string to tie in between)
- Scrap paper
- Pencils and coloured pencils or crayons
- Clipboard
- Sunblock and hat
- Measuring tape or ruler

INSTRUCTIONS:

1. Work in pairs and take a walk with your class to a park or nature area outside your school.

Teacher's note

- Identify in advance an area where you can take your class to study animals and plants within a certain area. Ideally this can be within a Nature Reserve, park or school garden, where different types of habitats can be studied.
- If you are going to walk the class there, walk from the school to this area to ensure that there are no dangers along the way that you need to make the learners aware of before leaving the school.
- Study the area before the day of this activity. Make sure that you avoid areas with lots of litter and dangerous sharp or rusty items that might cause injury to learners. Carefully take note of the main plants and animals in that area. If possible take samples of these plants to class. Display the plant with its name next to it in your class. Before going on the walk show these plants one by one to the class.
- Teachers are encouraged to invite one or two people/parents with local plant and animal knowledge to come along on this nature walk to walk between pairs and help them with identifying different plants and animals. They can also help with escorting learners safely to the spot.
- Before leaving the class prepare learners for this activity. Explain that they are going to count the plants and animals inside their marked-out area. Tell learners that they may only count the plants and animals that are actually INSIDE the marked-out area or flying directly above it. They may not coax or carry animals into their marked-out area or take others that they don't like out of it.
- They need to distinguish between plants based on the size and shape of their leave, flowers or fruit. If you were able to arrange for parents to escort you the learners may ask them for help to identify which plants are in their hoola hoop.

2. Choose an area where you would like to work. Carefully mark out a section of your area with the sticks and string.
3. Study the animals and plants in that area. Make a drawing of the habitat showing all the plants and animals that you see there. Use scrap paper for this.
4. Do you know the names of these plants and animals? Perhaps an adult can help you name the animals or plants you don't know. Write the names of each animal and plant as labels.
5. Make sure that you have at least five examples of different plants and animals.
6. Measure the heights of the plants and record them in a table.
7. Collect leaves from two of the plants and make leaf rubbings as you did in Grade 4.
8. If there are any flowers or seeds, gently collect some and take them back to class. Your teacher will show you how to press them.
9. When you return to class make a neat copy of your drawing in your book.
10. In your exercise books, write a heading: Plants and animals we found in our habitat area.

1.2 Interdependence in an ecosystem

Plants and animals, humans, rivers, mountains – everything is connected in one way or another. All the living and non-living things depend on each other.

QUESTIONS

Do you think you are connected to or interdependent with plants and rivers? Discuss this with your class and write the answers in your exercise books.

Teacher's note

- Form a circle with the class – each learner facing the back of the learner in front of them. They must hold each other's waists. Make sure they are standing as close to each other as possible. Explain that they are all going to be interdependent on the other. They need to sit on each other's laps in this circle. If one fails or does not do their job properly the whole circle will collapse. If they all do their jobs properly the circle will work and remain intact.
- This bbc website is an excellent resource to read before starting this lesson: goo.gl/FKPDo
- This website provides two powerpoint slide shows – although they are far too advanced for learners at this level, they provide an excellent introduction to ecosystems and interdependence goo.gl/Tuk8X

QUESTIONS

Do you think you are connected to or interdependent with plants and rivers? Discuss this with your class and write the answers in your exercise books.

Teachers can use this question to assess the pre-knowledge and understanding of learners regarding ecological interdependence.

We say that animals, plants and their habitats are interdependent. That means they depend on each other to survive. If one part is left out, for example water during a drought, then the rest of the animals, plants and habitat might be destroyed!

New words
- ecosystem
- herbivores
- carnivores
- omnivores
- scavengers
- decomposers
- pollination
- nectar
- seed dispersal

We can group interdependence into two main groups:
1. The interdependence in an ecosystem between living things: when we talk about how animals and plants are interdependent.
2. The interdependence in an ecosystem between living and non-living things.

Interdependence between living things

Many plants and animals depend on each other for different things. Let's have a look at some of these.

Interdependence and feeding

Animals depend on plants and each other for food. We get the following groups of animals:
- Herbivores eat plants.
- Carnivores eat the animals that eat the plants.
- Omnivores eat plants and animals.
- Scavengers feed off dead animals and plants.
- Decomposers eat and break up the dead animals and put the chemicals from their bodies (carbon, phosphorus and nitrogen) back into the soil to feed the plants.

Did you know?

Sometimes farmers don't have enough bees on their farms to pollinate their crops. They rent hives from travelling bee hive managers who bring their hives to pollinate the farmer's crops.

Interdependence and pollination

Plants also depend on animals for pollination. This is when the pollen of one flower travels to another to fertilise it.

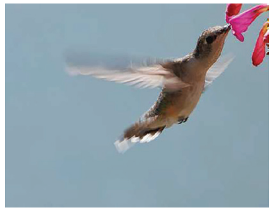
We call animals that pollinate flowers pollinators. Plants produce something that attracts pollinators. This is often nectar, a special smell or a brightly coloured flower, but it can also be a safe place to lay their eggs. Some plants even make their flowers look like female wasps to attract male wasps!

Bees about to collect nectar and, at the same time, pollinate the flowers.[16]

Plants and animals depend on each other. Many flowering plants depend on bees to pollinate them. Bees depend on the nectar inside the flowers to make their honey. Without the nectar they cannot make honey, and without the pollen the flowers cannot fertilise their seeds – and will not be able to reproduce or live eventually.

QUESTIONS

Bees are not the only animals that can pollinate flowering plants. What animals do you think can pollinate a tree's flowers? Look at the pictures:



Bird feeding off the nectar and pollinating the flower.[17]

A wasp feeding off the nectar and pollinating the flowers.[18]

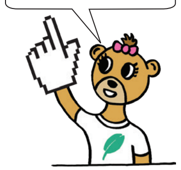
Did you know?

A third of everything we eat is there thanks to pollinators! We really depend on pollinators for our food!

A beetle feeding off a flower. As it moves around the flower, it also pollinates the flower.[19]

Visit

Video on pollinators. goo.gl/y7kAh



A world without pollinators would be very 'unsweet'. Look at the following things that we eat and drink, which all depend on pollinators.

QUESTIONS

Bees are not the only animals that can pollinate flowering plants. What animals do you think can pollinate a tree's flowers? Look at the pictures.

Birds, beetles, wasps, ants, honey eaters, etc

Teacher's note

Teachers are encouraged to let children discuss the type of animal that can pollinate a tree's flowers based on their physical characteristics. Perhaps ask if they think a tortoise or a bat is more likely to pollinate a tree's flowers. Then discuss why they say so. Also include a question that makes them think about the tree's adaptations to let fruit bats for example pollinate it – the flowers need to be open during the night for example to attract bats and therefore they won't need to have bright petals, but the petals will need to be bigger to allow the bat to find it using eco-location!

Teacher's note

Teachers should try and watch this video with their classes – it is very well done and explains everything at a Gr 4 / 5 level with illustrations, young actors the learners' age, etc. The quality of the video isn't great so it wouldn't work to stream it on a large screen but perhaps a novel idea would be to ask everyone to bring in their cell phones and watch it together or to let them watch it on the computers in the computer lab?

Without pollinators, we would not have blackberries and raspberries to eat.[20]

Strawberries are delicious! The fruits are produced once the flowers on the strawberry plants have been pollinated.[21]

Lots of different types of nuts that form after pollination.[22]

Red and green apples are the fruits produced on apple trees after pollinators have pollinated the flowers.[23]

Interdependence and seed dispersal

Plants need to have their seeds spread over a wide area. If all the seeds fall in one spot, the plants that grow will not have enough water, soil or light to grow properly! Plants therefore make their fruit sweet and tasty. In this way they attract animals who will eat the fruit, walk a long way off and excrete the seeds. Where the seeds fall they will then have a rich, fertile soil (from the animal excretion) to grow in!

Other seeds stick to an animal's fur – they might not even know it's there! When they brush against a tree for example, the seed will just fall off. The plants depend on animals for seed dispersal.

ACTIVITY 1.4: The honey badger and the honeyguide

This is an example of interdependence between three different animals.

INSTRUCTIONS:

1. Read the story about the honey badger and the honeyguide below.
2. Answer the questions that follow.

The honey badger loves to eat honey! The honeyguide bird loves to eat bee larvae but cannot get into the beehive without being stung to death. The bird also cannot break the hive open. So when the honeyguide finds a beehive, it goes in search of a honey badger. The honey badger has a thick skin that bee stings do not easily get through.

The honeyguide then convinces the honey badger to follow it to the bee hive. The honey badger is able to use its strong legs, claws and teeth to break open the hive, and its thick coat protects it from being stung. After the badger has finished eating the delicious golden honey, the honeyguide can enjoy all the bee larvae!

Visit

The honey badger and honeyguide (video). goo.gl/G1OqG

QUESTIONS:

1. Why can't the honeyguide bird just eat some of the larvae without waiting for the honey badger?
2. How does the honey badger break open the hive?
3. Why does the honey badger not get stung by the bees?
4. Explain in your own words how this is an example of interdependence between three animals.

QUESTIONS:

1. The bird will get stung to death and cannot break open the hive.
2. It uses its legs, claws and teeth.
3. It has a very thick coat which the bees cannot get through.
4. Assess learners ability to rephrase and explain this scenario in terms of interdependence. Both animals benefit as they are able to get food. Without the bird, the badger would not find the honey and without the badger the bird would not be able to get to the larvae. Without the bees, the honey badger would not have larvae to eat and the honey bird would not have honey to eat.

Interdependence between living and non-living things

The living things are also dependent on the non-living things in an ecosystem. Living things depend on their environment for:

- Air (oxygen and carbon dioxide)
- Water
- Soil
- Food
- Shelter and a place to safely have their young.
- Places to hide from danger.

Water and oxygen are extremely important for all living things.

QUESTIONS

Have you ever wondered how the water 'gets' into the clouds if it runs in rivers and streams? Remember you did the water cycle in Gr 4.

Water that we drink from a tap or from a river, is all part of a gigantic system called the Water Cycle. The Water Cycle shows that we are all interdependent.

ACTIVITY 1.5: The Water cycle

INSTRUCTIONS:

1. The image on page 21 of the water cycle shows all the processes that take place.
2. Revise these processes with your partner.
3. Write a paragraph to explain the water cycle.

QUESTION:

1. You can change the water vapour you breathe out into water drops again! Find a mirror or window. Breathe on it. What do you see on the window?

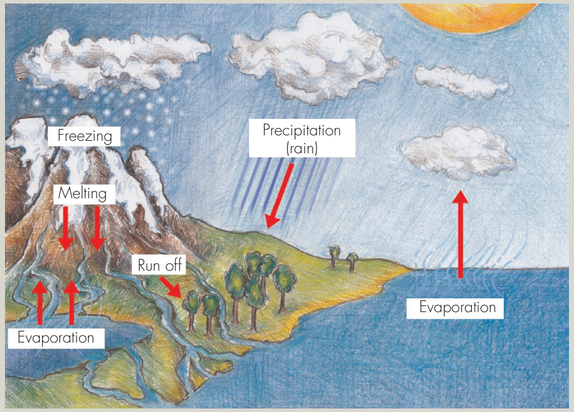
QUESTIONS

Have you ever wondered how the water 'gets' into the clouds if it runs in rivers and streams? Remember you did the water cycle in Gr 4.

Teachers can use this as an opportunity to discuss learners' preconceptions of the water cycle and to ascertain what they know or misunderstand in order to address this in the following section.

QUESTION:

1. See condensation on the window. Teachers can reinforce the concept that as soon as the mirror or glass warms up slightly the water drops on it will evaporate again.



The water cycle

Trees and other plants depend on the water in the soil. Other animals and plants depend on the water that runs down from the mountains in rivers and streams, and collects in lakes. Plants and animals in the sea depend on this water as it forms their whole environment that they live in.

ACTIVITY 1.6: Describing interdependence

INSTRUCTIONS:

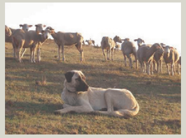
1. Work in groups and carefully study the animals on page 22.
2. See if you can identify the interdependence between the animals and/or plants, and the non-living things in their environment.
3. Discuss the interdependence with your group and make some notes on scrap paper.
4. Descriptions of each photo have been provided. You need to match the photo with the description by writing the correct letter next to each picture in your exercise books.

Chapter 1: Plants and animals on Earth 21

Teacher's note

Introducing this activity

After studying the interdependence of living and non-living things in their environment, this activity requires learners to identify interdependence between living organisms and their environment. If possible, collect books and information about the sets of animals in the photos in this activity. There should be enough for each group to have at least 4 or 5 books, printouts and/or other material. This can be used as a possible group project.

Picture	Answer	Description of interdependence
		**A:** Clownfish and anemones. Clownfish do not get hurt by the poison from the anemone. The clownfish feed on small creatures living in the anemone that may harm the anemone, and in turn the fish's waste nourishes the anemone. The anemone's poisonous stings protect the clownfish from predators.
		**B:** Earthworms in the soil. The earthworms are dependent on the soil for a place to live. They need rich, moist soil otherwise they will dry out if they are exposed to the dry air for too long. As earthworms dig through the soil they also excrete droppings back into the soil, which makes it more fertile for other plants and animals. As the earthworms dig, they also help to aerate the soil by creating tunnels.
		**C:** Weaver building its nest. Many birds rely on trees and plants to build their nests to raise their young. The weaver uses green reeds to build its nest. When the reeds are still green they are flexible and can bend. When they dry out they become harder and make a more stable, stronger nest.
		**D:** Rhino and oxpecker. The oxpecker picks ticks off the rhino as its food and frees the rhino from these pests. They also live on zebra, giraffe, buffalo, etc.
		**E:** Anatolian shepherd dogs and the herd of sheep they protect from cheetahs. Anatolian puppies are placed with a herd of sheep and they become attached to the sheep. When a predator (like a cheetah) comes near the flock the dog will chase them off. If the dogs are protecting a herd, the cheetahs are also protected because farmers will not kill them.

QUESTIONS:

1. Which interdependent relationship is between an animal and a plant?
2. Which interdependent relationship described is between an animal and the non-living things in its environment?
3. Which example in the photos involves the inter-dependence between three animals, and what are they?

Visit

Website about the Cheetah conservation project. goo.gl/Roayb

1.3 Animal types

We now know about some of the different habitats on Earth and in South Africa, and we know that animals and plants depend on each other and on their habitat. Let's look at the different types of animals that live on Planet Earth.

New words

- exoskeleton
- endoskeleton
- hydroskeleton
- molluscs
- segmented
- thorax
- abdomen

Grouping animals

When we group similar things together, we call this classifying. When classifying animals, there are really two main groups of animals – those who have bones inside their bodies with a backbone, and those who do not have bones inside their bodies.

- Animals with a backbone are classified as vertebrates.
- Animals without a backbone are classified as invertebrates.

ACTIVITY 1.7: Classifying animals

INSTRUCTIONS:

1. A radiographer takes x-rays of people and animal's bones. Tracey the radiographer took some interesting x-rays of five animals. Carefully look at these x-rays on page 24 and decide which animals are vertebrates.

   In your exercise books, write down the names of animals that are vertebrates.

QUESTIONS:

1. The weaver and the reeds it makes its nest from.
2. The earthworm and the soil.
3. The Anatolian Shepherds, the sheep and the cheetahs.

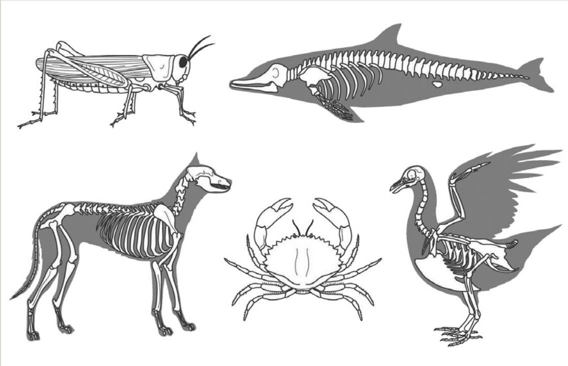
Teacher's note

Introducing this topic

This unit explores the different kinds of animals grouped into two main groups: vertebrates and invertebrates. CAPS refer to animals with bones and those without bones. The vertebrate groups are: mammals, birds, reptiles, frogs (amphibians) and fish. The invertebrate group are those without bones such as worms, millipedes, insects, spiders, scorpions and crabs.

Presentation hints

1. Introduce this unit with a class discussion comparing the different animals from the previous activity.
2. Ask learners to group the animals listed in only TWO groups. What do they look for? Let them come up with ways to classify. Some might group according to size (small or large) or on physical features such as limbs and body covering.
3. Explain the concepts vertebrate and invertebrate using the words bones and without bones. Make a table on the board showing animals that have bones inside their body and animals that don't have bones inside their bodies. The ask learners to write the names of the animals from their posters in the correct column.
4. Discuss how accurately they were able to classify the animals.
5. If possible make a poster for the wall displaying the animals that have bones inside their bodies and those without.
6. Make it personal: Ask them to feel their bones and specifically their backbone. (It is the line of bones down the middle of back.) Ask them in which group they would fall.



Different vertebrates and invertebrates

2. Why can you not see bones inside the crab or grasshopper's bodies?
3. What do we call animals like the grasshopper and the crab?
4. Study the animals from Activity 1.6 on interdependence. Decide if they are vertebrates with bones *inside* their bodies, or invertebrates *without* bones inside their bodies.
5. Copy the table below in your exercise books and write the name of each animal in the correct column.

Vertebrates with bones	Invertebrates without bones

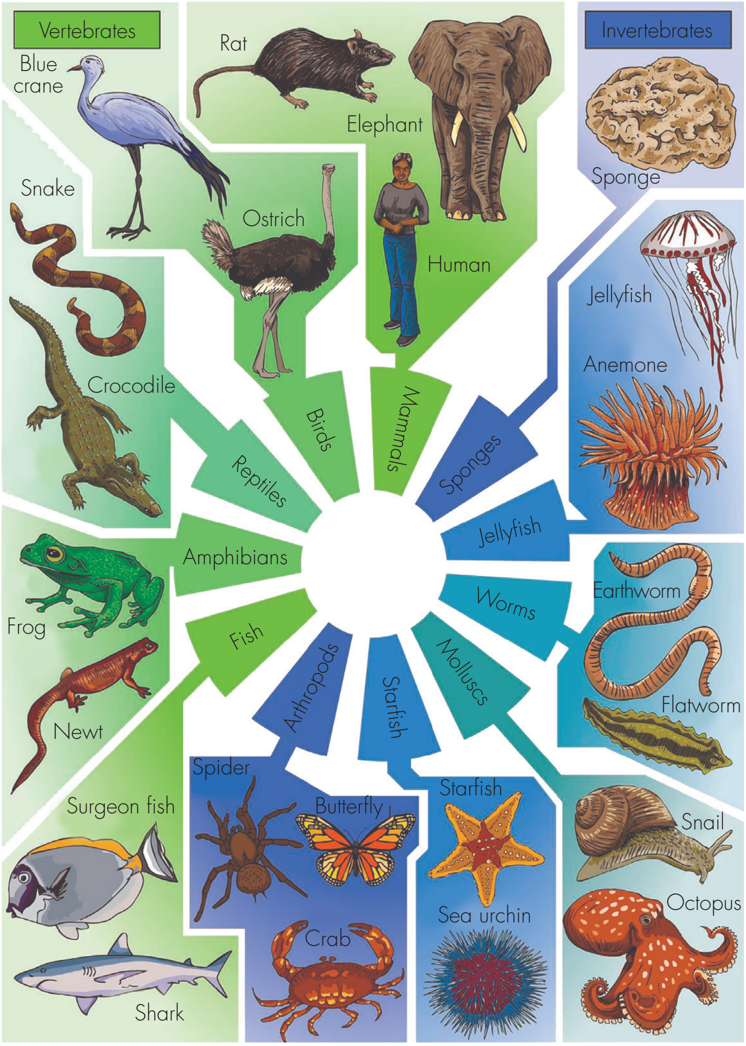
When people saw that they could group the animals into two main groups, they started grouping them into smaller groups within these two main groups. Look at this next illustration, which shows some of these groups.

INSTRUCTIONS:

1. dolphin, dog, seagull
2. They do not have bones inside their bodies but have a hard outer bony skeleton.
3. Invertebrates.

5.

Vertebrates with bones	Invertebrates without bones
Rhino, Ox pecker, Weaver, Anatolian sheepdog, Sheep	Earthworm, Sea anemone



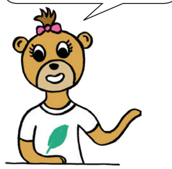
Classifying animals

QUESTIONS

1. Look again at the illustration of all the different groups.
2. Why do you think the animals were put into a left group and a right group?
3. Vertebrates are divided into five groups. What are these groups?
4. One of the birds in the illustration is South Africa's national bird, which one is it?
5. Give two examples of an arthropod.

Did you know?

If 'hydro' is in a word that word generally has something to do with water!



Let's now have a closer look at invertebrates and vertebrates.

Invertebrates

Invertebrates are animals that do not have an endoskeleton or a bony skeleton inside their bodies. Some have a hydroskeleton and some others have an exoskeleton.

QUESTIONS

Look at the illustration of all the classes of animals on page 25 again. Can you find other examples of animals with no bones inside their bodies (endoskeleton) and with no hard outer skeleton (exoskeleton)? Write the answers in your exercise books.

These soft-bodied animals mostly have what we call a hydroskeleton. Examples of animals with a hydroskeleton are:

- sea anemones
- earthworms
- jellyfish
- some starfish and sea urchins

QUESTIONS

1. Look again at the illustration of all the different groups.
2. Why do you think the animals were put into a left group and a right group?
3. Vertebrates are divided into five groups. What are these groups?
4. One of the birds in the illustration is South Africa's national bird, which one is it?
5. Give two examples of an arthopod.

2. This question is meant to reinforce the learner's understanding and recognition of vertebrates and invertebrates.
3. Mammals, reptiles, birds, amphibians and fish.
4. The Blue Crane
5. Spider, butterfly or crab

QUESTIONS

Look at the illustration of all the classes of animals on page 25 again. Can you find other examples of animals with no bones inside their bodies (endoskeleton) and with no hard outer skeleton (exoskeleton)? Write the answers in your exercise books.

bath sponge, sea anemone, jellyfish, flatworms, octopuses and earthworms.

Animals with such a body often need to live in or near water or damp soil. Their skins are often thin and moist because they breathe through their skin.

An earthworm needs to live in damp soil.[24]

A jellyfish has a hydroskeleton.[25]

Invertebrates that have a tough hard covering over their soft bodies have an exoskeleton or an external skeleton.

QUESTIONS

Can you think of any invertebrates that have exoskeletons? Write your answer in your exercise books. Have a look at the illustration on page 25 again if you need some ideas.

Many invertebrates have a shell covering their bodies to protect them.

Underneath a starfish. Can you see the little "legs" sticking out of the exoskeleton?[26]

Sea shells protect the soft bodies of invertebrates.[27]

QUESTIONS

Can you think of any invertebrates that have exoskeletons? Write your answer in your exercise books. Have a look at the illustration on page 25 again if you need some ideas.

starfish, butterfly, millipede, crab, spider

Did you know?
Hermit crabs have very soft bodies, not like their other crab and crayfish family. The hermit crab finds an empty shell and settles down inside. When the crab grows too big for the shell, it moves out and finds a bigger shell!

Have you ever walked along the beach and picked up shells? I love picking up shells to make things, such as mobiles and necklaces!

A hermit crab hiding safely in a hard shell.[28]

The hermit crab now decides it is safe to walk around.[29]

Did you know?
97% of animals alive today are invertebrates! (That means almost all animals are invertebrates!)

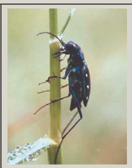
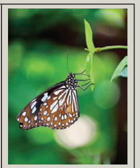
Insects are in an interesting group of invertebrates:

- All insects have exoskeletons.
- They all have segmented bodies and legs. That means their bodies and legs are made up of different sections.
- Insects have six legs and three main body parts – a head, chest (thorax) and a tail (abdomen).

ACTIVITY 1.8: 1, 2, 3, 4, 5 ... once I caught a bug alive!

INSTRUCTIONS:

1. Study the photos of the invertebrates in in the table below.
2. Can you see if they have a head, thorax and tail or abdomen?
3. Carefully count their pairs of legs. (If you can see all their legs!)
4. Do they have any wings?
5. Copy the table below in your exercise books and write the amount of legs and/or wings each invertebrate has.
6. Describe how each animal's body is covered.

	 30	 31	 32
Legs			
Wings			
Coverings			

Vertebrates

Vertebrates are animals that have a skeleton inside their bodies called an endoskeleton. Part of their skeleton is a backbone with a hollow nerve tube inside it. Vertebrates are broken down into five smaller groups:

- Fish
- Frogs (amphibians)
- Reptiles
- Birds
- Mammals

Visit
Endoskeleton video: goo.gl/I5lsz

Teacher's note

Extension

Build a terrarium in your class for invertebrates. A terrarium is an enclosure, container, or structure adapted or prepared for keeping smaller land animals, esp. reptiles, amphibians, or terrestrial invertebrates under semi-natural conditions for observation or study or as pets; typically in the form of a glass-fronted case.

1. Find an old glass container that no one is using – with a lid.
2. Put about 10 – 15 cm of soil in the bottom.
3. Plant some ferns and other easy-to-grow plants in there.
4. Collect insects and other invertebrates and keep them in your terrarium. The plants growing inside the terrarium will produce oxygen for your little critters. Water the plants once a week or so.
5. Each learner can choose one specific invertebrate and keep a diary of that animal's "life" over the next 3 – 4 weeks.
6. The learners can then present their findings to the class.

Safety warning

Some learners might be allergic to some of the animals you find. Avoid bringing any potentially harmful animals such as stinging insects.

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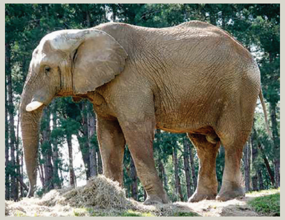
Animals with a backbone can grow bigger than invertebrates because their bones grow with them and support their muscles better.

ACTIVITY 1.9: Identifying common characteristics

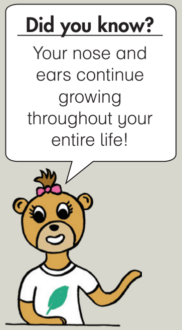
INSTRUCTIONS:

1. Work in pairs and study these photos of animals that all have an endoskeleton.
2. Identify characteristics that are similar in all these animals. Write down your observations in your exercise books.
3. Report back to the class and compare your ideas with those of your friends. Add to or change your observations in your exercise books.

Dog[33]



Elephant[34]



Frog[35]

Person

Teacher's note

Introducing this activity

The following section in the CAPS / textbook covers the animal skeletons in more detail. This activity practises learners' abilities to identify common features or characteristics, but more so helps them appreciate that learning can happen within an interdependent community of learners working together. Teachers are encouraged not to "teach" this activity but to facilitate discussion by asking probing questions and walking between groups to make sure everyone remains on task.

Seagull[36]

Sharks[37]

Crocodile[38]

QUESTIONS:

1. Now complete this sentence in your exercise books. Write down all the characteristics which are common to animals with endoskeletons.

   Animals with endoskeletons all ...

2. Give two examples of mammals from the photos.
3. What type of bird is shown in the photos?
4. Give an example of a reptile.

Let's now look at the differences and similarities between exoskeletons and endoskeletons.

QUESTIONS:

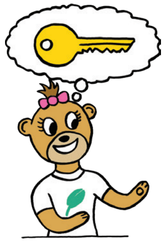
1. Animals with endoskeletons all have vertebrae, a spine and bones.
2. Elephant and dog
3. A sea gull
4. Crocodile

ACTIVITY 1.10: Extension – Comparing endoskeletons and exoskeletons

INSTRUCTIONS:

1. Divide into groups and carefully study the section on animal types. Focus especially on the differences between exoskeletons and endoskeletons.
2. Brainstorm as many differences between exoskeletons and endoskeletons in your group as you can think of.
3. Once you have brainstormed in your group, share your ideas with the class.
4. Copy the table below in your exercise books and record the comparisons you have discussed.

	Exoskeleton	Endoskeleton
Examples of animals		
Position of the skeleton		
Functions of the skeleton		
Muscle attachment		
Joints		
Mode of movement		



KEY CONCEPTS

- There are many different plants and animals.
- They live in different habitats on Earth.
- All the plants and animals, and their habitats make up the total biodiversity of the Earth.
- South Africa has a rich variety of indigenous plants and animals in different habitats.

Teacher's note

This extension activity is not required by the CAPS but is a good introduction to the following section on Animal Skeletons where the function of the skeleton is covered in great depth.

	Exoskeleton	Endoskeleton
Examples of animals	crab, bee	lion, human, bird, frog
Position of the skeleton	outside the body	inside the body, fluid-filled
Functions of the skeleton	protects, prevents drying out, supports	protects soft organs, support, movement, stores minerals in bones
Muscle attachment	attaches to inside of the exoskeleton parts	attaches by tendon onto the bones of the skeleton
Joints	only hinge joint	various joints between the bones
Mode of movement	walking, jumping, swinging, flying	walking, running, jumping, swinging, swimming, flying

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REVISION

1. Copy the table and match the type of habitat in the left column to the description in the right column.

   Next to each habitat write an example of an animal and plant that live specifically in that kind of environment. Choose animals that live specifically in that habitat.

Example of a plant and animal that lives in this habitat	Habitat	Description
	Forest	Even though the animals in this habitat can be the biggest on the planet, some of these giants only eat tiny plants!
	Desert	Many large mammals and other animals, and a range of plants and big trees live here.
	Aquatic	Very few trees grow here even though the soil is fertile.
	Grassland	Very few plants grow here because water is not common.

2. Write a short description of the interdependence of the honey badger, the honeyguide bird and the bees. Which animals benefit from this relationship and which do not?
3. Name the different types of skeletons.
4. In the table below write which kind of skeleton the animal has. Then in the next column write whether the animal is an invertebrate or a vertebrate.

Animal	Type of skeleton	Vertebrate or Invertebrate?
 *Grasshopper*[39]		

REVISION

1. Learners need to list appropriate animals – preferably from those we studied in this chapter
   - Even though the animals in this habitat can be the biggest on the planet, some of these giants only eat tiny plants! **Aquatic**
   - Many large mammals and other animals and a range of plants and big trees live here. **Forest**
   - Very few trees grow here even though the soil is fertile. **Grassland**
   - Very few plants grow here because water is not common. **Desert**
2. The badger doesn't know where the bee hive is so it cannot get honey. The honey bird knows where it is but it cannot get to the larvae inside the hive because the bees' stings will kill it. The badger has a thick skin that the bee stings cannot penetrate. The honey guide shows the badger where the honey is and the badger breaks open the hive, eats the honey and leaves the larvae to the honey guide. The bees make honey which the birds feed off and the badger eats the bees' larvae. The bees do not benefit from this relationship.
3. Exoskeleton, hydroskeleton and endoskeleton
4. Grasshopper: Exoskeleton, invertebrate
   Bluebottle: Hydroskeleton, invertebrate
   Cape Sparrow: Endoskeleton, vertebrate
   Tortoise: Endoskeleton, vertebrate
   Sea horse: Endoskeleton, vertebrate
   Frog: Endoskeleton, vertebrate
   Crab: Exoskeleton, invertebrate

Animal	Type of skeleton	Vertebrate or Invertebrate?
 *Bluebottle*[40]		
 *Cape sparrow*		
 *Tortoise*[41]		
 *Frog*[42]		
 *Crab*[43]		

I loved learning about some of the plants and animals that live on our planet Earth.

Let's now take a closer look at animal skeletons, including our own skeletons!

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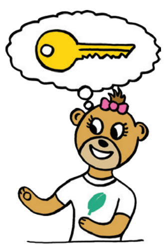
2 Animal skeletons

KEY QUESTIONS

- How does my skeleton look?
- Why do I have bones in my body?
- Do all skeletons look like mine?
- Can you tell if a skeleton belongs to an animal or a person?



2.1 Skeletons of vertebrates

As you now know, all vertebrates have bones inside their bodies and invertebrates do not have bones.

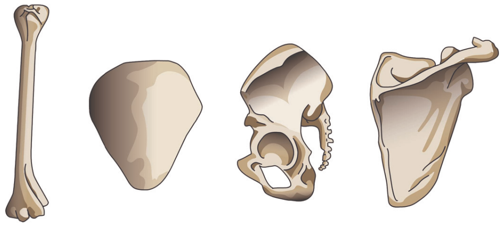
Every time a vertebrate animal moves, it uses its bones, joints and muscles to do this. In this section we are going to study the bones, joints and muscles that help vertebrates to move.

New words
- backbone
- skull
- spinal cord
- ribs
- shoulder blades

Bones

Bones are hard and form a very strong frame structure to support and protect a vertebrate animal's body.

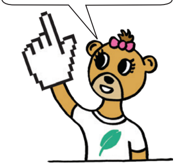
All vertebrates have similar kinds of bones – some are much bigger than others, but the basic structure of the bones are very similar.



Long bone | Short bone | Irregular bone | Flat bone

Different kinds of bones

Visit
The skeleton song.
goo.gl/SPfw1



Teacher's note

Introducing this topic

If possible, stick old x-rays on the windows before the class commences – when they walk in it would make quite an impact as to the nature of the lesson. Perhaps visit a local veterinary hospital and ask if they don't have old x-rays that you could use. If you have enough x-rays covering the windows the light in the class should be dimmed which will lend an element of eerie fascination to the lesson.

- Start by asking learners about skeletons and if they have ever seen a skeleton. Many at this age are quite 'into' skeletons and things that go bump in the night.
- Explain that you are going to learn about the skeletons of vertebrates. Because humans are vertebrates you will start by learning about their own skeletons and what the different bones are for in the body (their function). Then you will learn about the skeletons of other vertebrates and because you will know about the human skeleton, you will be able to compare its function to that of the human skeleton.
- Collect cereal boxes for their skeleton puzzles.

ACTIVITY 2.1: Identifying bones in your body

MATERIALS

- Photocopied bones puzzle picture of the human skeleton
- Photocopied labels that go with the picture of the human skeleton
- Scissors
- Glue
- Recycled thin cardboard such as a cereal box
- Pencils and ruler
- Colouring pencils if you want to decorate your skeleton

INSTRUCTIONS:

1. How many functions of the bones in the skeleton can you remember?
2. Your teacher will hand out a jumbled puzzle of the human skeleton. Carefully cut out each piece along the dotted line.
3. Build your human skeleton on the back of your recycled cardboard – do not stick it on yet as you might need to move it slightly if it does not fit properly onto the cardboard.
4. When you have it in place correctly, use glue to stick it to the cardboard.
5. Cut out the labels from the table.
6. Carefully pack the labels in the correct places. Do not stick these down until you have done all of them, as you might need to reposition them to fit it all in.

Did you know?

An adult has an average of 206 bones in their body!

Here are the words of a very old song that teaches you about bones. The chorus lines have been left out each time.

1. Work in groups and compose a rap rhythm and beat.
2. Compose your own tune or use an existing song to accompany these lyrics. Feel free to make or use instruments to accompany your singing.
3. Present your song to the class.

Teacher's note

Teachers must emphasize that learners cut only on the dotted lines. This is a good activity to assess learner's fine motor, spatial and hand-eye coordination skills as this impacts many other areas where learners might battle in their schoolwork and might give teachers some idea as to the types of problems they experience and how they can address these. We suggest that teachers walk through the class and carefully observe learner during this activity and assist those who need their help.

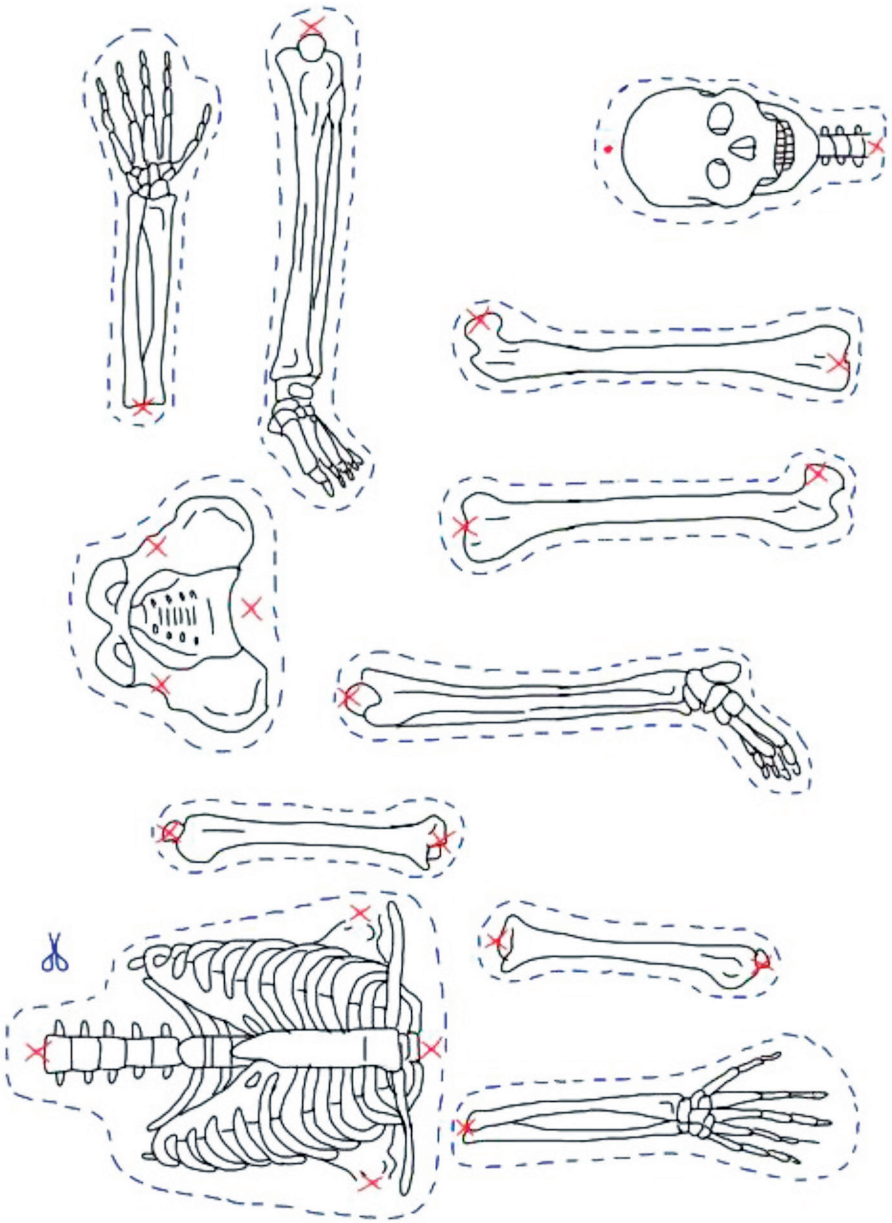
Teacher's note

Photocopy the bones puzzle sheet on the right, enough for each learner.

The labels below are for the bone puzzle and also need to be photocopied for the learners to cut out and add.

skull	foot bones	lower jaw bone
thigh bone	ankle bones	inner forearm
calf bone	toe bones	shin bone
ribs	backbone	wrist bones
kneecaps	hip bone	finger bones
tail bone	collar bone	hand bones
breast bone	arm bone	outer forearm

Teachers who feel industrious can enlarge this puzzle and make a "life-size" version to hang or stick on the classroom door. Add labels and stick a small box to the door for suggestions for a name for the skeleton.



The bone song

Your head bone's connected from your neck bone,
Your neck bone's connected from your shoulder bone,
Your shoulder bone's connected from your back bone,

So ...
Your back bone's connected from your hip bone,
Your hip bone's connected from your thigh bone,
Your thigh bone's connected from your knee bone,

So ...
Your knee bone's connected from your leg bone,
Your leg bone's connected from your ankle bone,
Your ankle bone's connected from your foot bone,
Your foot bone's connected from your toe bone!

So ...

Now that you know where all the bones in the body are, you are probably wondering what exactly each bone's job is. Let's find out!

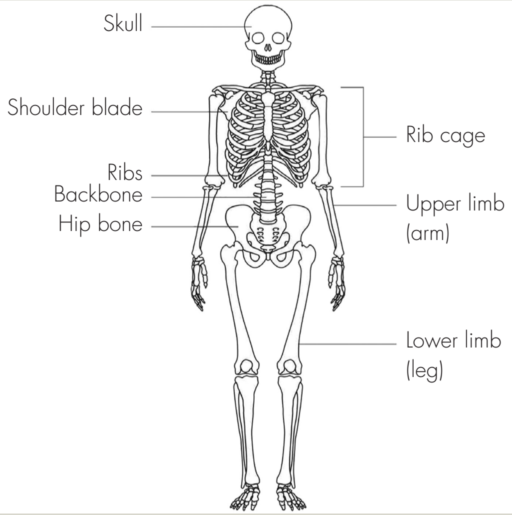
ACTIVITY 2.2: The bones in the human skeleton

INSTRUCTIONS:

1. Examine your skeleton puzzle. This illustration of the human skeleton on page 38 might also help. Pay special attention to the shapes of different kinds of bones.
2. Can you identify examples of the four different kinds of bones? Write the examples of each kind of bone that you can find in this table.

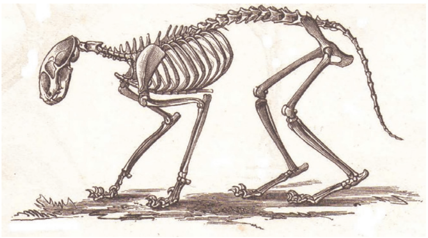
Type of bone	Where in the vertebrate body can you find it?
Long bones	
Short bones	
Flat bones	
Irregular bones	

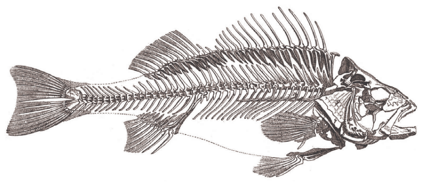
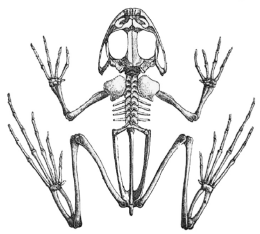
Type of bone	Where in the vertebrate body can you find it?
Long bones	arms, legs, finger bones and feet bones
Short bones	wrist and feet
Flat bones	hip bones, skull, sternum (chest bone) and shoulder blade; ribs are also considered flat bones
Irregular bones	irregular bones vertebrae/ backbone; jawbone



The human skeleton

3. Now see if you can identify these bones in some other vertebrate skeletons! Use this key to show on the picture of the skeleton where the different bones are:
   - L = Long bone
   - S = Short bone
   - F = Flat bone
   - I = Irregular bone

Cat skeleton


Fish skeleton

Frog skeleton


QUESTIONS:

1. Which of the animals is a mammal?
2. Which is an amphibian?

Functions of the bones in a vertebrate skeleton

Now that you know how to identify the different kinds of bones in vertebrates, let's take a closer look at the functions of some of these bones.

The skull

Vertebrate skulls are made up of different bones that grow together to form a protective 'box' or 'shell' structure.

- The skull protects the eyes and ears, nose and mouth.
- It protects the brain.
- Vertebrates' teeth and lower jaw is also attached to the skull.

QUESTIONS:

1. Cat
2. Frog

Teacher's note

Remind learners that we study the human skeleton as an example of a vertebrate but that most vertebrates share the same structure of the bones and that these bones' functions are similar.

NatSci&Tech_Gr5_TG_Book.indb 38 2018/05/18 12:28:54 PM

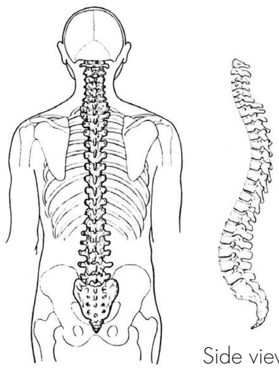
QUESTIONS

Can you identify the animals that each of these skulls belong to? Write the names in your exercise books.

Did you know?

A baby and an adult do not have the same amount of bones. When a baby is born, their skull bones are not joined. The bones can move over each other to allow the baby to go through the birth canal! After birth the skull bones start to grow together!

The backbone



The human backbone and vertebrae

QUESTIONS

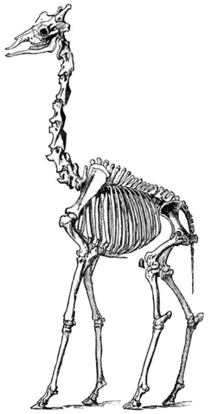
Can you identify the animals that each of these skulls belong to? Write the name in your exercise books.

	
crocodile skull	horse skull
	
rhinoceros skull	human skull

- The backbone is made up of vertebrae.
- A hole runs through the middle of each vertebrae. The holes all light up to form a tube that the spinal cord lies in.
- The backbone has two functions (jobs):
  - It protects the spinal cord with all the nerves and vessels in it.
  - It supports the upper part of the body.

QUESTIONS

Compare the bones in the backbone of the giraffe below with that of the human above. What do you notice about the shape of the vertebrae in the neck and in the back of the giraffe and those of the human's neck and bones?



Giraffe skeleton

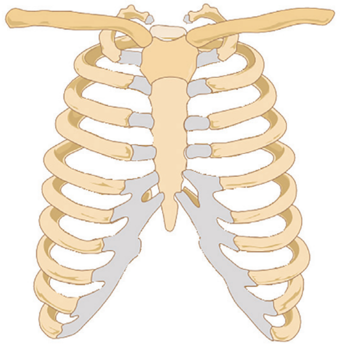
Did you know?

Giraffe only have seven vertebrae in their necks – go ahead and count them! That is exactly the same as in a human neck – and almost all other mammals.

The ribs

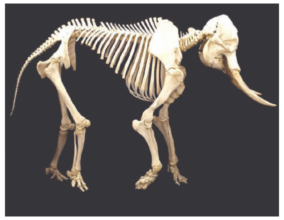
Vertebrates have long curved bones that we call ribs. These ribs are joined to the backbone and often to the front to form the rib cage.

- In most vertebrates the ribcage is around the chest area of the animal to protect the lungs, heart and other important organs.
- In animals like snakes, the ribcage can protect and support the whole body.
- The breast bone in birds is much longer. The flight muscles attach to this.

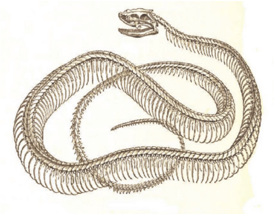


This is a human rib cage.

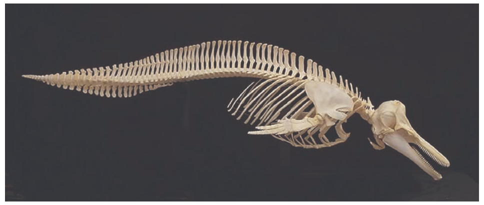
Many mammals have a similar shape rib cage. Compare the rib cages of these animals to your own.



An elephant skeleton – do you see the rib cage and backbone?



A snake's rib cage protects and supports almost the whole body.



Do you see the front limbs of a dolphin look just like the limbs of other mammals?

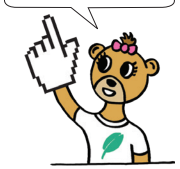
Shoulder blades, arms, legs and hip bones

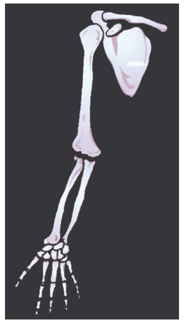
Vertebrates use their fore and back limbs for movement. Many animals' limbs are attached to their bodies at the shoulder or hip joints. However not all animals have hip or shoulder girdles – like fish and snakes.

- Muscles attach to the shoulder blades and they control the movement of the forelimb or arm.
- The lower or back limbs (legs) attach to the body at the hips.

Visit

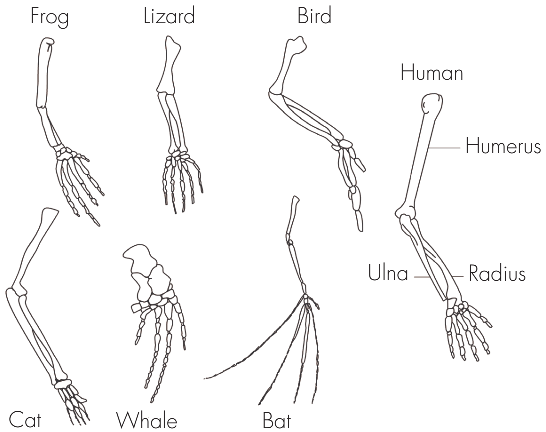
Skeletal system video:
goo.gl/D5wuL
goo.gl/TMRRy





The human arm. Can you see the flat shoulder bone and the long bones making up the arm?

The bones in different vertebrates' limbs look very similar. Look at the picture on page 44, which shows the limbs of different animals.



Different forelimbs of vertebrate animals.

New words
- ligament
- tendon
- joint

2.2 Movement in vertebrates

Now that you know a little more about a lot of bones, let's see how animals use their bones, joints and muscles to help them move.

QUESTIONS

Do you remember what a skeleton's function is? List as many of the functions of the skeleton as you can think of in your exercise books.

Vertebrate animals can move because of two really important things:

1. They have joints between their bones that can let their bones move.
2. Their muscles are attached to their skeletons.

If you want to know how an animal moves you need to know how their joints and their muscles work.

QUESTIONS

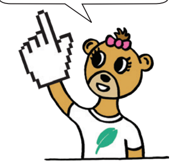
Do you remember what a skeleton's function is? List as many of the functions of the skeleton as you can think of in your exercise books.

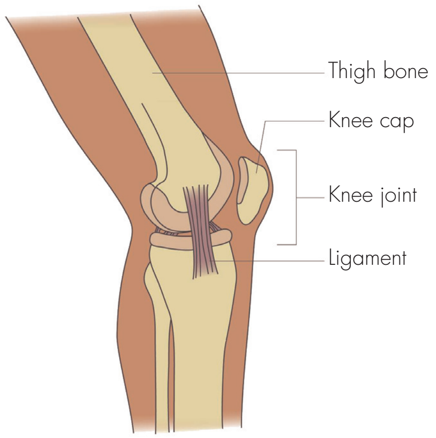
- The skeleton gives support and shape to their bodies.
- It protect soft organs and tissues.
- Muscles are attached to the bones.
- Muscles allow vertebrates to move around.

Joints

Joints are the places where bones come together. They come together in a special way to allow the animal or human to move – like at your elbow or wrist. There are different kinds of joints.

Visit
Types of Joints video:
goo.gl/5BhaI





This is a knee joint. Can you see that it is where the bones of the leg come together?

QUESTIONS

List 4 other places in your skeleton where you have a joint in your exercise books.

How do the bones and the joints move?

Let us look at an example of the arm moving. Look at the pictures on page 46. There are two muscles that enable your arm to move – your tricep and bicep. They work as a pair.

To bend your arm, the bicep muscle "contracts" and pulls on the radius bone. Your arm then bends at the elbow joint.

Teacher's note

Introducing this topic

There are many ways to introduce this topic and depending on the class' discipline and behaviour one might be inclined to choose one rather than the other.

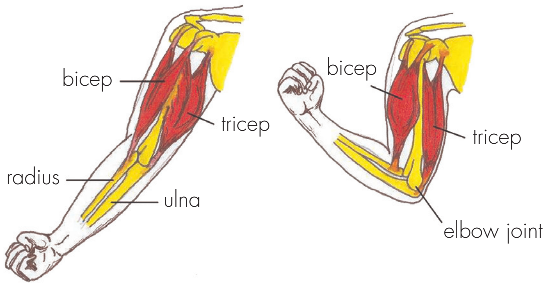
- Prepare a large variety of music genres: hip hop, classical, nursery rhyme, rock, gospel, orchestral, opera, metal, etc... If at all possible try to "copy" them into one playlist so each song plays at the most typical part for about 30 – 45 seconds. It's difficult to get into the sway of things when you have to wait for the intro of each song to finish and then for the teacher to take out and load another CD!
- Distribute scrap paper to half the class and ask them to take a pencil and hard book to press on and sit in a circle around an open space in the class or hall. The other half of the class will dance or move to the music. They will need to write down or quickly sketch as many different types of movements that the "dancing group" does to the different kinds of music.
- Swap over and let the "dancing group" observe this time.
- Discuss the different kinds of movement that they identified and try to make a chart or class mind-map – use words like: sway hips and arms; jump up and down with legs and feet; swing arms around wildly; jiggle whole body; nod head up and down; shake head; slide arms and legs across the floor; etc. Write this mind-map on a large sheet of paper to display in class. You will refer to this later.
- If possible combine this lesson with a lesson on the different kinds of verbs in Home Language teaching.
- Discuss what they think made them move: the muscles, bones and joints.

QUESTIONS

List 4 other places in your skeleton where you have a joint in your exercise books.

Elbow joint, shoulder joint, hip joint, joints between fingers, joints between toes, ankle joint, etc.

To straighten your arm, the tricep muscle "contracts" and pulls on the ulna bone.



The arm moves using muscles, joints and bones.

ACTIVITY 2.3: Describing movement in vertebrates

INSTRUCTIONS:

Now that you know that bones and joints are controlled by muscles to get you to move, let's look at some of the ways that muscles and bones can make you and other vertebrates move!

1. Play charades in two or four teams in your class.
   a. Your teachers will put the names of different animals in a hat.
   b. A person from one team pulls an animal's name from the hat.
   c. They may not make any noise or make any signals that will give the animal away!
   d. They need to mime the movement of this animal to their group.
   e. Three people in their group may have a turn to guess which animal they are miming. If all three get it wrong then the other team can guess what the animal is. If they cannot get it right then the 'mime-artist' must reveal their animal.

Points will be awarded as follows:

- 5 points for the first guess that is correct ... If this guess was wrong ...
- 4 points for the next guess that gets it correct ... If this guess is wrong ...
- 3 points for the next guess that gets it correct ... If this guess is wrong, ask the other team but the mime is not allowed to demonstrate their action again.
- 2 points for the other team if someone gets it correct the first try. If they get it wrong then ...
- 1 point for the last try. If they get it wrong then no points are awarded.

2. Choose three of the animal movements that your friends mimed that you really liked. Write down for each of these:
   a. The bones that were used to create that movement in the animal.
   b. The joints that were part of the movement.
   c. The muscles that controlled the movement.

KEY CONCEPTS

- A vertebrate skeleton (inside the body) has bones and joints.
- Bones are strong and form a strong frame structure.
- A skeleton protects the body.
- A skeleton supports the body.
- Vertebrate animals can move because they have muscles attached to the skeleton.

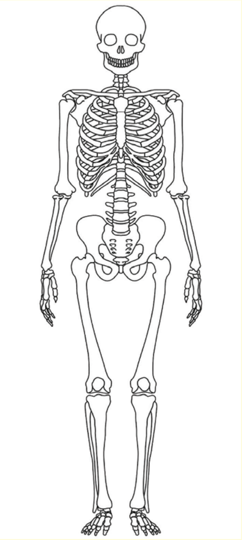
Teacher's note

Suggestion: depending on the class atmosphere and discipline teachers can choose to let the mime choose who should answer but it might be easier if teachers called the names of those who should venture a guess.

REVISION

1. What type of skeleton do you have?
2. What do all vertebrate animals have that makes them vertebrates?
3. What is a major difference between the skeletons of a mouse, a crab and an earthworm?
4. Below is a diagram of the human skeleton. Label the following on the diagram of the skeleton:
   - skull
   - backbone
   - ribs
   - rib cage
   - shoulder blade
   - hip bone
   - upper limb
   - lower limb

   Think of at least two other bones in the skeleton that we did not include in this list. Label them on the skeleton.



REVISION

1. Endoskeleton
2. Vertebrates have a backbone and skeleton inside their bodies.
3. A mouse has a skeleton and backbone inside their bodies. This is called an endoskeleton.

   A crab has no bones inside its body but a hard shell outside its body to protect it. This is called an endoskeleton.

   An earthworm has no bones inside its body nor does it have a casing on the outside like the crab. It has a hydroskeleton which is fluid support.

5. Joints help us to move. Look again at the diagram of the human body. Add in labels to show where you can find an example of the following:
   - elbow joint
   - knee joint
   - shoulder joint
6. Name the three things that all vertebrates need to be able to move.
7. What is the difference between the way a human moves, the way a dolphin moves and the way a dog moves? Describe the movement of each animal, the limbs that are used and the position of the body.

6. bones, joints and muscles; if they say tendons and ligaments that is technically correct too so give them a point for each one (this should earn them 2 bonus points)
7. A human walks upright on the hind limbs whereas a dog walks on all four limbs. A dolphin uses its front limbs and its tail to move through the water. A human and a dog move on the ground whereas a dolphin moves in the water. Humans and dogs have four limbs, but a dolphin only has two limbs and a tail for movement.

3 Skeletons as structures

KEY QUESTIONS

- How does a skeleton or shell keep things safe inside?
- Do humans have shell or frame structures?
- How do you make a structure really strong?

In this chapter we will investigate two kinds of structures, frame and shell structures.

3.1 Structures

New words
- frame structure
- shell structure
- enclose
- resist
- load

A structure is something that is arranged or put together in a specific way, and is made up of different parts. A jungle gym is an example of a structure. It has many different parts like beams, ropes, and bars, which are put together in a special way.

A jungle gym is a type of structure.[1, 2]

Most structures are designed to remain stable and rigid, which means they should not break, crumble or topple and fall over if something heavy is placed on top of or against them.

Teacher's note

Introducing this topic

This is a technology unit and will follow the principles of technology teaching and specifically the design process. As such the different activities in this unit will be preparing learning to build their own shell or frame structure at the end of the unit – these are called enabling activities. They are designed to enable learners to tackle the problem at the end of the unit with the necessary knowledge, understanding and skill to complete it confidently.

Learners will have to make a model of a vertebrate skeleton using struts made from rolled paper or drinking straws as a project. Enabling activities in this unit will therefore be:

- What is the difference between a shell and a frame structure?
- Are there shell and frame structures in nature?
- How can a structure be reinforced or made stronger?
- What is a strut and how does it make a structure stronger?

Structures have different jobs or functions:

- Support
- Protect
- To enclose, which means they keep something in or they keep things from getting in (like a tin of juice or a fence around a building).
- Help with movement

We get three kinds of structures:

- Frame structures
- Shell structures
- Solid structures

In all structures, the shape of the structure is very important. A structure will be able to resist or hold a certain weight depending on its shape.

In Grade 4 we looked at strong frame structures and also how to make structures stronger using struts and braces. In this chapter in Life and Living, we are going to focus on two kinds of structures: frame structures and shell structures. This is because they relate to the skeletons of animals.

QUESTIONS

Turn to a friend and talk about the words "shell structure" and "frame structure". What could these mean? Then think of examples of frame and shell structures that you can see in buildings or perhaps on your walk or ride to school. Report back and discuss these with your class.

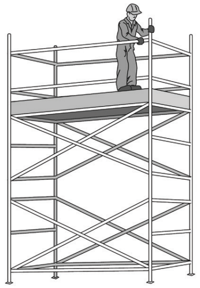
Frame structures

Frame structures are easy to identify because they have a frame or a skeleton. These structures are built or put together by attaching pieces of material together to make a frame. Look at the photos of frame structures on page 52.

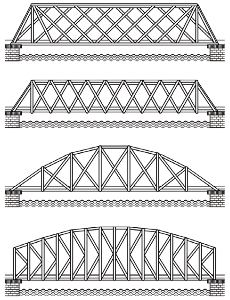
QUESTIONS

Turn to a friend and talk about the words "shell structure" and "frame structure". What could these mean? Then think of examples of frame and shell structures that you can see in buildings or perhaps on your walk or ride to school. Report back and discuss these with your class.

Teachers can use this question to assess pre-existing knowledge of shell and frame structures as similar work should have been covered in the previous year. Frame structures: burglar bars, palisade fences, cell phone towers, Eskom towers, sieve, jungle gym, etc. Shell structures: tortoise shell, hut, trailer, canopy on a bakkie, egg shell, snail shell, lids, pipes, etc.)



Construction workers use scaffolding. The scaffolding forms a frame.



All of the triangles in these bridges make them strong frame structures.

A pylon is a frame structure that supports electricity lines.[3]

The veins in a leaf form a frame structure.[4]

A spider's web is a frame structure.[5]

Teacher's note

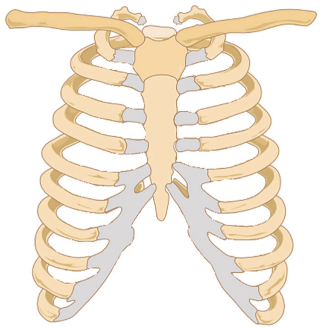
These photos are all examples of frame structures. In some the frame is clearly visible – these are called open frame structures. In others the frame is covered by a "skin".

QUESTIONS

Turn to a friend and discuss what you think all these structures have in common – what is the same? Report back to your class.

One of the most important frame structures for all vertebrate animals is their skeleton. The material used to make this frame is bone that is attached to the muscles that move the skeleton. The skeleton supports the muscles and protects the organs.

Here is a picture of a human rib cage. Can you see how it makes a frame structure?



The rib cage is a frame structure.

QUESTIONS

Which organs does the rib cage protect?

In general, we can say that all vertebrates have a frame structure as a skeleton. This is because vertebrates have an endoskeleton, which makes a frame to support the body.

QUESTIONS

Turn to a friend and discuss what you think all these structures have in common – what is the same? Report back to your class.

There are struts and triangle shapes. The frame is sometimes bare and is the whole structure (such as the pylon or jungle gym) or the frame structure is covered by a skin, such as the leaf.

QUESTIONS

Which organs does the rib cage protect?

The heart, lungs and liver

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Shell structures

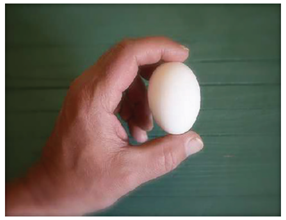
Shell structures generally hold or protect things inside the structure. Humans make shell structures to protect and hold things, like a dish, a tin, a car or house.

A car has a shell structure, which protects the passengers inside.[6]

These guavas are kept in a basket, which is a shell structure.[7]

In nature eggshells and the exoskeletons of invertebrates, like crab and crayfish shells, are examples of shell structures. Shell structures are made to resist a very heavy load.

Did you know?
It is almost impossible to crush an egg shell if you hold it vertically between your thumb and index finger!



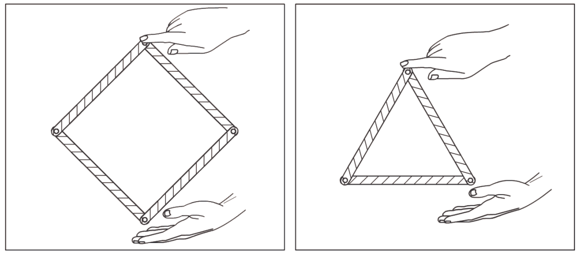
An egg shell is an example of a strong shell structure.[8]

A crab has an exoskeleton which is a shell structure.[9]

Strengthening structures

Structures that protect something or hold a weight without breaking or falling, need to be really strong. Let's investigate the different ways we can use to strengthen a structure.

Do you remember in Grade 4 Matter and Materials when we looked at whether a triangle or a square was stronger? Look at the pictures to remind yourself.



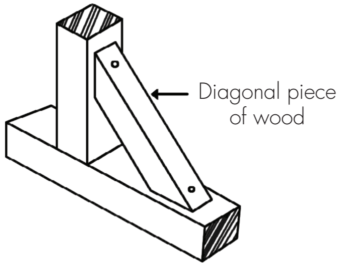
Creating a square and a triangle shape.

QUESTIONS

When you press on the shapes as in the picture, which shape is the most stable and rigid? Explain how you could make the other shape stronger and more stable.

Corners in structures are very important because it is often the weakest point of a structure. To strengthen corners you can:

- Put another support (called a brace) across a rectangle's corner to make a triangle. The corner is then made much stronger.



A diagonal brace on a corner where two pieces of wood meet.

QUESTIONS

When you press on the shapes as in the picture, which shape is the most stable and rigid? Explain how you could make the other shape stronger and more stable.

The triangle is the strongest. The square can easily be squashed. You can make the square stronger by putting a diagonal strut in from one corner to the other.

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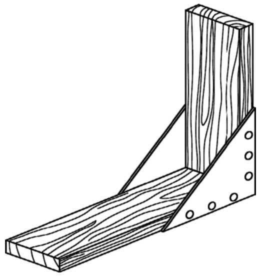
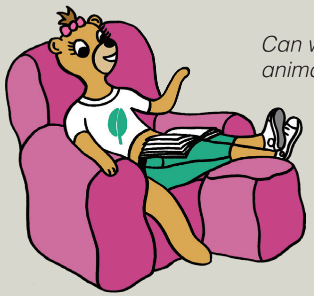
- Place a triangular patch over the corner. This is called a gusset.



Another way of strengthening a corner so it can't collapse, called a gusset.

ACTIVITY 3.1: Making and designing a skeleton

The local museum has asked your school if they have any models of vertebrate skeletons for a display. Mothusi had an idea. She loves making things and she also loves animals. So Mothusi suggested making our own animal skeleton models. We can then better understand the idea of skeletons as structures and use these models to put on display.



Can we make our own animal skeletons?

As a project, you need to design and make a skeleton for a vertebrate. This will be a frame structure.

Teacher's note

This is the first time learners are doing a Technology project in Grade 5. They will have done some projects in Gr 4, but it will be useful to emphasize the Design Process again as you are going through the project. The first step is to identify a need to do a design. In this case, a scenario has been set up that the local museum is looking for models of skeletons to put on display and Mothusi has a suggestion for the Gr 5 class to build their own models as you have just been learning about skeletons as structures. Use this to generate the need for doing the design and making the model. At the end you can make a "display" on one side of the classroom as though this is the museum and place the models on display with name tags for each skeleton.

You may use the following materials:
- Drinking straws
- Rolled up paper for members and struts
- Wooden dowels or sticks (30cm x 10 mm)
- Cellotape
- Metal paper fasteners

Visit
Need ideas on how to build a skeleton from rolled-up newspaper?
goo.gl/YNFcP

INVESTIGATE:

Let's investigate and do some research around how to build a shell or frame structure. We looked at different ways to strengthen structures using special shapes and struts. Remember this when you are investigating and designing your skeleton.

DESIGN:

Now you need to use the information we found out to come up with a design for your skeleton. Your skeleton should have the following specifications:
- It must be three-dimensional.
- It must look realistic.
- It must have or show the basic parts, (for example skull, backbone, ribs).
- It must be strong and rigid so it can stand on its own.

Your design has the following constraints:
- You cannot make your skeleton at home – you must make it at school.
- You are confined to using some of the following tools and materials: waste paper (A4 and A3), card, brass paper fasteners, glue, scissors, wooden sticks and nails (to make holes).

Once you have thought about these specifications, you need to answer these questions:
1. What do you need to design?
2. What will the size and shape of your skeleton be? Remember that your skeleton must stand up straight for at least three minutes.
3. What materials are you going to use to build your skeleton? Make a list of all the materials you will need.

Teacher's note

The pattern followed for Technology projects is 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. In this case you would have already done a lot of investigating prior to the activity when first looking at animal skeletons and then at structures and ways to strengthen structures. Learners must use this knowledge and experience when doing their designs.

D stands for Designing. That means using what you learned from investigations to think of good ways to solve the problem. Remember that learners may come up with new designs for their skeleton as they are going through the project. Encourage them that modifications are allowed and that they should not scrap the original idea but show how their idea has progressed and changed and why they might have changed their design.

M stands for Making. When you make your model, you use the materials and tools specified to make the model according to the design. 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 the model of a skeleton, you need to evaluate it to see ifit followed the specifications, for example, can it stand up by itself? Is the model 3D and realistic? Is it a stable structure? Are there any improvements to be made?

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

4. What tools are you going to need to make your skeleton?
5. Are there any other specifications and constraints that you can think of for your skeleton?

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

Did you know?
When making your skeleton, you may come up with a better design! So do a second drawing if needed.

MAKE:

Now comes the fun part! You have to make your skeleton according to your sketch and using the materials you identified. Do this in class.

Once you have all finished making your skeletons, you need to show your classmates what you made and tell you what you did to make your skeleton. This is called presenting your design.

EVALUATE:

Answer the following questions about your skeleton.
1. Did your skeleton stand up for three minutes without your support?
2. What could you change in your skeleton to make it work better?
3. Did your skeleton fulfil all the requirements in the specifications given to you?
4. If you ever had to build this skeleton again, what would you do differently?

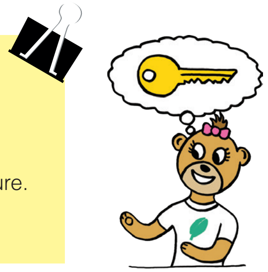
COMMUNICATE:

An important part of the design process is to communicate what you found to others so they can learn from what you did.

Write a paragraph where you tell Mothusi about the skeleton that you built. What worked and what did not work? This is so that she can learn from what you did and also build a model skeleton to put on display at the museum.

KEY CONCEPTS

- Structures can be shaped as a shell or frame.
- Structures have specific functions – to protect, support, enclose or help to move.
- Shell and frame structures can be found in nature.
- Structures can be strengthened.
- Struts can strengthen structures.



REVISION

1. Complete the following table in your exercise books by stating whether the structures are frame or shell structures.

Structure	Shell or frame structure?
Jungle gym	
Eggshell	
Dog skeleton	
Cellphone tower	
Crab skeleton	
Scaffolding	
Car	
Basket holding fruit	

2. How would you strengthen a square shape? Give two different ways.
3. Give two examples of animals with skeletons that are frame structures. What is the name given to this type of skeleton?
4. Give two examples of animals with skeletons that are shell structures. What do we call this type of skeleton?
5. What are the advantages to humans for having a frame structure as a skeleton? Explain your answer.

Now we are going to find out how plants and animals get their food!

REVISION

1.

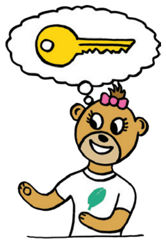
Structure	Shell or frame structure?
Jungle gym	frame
Eggshell	shell
Dog skeleton	frame
Cellphone tower	shell
Crab skeleton	shell
Scaffolding	frame
Car	shell
Basket holding fruit	shell

2. Place a diagonal strut across from one corner to the next. Or put a gusset on the corners.
3. Endoskeletons – dog, human, birds, fish, etc
4. Exoskeletons – crab, insect, etc
5. Frames provide support for the muscles for movement. The frame provides protection to the internal organs. The frame structure does these while allowing the human to still grow as the bones are on the inside (endoskeleton). This means humans do not need to get a new skeleton when they grow as animals with exoskeletons do.

4 Food chains

KEY QUESTIONS

- Why do I get hungry?
- Do plants get hungry?
- What are food chains?
- What would happen if all the plants on the planet died?
- Why does a predator have to hunt and kill – can't it just eat grass?



4.1 Food and feeding in plants and animals

Let's read the following story together.

Who is the most important?

Some animals stood on the soft green grass around the waterhole one day, admiring the fine job that the maker had done!

The tortoise, slowly and carefully said: "Of all creation I think I like the flamingos the best! Their beautiful pink and white feathers, their graceful necks and long legs – they're just amazing! They are so beautiful maybe they're the most important."

Warthog just *humfed* and rolled in the squishy brown mud, munching on some roots.

"Those flamingos are far too delicate!" said the hungry springbok, "Look at that strong, fearsome buffalo – no one ever messes with him! His horns are so sharp he can pierce a rock! I think he is the most important in all creation!"

New words
- photosynthesis
- by-product
- producer
- consumer
- food chain
- food web

Teacher's note

Introducing this topic

Read the following story to the class.

- Discuss how the different animals thought another kind of animal would be more important.
- Discuss who or what they think is more important in the world.

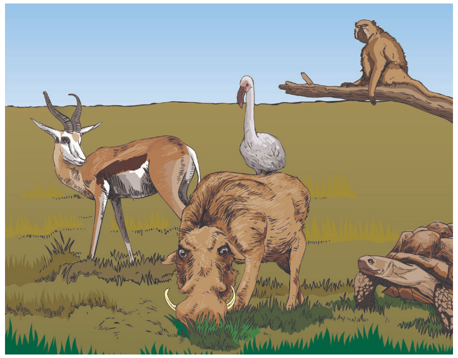
Warthog just *humfed* and sat on the cool green grass taking a huge tasty mouthful.

The baboon jumped from his perch in a nearby tree "Hahaha-ing" and "KwahKwahKwah-ing" as he went. "You are all so wrong! Look at the eagle – she soars over everyone and can see everything. She is always safe high in the cliffs and never has to come to this messy old waterhole. She doesn't need us – she is the most important of everyone!"

Warthog just *humfed* and scratched his back against the rough hard bark of a baobab tree.

The dungbeetle clambered on top of his ball, rested his head on his hand and said: "You have no idea – the ants, now they're an important bunch. Without those little fellows the entire world would be covered in dead stuff. The smell would be un-be-lie-va-ble! They are the most important by far!"

Warthog *humfed* and this time it was really loud – "*HUMF*" he *humfed* again. "Without plants we'd all be gone!" and with that he shoved a clump of reeds and munched at the little insects escaping.



Teacher's note

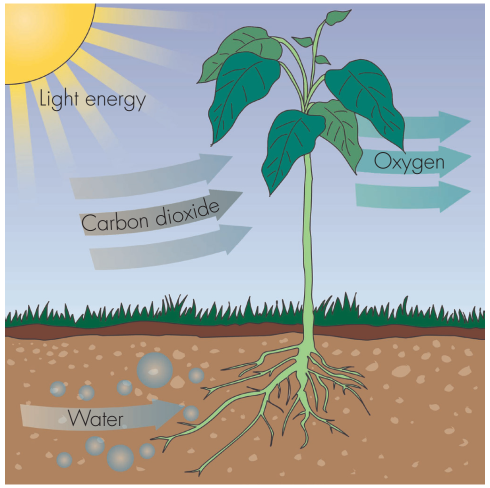
After reading the story ask learners why the warthog said "Without plants we'd all be gone"? Discuss the different things we get from plants – use this opportunity to assess their existing knowledge about plants and photosynthesis.

Photosynthesis

Plants make their own food through a process called photosynthesis.

- They absorb water and nutrients through their roots.
- The water travels to the leaf or stem where the plant produces the food.
- Plants use carbon dioxide from the air and sunlight energy for this process.
- The plants use the water and carbon dioxide gas with the sunlight energy to make food that we call sugars.
- They give off oxygen as a by-product of this process.
- The plant can then use the food (sugars) that it produced to carry out the life processes.
- Plants generally make far more food than they need so they store the extra food in different parts of the plant.
- Animals then eat these parts of the plant (or the whole plant) to get food.

Visit
Plants make their own food (video).
goo.gl/ZMv1B

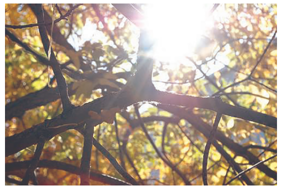


Plants make their own food by the process of photosynthesis.

QUESTIONS

Why do animals need the food that plants make? Discuss this with a friend and report back to the class. What would you be prepared to pay for a day's worth of oxygen? Plants make this all for free for us!

In this way, the warthog was completely right: "Without plants we would all be gone!" We would not have food to eat and we would not have oxygen to breathe.



The sun is a source of energy for all living things on Earth.[1]

Producers and consumers

In the beginning of this term you learnt that animals and plants are interdependent. That means they need each other and depend on each other to survive. All living plants and animals need food to give them energy in order to survive.

Plants can make their own food through photosynthesis. Living things that make their own food are called producers because they produce their own food.

QUESTIONS

Work with a friend and take turns to explain what 'ingredients' a plant uses during the process of photosynthesis. What do the plants make or produce from this? Write your answers in your exercise books.

QUESTIONS

Why do animals need the food that plants make? Discuss this with a friend and report back to the class. What would you be prepared to pay for a day's worth of oxygen? Plants make this all for free for us!

Animals need the food that plants make to carry out the life processes. If they do not have the food or oxygen they will die. Facilitate this discussion to reach a conclusion that without plants animals will not be able to live.

QUESTIONS

Work with a friend and take turns to explain what 'ingredients' a plant uses during the process of photosynthesis. What do the plants make or produce from this? Write your answer in your exercise books.

A plant uses sunlight energy, water and carbon dioxide during photosynthesis and makes food (sugars) and oxygen.

If an animal needs energy it cannot use sunlight, water and carbon dioxide like a plant does to make food. Animals need to eat plants to get energy to carry out their life processes. Living things that get their energy by eating either plants or animals are called consumers.

- Many animals eat plants to get energy. We call these animals herbivores.
- Some animals eat other animals to get energy. We call these animals carnivores.
- Other animals eat both plants and animals, like baboons or people. We call these animals omnivores.
- We get special animals called scavengers and decomposers. They eat dead animals and break their bodies into tiny pieces that can go into the soil as compost. These pieces must be small enough for plants to absorb.

A cow is a herbivore.[2]

A baboon is an omnivore.[3]

Lions are carnivores.[4, 5]

Teacher's note

Hand out little pieces of paper (post-its work well) and get learners to write their favourite animal on it. On the board make three columns and write as heading on each: (Plant-eaters, Herbivores)/(Meat-eaters, Carnivores)/(Omnivores). Ask learners to think about their animal and what they would eat. Let learners paste their post-its or little papers with prestik in the correct column. Discuss the adaptations, similarities and differences between groups with the class.

ACTIVITY 4.1: Identifying herbivores, omnivores, carnivores, scavengers and decomposers

MATERIALS:

- Books and reading material on all sorts of animals displayed in class.
- Do research in your local library or on the Internet for information on one of the animals on page 67.

INSTRUCTIONS:

1. Identify the different animals on page 67. Work with a friend and see if you can name as many of the animals as possible.
2. What do the animals eat?
3. Classify the animals as a herbivore, omnivore, carnivore, scavenger or decomposer.
4. Select three of each and record them in the table in your exercise books.

Name of animal	Food that it eats
Carnivores	
1.	
2.	
3.	
Herbivores	
1.	
2.	
3.	
Omnivores	
1.	
2.	
3.	
Scavengers	
1.	
2.	
3.	
Decomposers	
1.	
2.	
3.	

Teacher's note

PREPARATION: Collect and display as many books and reading material related to animals as possible and where possible display information specific to the animals in the activity.

Name of animal	Food that it eats
Carnivores	
1. crocodile	animals that come to drink at the water
2. dolphin	fish
3. mosquito	warm blooded animals
shark	fish, seals, penguins, etc.
lion	animals
leopard	animals
eagle	rodents, rabbits, snakes, fish, etc.
seal	fish, crabs, snails, etc.
Herbivores	
1. elephant	leaves, fruit off trees
2. horse	
3. buffalo	
springbok	
grasshopper	
squirrel	some squirrels have been known to eat small insects, birds, etc when food is very scarce
zebra	
rhino	
cow	

Chapter 4: Food chains 67

Name of animal	Food that it eats
Omnivores	
1. pig	
2. cockroach	
3. flamingo	filter feeders – small plant and animal material
Scavengers	
1. fox	
2. vulture	
3. crab	
Decomposers	
1. earthworm	
2. fly	
3. snail	

4.2 Food chains

QUESTIONS

How does a lion or a shark get their energy? They do not eat plants.

There is a feeding relationship between producers and consumers. We call this relationship a food chain:

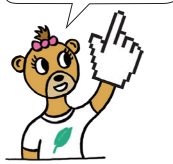
- Plants are the producers.
- Animals are the consumers.

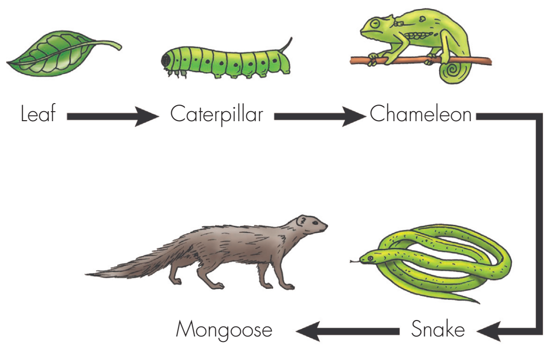
A food chain shows how each organism gets food, and how energy is passed from one organism to the next.

When we draw a food chain we use an arrow (→) between organisms to show that one eats the other and that energy is transferred from the one organism to the next. A simple food chain is: grass → cow → human.

Food chains that are interdependent and linked are called food webs.

Visit
The Food Chain song.
goo.gl/nY1XX





A simple food chain. Can you name the herbivores, carnivores and scavenger?

Teacher's note

Introducing this topic

Ask the question: So if ALL animals depend on plants for food what about an animal that NEVER eats plants – like a crocodile or a lion, or a shark perhaps? Do they depend on plants for food? Discuss this at length without "giving the answer away" to judge their level of understanding of the preceding work.

Discuss predator and prey animals and let learners identify predator and prey relationships and justify their choices by listing adaptations in the predator that allows it to catch its prey. Where possible identify characteristics in prey animals that help them elude predators.

QUESTIONS

How does a lion or a shark get their energy? They do not eat plants.

The learners should have a much better idea of how these predators will get their energy hence the questions here. It would be a good point to let them reflect on their own developing knowledge and understanding at this point using this question/answer in preparation for the following work on food chains.

Teacher's note

A very big common misconception is that the sun is part of the food chain. This is incorrect. The Sun is the source of energy, but it is not a source of food for the plant. The Sun is not food for the plant. So the food chain does not start with the Sun, it starts with the PLANT which is the PRODUCER of food. The learners should just know that the Sun is the source of energy (NOT FOOD) otherwise plants will not be able to make their own food. The FOOD CHAIN always starts with the PLANT (PRODUCER OF FOOD). Decomposers are generally also not put in as

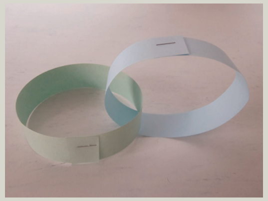
ACTIVITY 4.2: Making food chains

MATERIALS:

- Your teacher will make a big yellow sun and pin it to the center of your classroom's ceiling.
- Three different coloured pieces of paper (Green for plants and two other colours, not yellow as the sun is already yellow)
- Stapler and staples (or cellotape, pins). If you use glue, hold the ends together with washing pegs until the glue has dried.
- Scrap paper, colouring pencils (or cut out pictures of animals and insects)
- Scissors and glue
- Thumbtacks and Prestik

INSTRUCTIONS:

1. Cut the paper into long strips, 3 cm wide.
2. Use the colours like this:
   a. Green strips for the producers – the plants.
   b. One colour for the consumers – the animals eating the plants. (You could even have two colours here – one for herbivores, and one for carnivores and omnivores.)
3. Design your own food chain. Remember to start with the producers then add in consumers. To show the flow of energy you must use an arrow (→).
4. Collect pictures of the animals in your food chain. Or draw your own pictures on scrap paper and cut these out carefully.
5. Put your chain together as follows:
   a. Start with the green strip for the plants. Staple the two ends together to form a link on a chain. Stick your picture of the plant in your food chain on.



Two links in the chain so far – a green plant and the first consumer (a herbivore).

part of the food chain. Decomposers could go at both ends. Their exact position can't really be pin pointed, since it could go in at any point. The decomposer would supply nourishment to grass. Then that grass would be eaten by a rabbit or some herbivore/omnivore, which might get eaten by a carnivore. But when the carnivore dies, the decomposer would come back into the equation and break down the carnivore, thus giving to the grass or other vegetation, creating a loop. Also the decomposer could come in at any point should any other link die; the decomposer would just break it down again.

Teacher's note

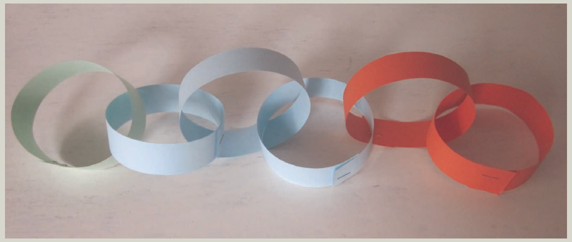
Collect as many books and any reading materials about habitats.

- Before the next activity, allow the learners to go through these and choose a specific habitat like the savannah, woodlands, aquatic, arctic, etc.
- They need to identify all the animals and plants in that specific habitat.
- Let them make notes on scrap paper using the headings: PRODUCERS & CONSUMERS

The reason for doing this next activity:

- To help learners understand the flow of energy in a food chain.
- To help learners see the interdependence of organisms in a food chain. They learnt about interdependence at the start of this term's work and this is a wonderful way to reinforce this knowledge.
- To teach them that food chains are linked and are called food webs.

b. Use the same amount of 'consumer coloured' strips as the amount of consumers in your food chain. Stick the pictures of your consumers in order onto these strips.



A longer chain – remember your chain will have pictures of the plants and animals on each link!

6. Pin your food chain to the ceiling. It should look like a large spider web when everyone's chains are up.
7. Use string or wool to show this interdependency. So you can see that food webs show how food chains are linked.

The organisms that make up a food chain cannot be in any random order. They have to be in the specific order in which the energy is transferred between them in an ecosystem. Let's have a look at re-ordering food chains that are broken.

ACTIVITY 4.3: Sequencing plants and animals in food chains

INSTRUCTIONS:

1. The following lists of animals and plants are in the wrong order.
2. You must sequence them so that they make up a proper food chain in which the energy is transferred from one organism to the next.
3. Make sure to draw an arrow from one organism to the next to show the direction.

Teacher's note

When the learners bring their food chains to be put up, it is important that you group similar habitats together. (And that you wear trousers that day!)

Point out that different predators from the same habitat can feed on different prey in other food chains, i.e. the fox that eats the rabbit in one food chain can also catch the chicken, rat or mouse in other chains or eat the dead sheep in another.

4. You can even draw some pictures of the animals in your exercise books if you want to.

   Grasshopper, Hawk, Snake, Grass
   Shrimp, Seal, Fish, Algae
   Bee, Daisy flower, Butcher bird, Spider
   Mouse, Jackal, Leopard, Grass

Are humans also part of a food chain?

Most humans are omnivores and like to eat plant and animal products.

QUESTIONS

What do you call a human herbivore?

Let's look where humans fit into food chains.

ACTIVITY 4.4: Discovering your place in different food chains

MATERIALS:

A list of all you ate and drank from when you woke up yesterday morning to when you went to sleep last night.

INSTRUCTIONS:

Copy the table below in your exercise books and order everything you ate and drank in a day into the different categories.

Plants I ate were:	
I drank the juice of plants when I drank:	
I ate animal products when I ate:	
I drank animal products when I drank:	
I ate a combination of animal and plant products when I ate:	

INSTRUCTIONS:

4. Grass → grasshopper → snake → hawk
   Algae → shrimp → fish → seal
   Daisy flower → bee → spider → butcher bird
   Grass → mouse → jackal → leopard

QUESTIONS

What do you call a human herbivore?

Vegetarian

Teacher's note

The reason for doing this activity is to apply the knowledge, skills and concepts learnt about food chains. Learners need to do some homework before this activity so make sure to instruct them to do so the day before you want to do this activity. Homework: Make a list of all the things you eat and drink from when you wake up to when you go to sleep at night.

QUESTIONS:

1. Now design a food chain of some of the plant and animal food products that you ate.
2. Why do you think people say that human beings are "at the top of the food chain"?

Wow, I feel really humbled by our place in the food chain. Although we are "at the top" it also means we have a lot of responsibility to be conscious of what we eat.

ACTIVITY 4.5: Write a food chain poem

MATERIALS:

- The habitat and animal books on display in your class
- Scrap paper for planning and drafting

INSTRUCTIONS:

1. Write a food chain poem.
2. The heading of your poem must describe or label the type of habitat in which the food chain is located.
3. The body must explain the flow of energy in the food chain.
4. The ending must repeat the heading and your name.
5. Use a thesaurus to get ideas for different verbs instead of only using "eat".

72 Life and living

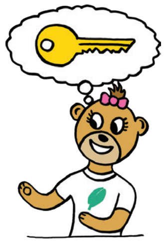
Here is an example of a food chain poem written by Mothusi:

The Savannah

There are the lion cubs
that were fed by the graceful lioness
that caught the zebra
that munched the grass
that grows on the savannah where Mothusi lives!

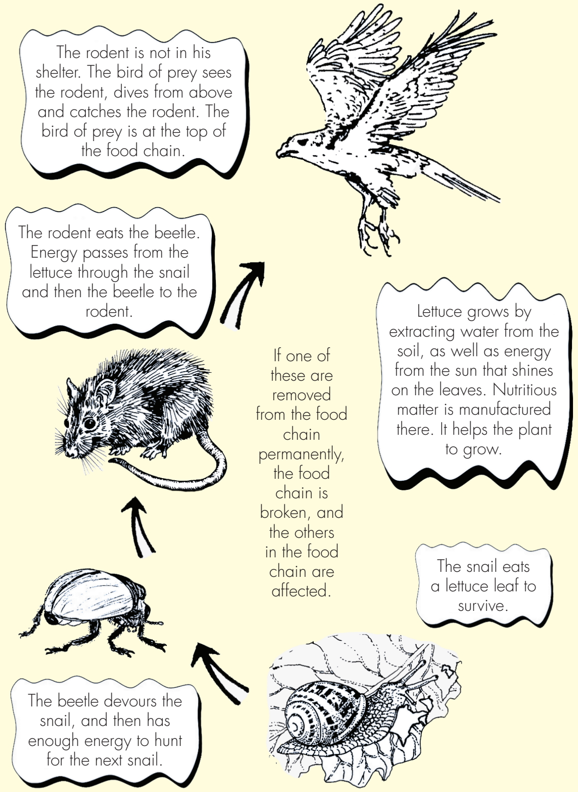
KEY CONCEPTS

- Green plants make their own food to build their branches and stems.
- Green plants use water, carbon dioxide and sunlight energy to make food.
- Plants are called producers.
- Animals need food to grow and carry out the life processes.
- Animals cannot make their own food and have to eat plants or other animals for food. Animals are called consumers.
- Food chains describe the feeding relationships between plants and animals.
- Energy is transferred from the sun to green plants, and then to the animals in the food chain.



REVISION

Read the information and look at the pictures below. Then answer the questions that follow.



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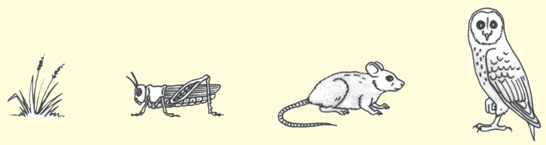
1. Write a five link food chain using the information and pictures on page 74.
2. Which organisms are herbivore?
3. Which organisms are carnivores?
4. The energy flow in this food chain started with a main source of energy. What source of energy provided this energy?
5. Explain the interdependence in this food chain.
6. What would happen if the eagle was removed from this food chain?
7. The eagle got old and died. Explain how the eagle's body was broken down and became part of the soil. Give examples of animals that helped this process.
8. Look at the following picture of a food chain. Name the producer, the herbivore and the carnivores.

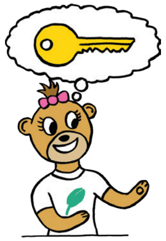


9. The mouse also eats other plants, such as seeds and nuts. So the mouse is not only a carnivore. What is it?

REVISION

1. lettuce → snail → beetle → rodent → eagle
2. snail
3. beetle, rodent and eagle
4. sun
5. Each animal depends on the one before it for food. If one of the animals is removed from the ecosystem then the next animal would not have a food source. This animal would suffer and die out, which means the next animal would then also die out. Each animal is dependent on all the other organisms which come before it in the food chain, even if it does not eat it directly.
6. There would be nothing eating the rodents. The rodents would then start to flourish and their numbers would increase. This would put a stress on the beetles as there would be more rodents eating the beetles. The beetle population would then start to decrease. The whole ecosystem would become unbalanced.
7. Decomposers, such as earthworms and microbes, break down the body of the eagle. The body decomposes and nutrients and minerals are returned to the soil.
8. Producer: Grass
   Herbivore: Grasshopper
   Carnivore: Mouse and owl
9. An omnivore.

5 Life cycles



KEY QUESTIONS

- Why do chickens lay eggs but dogs do not?
- When we were at the pond I found some frogspawn. Why are the frog eggs soft but the chicken eggs are hard? I thought eggs had hard shells that can crack and break?
- Our puppies looked similar to the mother dog but the tadpoles I found in the pond did not look like frogs at all. I wonder why?
- Our puppies are a year old now and look very similar to the adult dogs – will they still change a lot? When will I know that they are adult dogs?

New words

- generation
- life cycle
- offspring
- maturation

This term we studied many of the different plants and animals on Earth and their interdependence in different habitats. In this section we are going to finish our study of plants and animals, and look specifically at their life cycles.

5.1 Growth and development

Plants and animals grow and develop throughout their lives.

QUESTIONS

When will you stop growing? Discuss this with a friend and then share your ideas with the class.

All plants and animals need to make new plants and animals, or they will become extinct and no longer exist on Earth. The adult plant or animal needs to produce offspring that will grow over time into new adults, which will produce offspring of their own. We call this a life cycle.

76

Teacher's note

Introducing this topic

Play the song, Circle of Life, from The Lion King Disney classic. Discuss at length the words and meaning of this song as it pertains to our interdependence on each other and the circle of life that we are part of. It is available on: goo.gl/Gr0My.

This topic LIFE CYCLES has a very strong emphasis on the growth and development of plants and animals, to show that all living things need to grow and develop which is a theme carried through from Gr 4. This textbook treats these topics therefore as a focus on GROWTH and DEVELOPMENT and not on individual plants and animals per se. Teachers are encouraged to follow a similar route to develop the underlying concepts and to draw learners' attention to the similarities between living organisms that grow and develop.

Teachers are encouraged to display as many different reading material, including books, posters, print-outs, etc showing animal and plant life cycles, and to refer to these often during the course of this section.

Teacher's note

Introducing this topic

Show learners a plant and the seed that it has grown from – if necessary buy a seedling from a nursery or grow your own seeds a few weeks before this lesson.

- Ask learners to describe how the seed changed from the seed-form to the plant-form and ask them to explain how the seed that seemed not to be living could come alive. (This is revision of Gr 4 work on living and non-living things.)
- Remind them that under the right conditions something that seemed non-living can come alive again – the seed needed water and heat to come alive.
- Ask them whether the plant will stop growing once it has reached the present size and discuss their ideas about plant growth (a really good opportunity to assess existing knowledge of this topic.)

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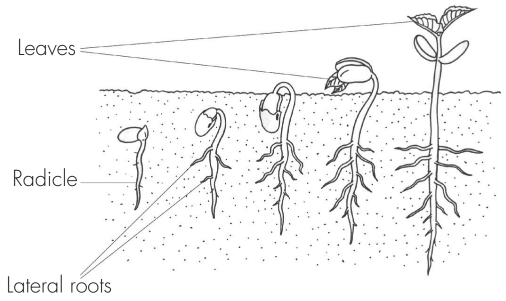
It is a cycle because when a new plant or animal is made the cycle begins again.

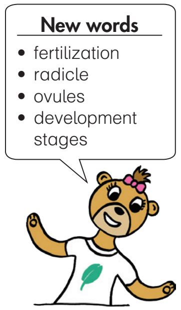
The plant or animal can die anywhere in its life cycle – at birth, or as a young or old plant or animal. Let's take a closer look at the life cycle of flowering plants.

5.2 Plant life cycles

In flowering plants, the life cycle begins when a seed germinates. Look at the diagram showing the seed after it has germinated.



The development stages in a plant's germination and growth.



The seed germinates when a small root (radicle) and stem start to grow out of the seed. This grows into a young plant.

A very young plant just after it has germinated and begun to grow.[1]

QUESTIONS

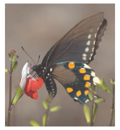
When will you stop growing? Discuss this with a friend and then share your ideas with the class.

This question is meant to make learners think about growth and development in their own lives before requiring them to apply this knowledge to other plants and animals.

The plant grows and develops into a seedling. In time the seedling grows and matures into a young adult plant that is bigger. The young adult plant continues to mature and becomes a mature adult plant. The adult plant can reproduce using flowers that produce seeds. The plant reaches maturity when it makes flowers.

QUESTIONS

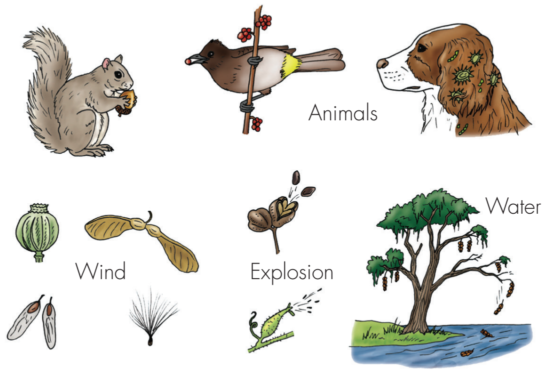
Look at the three different photos below. What do you think the insects in these photos are doing?

 A fly[2]	 A bee[3]	 A butterfly[4]

The flowers produce pollen and unfertilised seeds (these can't yet grow new plants). Insects carry the pollen from one flower to the next. This is called pollination:

- The pollen fertilises the ovules in the flower.
- Fertilised ovules then develop into seeds.
- The seeds are then dispersed in a new place.
- Seeds can be dispersed in different ways.
- When a seed lands in soil it can start to germinate. The life cycle begins again.

Visit
A video on pollination.
goo.gl/GWtMi



Different methods for seed dispersal

Visit
Video on seed dispersal.
goo.gl/YOoQ0

QUESTIONS

Why does a plant need to disperse its seeds? Look at the pictures showing ways in which seeds are dispersed. Discuss these four ways and explain how you think the seeds are adapted in each method to be the most efficient.

QUESTIONS

Why does a plant need to disperse its seeds? Look at the pictures showing ways in which seeds are dispersed. Discuss these four ways and explain how you think the seeds are adapted in each method to be the most efficient.

Teachers are encouraged to discuss this question with the class. Point out that new plants will be in competition with the parent plant for resources like water, soil, sunlight, etc and therefore the seeds to go far away to find its own resources. Also the parent plants wants to ensure the places to 'minimize risk' should something happen at that location.

The seeds dispersed by animals are either tasty so that birds and squirrels eat them, such as berries and nuts, or they have burrs so that they stick to the fur of animals. Seeds which are dispersed by the wind are light and have features which enable them to "fly" in the wind, such as wings. Seeds can be dispersed by explosion when the seed pods burst open and spray the seeds out. Seeds can be dispersed by water if the seeds drop into a river for example and are carried downstream. These seeds also need to be light and must float.

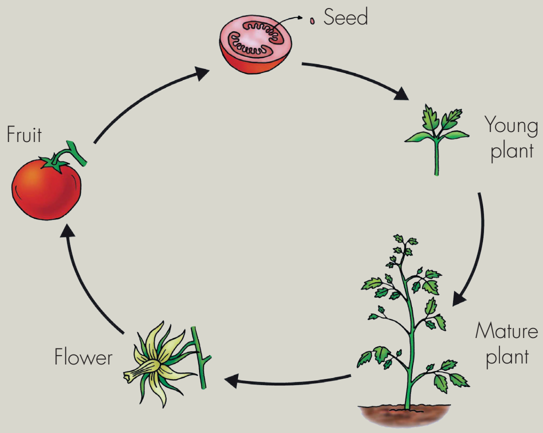
ACTIVITY 5.1: Life cycle of a tomato plant

MATERIALS:

- Tomato plants in your classroom or in the garden
- Packaged tomato plant seeds
- Ripe tomatoes like the ones growing in your class

INSTRUCTIONS:

1. Study the life cycle of a tomato plant. List the developmental stages of a tomato plant, starting at the seeds. Use the illustration to help you.



Life cycle of the tomato plant

2. Carefully study the tomato fruit that is on display in your class. Do you see where the little stem is connected? Can you see any leaves around it?
3. Draw the tomato fruit in your workbook. Remember to make a scientific drawing using the correct way of labelling that you learnt in Grade 4.
4. Carefully examine the tomato seeds from the seed packet. Your teacher will cut open the tomato fruit.

Teacher's note

About 5 – 6 weeks before this activity plant some cherry tomato seeds in a large container or in a sunny spot in the school garden. They grow really easily given enough water and light and can provide the perfect example for this activity. Also the learners can eat the cherry tomatoes that are harvested! Large tomatoes will take very long to ripen but can also work here. Remember to stake the tomato plants (for a VERY simple stake you can use any sort of stick, just stick it into the ground near the plant and tie the plant's biggest stems to this).

Teacher's note

Consider halving the class / breaking into groups. One group can do the observation of the tomato plant while the other group does the drawing of the tomato with the teacher's assistance.

Teacher's note

In grade 4 a lot of time was spent teaching learners to make scientific drawings. The teacher must go through this/revise this carefully. Perhaps make a poster and display this in class. The labeling must be done scientifically:

- the drawing must have a heading (printed in pen)
- 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.

Compare the seeds from the fresh fruit with those from the seed packet. Copy the table below in your exercise books and write in the comparison:

The fresh tomato seeds looked:	
The seeds from the seed packet looked:	

5. Look at the tomato plant in your class.
   a. Find the following plant structures on the plant and describe each of them.
   b. Make a sketch of each plant structure.

	Describe the plant structure	Sketch the plant structure
Stem		
Leaves		
Flowers		

Visit
A very young plant just after it has germinated and begun to grow.
goo.gl/dwHAk

5.3 Animal life cycles

All animals need to reproduce or they will become extinct. In this section we will learn more about the life cycles of animals.

ACTIVITY 5.2: Life cycle of a frog

MATERIALS:

- Large glass or plastic container (ice-cream tub)
- Chlorine-free water
- Water plants (if available)
- Large rocks (must stick out above the water)
- Fish flakes

ACTIVITY: Extension – Learning about life cycles

MATERIALS

- Flower (like a petunia for instance)
- Sharp blade or knife (be very very careful with this as it might cut you!)
- Magnifying glass

INSTRUCTIONS

1. Gently remove the green leaves at the base of the flower. You can use your fingers for this. These are the sepals which protect the flower bud.
2. Carefully remove the colourful petals of the flower. Also use your fingers here.
3. Remove all the parts that you find inside and sort them into groups. Remember to work carefully because the parts are fragile.
4. Carefully dissect (cut) the pistil from the sticky top stigma down to the bottom ovary.
5. Use a magnifying glass to see the ovule in the ovary.
6. In the space below, make a scientific drawing of the different flower parts that you discovered inside the flower. Remember to follow the scientific method for making scientific drawings using the correct labelling, headings and a sharp pencil.

Teacher's note

The reason for doing this activity is to let learners experience the different stages in a frog's life cycle. This activity is placed here to allow teachers to demonstrate the different stages as work progresses through this section in the workbook.

INSTRUCTIONS:

1. Prepare the habitat for the tadpoles using the materials.
2. Collect a few tadpoles from a local stream in a sealable container and bring them to school.
3. Carefully place the tadpoles in the water habitat.
4. Change the water at least every second day.
5. Feed the tadpoles with fish flakes.
6. Keep a diary of the tadpoles' growth and development over the next few weeks:

Date	Description of your observations	Sketch of your observations

Visit

Frog life cycle (video) goo.gl/zUiJP

Stages in the animal life cycle

New words

- reproduce
- gestation
- pregnancy
- embryo
- womb
- metamorphosis
- pupa
- sperm cells
- gills

Most animals, like fish, reptiles, birds and mammals, have a simple life cycle. We can identify different stages in such a simple life cycle:

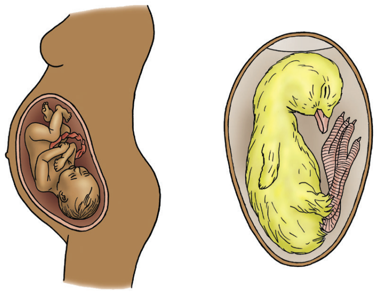
- Gestation or pregnancy – before birth
- Growth and development
- Maturation
- Reproduction

The gestation stage in an animal's life is the time before the embryo (young animal) is born. Animals produce young in different ways:

- **Live birth:** Some animals grow inside the womb of the mother animal and are then born alive.
- **Hatch from eggs:** The mother animal lays eggs and the embryos develop inside the eggs before hatching.
- **Hatch from eggs inside the mother animal's body and are then born alive:** The embryo develops within an egg inside the mother animal's body. The eggs can hatch just before or just after birth.

Teacher's note

NB: Tadpoles are VERY sensitive to chlorine and need fresh water regularly. Change the water REGULARLY (every day or two) by pouring half of the used water out and replacing it with fresh water. Do not add tap water directly to the remaining water. Boil the tap water and let it stand for 24 hrs before adding it to the tadpoles' water. Alternatively buy de-chlorinating tablets but even then let the replacement water stand for 24 hrs before the water change. Here is an easy step-by-step guide to keeping tadpoles: goo.gl/WQ6Re



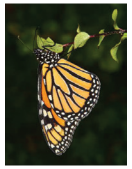
In human gestation the baby grows in the mother's womb and is then born. In a chicken, the mother lays an egg and the embryo develops in the egg before hatching.

Animals grow and change after birth or after hatching from their eggs. Some animals undergo a simple change. For example, in dogs the puppy looks similar to the adult dog.

In dogs the puppy looks similar to the adult dog.

Other animals, mostly amphibians and insects, hatch looking completely different to the adult animal. They go through very big changes in their life cycle. This change is called a metamorphosis. Look at the stages of metamorphosis of a monarch butterfly.

Visit
Video on metamorphosis.
goo.gl/uYjt4
Life cycle of a monarch butterfly.
goo.gl/5SVbi

A monarch caterpillar eats and grows.	The caterpillar gets ready to make a pupa.	Inside the pupa the caterpillar is changing into a butterfly.	The adult butterfly emerges from the pupa.
			

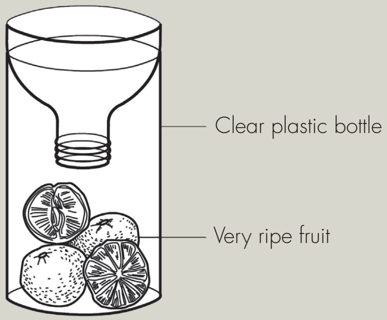
ACTIVITY 5.3: Observing fruit fly reproduction

MATERIALS:

- Clear plastic bottle
- Sharp knife
- Ripe fruit

INSTRUCTIONS:

1. Cut the top part of the plastic bottle off.
2. Put ripe fruit in the bottle. (Be careful – if the fruit is too watery, the flies will die.)
3. Put the top upside down in the bottle as if this is a funnel. Look at the picture below.

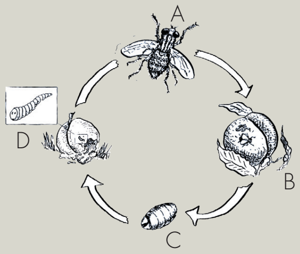


Set up for this activity

4. Keep a diary of all that you see happening inside the bottle over the next two to three weeks. Provide short descriptions and neat sketches (not scientific drawings).

Date	Description of your observations	Sketch of your observations

5. Carefully study the following diagram of the fruit fly life cycle. Label each stage. Then write a sentence or two explaining what is happening at each stage of the fruit fly life cycle.



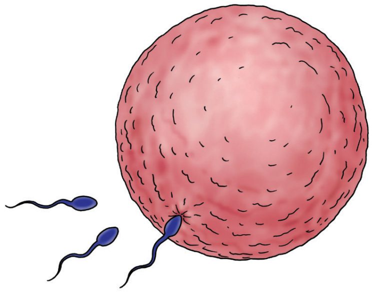
Fruit fly life cycle

	Label the stage	Describe the stage
A		
B		
C		
D		

Teacher's note

Fruit-flies can smell ripe fruit and come from a long distance to find it. The females lay eggs on the fruit. When the eggs of the fruit-fly hatches, little worm like larvae hatch. The larvae eats as much as it can and grows quickly. It turns into a pupa. The pupa has a hard case or chrysalis. Inside the chrysalis the pupa undergoes tremendous changes. After four days the case breaks and a fly with wings comes out. The activity might not work and you might not get fruit flies coming. In that case, explain to the learners that the flies did not smell the fruit and did not come. Refer to the diagram below to continue the activity.

Once the animal has grown and developed into a young adult animal, it matures and gets ready to produce offspring. At maturation the female produces egg cells and the male produces sperm cells. When they mate the male sperm cells will fertilise the female egg cells and start the life cycle all over again.



Fertilisation is when a male sperm enters the female egg.

An animal can die at any stage in its life cycle. Various things can cause death to the animal.

QUESTIONS

Discuss in your group what the causes of death for an animal could be and write them below.

ACTIVITY 5.4: The frog life cycle

INSTRUCTIONS:

1. Hopefully you were able to see some tadpoles develop into frogs.
2. Let's revise the stages of a frog's life cycle. Look at the illustration on page 87.
3. Describe the various stages in the life cycle of this frog. (See the table on the next page.)

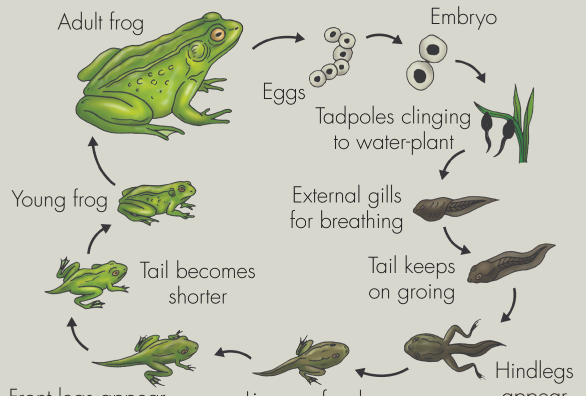
QUESTIONS

Discuss in your group what the causes of death for an animal could be and write them below.

Causes include: old age, illness, environmental conditions such as drought or flooding, being eaten by predators or hunted by humans, death due to human causes, like poisoning or destroying the environment or through pollution.

Teacher's note

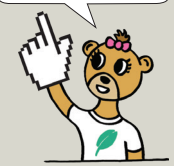
You should have been watching and observing the tadpoles develop into frogs over the past while. This activity is to reinforce what you have observed. If you were not able to actually watch tadpoles develop in class, then just use the following activity to show how tadpoles change into frogs.



The frog life cycle

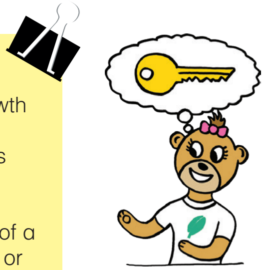
Development stage	Description of this stage
Gestation	
Larva	
Young adult	
Adult	

Visit
Animal Life cycles (video).
goo.gl/5IaoW



KEY CONCEPTS

- All living things carry out the life process of growth and development. This is part of their life cycle.
- A life cycle describes the stages and processes that take place as a plant or animal grows and develops.
- A life cycle also describes how one generation of a plant or animal reproduces to make new plants or animals that will make many more generations.
- Death can occur at any stage in the life cycle.



Development stage	Description of this stage
Gestation	Frog embryos develop inside the eggs and then tadpoles hatch from this.
Larva	The tadpole has a tail and gills; it looks like a fish; after some time it grows hind legs, front legs and the tail shrinks.
Young adult	The young adult doesn't have a tail anymore and the front and hind legs develop fully.
Adult	The frog matures and can reproduce.

REVISION

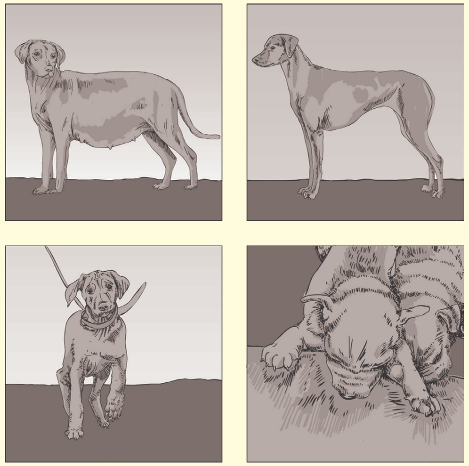
1. Explain what it means when we say that a plant or animal has a life cycle.
2. Explain the four stages in the life cycle of a flowering plant – think for example of a tomato or bean plant.
3. Plants use their brightly coloured petals and their scent to attract animals. Why do they need animals to come to them?
4. Wind pollinated plants are much less attractive than plants that have to attract birds and insects. Why do you think this is?
5. When plants disperse their seeds by means of water, what important features do these seeds need to have?
6. Why do animals and plants have to reproduce?
7. Use the following words to complete the sentences. Write the sentences out in full.
   - egg-laying
   - umbilical cord
   - born alive
   - external
   - life cycle

   a. A _________ describes how reproduction takes place and shows the way in which a plant or animal changes as it grows.
   b. A chicken and snake embryo have an _________ type of gestation.
   c. A puppy or kitten are _________ from the wombs of the female animal.
   d. While in the womb the embryo of a cow or horse receives nourishment through the _________ that attaches it to the mother's body.

8. Order the pictures of the dog life cycle into the correct order that it takes place in. Write numbers 1 – 4 in the order that the pictures should be.

REVISION

1. Plants and animals grow and develop throughout their lives and a life cycle describes the stages and processes that take place as a plant and animal grows and develops from embryo to mature reproducing adult.
2. Seeds – germinate to form little plants – little plants grow and develop – plants mature and make flowers – flowers are pollinated and form little tomatoes – tomatoes make seeds
3. Plants need these animals to spread their pollen and receive pollen from other flowers.
4. The wind does not choose which plant to pollinate and pollinates all the plants therefore the plants only have to make their pollen available to the wind to disperse.
5. The seeds need to be watertight.
6. If they do not reproduce they will become extinct.
7. a. life cycle
   b. egg laying
   c. born alive
   d. umbilical cord



Life cycle of a dog

9. Describe the different stages in the life cycle of a cat and the processes that take place.
10. When does an animal die?
11. Why do you think certain plant species declined in areas where specific animals have been poached, like chimpanzees, orangutans or hornbills, parrots and other exotic birds?
12. What possible dangers do crop sprays, pesticides and pollution hold for plants and animals?

9. Gestation: the kittens develop inside the womb of the female cat
   Growth and Development: once the kittens are born alive, they are blind and suckle from the mother cat. After about 6 weeks they leave the mother cat and grow and develop on their own.
   Maturation: The kitten grows and matures. It changes but the basic body shape remains the same.
   Adult reproduction: The cat matures and can reproduce.
10. An animal can die at any time during its life cycle.
11. These animals spread the plants' seeds and if they are removed the seeds cannot often germinate or grow and develop as needed.
12. This question is meant to engage learners and requires them to display their understanding of the negative human impact on the environment. Learners' answers will vary but needs to display this understanding.


Matter and materials
and processing

6 Metals and non-metals

KEY QUESTIONS

- How can we tell if something is made of a metal or a non-metal?
- How do we decide what material to use when we want to make or build something?

In this chapter we will learn about metals and non-metals. Do you remember learning about materials in Grade 4? Metals and non-metals are two different classes of materials. Each class has its own unique properties. Properties are those things that are special about an object or a material. We can use the properties of a material to describe what it is like. For example, we could say that a property of gases is that they can be compressed.

When we want to make a new product (a building, a tool or any kind of object) we first have to decide what the purpose of that product will be. Perhaps we want to make a tool for digging in the garden, or a kennel (dog house) for our new puppy. The purpose of the product will help us decide what would be the best material to make the object from.

What would be the best material for a digging tool? Surely we would need a tool that is strong and durable; with a sharp edge that will allow us to cut through the soil when we dig into it.

QUESTIONS

1. What material would allow us to make a dog house that is cool in summer and warm in winter?
2. What material would you choose to make a spade for digging in the garden?

Teacher's note

The first important message of this unit is that **purpose** comes before **choice of material**. Once we know the purpose of whatever product it is we want to produce, we can decide what properties we need the building material to have, and then choose a material that possesses those properties.

In the first unit of Matter and Materials, we distinguish between materials that are metallic and those that are not. Although this is not a formal definition, we group everything that is not metallic into the category of non-metals. We make the distinction between metals and non-metals on the basis of properties, and so it is important to establish a firm understanding of the term **properties** early on.

You could start with a conversation about building something new (like the dog house example below), then steer the conversation towards properties by asking questions around the ways in which the object will be **used**.

QUESTIONS

1. What material would allow us to make a dog house that is cool in summer and warm in winter?
2. What material would you choose to make a spade for digging in the garden?

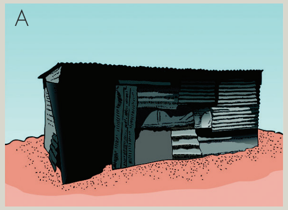
1. Wood
2. Metal or hard plastic

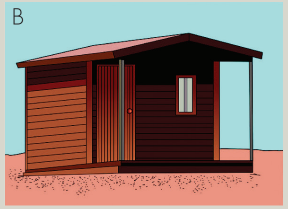
The next activity is about the things we think about when we choose materials for a specific purpose. In this case the purpose is building a house.

ACTIVITY 6.1: Choosing materials to build a house

INSTRUCTIONS:

1. When we choose a material for a certain purpose, we look for a material with the right properties for the job. Look at the two pictures of houses below.
2. Can you see that house A and house B are made of different materials?
3. Answer the questions that follow.





QUESTIONS:

1. What material was used to build house A?
2. What material was used to build house B?
3. If you had to build a house next to the ocean, which one would you choose, house A or house B?
4. Write a reason why you would build this house next to the ocean, rather than the other one.
5. Write down at least three other materials that could be used for building a house.

We have looked at the different types of materials that you could use to build a house. You have seen that there are different cases when you would use one material or another. Now let's look at the actual properties of metals and non-metals.

Teacher's note

The purpose of the activity is for learners to discover that there are many options to choose from when choosing materials for a particular job, and that circumstances may dictate which material would be the best choice. For instance, the learners are required to say which material (corrugated iron or wood) would be best suited for a house located next to the ocean. They should be encouraged to think about aspects such as corrosion (which will be dealt with in greater detail later) and thermal conductivity (also covered later) which would make wood the better choice. Availability and cost are also aspects that could be brought into the conversation. How available is corrugated iron versus wood?

QUESTIONS:

1. House A is made of corrugated iron (tin/metal).
2. House B is made of wood.
3. House B

Teacher's note

House B would be a better choice, but house A is not wrong. Read the suggested answer to the next question to see why B is the better choice.

4. Metal objects usually rust in the wet, salty air close to the ocean. That would make a corrugated iron house a poor choice. Metals are also good conductors of heat, which would make the iron house cold inside when the outside temperature is cold, and hot inside when the weather is hot.

Teacher's note

House B (the wooden house) would be the best choice, provided that wood is cheaply available. Often people build tin houses because it is the cheapest material available.

5. Bricks, reeds, concrete, hard plastic sheets (any durable, waterproof material would be suitable.)

6.1 Properties of metals

So how can we tell if something is made of metal?

New words

- property
- metal
- lustre/lustrous
- dense
- conduction
- electricity
- malleable
- ductile

Good question Walt! Let's look at the properties of metals. A property is a word used to describe a material or object and tells us something about it.

- Metals are usually shiny. The shine that we see when light reflects off the surface of a metal is called the lustre of the metal.
- Most metals are hard and they feel heavy.
- We say metals are dense as they have particles which are packed close together.
- Metals conduct electricity and heat well. (Next term you will learn more about electricity in Energy and Change. In Grade 6 you will learn more about metals as conductors of electricity.)
- Metals are malleable (they can be shaped into flat sheets) and they are ductile (this means they can be pulled into thin wire).
- Most metals can be heated to high temperatures without melting or changing their shape, which is one of the reasons why pots and pans are made of metal. Can you think of any other reasons why pots and pans are made of metal?
- Metals are mined from the Earth. You will learn more about this in another subject, Social Sciences.

Teacher's note

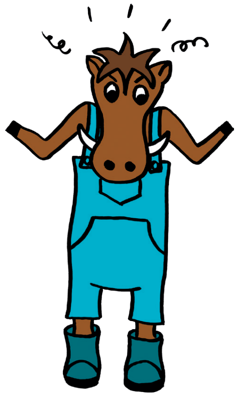
In this section learners will investigate and contrast the properties of metals and materials that are not metallic (so-called "non-metals"). You could draw their attention to metallic and non-metallic items in the classroom, or in pictures, as an introduction to the topic and related activities.

Teacher's note

Explanation of the new words to be covered in this section, associated with metals.

- Properties: A word we use to describe a certain type of matter, a material or even an object, e.g. a property of gases is that they can be compressed.
- Metal: A shiny solid that can conduct heat or electricity and can be formed into sheets or wire.
- Lustre/lustrous: The "shine" we see when light reflects off the surface of a metallic object such as a key or a coin. We say that metals are "lustrous".
- Dense: Dense materials have lots of particles packed close together. Less dense materials have fewer particles packed together. When we compare a metal teaspoon with a plastic teaspoon of the same size and shape, the metal teaspoon would be heavier, because metal is more dense than plastic.

  NB: Do not refer to dense objects as "heavy" and less dense objects as "light". This creates a misconception that density is the same as mass. Density is the mass per unit volume. Mass does therefore influence density, but it is not the same as density. Rather explain it as how closely the particles in a substance is packed, which includes both mass and volume. The more particles that can fit into a specific size/shape, the more dense the object will be.
- Malleable: Malleable materials can be hammered into different shapes without breaking. As a simple example you could think of bending a paper clip into a new shape.



Aaah! All these new words about metals! I still do not really know what they all mean?

Do not worry Walt! These are new, big words but here is an activity where we can investigate some of the properties of metals. We will use our skills of observation (looking, listening and touching) during the investigation.

INVESTIGATION 6.1: What are the properties of metals?

Walt identified a problem and a question – he wants to experience the properties of metals. In a Science investigation we want to answer a question or find something out.

AIM:

What would you like to find out in this investigation? (We call this the aim of the investigation.)

MATERIALS:

- Coins
- Metal spoon, pencil sharpener and nail or screw
- Paper clip or thumb tack
- Pin
- Steel wool
- Metal bottle cap

Teacher's note

Here, the conversation could be directed in such a way that learners realise that when we cook food, we heat the **outside** of the pot, the food cooks on the **inside**. That means the heat that cooks the food travels through the metal. Would heat travel through plastic in the same way? No, the plastic would melt. Would heat travel through wood in the same way? No, the wood would burn.

Teacher's note

Here, a comment about skills of observation may be appropriate. What are skills of observation? What does it mean to observe something? Does observation only refer to things we can see? No, we can also observe (hear) sounds, observe (smell) odours, observe (feel) textures and observe (taste) flavours. Learners might also find it difficult to express what they observe. Encourage them to find words to write down, or say what they see, hear, smell, feel and taste. This will help to develop their science vocabulary.

Teacher's note

Investigation 6.1 is ideal for small group work. Learners could discuss their observations in the group and fill in the table of observations together. Learners may need help finding words for what they are observing. For this reason a word box is provided, but learners could also be encouraged to use their own words. Since this is an investigation, there are no right or wrong answer, as long as learners can justify their answers from their own observations. Rather learners should be encouraged to discover freely, and then link descriptive words to their observations.
At the end of both investigations (The properties of metals and The properties of non-metals) they should be able to compile a list of the general properties of metals and non-metals similar to the lists given at the end of this unit.

METHOD:

1. A few metal objects have been placed in front of you. Notice all the different shapes. Write the name of each object in the table below.
2. Hold each object in your hand. Does it feel hot or cold? Rough or smooth?
3. Look at each object carefully. Is it shiny or dull? Can you describe its colour?
4. Drop each object on the floor, or tap it. What sound does it make?
5. Write your observations in the table. You may use words from the box below or use your own words.

shiny, dull, rough, hard, smooth, makes a ringing sound, cold, warm, heavy, rigid, sharp, flexible, soft, light

OBSERVATIONS:

Name of the object	How the object feels when I touch it	What the object looks like	The sound that is made when the object is tapped or dropped

CONCLUSION:

What have you learned from investigating the properties of metals?

Remember when we looked at the two different houses made from tin and wood? Metals are used to make objects because of the properties that they have.

ACTIVITY 6.2: The properties of metals make them useful to make things

INSTRUCTIONS:

1. Now that you have investigated the properties of metals, look at the following photos of different objects made from metal.
2. Answer the questions about each object.

Metal pot[1]

3. Describe the properties of the metal that this pot is made from.
4. Why are some of the properties useful to the function of the pot?

Barbed wire fence

Did you know?

At room temperature, the metal mercury is the only metal which is in a liquid form.

5. The fence in the photo above is made from metal wire. What property of metal allows us to make this barbed wire fence from metal?

INSTRUCTIONS:

3. The pot is shiny, strong and hard, it conducts heat, and only melts at very high temperatures.
4. Being strong and hard is useful as the pot needs to be able to carry food and you do not want it to break or shatter if you put it down hard on a surface. The metal conducts heat which is useful to cooking food (heat conductivity of metals is only meant to be introduced in the next chapter, but it can be mentioned here.) But the pot also will not melt as metals only melt at very high temperatures, higher than what the pot is experiencing from the stove.
5. Metal is ductile meaning it can be made into thin wires without breaking, which is why we can make barbed wire.

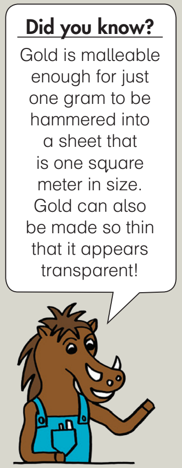
A spanner made from metal.

6. What properties does a spanner need to have in order to be used to tighten bolts?
7. How do the properties of metal help the functioning of a spanner?
8. If the spanner was made from plastic, do you think it would work as well? Why?

Coins are made from different metals.

9. Why do you think coins are made from metals?

A tank made from corrugated iron.[2]



6. The spanner must be hard and strong.
7. The metal is strong and hard and the spanner needs to be strong and hard. The metal will not break when trying to tighten a bolt.
8. A plastic spanner would not work so well as it would easily break. Plastic is not as strong or hard as metal.
9. This is because metals are hard and strong. Coins need to be hard and strong as they are often in a wallet where they bump against other coins, they are put into machines, such as to pay for parking, they might be slammed down on a counter when buying something. All of these actions require coins to be durable and not break, so they are made from metals.

10. This structure is made from sheets of corrugated iron metal. What property of metal allows people to make sheets of metal like this?

We have said that metals are shiny (they have lustre). But sometimes, when metal gets old it becomes dull. If something is dull, it has lost its shine. There are ways to make metals shiny again.

ACTIVITY 6.3: How can dirty copper coins be cleaned?

INSTRUCTIONS:

1. In this activity, you will not be given the list of materials and a method to follow.
2. Rather, you have to come up with your own steps in this activity to answer the question.
3. Your teacher will place various objects in front of you or the class.
4. Experiment with the objects and see how you can best answer the question for this investigation.

QUESTIONS:

1. What question were you trying to answer in this investigation?
2. Write the list of materials that you needed for this activity. Write it in a bulleted list.
3. Imagine you have to tell the Quantum Club how to do this activity to answer your question. Write down the steps to follow to do this activity. Use your experience from experimenting with the objects to come up with a method for the activity. Remember to number the steps in the method.
4. What can you conclude was the best and quickest way to make dull metal shiny again?

10. Metal is malleable meaning it can be hammered and shaped into thin sheets of metal.

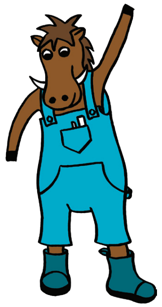
Teacher's note

The purpose of this activity is for learners to investigate ways to make metals shiny again – do not tell them directly what to do, but rather let them investigate and find out for themselves. They can then write up the activity after completing it. Materials to bring to class are old cloths, Brasso, coins, old pots, a bowl of water. Try and bring some metal objects to school which are old and dull, especially old metal pots which you may have at home. Place the objects in front of the learners and ask them to find the best way to make a metal object shiny again. Let them compare rubbing with a cloth, rubbing with a cloth dipped in water and rubbing with a cloth with some Brasso.

QUESTIONS:

1. How can you make a metal object shiny again? How can you clean dirty copper coins or pots?
2. - cloths
   - Brasso
   - coins
   - old pots
   - a bowl of water
3. Assess the learner's ability to record what they did and write short, brief sentences. You might want to start them off with the first step, depending on what you did in class. For example it might be: "Examine an old, dull metal object such as a coin or old pot", the step 2 is "Rub a spot on the surface of the object with a cloth to see if you can make it shiny again", then step 3 "Dip the cloth in water and rub a different spot on the surface of the object, or a different coin", and step 4 "Pour some brasso onto the cloth and rub this onto another spot on the surface of the object. Let the Brasso dry and then polish it off", etc
4. Something about the fact that rubbing with a cloth and brasso is the best way to make a dull metal object shiny again.

6.2 Properties of non-metals



How can we tell if something is made of a non-metal?

New words
- non-metal
- dull
- brittle
- insulator

Non-metals are materials that do not have the same properties as metals:
- Non-metals are not shiny but tend to be dull.
- Many non-metals are not bendy but brittle. This means that they will break when we try to bend them with enough force.
- Non-metals do not conduct electricity or heat well. We call them insulators. Can you think of a reason why pots and pans often have plastic or wooden handles?

This kettle is made from metal and has a plastic handle.

In the next activity we will investigate some of the properties of non-metals. We will test and observe the non-metals in the same way that we tested the metals in Investigation 6.1. This is so that we can compare metals and non-metals later on.

Teacher's note

Explanation of new words in this section
- Dull: Dull is the opposite of shiny. When a surface is shiny, it acts like a mirror. An example could be paper or your school shirt. NB: The reflection of light is not done at this level, but dullness can be defined as the scattered reflection of light off a surface. Light is uniformly reflected off a shiny surface, for example off a mirror.
- Brittle: Brittle materials crack or break easily. Glass is brittle, and so is pottery.
- Insulator: Insulators are materials which prevent the flow of heat (thermal insulators) or electrical current (electrical insulators). Glass, porcelain, pottery and plastic are examples.

Teacher's note

This conversation could be linked to an earlier conversation in which learners were helped to discover that metals are good conductors heat ("when we cook food, we heat the outside of the pot, the food cooks on the). That means the heat can also **inside**" travel along the handle of the pot or pan and burn our hands. Would heat travel through plastic or wood in the same way? No, the plastic or wood acts as insulator, to protect our hands from the heat. These materials do not conduct heat well. Learners could also be reminded that a hot pot or pan could also be handled with a thick cloth or oven mitt to protect the hands. Cloth does not conduct heat well either.

INVESTIGATION 6.2: The properties of non-metals

AIM: What do you want to find out by doing this investigation?

MATERIALS:

- Paper or cardboard
- Cotton wool
- Fabric
- Plastic spoon
- Cork
- Sponge
- Piece of chalk
- Small, strong glass

  IMPORTANT! Do not drop this on the floor!

METHOD:

1. A few non-metal objects have been placed in front of you. Write the name of each object in the table on page 102.
2. Hold each object in your hand. Does it feel hot or cold? Rough or smooth?
3. Look at each object carefully. Is it shiny or dull? Can you describe its colour?
4. Drop each object on the floor, or tap it. What sound does it make?
5. Write your observations in the table.

   You may use words from the box below or use your own words.

shiny, dull, rough, hard, smooth, makes a ringing sound, cold, warm, heavy, rigid, sharp, flexible, soft, light

Teacher's note

This activity is ideal for small group work. Learners could discuss their observations in the group and fill in the table of observations together. Learners may need help finding words for what they are observing. For this reason a word box is provided, but learners could also be encouraged to use their own words. Since this is an investigation, there are no right or wrong answers. Rather learners should be encouraged to discover freely, and then link descriptive words to their observations. At the end of both investigations (The properties of metals and The properties of non-metals) they should be able to compile a list of the general properties of metals and non-metals similar to the lists given at the end of this unit.

AIM:

I want to find out about the properties of non-metals.

OBSERVATIONS:

Name of the object	How the object feels when I touch it	What the object looks like	The sound that is made when the object is tapped or dropped

CONCLUSION:

What have you learnt from investigating the properties of non-metals?

6.3 Comparing metals and non-metals

What have we learnt about the properties of metals and non-metals? Now we are ready to compare the properties of metals and non-metals. Read through the two lists below. Do you agree with the properties that have been listed? Are there other properties that you would like to add?

Most metals:
- Solid and strong
- Malleable and ductile (This means they can be hammered or bent into different shapes.)
- Shiny or silvery (lustrous), especially when they are new
- Cold to the touch

Non-metals:
- Can be soft or flexible, like rubber
- Can be hard and brittle, like glass
- Do not have a silvery (lustrous) appearance, but tend to be dull
- Can be grouped into different categories (ceramics, wood, rubber, plastic, glass, etc.)
- Usually feels neither cold nor warm.

KEY CONCEPTS

- Every type of matter has its own set of properties.
- Shiny, brittle, malleable and dense are all examples of the properties of materials. There are many more examples.
- Metals and non-metals have different properties.
- Materials are useful because of their properties.
- Metals are mined from the Earth.

REVISION

1. What does the word 'property' mean?
2. How can we tell if something is made of metal?
3. What does it mean to 'use our skills of observation'?
4. Design an investigation in which you are trying to work out whether an object is made of metal or a non-metal. You do not need to write out the materials and apparatus you will need. Rather, explain in a paragraph about the different types of tests you would do to determine if something is made of metal or non-metal.
5. Sometimes, just using one property to classify an object or material as a metal or non-metal might not be enough. For example, plastic is flexible but strong, so does this make it a metal? The answer is no. Another example is glass. Glass is also hard, but is it strong? What other properties does glass have which make it a non-metal or metal?

Now that we have learnt about metals and non-metals, let's see how we use metals in the world around us.

REVISION

1. Properties are the things that are special about an object or a material. The properties of a material tells us what it is like.
2. Things that are made of metal is shiny, and hard and they can sometimes feel heavy.
3. Skills of observation are looking, listening and touching. Smelling and tasting are also forms of observation.
4. Learners must use their experience from the investigations to explore the properties of metals and non-metals in this chapter, and from designing their own investigation with the Brasso and dull metals. They should explain some tests to do and the result from the test will say whether it is a metal or not. For example, they could drop the object on the floor to see if it is brittle or not (not all non-metals are brittle though), they could see whether the surface is dull (non-metal) or shiny (metal), they could see whether the object is strong and hard (metal) or soft and bendy (non-metal). But it is important to point out that you cannot just do one of these tests to make a conclusion as there will be some exceptions, such as plastic is hard and smooth like a metal, but it is brittle. So learners need to do more than one test to make a conclusion. This is explored further in the next question.
5. Glass is not strong as it can break easily, it is brittle. It is not shiny (have lustre) like a metal, nor can it be hammered into flat sheets or made into thin wires (it is not malleable or ductile).

7 Uses of metals

KEY QUESTIONS

- How can we use the special properties of metals (magnetism, electrical conductivity and thermal conductivity) to our advantage?
- Which additional properties of metals make them so suitable for use in items such as jewellery, coins, buildings, vehicles, furniture and kitchen utensils?

We have learnt that, whenever we wish to make something new, we first have to decide what the purpose of that product will be. Since we are learning about Matter and Materials, let us assume that the product will be a tool or any other kind of object that will be doing a job for us. Once we have decided what the purpose of the object will be, we can choose a material with the right properties for the job.

7.1 Special properties of metals

New words

- conductivity
- thermal
- magnetic
- scrap metal
- rust
- corrosion
- tarnish

In this chapter we will learn about some of the uses of metals. The properties of metals make them suitable materials for many different objects. We will soon investigate some special properties of metals that we have not thought about yet.

Metals and magnets

Have you ever played with magnets? Did you notice how magnets attract other magnets, and also certain metal objects?

In the next activity we will investigate magnetism and write our findings in a table.

Teacher's note

This unit addresses additional properties of metals, such as magnetic properties, conductivity and corrosion. One way of introducing this unit would be to have a conversation about magnets; this could include a demonstration of magnets attracting each other. You could ask students to name examples where magnets are used in everyday life (fridge magnets, magnetic cupboard doors, magnetic strips in the doors of fridges and freezers, magnetic toys, etc.). They could be asked to predict whether a metal object (a key for instance) would be attracted to a magnet, and this could be followed by a demonstration. The prediction could be repeated with a non-metal object such as a piece of chalk or plastic.

ACTIVITY 7.1: Learning about magnetism

MATERIALS:

- Metal objects: Coins, spoon, pencil sharpener, nail or screw, paper clip, thumb tack, pin, steel wool, etc.
- Non-metal objects: Paper or cardboard, cotton wool, fabric, plastic spoon, cork, sponge, piece of chalk, small glass
- Magnet

INSTRUCTIONS:

1. Sort the objects in front of you into two groups: Metals on one side and non-metals on the other.
2. Write the names of all the metal objects in the table below in your workbook.
3. Then write the names of all the non-metal objects in the table.
4. Hold each object close to the magnet to see if it is attracted to the magnet or not.
5. Write your observations in the table below.

Metal object	Is the object attracted to the magnet? Answer YES or NO	Non-metal objects	Is the object attracted to the magnet? Answer YES or NO

QUESTIONS:

1. Use the information in your table to decide whether the following statements are True or False in your workbook.

   If the statement is True, draw a ✗ in the 'TRUE' column. If the statement is False, draw a ✗ in the 'FALSE' column.

Teacher's note

This investigation helps learners to discover that magnetism is a property unique to metals. Some metals are attracted to a magnet, but non-metals are generally not attracted to a magnet. One of the important **misconceptions** that learners have is that **all metals are magnetic.** The activity following this investigation will help them to discover that this is **not true.**

Statement	TRUE	FALSE
All the metal objects are attracted to the magnet.		
Some of the metal objects are attracted to the magnet.		
Some of the metal objects are not attracted to the magnet.		
Some of the non-metal objects are attracted to the magnet.		
None of the non-metal objects are attracted to the metal.		

2. Write a paragraph to explain what you learnt about magnetism. What must objects be made from to be attracted to a magnet?
3. Complete the following sentence by filling in words from the box below: __________ of the metal objects are attracted to the magnet, but __________ of the non-metal objects are attracted to the magnet.

all	some	none

Magnetism is a very interesting property, and playing with magnets and materials is fun! Were all the metals that you tested attracted to the magnet?

In the next activity we are going to test the magnetic properties of different metals. There is also a problem that Walt needs to help solve. After you have completed the activity you may be able to give him some advice on how to use magnetism to solve the problem!

QUESTIONS:

2. Objects must be made of metal (iron) to be attracted to a magnet.
3. some, none

Teacher's note

Here, learners could be reminded that some **but not all** the metals were attracted to the magnet. Only Iron, Cobalt and Nickel are magnetic. Learners don't need to know this, but they need to know that it is only a few metals that are magnetic. However, MANY appliances and tools are made of iron, making lots of the metals objects around us magnetic.

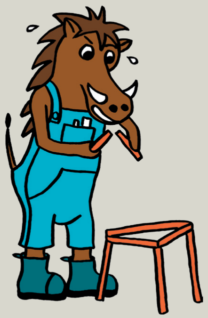
ACTIVITY 7.2: Using magnetism to solve a problem

MATERIALS:

- Metal pieces: iron, aluminium and copper
- Magnet

The problem:

Walt likes to visit the junkyard to look for bits and pieces of scrap to use in his inventions. Uncle owns the junkyard. He buys all kinds of scrap metal, which he then sells to a recycling company. The recycling company pays more if the metal is sorted by type. Uncle has a problem. He does not know how to sort the metal. One day, he is talking to Walt about his problem.



Uncle: "Walt, I need your advice. I know you are clever with inventions, and that you like a challenge."

Walt: "That is true, Uncle. I love a challenge! What is your problem? Maybe I can help you solve it with Science!"

Uncle: "I have a huge pile of metal scrap that I need to sort. I know there is iron, aluminium and copper in the pile of metal scrap. But I have no idea how to do this! Iron and aluminium are both metals, and look very similar. Can you think of a way to help me sort them?"

What do you think Walt's advice to Uncle will be?

Teacher's note

This activity is also ideal for small group participation. It requires a fair bit of reading, as there are a few lines of dialogue included. These could be read aloud by two learners, one playing the role of Walt and another playing the role of Uncle. The group can solve the problem together and Walt can present the solution to Uncle at the end of the activity.

It would be good to keep an eye out for small objects or pieces of aluminium, copper and iron (or steel) that could be used in the investigation. Zinc could also be used, as it is also not attracted to a magnet. Label the pieces with the type of metal it is made of.

Teacher's note

Do not use South African copper coins in this activity. They will be attracted to the magnet because they are made of iron and only have a thin coating of copper on the outside. When learners discover that the coins are attracted to the magnet they may come to the incorrect conclusion that copper is attracted to the magnet, when it is really the iron on the inside that is magnetic.

INSTRUCTIONS:

1. A few metal pieces have been placed in front of you. Find the label on each piece and read the name out loud. Give everyone in your group a chance to say the names of the metals.
2. Write the name of each metal in the table below.

Metal	Colour of metal	Magnetic	Not magnetic

3. Look at each metal carefully. Do they look the same or are they different? Can you describe the colour of each metal? Write the colour of each metal in the table.
4. Hold each metal near the magnet. If the metal is attracted to the magnet, draw a ✗ in the column 'Magnetic'. If the metal is not attracted to the magnet, draw a ✗ in the column 'Not magnetic'.
5. Write what Uncle should do to sort the metal scrap. It would help him if you gave him step-by-step instructions on how to sort the metals.

Not all metals are magnetic. We saw how this means the property of magnetism can be put to use to sort metals.

Metals and heat

We will now investigate another special property of metals. But first a question: How do we cook food on the stove? We put the food inside a metal pot, and then we heat the outside of the pot. This makes the food cook on the inside. How does the heat get inside the pot? The next activity will help us answer this question.

Teacher's note

Learners should be encouraged to think of multiple solutions. One way of sorting the copper from the other metals would be by colour. Copper is reddish-brown, and the other two metals are silvery. Aluminium is light compared to iron. But sometimes it is not that easy to distinguish the two metals on the basis of relative mass (Aluminium is actually less dense than iron, but the concept of density may be too advanced for learners to grasp at this level.) Iron, however, is magnetic, while aluminium is not. This means a magnet would "pick up" iron pieces but not aluminium pieces.

Teacher's note

Learners' lists could contain the following:

Instructions for sorting metals using a magnet:

1. Take out all the reddish-brown pieces of metal and place it in one pile. This is the copper.
2. Test the remaining metal pieces with the magnet. If the metal is attracted to the magnet it contains iron. Put it in a separate pile.
3. All the pieces that are left should be put in a third pile. This is the aluminium.

An idea for extending this activity would be to ask learners to design a magnetic arm for pulling iron pieces out of a pile of scrap metal. Depending on the ingenuity of the learners the design could be drawn on paper, or even built from whatever materials they can find.

Teacher's note

Here, we pick up on an earlier conversation that alerted learners to the fact that when we cook food, we heat the **outside** of the pot, the food cooks on the **inside**. That means the heat that cooks the food travels through the metal. In the investigation that follows learners will investigate whether heat travels through plastic and wood in the same way that it travels through metal.

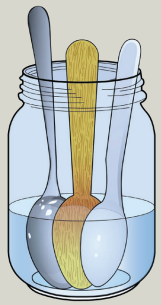
ACTIVITY 7.3: Learning about heat flow (thermal conductivity)

MATERIALS:

- Container (large yoghurt tub, bottle or an ice cream container)
- Warm water (not boiling)
- Ice cold water
- Metal spoon
- Plastic spoon
- Wooden spoon (a pencil or stick will also do)

INSTRUCTIONS:

1. Fill the container with the warm water.
2. Place the spoons in the hot water so that their handles are above the surface of the water as in the picture.



The three spoons in a container with warm water.

3. Leave them in the water for about 15 counts.
4. Feel the handles of each of the spoons in turn. Which spoon feels the warmest? Write your answer down.
5. Empty the container and rinse the spoons under the cold tap.
6. Fill the container with the ice cold water.
7. Place the spoons in the ice cold water so that their handles are above the surface of the water.
8. Leave them in the water for about 15 counts.
9. Feel the handles of each of the spoons in turn. Which spoon feels the coldest? Write your answer down.

Teacher's note

The handles of the spoons should not be in the water.

INSTRUCTIONS:

4. The metal spoon feels the warmest.

Teacher's note

The spoons should be rinsed so that they all have the same temperature at the start of this part of the investigation.

9. The metal spoon feels the coldest.

QUESTIONS:

1. Did the metal spoon feel warm after it had been standing in the warm water?
2. Where did the heat (that you felt with your fingers) come from?
3. How did the heat reach your fingers?
4. Complete the sentence. Write the sentence out in full. The spoon feels hot because heat flows from __________ to __________.
5. Did the metal spoon feel cold after it had been standing in the ice cold water?
6. Where did the cold (that you felt with your fingers) come from?
7. How did the cold reach your fingers?
8. Complete the sentence. Write the sentence out in full. The spoon feels cold because heat flows from __________ to __________.
9. Which material (metal, plastic or wood) is the best conductor of heat?

Metals and corrosion

Have you ever noticed how some metal objects are shiny when they are new, but over time the shine disappears and they become dull and blotchy? The car in the picture was once shiny and new, but look at it now! It is covered in rust from standing out in the rain for so long.

An old car covered in rust.[1]

QUESTIONS:

1. Yes it did. It felt the warmest of all three spoons.
2. The heat came from the hot water.
3. The heat travelled (moved) through the metal of the spoon.
4. The spoon feels hot because heat flows from the water to my hand.
5. Yes it did. It felt the warmest of all three spoons.
6. The learners may answer: The cold came from the water. Teacher note: This is the ideal opportunity to help them discover that **heat flows** (not cold!), and it is therefore heat that flows from the fingers into the cold spoon that makes us experience the cold feeling.
7. Heat flows from my fingers into the cold spoon. That is why my fingers feel cold.
8. The spoon feels cold because heat flows from my fingers to the spoon.
9. Metal is the best conductor of heat.

Teacher's note

The next section investigates corrosion (rust), and could be introduced by a conversation about metal objects that are shiny when new and become dull when they are left outside. Several pictures have been included below to stimulate the discussion. The important message to get across is that rust is a form of corrosion. Only iron rusts, but other metals can also corrode.

Rust has a reddish-brown colour and a rough texture. Rust is very common. It is the product that forms when iron corrodes. During corrosion, iron reacts with oxygen in the air or in water to form iron oxide (the chemical name for rust). Rust is a type of corrosion, but it is not the only type.

Other types of corrosion include:

- Tarnish, found on silver teapots, trays, trophies and jewellery.
- Patina, the green coating that we sometimes see on copper objects.
- Black spots that appear on brass.
- Aluminium oxide, which is a grey-white coating that forms on aluminium.

Can you see how this old cutlery is dull and tarnished?

Can you see the green coating forming on this copper tap?

INVESTIGATION 7.1: Learning about corrosion (rust)

AIM: To find out how rust occurs.

MATERIALS:

- 30 identical iron nails
- Three small, clean and dry containers (yogurt tubs or polystyrene cups)
- Tap water
- Salt water (made by dissolving ten teaspoons of salt in a litre of tap water)
- Plastic wrap to cover the containers

Teacher's note

This investigation is ideal for small group work, and should be done over a number of days. On the first day learners will place iron nails in different media, and then observe how they rust over a period of 5 to 10 days (depending how much time is available). The containers should be covered with plastic wrap if possible, to prevent evaporation of the water. It is important that the nails in container C should be kept as dry as possible, so learners should be told to handle them only with dry hands. It may help to instruct them to always check the nails in container C first, before checking the other containers. If any of the contents in the containers should spill, they can simply be refilled with the same solution (water or salt water).

METHOD:

1. Mark the containers by writing A on one of them, B on the second one and C on the last one.
2. Place ten iron nails in each of the containers.
3. Pour enough tap water on the nails in container A to cover them completely.
4. Pour enough salt water on the nails in container B to cover them completely.
5. Do not pour anything on the nails in container C.
6. Cover containers A and B with plastic wrap.
7. Place the containers next to each other in a safe spot where they can be left undisturbed for a few days.
8. Check the nails in the containers every day. Every day (preferably at the same time each day) count the number of nails that have rust on them. Make sure to return the same nails to the same container after you have examined them. Continue to do this over a period of ten days.
9. Copy the following table in your exercise books and record your results.

RESULTS:

Day	Number of rusty nails in the cup containing water only (A)	Number of rusty nails in the cup containing salt water (B)	Number of rusty nails in the cup containing no water (C)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Teacher's note

When learners draw the graphs they could be encouraged to think about what the dependent and independent variables would be. Time (measured in days in this case) would be the independent variable and should therefore go on the horizontal (x) axis. Explain to learners that the independent variable is the thing that you are controlling (ie. you are controlling the time). Number of nails with rust on them should go on the vertical (y) axis since it is the dependent variable. This is because the amount of rust that develops is dependent on the time that the nails are left on the containers for. If all three graphs are drawn on the same set of axes, the graphs can be compared. The graph with the steepest slope (gradient) would represent the conditions that are most conducive to rust. It might be difficult to draw all three graphs on the same axis. In that case, draw three separate graphs for each of the containers, but use the same scale. That way, you will still be able to compare the slope.

In your exercise books, draw a graph of how many nails had rust on them after each day.

QUESTIONS:

1. In which cup did the nails start rusting first?
2. Complete the following sentences. You may use the words in the box below, or any other words that will make the statement true for you.
    a. Iron rusts when it comes into contact with ________.
    b. Iron will rust more quickly in ________ than in ________.

- air
- water
- salt water

3. Can you think of ways to protect iron against rust? (Hint: Look at the following photo for a clue.)

These people are painting the iron poles and fences.[2]

QUESTIONS:

1. Cup B (the salt water).

Teacher's note

Since this is an investigation, there are no right and wrong answers. One would expect the salt water to be most conducive to rust, but the learners may come to a different conclusion on the basis of their findings. The purpose of an investigation is for learners to develop a scientific explanation that is based on their evidence.

2. a. water (and salt water).
    b. water, air
3. We can paint the iron to protect it from rust.

We have seen that iron rusts. Other metals also change when they are not protected. Have you noticed what coins look like when they are new? New coins are bright and shiny. Old coins are dull and they look dirty. That is because they have a dark layer of tarnish on them. In the next activity we will see how the layer of tarnish can be removed to make coins bright and shiny again.

ACTIVITY 7.4: How can dirty copper coins be cleaned?

MATERIALS:

- 20 dull, dirty copper coins
- Quarter cup white vinegar
- One teaspoon salt
- A clear, shallow bowl (not metal)
- Paper towels, tissues or newspaper

INSTRUCTIONS:

1. Put the salt and vinegar in the bowl. Stir until the salt dissolves.
2. Dip one coin halfway into the liquid. Hold it there for about ten seconds, then pull it out. What do you see?
3. Place all the coins into the liquid. You can watch them change for the first few seconds. After that you won't see anything happen.
4. After five minutes, take half of the coins out of the liquid. Put them on a paper towel but do not rinse them or dry them.
5. Take the rest of the coins out of the liquid. Rinse them really well under running water, and put them on a paper towel to dry. Write "rinsed" on the second paper towel.
6. After about an hour, look at the coins on the paper towels. Write your observations in the table on page 115.

Did you know?

Many plastics can be made strong enough to replace metals, glass and other materials. Some cars can be made from these plastics! The plastic weighs much less than metal, and this means the car needs less energy to move around.

Teacher's note

Although there are many ways to protect iron from rust, at this level it is enough for the learners to realise that applying a protective coating – such as paint – to the iron will protect it from rust. Soon they will learn that it is also possible to protect the iron from rust by processing it with other metals.

Teacher's note

South African copper and bronze coins (5c and 10c pieces) are suitable for this investigation. They should not be left in the salt and vinegar mixture for too long or the copper coating will dissolve completely to expose the iron underneath. The reason why a metal bowl is unsuitable is because the metal in the bowl will react with the copper in the salt and vinegar mixture. A clear bowl or large beaker (plastic or glass) would be best because learners will be able see the reaction through the side of the container, but a clean yoghurt or ice cream tub will also do the trick.

Teacher's note

If the coin is held with one half in the liquid and the other half above the liquid, then learners should clearly see the contrast between the treated and untreated halves of the coin. It may be better if the educator demonstrated this step.

Teacher's note

If the coins are put directly onto the paper without rinsing or drying them first, the reaction between the coins and the salt-and-vinegar mixture will continue and the paper underneath the coins will become greenish-blue. This is due to dissolved copper ions.

Teacher's note

If the coins are not rinsed and dried properly, the reaction between the coins and the salt-and-vinegar mixture will continue and the paper underneath the coins will become greenish-blue due to dissolved copper ions. You want to avoid this.

Item	What does it look like?
Coins before you put them in the vinegar-and-salt mixture	
Unrinsed coins after one hour	
Rinsed coins after one hour	
Paper under the unrinsed coins	
Paper under the rinsed coins	

QUESTIONS:

1. Why did the coins look dirty before you put them in the vinegar-and-salt mixture?
2. What happened to the coins in the vinegar-and-salt mixture? Why do you think this happened?
3. Taste a few drops of the clean vinegar. What does it taste like? **NEVER taste chemicals unless your teacher says it is OK.**
4. Can you think of another liquid that could be used instead of the vinegar? (Hint: What other liquids taste sour?)
5. What happened to the unrinsed coins? Did they also become clean and shiny?

We are going to learn more interesting things about metals and what they are used for next.

7.2 Uses of metals

Metals have thousands of uses. We use metals every day, sometimes even without knowing!

Metals are ductile and good conductors of electricity. This is why metal is used to make the wire inside electrical cables. Without electrical cables we would not have electricity in our homes or schools. We would not have lights, television or telephones. (Next term we will look more at electricity!)

New words
- goods
- durable

QUESTIONS:

1. The coins looked dull and dirty because they were covered with tarnish.
2. The coins became shiny again. The vinegar-and-salt mixture took away the tarnish.
3. The vinegar is sour.
4. We could use lemon juice (or orange juice) instead of vinegar.
5. No, they turned blue-green.

Teacher's note

This section focuses on more ways in which metals are used. Draw learners' attention to metallic objects in and around the classroom. They could each bring one picture of a metallic object to class and these could then be sorted into categories, for instance "transport", "the kitchen", "industry", etc. Learners could generate the categories themselves, and then be encouraged to think about the reasons why metal is used for each particular purpose. The second paragraph discusses why metal is used for electrical cables and is a good example of how such a discussion may be encouraged. The activity that follows has the same purpose.

Metals are extremely strong and can be turned into thin sheets. These sheets can be used to make the bodies of the cars, trucks, trains and aeroplanes that are used to transport people and goods from one place to another.

Aeroplanes are made from strong, durable sheets of metal.

A bridge made of metal.

Did you know?

South Africa has one of the biggest deposits of platinum in the world. Platinum is a very valuable and expensive metal.

The strength and durability of metals make them very important as building materials, not only in visible ways (such as metal roofs and window frames), but also in invisible ways (such as metal supports inside the concrete that bridges and tall buildings are made of. Even furniture is sometimes made of metal!

ACTIVITY 7.5: The uses of metals in your home

INSTRUCTIONS:

1. Choose 8 metal objects from home (you could also choose your classroom).
2. Next to each metal object on your list, write why you think metal was used to make this object. You should write what property of metals makes it the best material for that particular job.
3. If you think the object could also have been made from another material, say which material. You may want to look at the example below for ideas.

Teacher's note

This can be used as a possible project. Learners can also then choose one object and research how it is made.

Metal object	Reason for using metal in this object	Other material(s) that could be used instead of metal
Broom handle	Metal is strong and durable	Wood, strong plastic

4. Present your findings on a poster with a table where you record your observations. (It could be similar to the one above.)
5. Include some pictures or photographs of the objects and do not forget to give your poster a heading.

QUESTIONS

Turn back to the front cover for Matter and Materials on page 90 where you can see the Quantum Club are in a city construction site. Identify the objects that are made of metal and write them down.

KEY CONCEPTS

- Metals have some special properties.
- Metals can conduct heat and some metals are magnetic.
- Metals have many uses.
- When we choose a material for a certain purpose, we look for a material with the right properties for the job.

QUESTIONS

Turn back to the front cover for Matter and Materials on page 90 where you can see the Quantun Club are in a city construction site. Identify the objects that are made of metal and write them down.

All the cranes, pulley mechanisms, crates and frames used to build the buildings are made of metal.

REVISION

1. List as many properties of metals as you can think of.
2. Are non-metals magnetic?
3. Walt used magnetism to help his uncle. Which metal in the junkyard was attracted to the magnet?
4. Are all metals magnetic?
5. Why are most pots and pans made of metal?
6. Why do some pots and pans have handles made of plastic or wood?
7. Why does iron that is shiny when it is new become dull and blotchy when it stands outside for a long time?
8. What does rust look like? (Describe what it looks and feels like.)
9. What is another name for rust?
10. Do all metals rust?
11. Your dad is putting up a new iron fence in front of your house. What would you tell him to do to make the fence last long?
12. Look at the picture below of hammers. What is the head of each hammer made from and why do you think this material was used?

Different sized hammers.

13. You had to advise your parents or a family friend who wants to buy a set of chairs and tables for their garden to replace the plastic ones that have broken. What would you advise them are the best types of furniture for outside. Explain your answer.

REVISION

1. Metals are solid, strong, malleable, ductile, and lustrous. In addition: Some metals are magnetic; metals conduct heat and electricity; and some metals corrode (for instance iron rusts).
2. No
3. Walt used a magnet to pick up all the iron scrap in the junkyard.
4. No
5. Metal is a good conductor of heat and that makes it good for cooking things.
6. Metal conducts heat but plastic and wood do not. That means the handles will stay cool even when the pot is too hot to touch.
7. The iron rusts.
8. Rust is reddish-brown and feels rough and flaky.
9. Corrosion.
10. No, only iron rusts.
11. He can paint it as this will help prevent the iron from rusting.
12. The head of the hammer is made from metal. Metal is strong and hard and the hammer is used to hit other hard objects such as nails so it needs to be made from a hard material.
13. The best furniture should be some made of metal (not iron) as they will be more durable and not break like the plastic. Also, metal will last longer in the rain compared to wooden furniture which is outside.

14. Some jewellery is made from metal. What types of metal is jewellery made from? Why do you think some of these metals are so expensive?
15. Why do you think your kitchen utensils (such as knives, forks and spoons) are normally made from metal, and not plastic and wood? Why then do fast food restaurants give you plastic utensils with your take aways?
16. Below is a photo of a fire engine truck. Can you imagine a fire engine made from plastic or wood? What properties of metal make it suitable for the fire engine?

A fire engine made of metal

I love making objects and inventions with old materials from the scrapyard. But have you ever wondered how these materials are made? I have!

Let's find out about how materials are processed!

14. Jewellery is made from metals such as gold, silver, platinum, gold and also copper. These metals are expensive because they are not very common to find in the Earth and they go through expensive procedures to get them looking how they do in the finished product. They are also expensive due to the demand – a higher demand raises the price of something.
15. Kitchen utensils which you want to last a long time are made from metal. This is because the metal is strong and will not dent or break when thrown into the drawer or washed in the sink. However, as fast food restaurants, you are normally given plastic utensils as these can be thrown away. They are not meant to last long. If they had to supply you with metal utensils with all take-aways it would be much more expensive.
16. Metal can be hammered into sheets which are strong and durable and these are used to make the shell of the truck. The metal is hard and strong so when people climb on the truck, the metal does not break or crack like plastic would. Metal also only melts at very high temperatures. Since a fire engine often gets close to fire and in very hot areas, if it was made from plastic, the plastic would melt. The metal does not melt. If it was made from wood, the wood could also catch fire and burn. The metal will last long if it gets wet from the hoses or standing outside on the sun and rain. plastic or wood would not last as long and begin to perish or rot.

8 Processing materials

KEY QUESTIONS

- How can we make new materials?
- How does the amount of material we start with affect the amount of new material we can make?

8.1 Combining materials

When we combine materials, new materials are made. The properties of the new material are often different from the properties of the materials we started with.

There are many ways to process materials into new materials. There are also many reasons why we would wish to process materials into new materials.

When we bake a cake, we are processing flour, eggs and other ingredients (that may not taste very nice on their own) into a cake which tastes really good!

We process materials to make them stronger, or more durable, or waterproof, or even just to make them look more beautiful or interesting. New materials that form after mixing different materials are called mixtures.

New words

- combine
- process
- mixture

Mmmm! Yum! I think I am going to enjoy this chapter if we are going to be making cakes!

We are going to have some fun Walt! And at the same time learn about different ways to combine materials.

Teacher's note

This unit deals with the many different ways in which materials can be processed. The important messages is that new materials will have new properties, and that processing always has a purpose. We want to change materials into better materials, for instance metal (steel) that won't rust like iron does, but has all the other desirable qualities of iron (strength and durability). This unit also lays some of the groundwork for an understanding of Mixtures, which is covered in Grade 6 Matter and Materials.

8.2 Stainless steel

We have learnt that iron rusts over time, and that this process speeds up when the iron is in contact with water. Have you ever noticed rust on the knives and forks in your home? Probably not! That is because they are not made of iron but of stainless steel. But what is stainless steel?

ACTIVITY 8.1: A research project to learn about stainless steel

Stainless steel is made by combining iron with other metals to make it stronger and to prevent rust. Processing iron with other metals to turn it into stainless steel means we can use it even in wet environments. Water taps and pipes are sometimes made of steel. Some of the instruments that doctors use to operate on sick people are made of steel. So are the pots and pans that we use when we prepare food.

Stainless steel taps in the bath.

Look at this shiny pot made of stainless steel.[1]

New words
- stainless steel
- report

INSTRUCTIONS:

1. Your task is to find out as much as possible about stainless steel.
2. You may use books or the internet, or you may ask people in your family or your community what they know about stainless steel.

Teacher's note

Process (verb): To process material means to combine or mix it with other materials and/or to change it into something new by subjecting it to one or more processes (heating, cooling, firing, melting, pressurising etc.)

Teacher's note

This project is suitable for individuals or pairs of learners. If access to the library or internet is a problem, encyclopaedias, books and magazines could be made available in class. The following link may be useful and could be printed for learners: 1. Learners can complete this project while you carry on with the rest of the activities and content in class.

3. This process of finding out things about a topic is called research. You could use the following questions to guide your research:
   a. What is stainless steel?
   b. What is the main component of stainless steel?
   c. What other metals are in stainless steel?
   d. Why are other metals added to make stainless steel?
   e. Are there different types of stainless steel?
   f. What is stainless steel used for?
4. When you have gathered all your information, you should write a report with the title: Stainless steel.
5. Use pictures to make it more interesting.

New words
- dissolve
- solution
- starting materials

8.3 Mixing materials

Let's look at more ways to combine and process materials.

Mixing: Making glue

Often when we mix materials together, the properties of the new material or product is different from the properties of the materials we started with. Do you remember what the word 'property' means from Chapter 7 when we looked at the properties of metals and non-metals? Let's make some sticky glue to find out about this.

ACTIVITY 8.2: Making glue

MATERIALS:

- Flour and water
- Two bowls for the flour and water
- Bowl for mixing
- Pieces of paper

INSTRUCTIONS

1. We are going to make a sticky glue paste using flour and water.

Teacher's note

You do not need to do all the activities in this section, but learners should experience at least 2 different ways to process and mix materials. however, CAPS has allocated 3.5 weeks to this section so you may find that you do have time to do several activities and really let learners experience combining materials in a "hands on" fashion! The order of these activities has been changed slightly from what is suggested in CAPS so that one activity builds on the previous one.

Teacher's note

This is a very quick and easy activity to demonstrate the above concept of the finished product having different properties to the starting materials. Place the flour and water in separate bowls and allow learners to put their hands in to describe the properties. It might get a bit messy for learners to each do their own mixing, so you could do it as a demonstration at the front of the class.

2. First you need to look at the properties of the flour and water before we mix them together. Describe the properties of the flour and water.
3. Now experiment with mixing different quantities of water and flour together to make a sticky paste.
4. See if you can stick pieces of paper together using the glue that you have made!
5. Describe the properties of the paste you have made.

QUESTIONS:

1. What did the flour feel like before it was mixed with the water?
2. How would you describe the properties of plain water?
3. After mixing the flour and water together, what are the properties of the paste that you end up with?
4. Do you remember learning about the states of matter? What state of matter is the flour and water before mixing?
5. What state of matter would you say the paste is?

Did you get any of the paste you made in this activity on your fingers? Perhaps it started to dry and became hard? Often when we combine materials together we have to let them set.

Mixing and setting: Making jelly

Have you ever tasted jelly? Jelly comes in many different colours and flavours. Which is your favourite?

To make jelly, we dissolve the jelly powder in hot water. When the solution of jelly powder in water cools down, something very special happens: The solution sets, and turns into a delightfully wobbly, sweet treat! The jelly powder has been processed into something new! That is what the next activity is all about.

QUESTIONS:

1. Dry, powdery, soft
2. Wet, liquid, can pour, fills the container it is placed in, etc
3. Sticky, wet, more solid than water, etc
4. Flour is a solid, water is a liquid.
5. Dependent on the consistency of the paste that is made – it could be more like a liquid if there is more water, or it could be more like a solid if there is more flour. When the paste dries, it becomes a solid.

ACTIVITY 8.3: Making jelly

MATERIALS:

- Packet of jelly powder
- Bowl
- Cup for measuring
- Hot and cold water
- Spoon for mixing

INSTRUCTIONS:

1. Read the instructions on the packet of jelly.
2. Pour the jelly powder into the bowl.
3. Look carefully at the dry jelly powder. What does it look like?
4. Touch the jelly powder with your finger. What does it feel like?
5. Place a few grains of the jelly powder on your tongue. What does it taste like?
6. Copy the following table in your exercise books and record your findings.

Properties	Dry jelly powder (before mixing)	Water (before mixing)	Prepared jelly (after it has set)
What does it look like?			
What does it feel like?			
What does it taste like?			

7. Follow the instructions on the packet to make the jelly.
8. Cool the jelly until it sets.
9. Describe the properties of the prepared jelly in the same way that you did for the starting materials.

   Here are some words that you may find useful. You may also use your own words.

liquid, clear, powdery, sweet, sticky, transparent, wobbly, solid, gelatinous (jelly-like), slippery

Teacher's note

Jelly needs to set overnight in a cool place, and this should be kept in mind when starting this activity. It would be best if the educator handled the hot water, rather than letting the learners do this. Some learners could bring jelly to school and other could bring fruit to slice into the jelly before it sets. It may also be more hygienic to set a small portion of the dry jelly aside for the students to touch and taste, rather than have them dipping their fingers in the powder that will be made into jelly. The jelly could also be set in small yogurt containers or ice cube trays so that each learner can enjoy it the next day!

QUESTIONS:

1. What materials did you start with? (starting materials)
2. What happened to the jelly powder when you mixed it with the water?
3. Why is the water a different colour?
4. How did the jelly mixture change when it cooled down?
5. Write a short paragraph to describe how the process has changed the properties of the jelly. Try to use as many of the following words as possible:

investigation, powder, powdery, sand, water, disappear, colour, change, mixture, stiff

8.4 Concrete and reinforcing

In the photo below some strawberries have been added to the jelly after it was mixed with the water, but before it was cooled to set. It looks delicious! We could say the strawberries are embedded in the jelly.

New words
- plaster of paris
- reinforce
- binder

Strawberry jelly[2]

In Activity 8.3 we saw that jelly sets. Jelly is not the only material that sets. We are going to investigate another material that sets. Have you ever watched builders mix concrete when they want to build a wall or a house? Look at the people in the photos on page 126. What are they doing?

QUESTIONS:

1. Jelly powder, water, fruit (optional).
2. Learners may write something like: The jelly powder mixed with the water and "disappeared".

Teacher's note

You could encourage learners to think carefully about using the word "disappear". Has the jelly powder actually disappeared, or has it just been changed to a different form? What evidence do we have of it still existing? The jelly powder has coloured the water, which is evidence that it still exists.

3. The jelly powder mixed with the water and this changed the colour of the water.

Teacher's note

The following questions could be answered after the jelly has set, preferably the next time the class meets for Science.

4. The jelly mixture was liquid at first but it became stiff when it cooled.
5. Learners may write something like: When we started the investigation, the jelly was powdery, like sand. When we mixed it with water, the jelly powder looked as if it disappeared but we knew it was still there because it changed the colour of the water. When the jelly and water mixture cooled down, it became stiff.

Teacher's note

The word embedded will be used again later, when the notion of embedding materials in concrete for the purpose of reinforcing it, is introduced. It would be worth spending some time on its explanation here.

The people in the photos are mixing sand and water with building cement. The mixture of sand, water and cement is called concrete. Concrete is like mud when it is wet, but when it dries out it sets into a hard, strong material. Concrete can be used to make bricks and to plaster walls.

Mixing concrete using spades.

Mixing concrete using a mixer.

A concrete mixer.

Visit
Mixing concrete (video)
goo.gl/rWh9r

In the first picture people are using spades to mix the concrete. They use them like we would use a spoon to stir sugar into a cup of tea. The people are using their muscles to do the work required for mixing the concrete.

In the second picture the machine on the right is called a cement mixer. This machine mixes all the ingredients by turning mechanically, like an electric food mixer. Electrical energy does the work required for mixing the concrete.

Mixing and setting: Making bricks

In the next activity we are going to make some bricks, using sand, water and some plaster of paris (a material that is very similar to cement).

Teacher's note

Here you could link to other areas in the curriculum related to Energy and Change, and Life and Living.

ACTIVITY 8.4: Making bricks

MATERIALS:

- Plaster of paris powder
- Water
- Clean sand or sandy soil (beach sand or builder's sand would work well)
- Empty ice cube tray
- Ice cream sticks or plastic teaspoons for mixing and scooping
- Two empty large yoghurt tubs (one for measuring and one for mixing)

INSTRUCTIONS:

1. Look at all the starting materials and feel them with your fingers. **IMPORTANT!** Do not taste any of them!
2. Copy the table below in your exercise books and record the properties of the materials.

Properties	Plaster of paris	Sand	Water
What does it look like?			
What does it feel like?			

Making sand bricks:

1. Mix some of the sand with water to make some stiff mud. Fill three or four of the hollows in the ice cube tray with the mud.
2. When these bricks are dry, they will be sand bricks.
3. Do you think they will be strong and durable?

Making 'concrete' bricks:

1. Pour all the plaster of paris powder into the measuring tub. Measure the amount of powder in the tub by making a mark on the outside of the tub with a pen. Pour the plaster of paris into the mixing tub.

Teacher's note

- Plaster of Paris can be bought at most pharmacies and hardware shops. Look out for an old ice cube tray that can be used as a mold for the bricks and thrown away later, or reused for the same purpose next year.
- If you are not near a beach or sandy area where you could collect sand for the "bricks", you could look out for a building site, and ask if you could have a bucket full of sand for your science class.
- A permanent marker will come in useful when marking the level of the plaster of Paris in the tub.
- When materials that are not foodstuffs are investigated, it becomes important to impress upon learners that chemicals should **never** be tasted.
- In the 4th term learners will make a model of a fossil using plaster of Paris or polyfilla. You can refer back to this activity to remind them about the properties of plaster of Paris.

Teacher's note

Plaster of Paris sets quickly and gives off a considerable amount of heat in the process. Ensure that learners take note of the observation that the mixture becomes warm when it sets. Help them to formulate their ideas around this by asking questions like: "Why does the mixture get warm?" and "When do things get warm?" You want them to realise that things feel warm when they release energy/heat. When mixing, the plaster of Paris and sand need to be in a 1:2 ratio.

2. Pour sand into the measuring tub, up to the mark that you made in step 1.
3. Add the sand to the plaster of paris in the mixing tub.
4. Repeat steps 2 and 3 once more.
5. Pour water into the measuring tub, up to the mark that you made in step 1.
6. Add the water to the sand and plaster of paris and mix well with the stick. Now you have made wet 'concrete'. You will have to work fast because it will set quickly.
7. Scoop the wet 'concrete' into the empty hollows of the ice tray. Fill them all to the same height so that your finished bricks all have the same size. Make the top surface of each brick flat so that they will be easy to stack later.

   When these bricks are dry, they will be 'concrete' bricks. Do you think they will be strong and durable?
8. Wash your hands very thoroughly.
9. Leave all the bricks overnight to set. When the bricks have set they can be removed from the tray and placed in a sunny spot to dry out for a few days.
10. When the bricks are dry you can use them to build something interesting.
11. Examine both types of bricks. Copy the following table in your exercise books and record your observations.

Properties	**Wet sand**	**Sand brick**	**Wet 'concrete'**	**'Concrete' brick**
What does it look like?				
What does it feel like?				
Is it strong and durable? (Yes or No)				

QUESTIONS:

1. What materials did you start with?
2. How did the 'concrete' mixture feel after you mixed it? Did it get warmer or colder?

QUESTIONS:

1. Sand, plaster of Paris and water.
2. The mixture felt warmer.
   Encourage learners to think in terms of the concept of temperature: "That means the **temperature** was higher (increased)".

3. Where do you think the heat came from?
4. Do you think that sand and water alone would be good material for making bricks? Say why (or why not).
5. Did adding plaster of paris to the sand make the bricks better? In what way?
6. Can you think of other materials that we could add to the mixture of sand and plaster of paris to make the bricks even stronger and tougher?

Reinforcing

Real bricks are actually made by firing them in a kiln to bake them and make them hard. The potter makes objects like pots out of wet clay. Once they have dried and been fired the clay becomes hard.

These clay pots have been dried and they have just been loaded into a kiln to be fired.[3]

We have learnt that sometimes we can make materials stronger if we add other materials to them. When we make materials stronger by adding other materials, we say we are reinforcing it. Your bricks made of 'concrete' (sand and plaster of paris mixture) were stronger than the bricks made of sand only. The plaster of paris acted as binder to glue the sand grains together.

In the next activity we will be looking at photos showing examples of how concrete can be reinforced. There will be some questions to help you think about each process.

3. Learners might say: "From the starting materials".

   Teacher note: This is an opportunity to get learners to realise that when materials are mixed, they sometimes change. You could then ask: "Did the starting materials feel warm?" to which learners should respond: "No."

   Then: "When did it start to feel warm?" ... "When the materials were mixed."

   "What do you think happened when the materials were mixed that caused them to get warm?" Some learners may now begin to use words like "react" or "reaction". You could then bring in that energy is released by the starting materials reacting with each other. We observe this energy by the heat/warmth that we feel.
4. If the sand bricks were weak and easily crushed learners may respond: Sand and water is not a good material because the bricks will not be strong enough.
5. Teacher note: Here it is important to convey the idea that the plaster of Paris acts as binder to hold the sand grains together.

   The sand and plaster of Paris bricks should turn out stronger than the bricks made of sand alone, and therefore learners may respond: The bricks made of sand and plaster of Paris were stronger than the sand bricks.
6. Here you could allow the learners to use their imaginations: Some materials that may be mentioned are: cement, stones, rocks, etc. This question is an ideal opener for introducing the concept of reinforcement. You could use the meaning of the word "force" to conjure up notions of "strength" and making things "stronger".

ACTIVITY 8.5: Reinforcing concrete

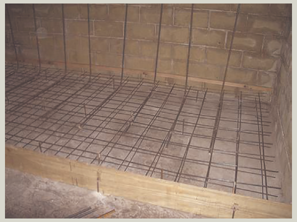
INSTRUCTIONS:

1. Look at the photo of a piece of concrete wall below. The concrete looks as if there are pebbles (small stones) embedded in it.

A close-up photo of a slab of concrete.[4]

2. Can you see that there are things embedded in the concrete? What do you think they are?
3. How did the stones get inside the concrete?
4. Why do you think the concrete was mixed with stones? (Hint: Is stone a strong material?)
5. What is the process called when we make a material stronger by mixing it with another material?

Look at the photo below. It shows how a floor is being prepared for reinforcement with steel bars.



A piece of floor being prepared.[5]

6. The floor in the picture is inside a garage. Why do you think the concrete needs to be reinforced with steel bars? (Hint: Why would the garage floor need to be extra strong?)

INSTRUCTIONS:

3. The stones were mixed into the concrete when it was still wet.
4. The stones were mixed into the concrete to make it stronger. (Here you may want to encourage the use of the word "reinforce".)
5. Reinforcing.
6. The floor needs to be strong because the garage may be used to store a car or a truck or heavy equipment.

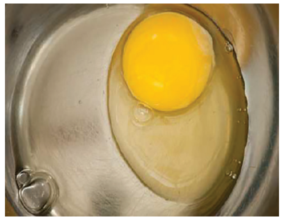
The next photo shows a new building that is being constructed.

A new building[6]

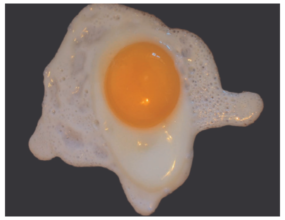
7. Can you see the steel bars that are sticking up into the sky? What do you think would be their purpose?
8. Why does the building need a structure that is extra strong?

8.5 Mixing and cooking

Cooking food is also a form of processing. Have you ever seen what a raw egg looks like? The same egg looks quite different when it is cooked. Notice how the egg white is transparent when it is raw, and white when it is cooked. When it is raw, the egg is runny, like liquid. When it is cooked, the egg is solid but soft like rubber or soft plastic. Look at the following photos.



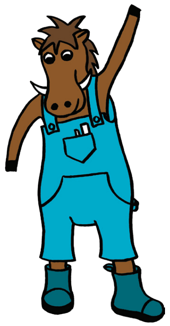
A raw egg.[7]



A fried (cooked) egg.

7. The steel bars are there to reinforce the walls.
8. (The purpose of buildings are to protect people and things. This looks like it might be large building, meant for holding many people and things, like equipment, computers and furniture.) Learners may write: The building needs to be extra strong to protect the people and the things, and to be stable enough to stay in one piece and not fall apart.

In the next activity we will be cooking some flapjacks. They are like pancakes but smaller and thicker. We will be comparing how the raw ingredients change when they are first mixed, and then cooked.



Choose me to be the taster!

ACTIVITY 8.6: Let's have fun making flapjacks!

MATERIALS (Actually ingredients and cooking apparatus!):

- Flour (2 cups)
- Baking powder ($2\frac{1}{2}$ teaspoons)
- Sugar (3 tablespoons)
- Salt ($\frac{1}{2}$ teaspoon)
- Two large eggs
- Milk ($1\frac{1}{2}$ to $1\frac{3}{4}$ cups)
- Butter (2 tablespoons melted)
- Cooking oil
- Two mixing bowls
- Frying pan
- Spatula
- Hot plate for cooking

INSTRUCTIONS:

1. Look carefully at the each of the ingredients in turn. What do they look like?
2. Touch each ingredient with your finger. What do they feel like?

Teacher's note

- For this activity you would need some ingredients, but also a simple plate-stove or gas-stove to cook the flapjacks. An electric hand mixer would be very useful for mixing the ingredients quickly, but a handheld egg beater would do the job just as well.
- Flapjacks are really easy to make and relatively "flop-proof".
- They can also be cooked immediately; the batter does not need to "rest" beforehand.
- It may also be more hygienic to set a small portion of the ingredients, and of the raw batter aside for the students to touch and taste, rather than have them dipping their fingers in the materials beforehand. Small yoghurt tubs or paper cups are good for this purpose.

Teacher's note

- You could demonstrate the process rather than have the learners make it themselves. While you are demonstrating, learners attention could be kept on the process by involving them in counting activities. Let them count the flapjacks, or make simple calculations, for instance: "If we cook flapjacks in batches of four, how many batches would we need if we needed to cook 20 flapjacks?" or "If we cook 6 batches and each batch has 3 flapjacks, how many flapjacks would we have?" This may be a good way of integrating the science curriculum with what they are learning in mathematics, and it also serves to sensitize learners for the activity that follows this one, in which learners are required to think about how the amount of starting material influences the amount of new material that can be produced.
- At the end of the activity learners are required to draw a flow diagram. Drawing flow diagrams is useful to help learners visualise the concept of 'process'.

3. Place a little bit of each ingredient on your tongue. What do they taste like?

   Do not use words like good, bad, tasty, funny or weird! The block below contains some descriptive words that you could use:

powdery, fizzy, sweet, salty, tasteless, sandy, crunchy, oily, smooth, liquid, milky, slippery, dry, grainy, bitter, frothy, runny

4. Sift together the dry ingredients. The dry ingredients are the flour, baking powder, sugar and salt.
5. In a separate bowl, whisk together the eggs. Add $1\frac{1}{2}$ cups of milk to the eggs and mix well.
6. Add the milk mixture to the dry ingredients. Stir until the batter is smooth.
7. Add the melted butter to the batter and mix.
8. If the batter seems too thick to pour, add a little more milk.
9. The batter is now ready to be processed into flapjacks.
10. Look carefully at the batter. Scoop some of it out of the mixing bowl and touch it. Now lick your finger. Write the properties of the batter in the table below. (Remember to look at the block above for some descriptive words.)

Properties	Uncooked batter	Cooked flapjack
What does it look like?		
What does it feel like?		
What does it taste like?		

11. Heat the pan on the hot plate and add a little bit of oil.
12. When the pan is hot, place scoops of the batter in the pan with a large spoon. You should space the scoops of batter so they don't touch each other.
13. When the flapjacks are bubbly and a little dry around the edges, you should flip them with the spatula.
14. Copy the table below in your exercise books and use it to record descriptions of the properties of the prepared flapjacks.
15. Now you can enjoy them, sprinkled with sugar or drizzled with syrup! Yum yum!

A stack of flapjacks!

QUESTIONS:

1. What were the starting materials of this activity? Copy the table below in your exercise books and use it to tabulate them.

Starting materials

a.	b.	c.	d.
e.	f.	g.	h.

2. Write a short paragraph to describe how the process changed the properties of the batter. How did the batter change when it was cooked? (Say what the batter looked, tasted, and felt like before and after it was cooked.)
3. Draw a flow diagram to explain how you made the flapjacks from the starting materials. You must include labels to explain the process. You could use the following flow diagram about how to make a cup of tea for inspiration.

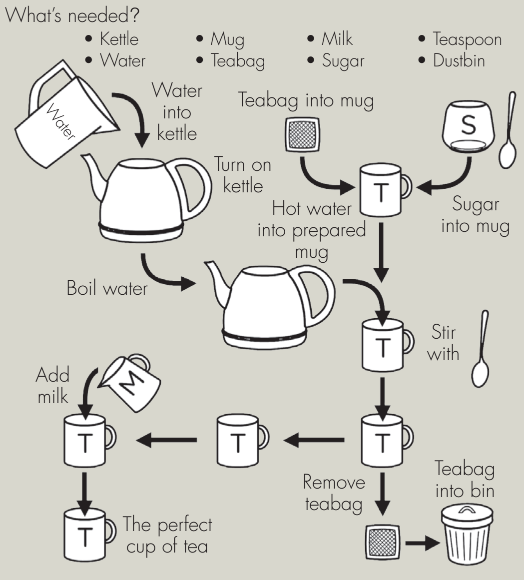
QUESTIONS:

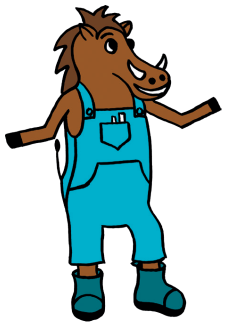
1.

a. flour	b. sugar	c. eggs	d. melted butter
e. baking powder	f. salt	g. milk	h. cooking oil

2. Learners might write: The batter was runny and a pale creamy colour when it was raw, and it was stiff and pale brown, with dark brown edges when it was cooked. Before it was cooked, the batter tasted sweet and raw (floury), but after it was cooked it tasted like cake. Before it was cooked the batter felt cold, slippery and liquid, but after it was cooked it felt warm, soft and rubbery.

Flow diagram for making a cup of tea





That was so good! I want to invite the Quantum Club over to my house on the weekend and make us flapjacks!

Great idea Walt, your friends will love that! But do you know how much batter you will need to make?

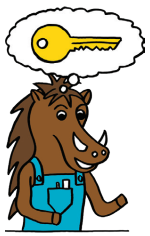
ACTIVITY 8.7: How much batter?

How does the amount of material we start with affect the amount of new material we can make? Walt is making flapjacks for Felicity, Mothusi and Phumlani. He uses the recipe in Activity 8.6. He is very careful not to waste any batter. He counts that he made 12 large flapjacks. Walt is very pleased because it means each one of them can have three large flapjacks.

QUESTIONS:

1. How many flapjacks could Walt make if he used only half of the batter?
2. Walt decides to invite four more friends to eat flapjacks. That means there will be eight people in total. How many flapjacks would he need if each person eats three flapjacks?
3. Walt needs to make enough batter for 24 flapjacks. Help him work out how much of each ingredient to use:

Ingredients	Amount needed for 12 flapjacks	Amount needed for 24 flapjacks
Flour	2 cups	
Baking powder	$2\frac{1}{2}$ teaspoons	
Sugar	3 tablespoons	
Salt	$\frac{1}{2}$ teaspoon	
Eggs	2	
Milk	$1\frac{1}{2}$ cups	
Melted butter	2 tablespoons	



KEY CONCEPTS

- Materials can be processed in many different ways to make new materials or products.
- When we process materials, the new materials may have different properties.
- The purpose of most processing methods is to make materials more useful.

Teacher's note

The purpose of this activity is for learners to develop an understanding that the amount of new material we can make is directly influenced by the amount of starting material we have.

QUESTIONS:

1. Walt could only make 6 large flapjacks if he used half of the batter.
2. Walt would need to make 24 flapjacks ($3 \times 8 = 24$).
3.

Ingredients	Amount needed for 12 flapjacks	Amount needed for 24 flapjacks
Flour	2 cups	4 cups
Baking powder	$2\frac{1}{2}$ teaspoons	5 teaspoons
Sugar	3 tablespoons	6 tablespoons
Salt	$\frac{1}{2}$ teaspoon	1 teaspoon
Eggs	2	4
Milk	$1\frac{1}{2}$ cups	3 cups
Melted butter	2 tablespoons	4 tablespoons

Teacher's note

In the next section the ideas that were developed around preparing (processing) food are extended to other contexts. It may be useful to link the new ideas back to the examples of food processing, because these are closer to learners' everyday experiences.

REVISION

1. List three reasons why we process materials.
2. Give an example of a solution from everyday life.
3. What is stainless steel?
4. Describe the properties of the materials in both photos and what processes took place to get from Picture 1 to Picture 2.

Picture 1	Picture 2
	

5. This boy in the picture below has broken his arm and has a cast on. Why do you think a cast for a broken arm is made from plaster of paris? (Hint: Think of the properties before and after mixing and setting).

A cast made from plaster of paris.[8]

6. Bricks are made by shaping the clay into rectangle shapes and then firing them in a kiln. What are the properties of bricks after firing? Where are some places that bricks are used?

REVISION

1. We process materials to make them stronger, more durable, waterproof, fire-resistant, more beautiful (any sensible reason is correct).
2. Tea, coffee or any beverage, salt water, sugar water or any other sensible example.
3. Stainless steel is iron mixed with other metals to make it strong and to prevent rust.
4. In Picture 1 the clay is wet and soft. It has been mixed with some water so it can be moulded. In Picture 2 the clay is hard and dry. But it is also brittle as if you drop it on the floor it will smash. To get from the clay in Picture 1 to the pot in Picture 2, the clay was moulded into a specific shape and then left to dry. After drying it was fired in a kiln to bake it and make it set. It was also painted at the end.
5. A cast is normally made of plaster of Paris as when it is wet and the powder is first mixed with water, it is soft and can be moulded onto the arm and fit the shape of the arm. However, when the plaster of Paris dries and sets it becomes very hard and strong. This is useful as the cast needs to protect the broken arm and hold it still until the bones have mended.
6. Bricks are hard and durable meaning they will build strong houses. Bricks are used to build houses and other buildings such as schools, shops, etc. Bricks could also be used to make a path or floor or driveway.

9 Processed materials

KEY QUESTIONS

- What are raw materials, natural materials and processed materials?
- Which traditional processing methods have humans been using to give materials more desirable properties?

9.1 Properties and uses

New words
- pigment
- fire resistant
- texture

We call materials that have not yet been processed raw materials. Raw materials are made into other things. When raw materials are in the form in which they are found in nature, we can call them natural materials. A natural material is any material that comes from plants, animals or the ground.

We have learnt that there are many different ways in which materials can be processed to give them new properties. After processing they may look, smell, feel or taste different. They will probably also be used for a totally different purpose from before.

Processed materials are materials that have been refined or built by humans from raw materials. Some examples are paper, steel and glass.

ACTIVITY 9.1: Raw or processed material?

Teacher note: In this activity the learners must study a list of materials and then decide which represent raw materials and which represent processed materials. It is recommended that this should be a small group activity, since discussion and joint decision-making is required.

Teacher's note

Introducing the unit

This unit provides an opportunity for learners to think of materials in terms of the distinctions between **raw** and **processed** materials. It is also an opportunity to link to Indigenous Knowledge when dealing with traditional methods of processing materials, and to draw learners attention to the fact that many of these traditional methods of processing are still used today. They are mostly supportive of sustainable living practices, and are becoming very trendy as a result. The introduction to this unit links it to the units that have preceded it.

INSTRUCTIONS:

1. A list of different materials is shown in the following table.
2. In your group, you need to sort the materials into two categories: Raw materials and processed materials.
3. You will have to discuss each material in your group before making a decision about which category it belongs to.

Bread	Minerals from a mine	Sausage
Rice	Metal furniture	Wheat
Maize meal	Wooden furniture	Animal skin
Toothpaste	Leather shoes	Honey
Vegetables	Petrol	Crude oil
Meat	Necklace made of shells	Mealies
Wood	Metal from a mine	Vegetable soup

Discuss each material in your group and decide how to classify it. Is it a raw material of a processed material? Does it come from plants, animals or the ground? Record the results in a table in your exercise books.

Categories of materials:

Material	What type of material is it? (raw or processed)	What is the origin of the material? (plant, animal or Earth)
Bread		
Rice		
Maize meal		
Toothpaste		
Vegetables		
Meat		

Categories of materials:

Material	What type of material is it? (raw or processed)	What is the origin of the material? (plant, animal or Earth)
Bread	Processed	Plant
Rice	Raw	Plant
Maize meal	Processed	Plant
Toothpaste	Processed	Earth (Minerals)
Vegetables	Raw	Plant
Meat	Raw	Animal

Material	What type of material is it? (raw or processed)	What is the origin of the material? (plant, animal or Earth)
Wood		
Honey		
Sausage		
Metal furniture		
Wooden furniture		
Leather shoes		
Petrol		
Necklace made of shells		
Minerals from a mine		
Crude oil		
Mealies		
Wheat		
Animal skin		
Vegetable soup		
Metal from a mine		

QUESTIONS:

1. In your exercise books, draw a new table in which you place each processed material next to the raw material that it may have been made from. For instance, in the table on page 141, bread and wheat have been placed next to each other, because bread can be made from wheat.
2. In your table, try to match up as many raw materials with processed materials as you can.
3. Which of the materials do not match any other materials? Can you think of a match for each one that does not have a match?

Material	What type of material is it? (raw or processed)	What is the origin of the material? (plant, animal or Earth)
Wood	Raw	Plant
Honey	Raw	Animal
Sausage	Processed	Animal
Metal furniture	Processed	Earth
Wooden furniture	Processed	Plant
Leather shoes	Processed	Animal
Petrol	Processed	Earth
Necklace made of shells	Processed	Animal
Minerals from a mine	Raw	Earth
Crude oil	Raw	Earth
Mealies	Raw	Plant
Wheat	Raw	Plant
Animal skin	Raw	Animal
Vegetable soup	Raw	Plant
Metal from a mine	Raw	Earth

Teacher's note

'Necklace made of shells', 'vegetable soup' and 'rice' do not have matches. Use your discretion in evaluating learners' answers; some possibilities have been suggested in the table.

Processed material	Raw material
Bread	Wheat

Materials that have been processed are very useful to us because they have some special properties. We already know that processed materials can be strong and durable. But what other properties do they have? Let's look at some examples.

What do you put on when it is raining outside? Some processed materials are useful to use because they are waterproof. A rain jacket is made of a material which is waterproof, and so is an umbrella. Maybe you might wear gum boots or wellingtons? These shoes are very waterproof and made from specially processed plastic and rubber.

These pink gumboots are very waterproof!

This man is wearing a rain jacket and has an umbrella made from waterproof materials.

Paint is a processed material. Some of the pigments (colours) used to make paint are natural materials, but the final product is a processed material.

Processed Material	Raw material
Bread	Wheat
Maize meal	Mielies
Toothpaste	Minerals from a mine
Sausage	Meat
Metal furniture	Metal from a mine
Wooden furniture	Wood
Leather shoes	Animal skin
Petrol	Crude oil
Necklace made of shells	Sea shells
Vegetable soup	Vegetables
Rice porridge / rice cakes / "Rice Crispies"	Rice

Paint is a processed material.

QUESTIONS

What special properties of paint make it useful to us? Think of all the cases where people use paint and write them down.

We have just seen that processed materials can be used because they have special properties such as having colour. In the last chapter we looked at concrete and how to make concrete by combining different materials. But concrete can also be used decoratively as it has many different textures. Look at the photos on page 143 which give some idea of the different textures of concrete and how it is used to make an interesting surface!

QUESTIONS

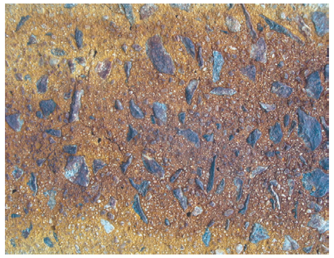
What special properties of paint make it useful to us? Think of all the cases where people use paint and write them down.

Paint is in a liquid form so it can be easily painted on a surface. Paint also has colour so it can be used decoratively. We paint the walls in our houses, we paint the outside walls of buildings, we paint roofs, we paint fences (especially iron fences to stop them from rusting), artists use paint to make paintings, people use paint to make signs which are informative, we paint road signs on the road to tell cars where to go.










Wow, I always thought concrete was so boring! Mothusi would love this!

That is right Walt! And there are so many more properties that we could discuss, such as being fire resistant. But the best would be for you to go out and experience it for yourself. Look at the materials around you with new eyes!

ACTIVITY 9.2: Investigating processed materials

INSTRUCTIONS:

1. Your task is to find examples of processed materials in the world around you, particularly non-metals.
2. You must look at why that material has been used. How do its properties help it to function for us?
3. Select two different locations to look for materials. One location can be the school or classroom. The other location could be your home or your community.
4. In Chapter 2, you did an activity looking at the uses of metals. Now you must focus on the uses of non-metals that are processed materials. Wood, for example, does not fall into this category. It is a non-metal but it has not been processed.
5. You must present your findings in the way that your teacher would like it done. Perhaps as a poster – or a mini-book or a flipfile.
6. Include some pictures of the materials or drawings. You could even make rubbings of the different textures!
7. Try to find at least four different processed materials in each location. The materials must be used for different purposes and have different properties.

Teacher's note

A fun activity here would be to take learners on a walk around school to see how many different textures you can identify on the buildings, paths, pavements, etc. They can make rubbings using pieces of paper and pencils or wax crayons.

Teacher's note

This can be used as a possible project where learners have to present their findings either in the form of a poster, a pamphlet or an oral to the class. Encourage learners to experiment with drawing, and even making rubbings of different textures. You can use some time in class for learners to walk around the school and classroom to investigate the materials used, and some part of the project can be set as homework to look at the processed materials in their homes and communities. This activity could also be combined with their other subjects like Art (use the rubbings to create an artwork) or Language (oral presentation).

In the next section we will learn about some of the ways in which people processed materials in early times. Some of these traditional methods of processing materials are still used today.

9.2 Traditional processing

People have been processing materials from the earliest times. In the old days only natural materials were available and people found many clever ways to make these materials more useful.

New words
- descendants
- pastoral
- expedition
- sustainable
- mould

The first people who lived in our land had ways to harden wood and bone for making tools and hunting weapons. They also had ways of reinforcing the mud used for making traditional huts. They knew which materials made the best clothes and blankets, and which grass made the softest beds. They also knew exactly which reeds would make the best mats to cover their walls, and how to build the best houses for their climate and lifestyle.

Some of these traditional ways of processing materials are still used today. In this section we will learn more about them.

ACTIVITY 9.3: Traditional materials and processing

Before South Africa was a country, several interesting groups of people lived in our land. The Khoikhoi people were one of the first nations to live in southern Africa and many modern-day South Africans are descendants of the Khoikhoi. The Khoikhoi were pastoral people who kept goats, but also hunted animals for their meat and skins.

INSTRUCTIONS:

1. The following story tells us about the young Khoikhoi hunter, Heitsi, who prepares to go on an expedition to hunt a springbok.
2. Read the story carefully, and look out for clues about the ways in which Heitsi's people used and processed materials.

Teacher's note

This section is quite reading-intensive. There are two rather long stories about the Khoikhoi youngster, Heitsi, that describe various methods of traditional processing. The stories have been written in such a way that they are factually correct, and so they may link well with other learning areas such as Life Orientation or Social Studies.

One idea would be to use these stories as comprehension pieces. Depending on the reading level of your learners you may choose to read it to them, or let the learners each read a paragraph in turn. (It is a requirement of CAPS that 'learners should read, write, draw and do practical tasks regularly'.) Another idea may be to allow learners to act out the two stories about Heitsi and his family.

An important cultural message to bring across is the **resourcefulness** of our ancestors, and how they used **what was available** to make their lives more comfortable.

3. When you have read the story, answer the questions that follow.

Heitsi prepares for the hunt

Heitsi is getting his hunting kit ready for the hunt. He is not a man yet, but already a good hunter. When he was born 11 summers ago, his mother named him after Heitsi-eibib, who was a mythical hunter, sorcerer and warrior in the stories of his people. His father and uncles have taught him how to use the bow and arrow, and the *kierie* (or throwing stick), which are the traditional hunting weapons of the Khoikhoi.

Heitsi is very excited about the hunt. Today he is hoping to kill a springbok, because he wants to cut a head dress for himself from the skin of the springbok. He can already imagine how envious his friends will be when he wears it proudly around his head.

He will give the rest of the springbok skin to his mother to turn into a blanket (*karos*) or a piece of clothing for his new baby sister. His mother will scrape the skin with a sharp stone or metal blade to remove the hair. Then rub it with animal fat for a long time to make it soft.

Heitsi slings the quiver in which he keeps his arrows over his shoulder. The quiver is made from tree bark. It is a good quiver, but he really wants one made of animal skin, like the one his father carries. The arrows inside the quiver have wooden shafts and sharp tips made of metal. His younger cousins have arrows with tips made of hardwood. In the old days all the arrow tips were made of wood or bone, but Heitsi's people have been making contact with other peoples who have introduced them to metal.

He also keeps some tinder in his quiver. Tinder is the name for the soft, dry plant materials his people use when starting a fire. Another item he keeps in the quiver is a hollow reed that can be used like a straw to suck up water that has collected on the leaves of plants.

He knows that he has to handle the arrow tips very carefully because they are very sharp. He keeps them sharp by rubbing them on a special stone.

Another reason why Heitsi handles the arrows very carefully is because their tips have been covered with a layer of poison. His cousins sometimes use the sap from poisonous plants to treat their arrow tips, but he prefers to use snake poison because it is more potent.

He picks up his bow, and admires it for a moment. He made it himself from the flexible wood of a wild olive tree. The bow string is made from the gut of a small wild cat that he hunted last summer. His uncle's bow has a string made of twisted palm leaves. It makes a beautiful sound when he holds the end of the bow in his mouth and taps against the string with a stick. Tonight, when they return from the hunt, the men will dance around the fire while the women sing and clap their hands. There will be stories told about the hunt, and Heitsi will honour the soul of the springbok that he has killed.

The last weapon he picks up is his *kierie*. It has a long handle and a knob at the top end. The *kierie* was a gift from his favourite uncle. Uncle made it himself from strong wood. To make the kierie even stronger, Uncle placed it close to the fire for a long time. The heat from the fire dried out the wood and made it tough and strong.

At last Heitsi is ready for the hunt ...

Did you know?

Fire-hardening is the process of removing moisture from wood (or bone) by slowly and lightly roasting it near a fire. This process makes a point (like that of a spear) or an edge (like that of a knife) stronger and more durable.

QUESTIONS:

1. In the story many different traditional materials used by the Khoikhoi people are mentioned. Copy the table in your exercise books. Fill in what material was

used for each purpose. In the last column you must fill in what other material could be used for the same purpose.

Purpose	What material was used?	What other material could be used?
Making a quiver for arrows		
Making the arrow shaft		
Making the arrow tip		
Making poison for the arrow tip		
Making a bow		
Making a string for the bow		
Making a blade for scraping the hair off animal skins		

2. What processing method was used to turn animal skin into soft leather?
3. What processing method was used to make wood harder, so that it could be used to make an arrow tip or *kierie*?
4. What processing method was used to make bone harder so that it could be used to make arrow tips?
5. How did Heitsi keep his arrow tips sharp?

Reinforced houses

Later we will read about the traditional Khoikhoi house that Heitsi and his family lived in. First we will learn about a different kind of traditional home, which is still seen today. Some of the traditional homes in Africa are made of clay or mud. In the activity to make bricks, we saw

QUESTIONS:

1.

Purpose	What material was used?	What other material could be used?
Making a quiver for arrows	Tree bark	Animal skin
Making the arrow shaft	Wood	(No alternative mentioned)
Making the arrow tip	Hardwood	Bone or metal
Making poison for the arrow tip	Poisonous plants	Snake poison
Making a bow	Olive wood	Any other flexible wood
Making a string for the bow	Animal gut	Twisted palm leaves
Making a blade for scraping the hair off animal skins	Bone	Wood or metal

2. The skin was scraped with a blade to remove the hair and rubbed with animal fat.
3. The wood was hardened in the fire.
4. The bone was hardened in the fire.
5. Heitsi rubbed the tips against a special stone to sharpen them.

that mud (mixture of soil and water) is not a very strong material. When it is dry, it crumbles and collapses. When it is reinforced it can make a strong and durable building material, which can be used to build a house. If it is well-built, the house will last for many years.

ACTIVITY 9.4: Making a mud house stronger

In this activity we are going to look at some videos and photos for ideas on how to process mud into a strong and durable building material. If you are not able to watch the videos, then look at the photos. Many of these traditional building methods have become very popular among modern-day people who want to live in a sustainable way.

INSTRUCTIONS AND QUESTIONS:

Watch the first video or study the photos.[1] Then answer the questions.

A boy helping to build a mud wall.

The wall of a mud house with a stick frame.[1]

1. What material is the house in the video and in the pictures made of?
2. The man in the video used two methods to strengthen the walls of his house. What are they? Or else look at the second photo above – a close-up photo of a wall, to see how they strengthened the wall.

Watch the second video or look at the photos on page 150. Then answer the questions.

Teacher's note

In this activity learners are required to watch internet video clips. In the case that internet access is not available, pictures have been included for learners to look at instead.

INSTRUCTIONS AND QUESTIONS:

1. Mud, sticks and cement
2. He added cement to the mud, and he used sticks to build a framework for the house.

A close-up photo of a mud used to make the wall.

The mud mixture

1. What materials are recommended to reinforce the mud?
2. Why do you think the wall should be built thicker at the bottom than at the top?
3. Write a step-wise procedure for building a mud shelter.

1. Dry grass and stones.
2. The wall will be more stable when it is built thicker at the bottom. It will not fall over easily.
3. Teacher note: In the video, the steps are laid out quite clearly. But you do not need the video to write the steps. For example the steps could include to first put sticks into the ground to mark out where the walls of the house would be, then to collect or make the mud, and to add grass and stones to reinforce it. Then pack the mud up against the sticks as the boy is doing in the first picture. Then to leave the mud to dry.

Visit
How to build a mud wall (video)
goo.gl/ybtMK

Watch the third video that shows how to build a mud wall. Alternatively you could look carefully at the photo below.

The mixture of clay and straw the man is using to build the wall is sometimes called cob. Another way of building a cob wall is to use bricks made of cob.

The woman in the photo is making bricks for a new house. Look carefully at the picture of the bricks she has made, then answer the questions.

A woman making bricks.

1. What material has the woman added to the mud to reinforce the bricks?
2. What is this mixture called?
3. Would it be possible to add the straw or grass after the bricks have been made? When should the straw be added to the clay?

1. Straw, grass
2. Cob
3. No, the straw should be added before the clay hardens into bricks.

Finally, the fourth video shows a different way to reinforce clay bricks. Watch the video to the end and then answer the questions. Or else look at the photos below.

Pouring water into the mixture of mud and straw.	
Putting the mixture into a mould.	
Packing the mud mixture into the mould.	
Removing the mould.	

Leaving the bricks to dry out.	

1. Do the bricks contain straw or stones?
2. How does the man get all the bricks to look the same?
3. After making the bricks they are stacked in a large pile and then a fire is made underneath the pile. What do you think is the purpose of this procedure?
4. Make a list of all the different ways in which mud or clay can be made stronger when we want to use it to build a house.

Matjieshuis of the Khoikhoi

The Khoikhoi people lived here in the days before South Africa was a country. In those days there were no borders, no provinces, no towns or cities, and no roads. No-one 'owned' land and it belonged to everyone who lived on it!

Like all early people, the Khoikhoi had to make everything they needed, because there were no shops then! They had to use whatever materials were freely available.

The Khoikhoi people were nomads. That means they did not live in one place for long. They moved their homes and their belongings when the seasons changed. This way they could always be close to good grazing for their goats. Fresh green grass and trees meant there would be leaf-eating animals around to hunt.

Read the story carefully for clues on which materials were used to make a traditional Khoikhoi house.

1. In the video, they contain only clay/mud. In the pictures above they do contain straw and grass.
2. He fills a box (mold) with the clay, then tips the wet clay out of the mold before it is dry.
3. The bricks are baked (fired) to make them hard.
4.
   - The mud can be mixed with straw or stones.
   - The mud can be mixed with cement.
   - The mud can be packed inside a framework of sticks.
   - The mud walls can be built thicker at the bottom.
   - The mud can be shaped into bricks and then fired.

Heitsi moves house

Heitsi's clan is on the move again. A few days ago, the clan packed up all their belongings and started their long trek to the place that will be their home for the summer months. The place where they lived had become dry and dusty and it was becoming more and more difficult to find good things to eat. They took apart their hut, which they will rebuild when they reach their destination.

During the long walk, everyone has to help carry. Heitsi is carrying his own sleeping mat and karos, and his hunting weapons. He also has to keep an eye on the goats in case they wander too far from the clan.

After many days of walking, they come to the right place. Now they can rebuild their house.

The framework of the house must be strong so that the house will stand firm. Heitsi's mother and aunties have found some young trees nearby and are cutting long, thin branches that will be perfect for making a frame for the house. Once they have cut the branches, they strip off the leaves.

The men bend the flexible branches into crescent (half-moon) shapes and tie them together with flexible strips of tree bark. This is how they build a dome-shaped framework for the house.

Can you see the framework of tree branches? Can you see what the house is made of?

Women attaching the reed mats to the framework.

Teacher's note

You could draw attention on the photos that the framework is made of thin, flexible branches, and the hut is made of reed mats.

Once the framework is built, it is ready to be covered with reed mats. For this reason the house is called a *matjieshuis* (mat-house). Heitsi's mother and aunties made the mats by threading reeds together with string that she made from the long thin leaves of palm trees.

The whole family has to help with the floor of the house. They bring clay from a nearby river and Heitsi's mother makes the floor by stomping down the wet clay with her feet. Once the clay has dried, the floor will be smeared with animal manure. This is not as bad as it sounds – the manure seals the clay to prevent it from becoming sandy and dusty.

A fire-hole will be dug in the middle of the floor, with sleeping hollows (about 15 cm deep) around it. Soft plant material will be placed in the sleeping hollows, and this will be covered with mats and *karosses* to make comfortable beds for Heitsi and his family.

Heitsi loves his portable home. It is the perfect shelter. In hot, dry weather the openings between the reeds allow air to circulate inside the house to keep it cool. It also lets in light. He knows that when the rains come and the reed mats get wet, the reeds will absorb water and swell out. Then they will seal tight and protect the inside of the house against leaks. During the cold months, the inside of the house will also be lined with animal skins to make it extra warm and comfortable.

A matjieshuis covered with material.

ACTIVITY 9.5: Thinking about Hetsie's matjieshuis

QUESTIONS:

1. In the story we learnt how many different traditional materials were used by the Khoikhoi when they built their portable homes. Make a list of all the materials you can find in the story, and say how they were used. Use the table below for your list.

Type of traditional material	How was the material used?

2. What does it mean when we say Heitsi's house is portable?
3. Write a paragraph to describe the materials and methods used by Heitsi's family to keep their home warm and dry during winter.
4. How does Heitsi's mother strengthen the floor of the *matjieshuis*?
5. Look at all three photos of modern 'houses' below. Which one is the most like Heitsi's house? Why do you say so?

Brick house

Caravan

QUESTIONS:

1.

Type of traditional material	How was the material used?
Animal skin	Used for making a karos (soft skin blanket)
Flexible branches	Framework of the house (matjieshuis)
Strips of tree bark	Ties for the matjieshuis framework
Mats	Reeds
String for tying the reed mats	Twisted palm leaves
Clay	Floor of the hut
Animal dung (manure)	Sealing the floor of the hut
Soft plant material	Lining the sleeping pits

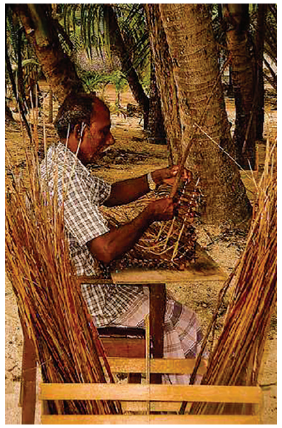
2. A portable house is a house that can be broken down, moved and built again in another place.
3. The family made warm beds out of plant material and covered them with mats and karosses. They made the beds around the fire, so everyone could sleep close to the fire. They built their house of reeds that would swell out in the rainy weather, to keep the inside of the house dry. They covered the house in animal skins for extra warmth.
4. Heitsi's mother makes the floor from clay, which will be hard when it is dry. Then she covers the clay with animal dung that will form a seal on top of the clay. This prevents the clay surface from breaking up into dust.
5. The tent is most like Heitsi's house because it can be broken down quickly and it is light enough to carry to a new location.

Tent

6. Draw a picture of the floor plan of Heitsi's house.
7. If you have time in class, build a model of Heitsi's house, using any suitable building materials.

We saw that Hetsie's family uses grass to make the reed mats for their *matjieshuis*. In Africa, many people make objects by using plant products, called plant fibres. The people weave and stitch the plant fibres together to make different objects, such as reed mats, baskets, or even thatch to make a roof for a house. This is also a type of traditional processing.

A woman weaving a grass basket.



A man weaving a reed mat.[2]

ACTIVITY 9.6: Identifying objects made from plant fibre

INSTRUCTIONS:

1. Each of the following photos shows an object made from plant fibre.
2. Identify what it is and how the people are using these objects.

Object made from plant fibre	Description
 3	A Zulu *iquamba* beer basket for holding and storing Zulu beer. It is made by weaving grasses together.
	
 4	
 5	

Object made from plant fibre	Description
 3	A Zulu *Iquamba* beer basket for holding and storing Zulu beer. It is made by weaving grasses together.
	This roof is made from thatch which is dried grass packed tightly together.
 4	This person is wearing a straw hat to protect their face from the sun.
 5	These houses are made from reed mats, similar to the matjieshuis.

KEY CONCEPTS

- Natural materials come from plants, animals or the Earth.
- Raw materials are materials that have not been processed.
- Processed materials are raw materials that have been changed or refined by humans.
- Humans have been processing materials from the earliest times.
- In Africa, people have processed materials for hundreds of years, for example to make clay pots and woven products.

REVISION

1. What are raw materials?
2. What are natural materials?
3. What are processed materials?
4. Which processing method did the Khoikhoi people use to make wood and bone hard and strong?
5. Where did the Khoikhoi people find the material that they used to make their homes?
6. How can sand and clay be made stronger if we want to use it to build a house?
7. Look at the photo of a *matjieshuis*. It is an old one and it was made differently to the one Hetsie's family made. This one does not use reed mats, but rather bushes that have been tied onto the frame. Which method do you think is better and why?

An old matjieshuis[6]

8. How is the woman in the photo on page 160 using a woven product? Think if you, or anyone in your family, uses any woven products in your daily life and write them down too.

REVISION

1. Raw materials are materials that have not been processed.
2. Natural materials come from plants, animals or the Earth.
3. Processed materials are raw materials that have been changed or refined by humans.
4. They used fire to dry the wood and bone slowly without burning it. This process is called fire-hardening.
5. All the materials were found in nature.
6. Sand and clay can be made stronger by adding a binder like cement, and/or by adding reinforcing material like straw, pebbles or even steel reinforcements.
7. Learners should say that the matjieshuis made by Hetsie's family is better as the woven reeds are stronger and hold together more firmly than the bushes which are just tied on to the frame.
8. A woman using a basket made from weaving plant sticks together to carry her fruit. Any possible answers where a learner might use a woven product.

A woman from Uganda[7]

9. Making objects out of plants is a traditional African process. There are different ways of doing it and different parts of the plants which can be used. The three pictures below all show photos of woven products, but they have been made using different plant parts. Write a description of each and say what kind of object you think it might be used for.

Woven product	Description
 *8*	

9.

Woven product	Description
 *8*	This is made from sticks or thick reeds which were bent when they were still green. It makes a very strong basket for carrying things.

Woven product	Description
	
	

Woven product	Description
	This is made from much smaller plant fibres which have been made into strings and stitched/ woven together. It will be quite flexible and useful for making a bag or sack.
	This is made from bigger strips of leaves or reeds (maybe banana palm fronds cut into strips), which have been woven together. It could also be used to make a basket or bag which is not as strong as the first basket, but can also be used to carry things. Or it could be a mat.

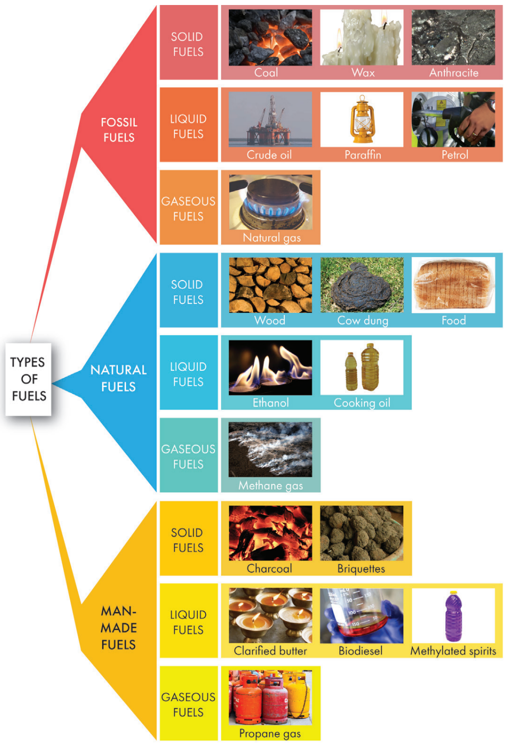
Energy and change

and systems and control

10 Stored energy in fuels

KEY QUESTIONS

- What are fuels?
- What is needed to burn fuels?
- How can we safely burn fuels?
- How can we prevent fires and what must we do if there is a fire?



10.1 What are fuels?

In Grade 4, we learnt that there are many different types of energy. This year we are going to learn about stored energy and how we can use it to do something useful.

QUESTIONS

What do you understand by the term 'fuel'? Discuss this word with your partner and write down your own definition.

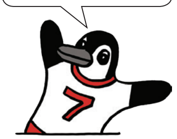
There are different definitions for fuel, but we will look at three main categories when we investigate fuels.

Everyday fuels

Wood comes from plants, especially trees. When plants are growing, they use the light energy from the sun (solar energy) as well as carbon dioxide and water. Plants absorb the energy and store it in their leaves, roots and other parts. Wood also contains this stored energy. Burning wood allows us to change this stored energy into light and heat, which is useful to us.

New words

- fossil fuels
- solar energy
- natural gas
- coal
- paraffin
- energy value
- calories
- kilojoules



This man has made a fire to keep warm and provide light.[1]

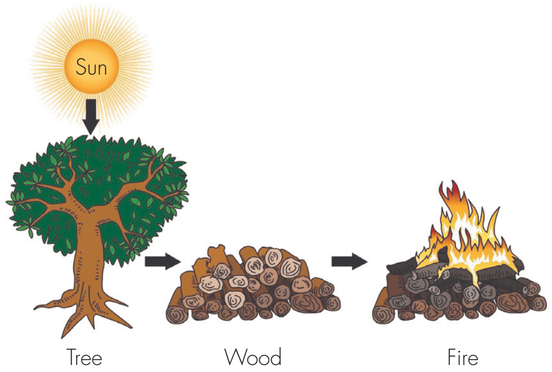
Cooking meat on a fire made from wood in Khayelitsha.[2]

Wood is often collected and burnt to give us heat and light. On a cold evening it is wonderful to sit around a fire to tell stories and warm yourself with friends.

QUESTIONS

What do you understand by the term 'fuel'? Discuss this word with your partner and write down your own definition.

Learner dependent answer (A material such as coal, gas, or oil that is burned to produce energy)



Energy from the sun is stored in the tree's wood, which is released as light and heat when we burn the wood.

Coal is a type of fossil fuel that is also burnt to provide us with heat that we can use. The heat from coal can be used to cook our food and warm our houses.

Hot coals burning.

Fossil fuels like **coal** were made from prehistoric plants. The plants got their energy from the sun and stored it in their bodies. Millions of years ago, a lot of the Earth was covered by water. The plants that died sank to the bottom of the water. Over millions of years, the layers of plants were covered by layers of sand and pushed down by the pressure and heat of the Earth. The plant material was buried deeper and deeper under the ground where it is much hotter than on the surface of the Earth. Over millions of years, the plant remains are changed into fossil fuels.

Visit
How fossil fuels are made.
goo.gl/PKY2V4

Fossil fuels get their name 'fossil' because they are made from plants and animals that were alive a long, long time ago.

Other types of fossil fuels are **natural gas** and **oil**. Scientists have realised that tiny sea organisms, also died, sank to the bottom of the ocean and were buried. Over millions of years, many layers of dead sea animals and plants got buried and compressed like this. Over millions of years, the dead organisms slowly changed into oil and natural gas.

Wax in a candle is burnt to provide light. There is stored energy in the wax, and burning it allows us to change the stored energy into light.

Candle wax is an everyday fuel that we use to give us light.

Paraffin is also a fuel that contains stored energy. Paraffin is burnt in paraffin lamps and paraffin stoves to provide us with useful energy in the form of light and heat.

A paraffin lamp.[3]

Food is fuel for the body

In order to live, people and animals need energy. We get our energy from the food that we eat. Do you remember learning about food chains in the beginning of the year in Life and Living?

QUESTIONS

Choose one of the foods that you will eat for lunch today and draw a food chain, including this food and ending with you.

Food contains stored energy that our bodies can change into useful energy that we need when we run, jump, breathe, learn – and in everything else that we do!

QUESTIONS

Choose one of the foods that you will eat for lunch today and draw a food chain, including this food and ending with you.

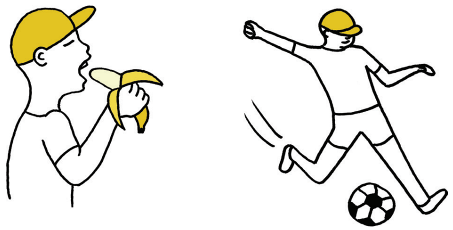
Any food chain starting with the Sun and ending with a person (the learner). Perhaps it is a piece of fruit, then it will just be a 3 link food chain. If it is a meat product, then it would be a four link food chain.

Teacher's note

Remind learners about food chains and how the direction of the arrows shows the transfer of energy from the Sun and then from one organism to the next.

Teacher's note

Spend a moment going over the link between units of measurements and the use of "kilo" as this is often a huge problem with learners in the higher grades. For example, write some of these on the board, 1 000 grams (g) = 1 kilogram (kg), 1 000 meters (m) = 1 kilometer (km), and then write 1 000 joules (j) = ….. and ask learners for the answer.



Food provides our bodies with energy to do things.

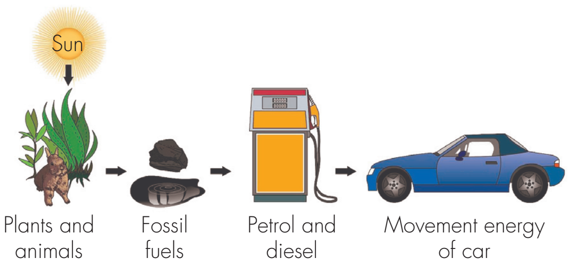
Fuels that are burnt to get output energy

Fuels can also be used to give us other forms of useful energy.

Putting petrol into a car at a petrol station.

Petrol or diesel is used in cars and trucks to make them go. The stored energy in the fuel is changed into movement energy of the car or truck.

Petrol and diesel are made from fossil fuels. Can you see that even energy for cars and generating electricity comes from the sun?



Energy from the sun is stored in the plants and animals that eat the plants. Their remains turned into fossil fuels over millions of years, which are then mined and used to make petrol and diesel to fuel cars.

Coal is not only burnt in our homes for cooking and keeping us warm. It is also burnt to make electricity. A power station is a large factory where the coal is burnt in large amounts to produce electricity.

A power station[4]

We are going to do an investigation to find out how much energy is stored in fuels.

INVESTIGATION 10.1: How much energy can we get from different fuels?

AIM:

To determine which fuel contains the most amount of energy.

MATERIALS AND APPARATUS:

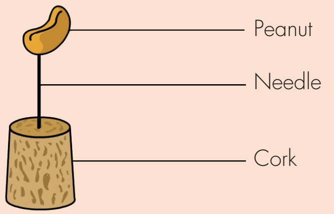
- Cork
- Needle
- Peanuts (other fuels such as a piece of wood, candle wax or piece of biscuit)
- Large metal can (coffee tin)
- Small metal can (soup can) with paper label removed
- Can opener
- Hammer
- Large nail
- Metal spike longer than the diameter of large can
- 150 ml of water
- Thermometer
- Lighter

Teacher's note

The teacher must make the apparatus as per the instructions in the method. This investigation must be performed by the teacher or under very careful teacher supervision due to the fire hazard. If possible, watch the video in the Visit box to get an idea of the experiment. If you cannot perform the experiment in your class, then possibly play the video for learners. This investigations makes use of simple equipment such as tin cans and corks. But, if you have access to a science laboratory, then you can use a metal retort stand, test tube and bunsen burner instead. But, the idea of this investigation is to show that you do not need fancy science apparatus to perform an experiment.

METHOD:

1. Carefully push the eye of the needle into the smaller end of the cork. Then gently push the pointed end of the needle into a peanut. If the peanut breaks use another peanut.



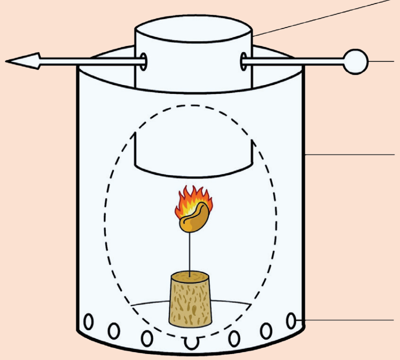
Set up your peanut and cork like this.

2. Remove both ends of the large can. Watch out for sharp edges.
3. Use the hammer and nail to make holes all around the bottom of the large can. These are air holes.
4. Punch two holes near the top of the small can exactly opposite each other.
5. Slide the metal spike through the two holes in the small can.
6. Pour 150 ml of water into the small can.
7. Use the thermometer to measure the temperature of the water. Record it in the results table on page 172 in your workbook.
8. Put the cork and peanut on a surface that cannot burn. Use the lighter to light the peanut. The peanut can be difficult to light so keep trying. It will eventually start burning.
9. As soon as the peanut is burning, carefully place the large can over the peanut. Balance the small can inside the big can as shown in the diagram on page 172. The small can must be a short distance above the peanut.

Visit
Burning a peanut (video)
goo.gl/JoXw6

Teacher's note

The idea of this investigation is to examine the amount of energy given off by a peanut. **NB:** Learners might struggle with linking a burning object, with energy given off, which then heats water, which then gives a reading on a thermometer. Take time to explain how a burning peanut can result in a different reading on a thermometer, and that we are actually looking at the energy given off and not the reading on the thermometer. The thermometer reading is an indicator that more energy is released. The experiment can be taken further to compare different fuels. You can also use a piece of wood, piece of candle wax, piece of biscuit (approximately the same weight of each fuel). It is important to burn the same weight of each fuel so that you can directly compare the amount of energy given off per gram of weight.



Set up your apparatus like this.

10. Let the peanut heat the small can with the water until the peanut stops burning. Stir the water, measure the water temperature and record it in the results table.
11. Repeat the experiment with two different fuels. Your teacher will decide which fuels to test. Copy and complete the results table for the other fuels tested. Remember to use quantities of the other fuels which are similar in size to the peanut, and to always start with a cold can of water.

RESULTS:

	Fuel 1: Peanut	**Fuel 2:** ________	**Fuel 3:** ________
Temperature of water before heating (°C)			
Temperature of water after heating (°C)			
Change in temperature (°C)			

CONCLUSION:

Write a conclusion for your investigation.

QUESTIONS:

1. Which fuel contained the most amount of energy and how did you determine this?
2. Where did the energy in the peanut originally come from?
3. Discuss what happened to the energy stored in the nut, or other fuels you used.
4. What was the input energy needed to make the peanut (and other fuels) burn?
5. What was the output energy obtained from the fuel?
6. Discuss how you could compare the amount of energy stored in a peanut to the amount of energy stored in a cashew nut.

In order to light the fuel, you had to put in a small amount of energy. The fuel however gave out a lot more energy than what was put in. The difference between the energy you put in and the energy the fuel gave out is how much energy was stored in the fuel.

The output energy obtained from a fuel is greater than the input energy needed to make the fuel burn.

10.2 Burning fuels

We have learnt that burning fuels provides us with energy that we can use. What does a fuel need to be able to burn?

New words
- combustion
- nitrogen

Burning fuel requires some energy to start burning. Fuel needs oxygen to burn. Fuel usually gets oxygen from the air around it.

There are other gases present in air as well, but they do not burn.

The following pie chart illustrates how much of each type of gas is found in the air around us. **(For enrichment only)**

CONCLUSION:

The energy stored in the peanut was changed into heat energy which we used to warm the water.

Teacher's note

At this point ask questions like if the peanut had stored a greater amount of energy would the final temperature of the water be greater or smaller. Lead the class to discuss which substance contained the most amount of energy. Also ensure the learners understand that to make a fair comparison about the amount of stored energy in each substance, that you would have had to have the same mass of fuel for each experiment. In addition, you could use a metal bottle top and fill with paraffin or other liquid fuel to compare stored energy.

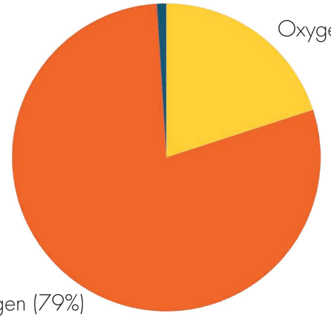
QUESTIONS:

1. The fuel containing the most amount of energy would have burnt for the longest and therefore caused the greatest change in the temperature of the water.
2. The energy comes from the Sun.
3. As the nut was set on fire, the stored energy was released as heat and light.
4. Heat energy
5. Heat and light energy
6. The experiment (peanut or cashew nut) that produces the biggest increase in temperature has used the fuel with the most stored energy.

   Repeat the experiment with a peanut and then a cashew nut of the same mass. Learners can go into the details of how to set up and perform the experiment. Unless they have done it, they won't be able to predict which one has the most stored energy, but the following conclusion could be made:

In order to light the fuel, you had to put in a small amount of energy. The fuel however gave out a lot more energy than what was put in. The difference between the energy you put in and the energy the fuel gave out is how much energy was stored in the fuel.

Visit
The science of fireworks (video).
goo.gl/d4HJj



Pie chart showing the percentage of gases in the air around us.

QUESTIONS

How much of the air around us consists of oxygen?

When something burns we say it is combusting. So, another word for burning is combustion.

So, what happens to a flame when we take one of these things away, such as oxygen? When we take something away, we say we deprive it. Let's find out what happens when a flame is deprived of oxygen!

INVESTIGATION 10.2: Deprive a flame of oxygen

AIM: To find out how long a candle will burn when given different amounts of oxygen.

MATERIALS AND APPARATUS:

- Candle
- Four glass bottles or jars (small, medium, large and extra large)
- Matches
- Flat-bottomed bowl

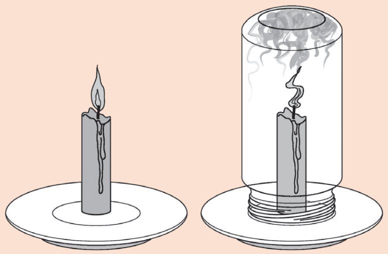
QUESTIONS

How much of the air around us consists of oxygen?

Oxygen makes up 21% of the air around us.

METHOD:

1. Light the candle.
2. Drip some wax in the middle of the bowl and 'mount' a candle in the wax.
3. Pour a small amount of water in the bowl around the candle for the glass jars to stand in.
4. When the candle is securely standing upright, light the candle with the matches.
5. Place the small bottle over the candle and time how long it takes until the candle goes out. Record the time taken in the results table below.



Cover the candle as shown with each of the different sized bottles.

6. Repeat the experiment with each of the different sized glass containers and record the time taken for the candle to go out.

RESULTS AND OBSERVATIONS:

Size of glass jar	Time taken for candle to go out
Small	
Medium	
Large	
Extra large	

1. In which glass jar did the candle last the longest?
2. In which glass jar did the candle burn out the fastest?

CONCLUSION:

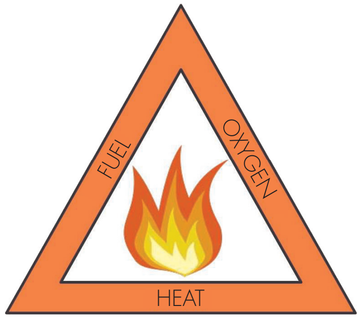
Write a conclusion for the investigation.

QUESTIONS:

1. When lighting a candle, identify the heat source that provides the starting energy and the fuel supply.
2. Why did the candle go out once you put the glass jar over the candle?
3. Why do you think there is a difference in the time taken for the candle to go out?
4. A candle that is allowed to burn freely in air will eventually burn down and go out. Why does the candle stop burning in this situation?

What we have learned is that if you take away the fuel or the oxygen, burning will stop.

For combustion to be possible, a heat source, fuel and oxygen are needed. Without one of the three, combustion will not happen. You can remember this using the Fire Triangle. All three sides of the triangle are required for combustion.



Fire Triangle

RESULTS AND OBSERVATIONS:

1. The extra large jar
2. The small jar

CONCLUSION:

The more air the candle has available, the longer the candle can burn for.

QUESTIONS:

1. Heat source is a lit match, fuel is the wax
2. The candle used up all the oxygen in the air. Burning cannot happen without oxygen so the candle went out.
3. The small jar has less air and hence less oxygen than the bigger jars. The smaller the amount of oxygen, the quicker it gets used up and the quicker the candle goes out.
4. The fuel has run out.

10.3 Safety with fire

Fire is a major source of heat energy for many people whether it is for keeping warm, cooking food, or for some other purpose. Although fire is very useful it is also very dangerous! Great care is needed when using fire. Fire is a threat in our communities.

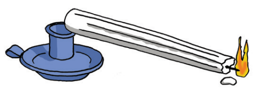
New words
- extinguish
- fire extinguisher

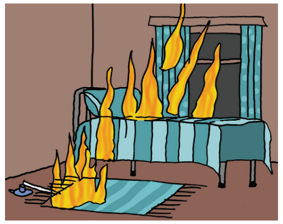
This is a wildfire that has gotten out of control.

This is a warning in a nature reserve during the dry summer months when fires can easily start up.

Did you know?
Some plants even need fire to survive! An example is fynbos. This is a group of plant species found only in South Africa. The seeds of fynbos plants need smoke and heat to germinate.

Threats of burning candles



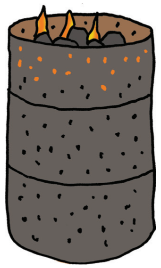


Candles can start/trigger house fires when they are left unattended, tip over, and ignite nearby combustibles (fuels).

Teacher's note

Invite someone from the local fire department to come and talk to the children in your school. Ask them to bring their equipment and talk to them about fire safety. The fire department is normally very willing to visit schools and they are the experts. If the fire department is not available, a community member can also be asked to talk to the learners.

Threats of coal-burning Brazier



As the coal burns, the concentration/amount of carbon monoxide gradually increases. Because carbon dioxide is toxic if it is inhaled over a long period it can cause death. Another threat is that of open flame.To prevent this, coal burning braziers should be used in a well-ventilated room. Make sure that all the windows and the doors are opened and never sleep near the brazier.

Threats of illegal connections

Illegal electricity connection can pose great risk as it overloads the system, which often causes the power connection to trip or fail, meaning no one in the area would have electricity. It can also cause a fire. Illegal connections can also cause **electrocution**, because such connections are usually unsafely constructed and don't have the required electrical protection.

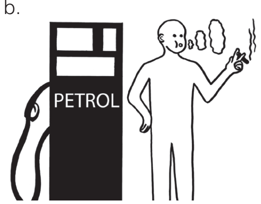
There are a few safety rules that everybody should know:

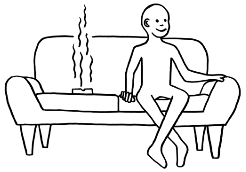
1. Never play with matches and lighters. Make sure that matches and lighters are kept out of reach of young children who do not know how to use them properly.
2. In case of fire – stay away. If there is a fire in your home, do not hide, rather go outside as soon as possible.
3. Know the number of the local fire department and phone in case of emergency.
4. Have an escape plan for your home and practise it with your family. Have a meeting place outside so that you will know everyone is safe in the event of a fire.

ACTIVITY 10.1: Dangerous situations involving fire

INSTRUCTIONS:

1. Below are four different scenes.
2. Each one is potentially dangerous involving fire.
3. Write a description for each scene about why it is dangerous.

Situation	Why is it dangerous?
a. 	
b. 	

Situation	Why is it dangerous?
c. 	
d. 	

Fire alarms are extremely important to warn people in buildings that a fire has started.

You should have some fire extinguishers in your school. See if you can locate them.

ACTIVITY 10.2: Talking about fire in our communities

1. Work in groups and talk about your experience of fire in your neighbourhood.
2. Copy the following table in your exercise books and list some good and some bad experiences.

Good experience of fire	Bad experience of fire

3. What causes of fire can you identify in your community?
4. How could you prevent each of the causes of fire you have been discussing?

Sometimes fires happen and we need to know what to do in the event of a fire.

ACTIVITY 10.3: Acting out what to do in case of a fire!

INSTRUCTIONS:

1. In groups, plan and act out a play for your class to teach them what to do in case of a fire.
2. Make sure that your play gives important information about the following:
   a. How to escape from a burning building.
   b. Not to open a door in a building that is burning.
   c. What to do if your clothes are on fire.
   d. What to do if your friend is stuck in a burning building.

Have you ever seen any fire posters in your school telling you what to do in case of a fire? Did this poster catch your attention and make you aware of the dangers that fire can hold in your school? Maybe your school does not have any fire posters. Let's create our own fire posters to put up in the school.

Teacher's note

A great additional activity is to demonstrate the use of a fire extinguisher and then ask the learners to explain why it puts out the fire. Does the fire extinguisher blow out the fire? Does it remove oxygen from the burning material? Does it remove heat from the fire? Does it prevent oxygen from getting to the fire? Lots of interesting questions can arise here that could lead to a valuable discussion. No mention need/should be made of carbon dioxide unless the idea has already been raised before this.

Teacher's note

The answers to these questions are unique to the community in which you live. Discuss the answers each group has come up with the class. Suggest that each group makes a poster about fire safety after the class discussion.

Teacher's note

The following actions should be shown in the plays:

To escape from a building – fall and crawl

When clothes are on fire – stop, drop and roll, or cover in a blanket or carpet

If a friend is in a building – learners should show that they NEVER go into the building themselves, but rather call for help.

Assess the plays as a group according to how clearly the learners speak and demonstrate the actions to do with their bodies and by acting out.

ACTIVITY 10.4: Creating a fire poster

MATERIALS:

- Pieces of paper and cardboard
- Coloured pens and pencils
- Old magazines
- Scissors
- Glue

INSTRUCTIONS:

1. Design a poster telling everyone in your school what to do if there is a fire.
2. Include some pictures to show the steps to follow. You can draw these pictures or cut some out of old magazines or newspapers.
3. Some points to think about when making your poster:
    - Does your school have an alarm bell?
    - If so, what is the signal?
    - Is there a safe place that a large amount of people can gather?
    - How will you make sure no one is left inside the buildings?
    - Is it safer to use the lift or the stairs when there is a fire?
    - What extra measures can you take to stop the fire? (Clue: Remember fire needs oxygen to burn so what can you do to your classrooms to help stop the fire and reduce the supply of oxygen?)

Did you know?

Smoke inhalation (breathing in the harmful smoke) from a fire kills more people in household or domestic fires than the actual fire does.

KEY CONCEPTS

- Energy is stored in fuels.
- Fuels are sources of useful energy.
- Fuels are burnt to be able to use their energy as heat and light.
- Fire can be dangerous.

I really enjoyed learning about fuels! Let's now find out more about energy and electricity.

Teacher's note

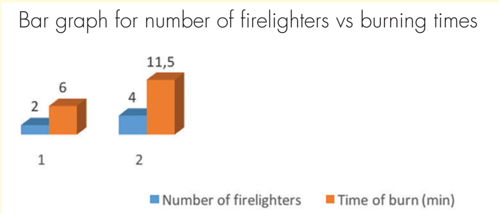
Extra precautions are to close windows and doors.

REVISION

1. List three types of fuel that you use in your community.
2. What is needed for combustion to take place?
3. Your dad is cooking with hot oil on the stove. The oil catches fire. Suggest a way to put out the fire and explain why it will work.
4. An enthusiastic Science learner decides to perform an experiment to find out how long different quantities of firelighters will last. Each firelighter was cut into equal size blocks. The experiment was performed under adult supervision, and the following results were obtained:

Number of firelighters	Time of burn (min)
2	6,0
4	11,5
6	18,6
8	23,8
12	37,0
16	48,0

Plot a double bar graph to represent the number of firelighters and time of burn.

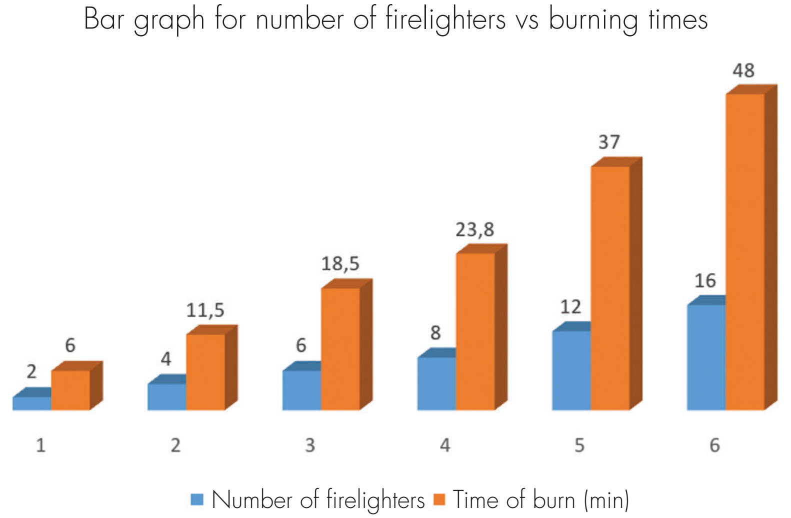


An example of how your bar graph can look. The first two sets of information have been added already

5. Describe the relationship between the time of burn and the number of firelighters.
6. Your mom leaves the iron on and it is next to a window with a curtain blowing in the wind. Explain to her why this is dangerous and what she should rather do.

REVISION

1. food, coal, any fuel that the learners have experienced
2. heat, fuel and oxygen
3. Put the lid on the pot. This will cut off the oxygen needed to burn and the fire will go out. Do not use water to put out an oil fire.
4.



5. As the number of firelighters increases, the time of burn also increases.
6. The wind can blow the curtain towards the iron and cause fire. Mom can either switch-off the iron or close the window to avoid the curtain to be in contact with the iron.

11 Energy and electricity

KEY QUESTIONS

- What do cells and batteries do?
- What is an electrical circuit?
- Where does energy come from in a power station?
- How does electricity get from a power station to where it is needed?
- How can we use electricity safely?

11.1 Cells and batteries

New words
- cell
- battery
- electrical circuit
- pacemaker

Batteries come in all shapes and sizes. Batteries are needed for many different purposes. Most torches, radios, watches, cell phones, some toys and even cars, pacemakers and hearing aids need a battery to work.

Typical batteries

Batteries are useful as they store chemical energy. When the battery is connected in an electrical appliance and it is turned on, the stored energy in the battery is changed into electrical energy, which is used to make the appliance work.

ACTIVITY 11.1: Investigating the source of electricity in a torch

MATERIALS:
- A working torch
- An old, broken torch

INSTRUCTIONS:
1. Turn your torch on and off. Can you see the bulb light up?
2. Turn your torch off, open it up and take the cells out. (Remember that 'cell' is the scientific name for what most people call a battery in everyday life.)
3. Now turn it back on.

QUESTIONS:
1. Does the bulb light up when there are no batteries in the torch?
2. What does this tell you about the need for batteries to use your torch in the dark?
3. Do you remember learning about transfer of energy in Grade 4? When the torch lights up, what is the chemical energy in the battery transferred into?
4. Bring an old torch to school that can be taken apart. Look carefully at all the parts that make up a torch and make a list of what you find. Each part of the torch is needed for it to work properly.

When the electrical energy is transferred to where it is needed, then we say that we have a circuit. A circuit is a system and consists of different parts.

Chemical energy in the battery in the torch is changed into electrical energy, which is changed into light.

Answers to Activity 11.1:

1. No
2. You need batteries for the light bulb to light up. This is because the cells are the source of electrical energy.
3. Chemical energy in the batteries is transferred into electrical energy. Electrical energy is then converted into light energy in the bulb.
4. Batteries, light globe, wires, switch, casing, glass or plastic front.

ACTIVITY 11.2: Making a simple circuit

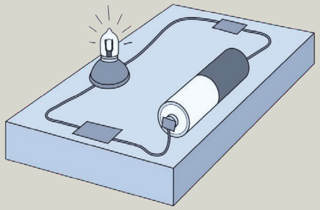
MATERIALS:

- Two torch batteries
- Light bulb
- Connecting wires

INSTRUCTIONS:

Part 1

1. Set up the circuit as shown in the diagram.
2. Make sure all the wires are connected to form a closed loop.



A simple circuit

QUESTIONS:

1. What do you observe?
2. What happens when you disconnect one end of one of the wires?
3. The one end of the battery is labelled positive and the other end is negative. Draw a diagram of the battery and label the ends as positive or negative.

Part 2

1. Set up a new circuit with two batteries and a globe.
2. Explain how you connected the batteries so the globe still lights up.
3. Describe if the globe glowed the same or brighter or dimmer than in Part 1?
4. Explain your answer to question 2.
5. Describe an electrical circuit.

Answers to Activity 11.2:

1. Globe lights up
2. The light goes out

Part 2

2. Batteries had to be connected end to end with positive side touching the negative side of the other battery
3. brighter
4. Two batteries contain more stored energy than 1 battery, more stored energy changes to more light energy
5. An electrical circuit is a pathway that allows electricity to flow or a system that allows electrical energy to move

Two or more cells connected end to end are called a battery. One cell stores a small amount of energy. If we need to store a lot of energy we use a battery.

A car needs energy to start its engine. One cell does not have enough stored energy. A car battery is actually six cells that are connected end to end inside the battery case. There is six times more energy stored in the battery than in a single cell. This gives the car enough energy to start the engine.

A car battery contains 6 cells.

Mmm...so a torch needs two batteries to light up. I wonder how many batteries are needed to light up our house?!

Good question Phumlani! Let's find out in the next section.

Teacher's note

If you have access to the internet, there is a wonderful site that allows you to build circuits and do experiments. Go to 1 and see if you can build some circuits. Experiment to see how to make the globes burn brighter and dimmer.

11.2 Mains electricity

New words
- mains electricity
- transmission lines
- substation

A battery has stored energy which can be changed into electrical energy. But our homes, schools, shops and factories cannot run on batteries. Electricity does a lot of work for us and is used many times every day. The main source of electrical energy is from power stations. We call this 'mains electricity'.

Power station

Visit
Electricity generation (video).
goo.gl/32irY

Power stations need a source of energy

Power stations use different ways to generate electricity. A power station needs a source of energy. In South Africa, most of our power stations burn vast amounts of coal to use the energy stored in coal to generate electricity.

QUESTIONS

Coal is not the only source of energy for power stations, there are also other types of power stations. Find out what these are and write down what source of energy they each use.

Electricity is transferred in a huge circuit to our homes

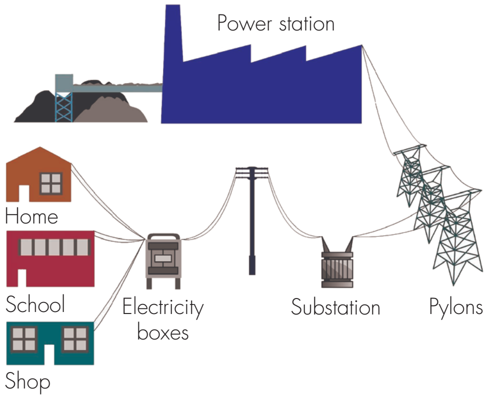
From a power station, electricity is transferred through transmission lines held up by pylons. The transmission lines are part of the circuit that connects the power stations to where we need to use the electricity.

Do you remember learning about the structures of pylons in Grade 4 in Matter and Materials? Remember they are made from triangular shapes and struts to make them strong and stable!

Huge pylons carrying the transmission lines across the country.

The transmission lines carry large amounts of electricity to substations in cities and towns.

From a substation, the electricity is carried in smaller amounts to electricity boxes for our homes. From the electricity box, electricity travels through wires to the plug points and light fittings in your home.



The transfer of energy from power stations to electricity boxes in our homes, schools and shops

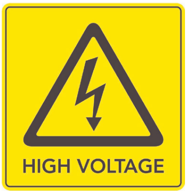
QUESTIONS

The diagram on page 189 shows how electricity is transferred from the power station to your home. Copy the diagram and continue it by drawing the path of electricity once it is in your home, and goes through the wires, wall socket and plug to get to an appliance, such as the TV.

11.3 Safety with electricity

Visit
Interactive site about electricity.
goo.gl/mrFiy

We use electricity every day. Electricity can be dangerous, so it is important that we use it safely. Electricity can give you an electric shock. An electric shock can hurt you badly or even kill you.



High voltage is very dangerous.
Look out for warning signs like these!

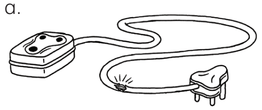
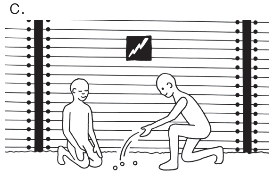
Electricity can cause fires and injuries, even death. Here are some rules for using electricity safely:

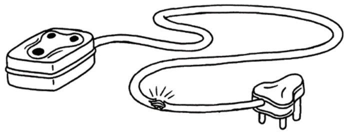
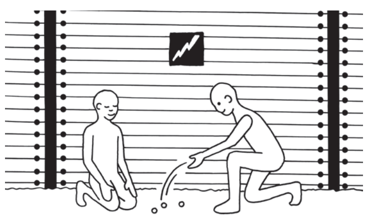
- Do not put anything into an outlet except a plug.
- Do not pull on the cord to unplug an appliance, hold the plug and pull.
- Dry your hands before you plug in or unplug a cord.
- If a plug is broken or a cord is cut or worn, do not use it.
- Do not plug too many cords into one outlet.
- Keep appliances away from water. Do not use a hair dryer if there is water nearby.
- If there is an electrical storm (with lightning), turn off and disconnect electrical appliances, like the TV and computer.
- Never touch any power lines.
- Some power lines are buried underground. If you are digging and find a power line, do not touch it.
- Do not fly a kite or climb a tree near a power line.

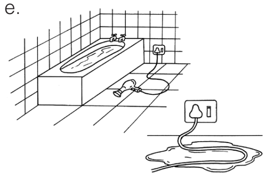
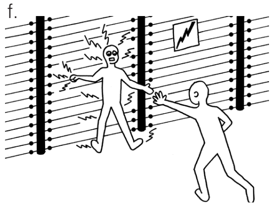
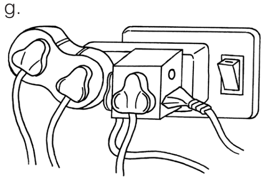
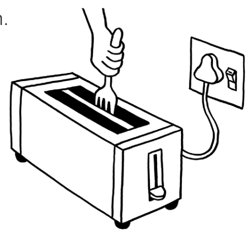
ACTIVITY 11.3: Ten safety tips for electricity

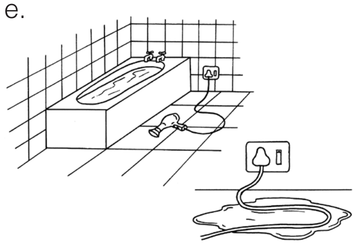
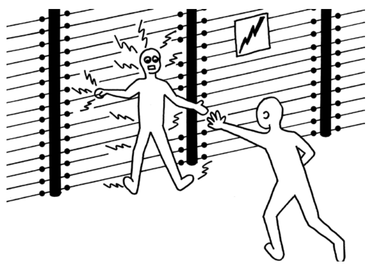
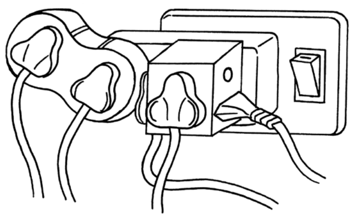
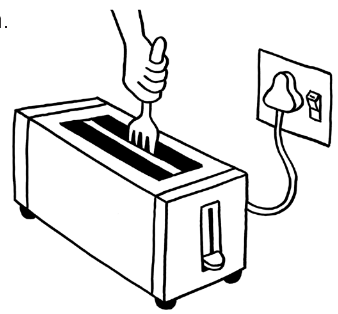
INSTRUCTIONS:

1. Look at the pictures. Each picture shows the incorrect use of electricity or an electrical appliance.
2. Use the picture to write a safety tip for the situation in the picture in your exercise books.
3. The first one has been done for you as an example.

Unsafe situation	Safety tip
a. 	Never use an appliance that has a broken cord or has some of the metal wire showing through the cord casing.
b. 	
c. 	
d. 	

Unsafe situation	Safety tip
a. 	Never use an appliance that has a broken cord or has some of the metal wire showing through the cord casing.
b. 	Do not play outside when there is thunder and lightning. If this powerful natural electricity strikes close to you, it will try to get to the ground through you!
c. 	Never play near to or on electric fences or power lines. These have live electricity running through them so you can get a shock without even touching them!
d. 	Never use electrical appliances outdoors in wet weather or if you are wet. Water conducts electricity well, so you WILL get a shock if you are touching an appliance and water drips into the socket, cord or motor. Wear closed shoes with rubber soles when using electrical appliances. Never use electrical appliances barefoot.

Unsafe situation	Safety tip
e. 	
f. 	
g. 	
h. 	

Unsafe situation	Safety tip
e. 	Never use electrical appliances in the bathroom. Remember, electricity can flow through water.
f. 	Electricity can flow from one person to the next. NEVER try to pull someone who is being shocked away from the appliance. You will get shocked too! Use a non-plastic/non-metal object to separate them from the electrical source.
g. 	Never put lots of appliances into one socket. Too much electricity flowing to one plug is dangerous. One multi-plug adapter is safe, but do not put adapters into each other. Rather use 2 different plug points.
h. 	Never stick a metal knife into a toaster while it is on. First turn the toaster off and unplug it and use a wooden or plastic knife. “Remember, electricity can flow through metals.

KEY CONCEPTS

- Energy can be stored in cells and batteries.
- The cells or batteries are a source of electrical energy for an electric circuit.
- An electrical circuit is a system that transfers electrical energy to where it is needed.
- A power station needs a source of energy.
- Electricity from the power station is transferred in a circuit to our homes.
- Electricity can be dangerous and needs to be used safely.

REVISION

1. Why do torches need cells (batteries) to operate?
2. What is an electric circuit?
3. How is a battery different to a cell?
4. Draw a diagram of a simple circuit containing one cell and one bulb so that the globe will glow.
5. How is it possible that electricity that is generated at a power station, reaches a TV in a home that is far away from the power station? Describe how the energy is transferred from a power station to your home.
6. When should you not handle electricity or electrical appliances?
7. Choose the correct answer: If someone is being shocked by an electricity source, I should:
   a. try to pull them away from the source of the electricity.
   b. throw water on them to cool down the shock.
   c. turn off the power source as quickly as possible then attend to them.
   d. attend to them then turn off the power source as quickly as possible once they are safe.
8. Give a reason for the following statement: Do not play under or near power lines or electric fences.

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REVISION

1. Cells (battery) are a source of energy for the torch. Chemical energy is stored in the battery which is changed into electrical energy and then light energy as the light glows.
2. An electrical circuit is a pathway that allows electricity to flow or a system that allows electrical energy to move
3. A battery is two or more cells connected end to end.
4. Diagram as in textbook (pg. 186 in LB).
5. Power station through transmission lines supported by pylons to substation. From substation through distribution lines to electricity box in your home. From electricity box through wires in our homes to plug points and lights and appliances.
6. When you are barefoot, have wet hands or in the bathroom.
7. Answer: C
8. If the electricity fields are live, I can get shocked even if just standing close to the electrical source.

12 Energy and movement

KEY QUESTIONS
- How can stored energy be changed into movement energy?
- How can we make things move using stored energy?

Do you remember in Grade 4 when we looked at energy and movement in a system? We were mostly looking at musical instruments and how they use movement energy (the input) such as plucking or blowing, to make them work.

In this chapter we are going to look at some other ways of using stored energy to produce movement energy.

New words
- catapult
- stretch
- compress
- potential energy

12.1 Elastics

Stretching an elastic band

QUESTIONS

Have you ever stretched an elastic band? When you pull it apart and then release it what happens?

Teacher's note

This chapter is an introduction to stored (potential) energy and movement (kinetic energy). Although the proper terms are not used here, you could introduce them in class so that learners start to become familiar with these words for the later grades.

QUESTIONS

Have you ever stretched an elastic band? When you pull it apart and then release it what happens?

When you release the elastic band, it shoots back into position.

Wow, I wonder how far I could shoot an elastic?

When we stretch an elastic band, we store energy in it. This is because when the band is stretched it can do work when you release it. We are going to look at some other ways of using stretched elastic bands to do work and produce movement.

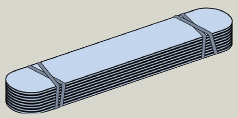
ACTIVITY 12.1: Making your own catapult

MATERIALS:

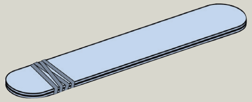
- Ten ice lolly sticks or craft sticks
- Four to six rubber bands
- Plastic spoon
- Bag of marshmallows

INSTRUCTIONS:

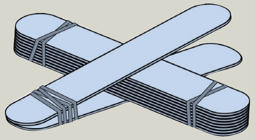
1. Place eight of the sticks together and tie a rubber band tightly around one end.
2. Tie another elastic band around the other end so that the sticks are bound tightly.



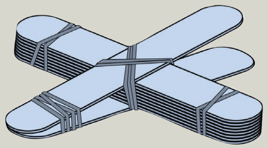
3. Tie a rubber band around the remaining two sticks, close to the one end.



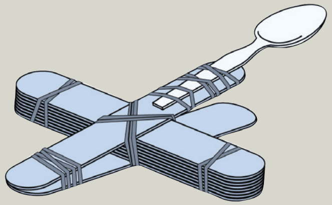
4. Insert the bundle of eight sticks bound together through the two stick bundle like this:



5. Tie another rubber band in a cross so that the two bundles are held in place, as shown below:



6. Use a rubber band to secure the plastic spoon on the end. You now have a simple catapult.



7. Shoot the marshmallows by placing one on the spoon, pulling down and then releasing it.
8. Have a competition – who can shoot marshmallows the furthest and most accurately?

QUESTIONS:

1. How are you able to shoot a marshmallow closer or further away?
2. When the marshmallow goes as far as possible, how much did the elastic band stretch compared to when the marshmallow did not go far?
3. Where did the movement energy of the marshmallow come from?

We saw in this activity that if you stretch an elastic band, you can produce movement. The stored energy in the band when it is stretched has the potential to do work. We call the stored energy in the elastic band potential energy because it has the potential to do something for us later. But what does the word 'potential' mean?

QUESTIONS

Look up a definition for potential in your dictionary.

A stretched elastic band can also produce movement and do work in the future when it is released.

Let's look at another way of using an elastic band to produce movement energy. We are not going to stretch, but rather twist the elastic band.

ACTIVITY 12.2: Build an elastic powered boat

MATERIALS:

- Rectangular wooden block (about 5 cm by 8 cm by 2 cm)
- Two popsicle sticks
- Piece of plastic cut from a plastic coffee tin lid (6 cm by 2,5 cm)
- Thick rubber band
- Thin rubber band
- Tub of water to test your boat in

Answers to Activity 12.1:

1. Pulling the spoon down further will make the marshmallow shoot further.
2. The greater the stretch of the elastic band, the further the marshmallow went.
3. Stored energy in stretched elastic.

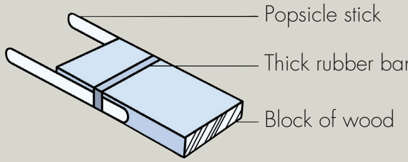
QUESTIONS

Look up a definition for potential in your dictionary.

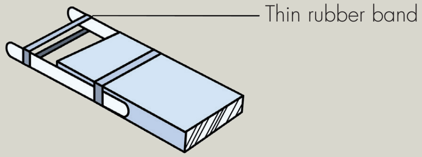
Having the capacity to do or develop into something in the future. Synonyms are possibility/feasible.

INSTRUCTIONS:

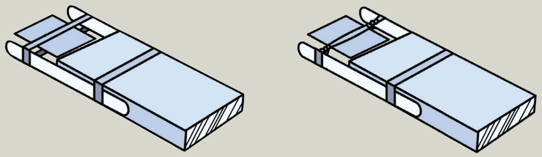
1. Secure the popsicle sticks flat against the sides of the wooden block with the thick rubber band, so that about a quarter to half of each stick is extending out beyond the end of the block.



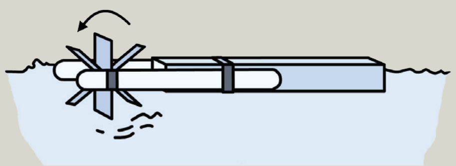
2. Place the thinner rubber band across the ends of the sticks.



3. Slip the piece of plastic through the thin rubber band. Turn the plastic to twist the rubber band.



4. Place it in the water, and let it go.



5. Challenge: Can you get your boat to move backwards and forwards?

QUESTIONS:

1. What is the purpose of twisting the elastic band?
2. Why does the boat go?
3. How could you make the boat go in different directions (backwards and forwards)?
4. Write down what you have learnt from the last two activities that you have completed.

12.2 Springs

We have been looking at elastic bands and how they can be stretched or twisted to store energy to do work (to produce movement). Springs can also be compressed or stretched to store energy.

A slinky is a metal coiled spring. When you stretch a slinky spring it stores energy. When the spring is released, the stored energy is changed into movement energy as it springs back into place.

A slinky is a spring.[1]

Visit

Slow motion slinky spring (video). goo.gl/FwlFL

Springs can also be compressed to do work. To compress something means that you squash it. Look at the photo on page 201 of a child jumping on a pogo stick. This pogo stick works using a compressed spring.

Answers to Activity 12.2:

1. To store energy in the elastic band
2. Stored energy in the elastic band is changed into movement energy of the plastic and the boat
3. Twist the piece of plastic in different directions. Twisting it towards the boat will make the boat move forwards, twisting it away from the boat will make it move backwards in the water.
4. Elastic bands that are stretched or twisted store energy. The stored energy can be changed into movement energy when the elastic band is released and returns to its normal shape.

NatSci&Tech_Gr5_TG_Book.indb 197 2018/05/18 12:29:28 PM

This spring was stretched and when released it moves back.[2]

Jumping on a pogo stick.[3]

QUESTIONS

Use your knowledge of springs to explain how a pogo stick works. Your answer must include the words compress, stored energy and movement.

KEY CONCEPTS

- Stored energy can be changed into movement energy.
- Energy can be stored in a stretched or twisted elastic.
- Energy can be stored in compressed or stretched springs.

QUESTIONS

Use your knowledge of springs to explain how a pogo stick works. Your answer must include the words compress, stored energy and movement.

When a child jumps on a pogo stick he compresses the spring (squashes it). The spring then has stored energy and releases back up and pushes the child up again. The stored energy from the compression is released and turned into a movement.

REVISION

1. A jack in the box is a fun toy. An object jumps out of a box when the lid is opened. Explain how it works by using a spring.

2. Is a stretched elastic band an example of stored or released energy?
3. What else, besides stretching, can you do to an elastic band to give it stored energy?
4. Think of some examples that you have experienced which use springs to store energy.

REVISION

1. A compressed spring is under the object. When the lid is opened, the spring is released and the stored energy is changed into movement energy of the object.
2. stored energy
3. Twist it

13 Systems for moving things

KEY QUESTIONS

- What is a wheel and axle system?
- What is the purpose of using wheels and axles?
- How can I make my own wheel and axle system?

Have you ever looked underneath a car? It looks very complicated and there are all sorts of pieces and parts, each with their own job to do. We are going to focus on two of the main parts in a vehicle that allow it to move.

New words
- axle
- diameter
- bearing

13.1 Wheels and axles

All vehicles have wheels. Most cars have four wheels, but some have a lot more, while other cars have only three wheels. Trucks and buses have many wheels, while some trailers or bicycles only have two wheels.

QUESTIONS

Why do you think wheels are round? Why will a square or a triangular wheel not work?

How did wheels and axles develop?

In the past, before the wheel was invented, it was very difficult to move things around. People would try to drag heavy things along the ground using ropes, or else they had to carry things. But this was very inefficient! So people started to experiment with ways of making it easier to transport goods and heavy objects.

The pyramids in Egypt were built long before trucks and modern transport were invented.

Teacher's note

There is no specified Technology Design Process in this chapter, but the focus is on Technology and systems. In Grade 6 in Earth and Beyond, learners will follow a Design Process and design and make a car to move on the Moon or mars. They will revise some of the concepts that they learned here about wheels and axles.

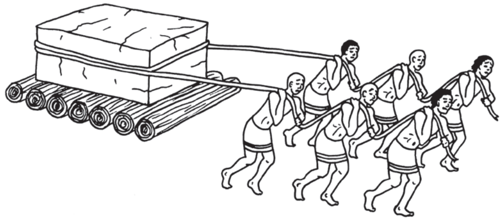
QUESTIONS

Why do you think wheels are round? Why will a square or a triangular wheel not work?

Wheels need to be round in order to roll. A square or triangle wheel will not roll.

The pyramids are very high structures made of stone.[1]

The Egyptians were very clever in finding ways to move very heavy objects. They used logs that were laid down. The heavy objects were placed on them, rolling them creating movement like in the picture below.



Egyptians pulling heavy stone blocks along logs.

The Egyptians used this method to move the massive blocks of stone to build their pyramids. But, there were still many problems with using logs cut from trees.

QUESTIONS

Can you think of some of the problems of using logs to try to move very heavy objects? Discuss with your friends around you and write your answers below.

Teacher's note

You can demonstrate this by using pencils and placing a bunch of pencils next to each other. Then put a heavy object on top of the pencils and push it along. As the object moves the pencils underneath it move too.

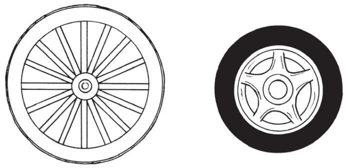
QUESTIONS

Can you think of some of the problems of using logs to try to move very heavy objects? Discuss with your friends around you and write your answers below.

Logs not of the same size or length. Needed a lot of logs and then had to move logs as well.

Later on, people then started to cut the logs into short pieces so that they were the same size. It was like a wooden disc. But the wooden disc could not stand up by itself so people attached a wooden pole between two of the wooden discs. This was the axle that is still used nowadays. This is how the first wheel and axle were developed!

People could then balance goods on the axle and use this simple machine to pull or push objects along. But this wheel was still very heavy! To make it lighter, the wheel was changed to a round frame with spokes, like a wagon wheel. This made it much lighter and easier to move. Since then, the wheel has advanced a lot. Think of the shiny metal and rubber wheels you see on cars today!



A wagon wheel and the modern rubber and metal-rimmed wheels we have today.

Did you know?
The first inflatable tire was made of leather. Today they are made from rubber.

Visit
Wheels and axles (video).
goo.gl/LAvza

How do wheels and axles help us?

A wheel and axle is a simple machine. A machine is used to make it easier to move a load.

It is much easier to move a heavy bag on a wheelbarrow than to carry it by hand.

Did you know?
The earliest record of a wheelbarrow comes from China in the Three Kingdoms period (AD 184–280).

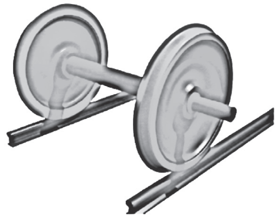
Teacher's note

This can be demonstrated by using different shapes and sizes of pencils and pens.

A wheel and axle is made up of two wheels (large cylinder) joined onto an axle (which is a small cylinder).

QUESTIONS

Use the diagram to label wheels and axles. Your teacher will provide you with a copy of the diagram.



Wheels and axle[2]

When we think of wheels and axles, we think of cars and other vehicles that we see all around us that have wheels.

A wagon wheel and axle.[3]

However, there are many examples of machines that use wheels and axles:

1. rolling pin
2. windmill
3. fan
4. egg beater
5. door knob
6. bicycle wheels

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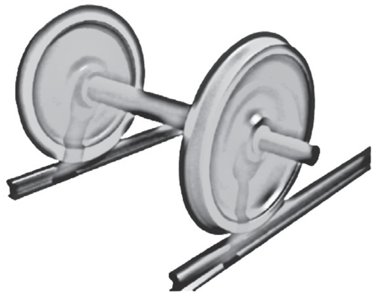
QUESTIONS

Use the diagram to label wheels and axles. Your teacher will provide you with a copy of the diagram.



Wheels and axle[2]

ACTIVITY 13.1: What do all wheels and axles share in common?

1. Find pictures of three of the examples on page 206. Look in old magazines and newspapers at home, or on the internet for pictures. Paste the pictures in your exercise books and label the axle and the wheel in each picture.
2. Explain carefully how a door knob is a wheel and axle machine.

Let's make a simple wheel and axle mechanism to understand how it works.

ACTIVITY 13.2: A simple wheel and axle machine

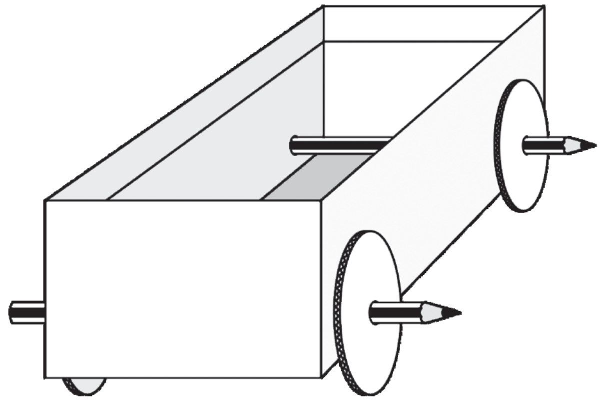
MATERIALS:

- Two chairs
- Broom handle
- String
- Bucket with handle
- Masking tape
- Scissors
- Ruler

INSTRUCTIONS:

1. Place the chairs back to back, about 30 cm apart. Rest the broom handle across the back of the chairs.
2. Tie a 50 cm length of string to the bucket handle.
3. Tape the free end of the string to the middle of the broom handle.
4. Place a few marbles or some other light objects in the bucket.
5. Turn the broom handle with your hands to raise the bucket into the air. Turn it back the other way to return the bucket to the ground.
6. Tape the ruler straight up and down the broom handle near one end.
7. Use the ruler, which acts as a wheel, to turn the broom handle and lift the bucket.

1. Example:



2. A door knob has a large cylinder on the outside, attached to a small cylinder on the inside. It is easier to turn the large cylinder than the small cylinder with your hands.

QUESTIONS:

1. Could you lift the bucket by turning the broom handle with your hands?
2. Was it easier to lift the bucket when you turned the broom handle using the ruler?
3. Replace the ruler with a stick that is longer than the ruler and use the stick to turn the broom. Was it easier to lift the bucket using the long stick?
4. Identify the axle in the setup.
5. Identify the wheel in the setup.
6. Write a conclusion to summarise what you learnt in this activity.

Now, let's put two axles and four wheels together to make a simple wagon!

ACTIVITY 13.3: Making a wagon with wheels and axles

MATERIALS:

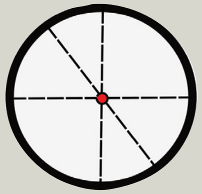
- Cardboard
- Two pencils
- Small box
- Scissors

INSTRUCTIONS:

1. Cut out four circles of the same size from the cardboard. You can use a lid from a bottle or a cup to trace around to get circles that are all the same.
2. Make a whole in the centre of each circle and in the bottom four corners of your box.
   a. To find the centre of the wheel draw diameter lines across the middle.
   b. A diameter line is the longest straight line you can draw across a circle. Where diameters cross, that is the centre.
3. Push a pencil through the middle of one circle and through a corner of the box.
4. Push the pencil through to the other hole on the other side of the box.

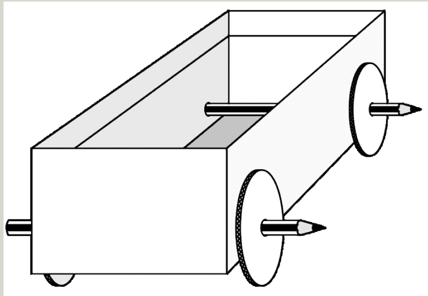
Answers to Activity 13.2:

1. Yes
2. Yes
3. Yes, the longer the ruler or stick the easier it was to lift the bucket.
4. The broom handle
5. The ruler or long stick
6. We could lift the bucket by turning the broom handle. It was much easier to lift the bucket when we used the ruler. Our hand had to move further when we used the ruler, but it was easier and the bucket felt lighter. We made a simple wheel and axle machine to make it easier to lift the bucket.



A wheel is a circle. Find the centre by drawing some diameters. In this example the centre is the red dot.

5. Then attach another circle on the end of the pencil poking out of the side of the box.
6. Repeat this for the other two wheels.
7. You now have a simple wagon like in the picture below.
8. Put an object in the box and push your vehicle along the floor.



QUESTIONS:

1. Can you see the wheels turning on the axles and how the axles connect the wheels?
2. Which part of the vehicle that you made is the axle?

Different ways to make wheels and axles

We are now going to experiment with different ways of making wheels and axles, and finding out the best materials to use.

Chapter 13: Systems for moving things 209

Answers to Activity 13.3:

1. Yes
2. The pencils

Teacher's note

This section shows different ways of making wheels and axles using materials which are easily obtainable. First go through some of the ways to make wheels and axles, and finally the last activity is to experiment with different materials and evaluate which set ups work best.

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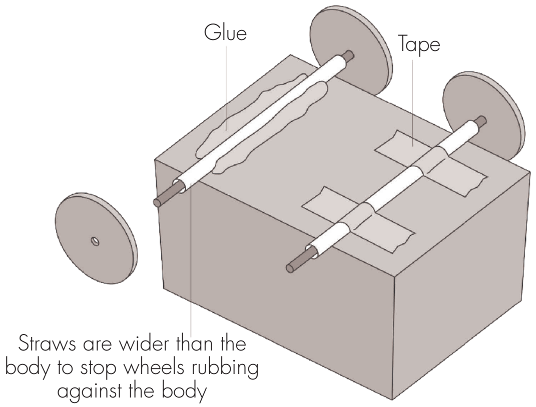
There are two ways to let wheels turn on an axle. One way is to have the axle fixed to the body, and the wheels are free to turn on the axle. The other way is to have the wheels fixed to the axle and the axle turns in a bigger tube called the bearing. The bearing is the hollow tube that the axle goes through. The bearing must be bigger than the axle so that the axle can turn easily.

You can use plastic straws or the barrel of an old ball-point pen to make a bearing for an axle. The picture shows you two ways to fix the bearings onto the body.



Two ways to fix the bearing onto the body.

QUESTIONS

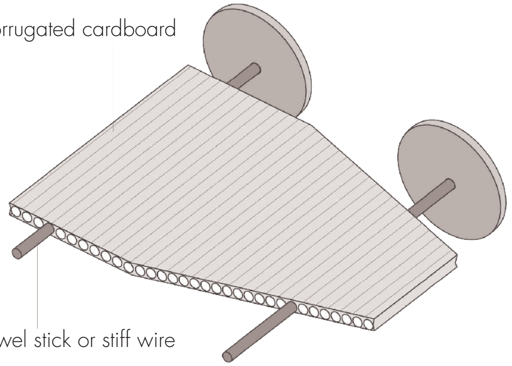
What are the two ways used in the picture above to fix the bearing onto the body? What are some materials that you could use to make the axle in the picture?

You can also use plastic advertising-board or strong corrugated cardboard to make a body with wheels. Can you see how the axle goes through the holes in the cardboard?

QUESTIONS

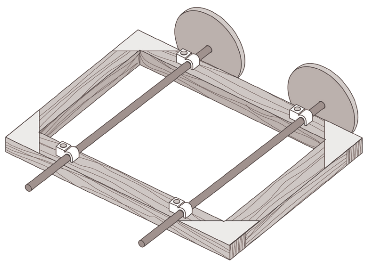
What are the two ways used in the picture above to fix the bearing onto the body? What are some materials that you could use to make the axle in the picture?

Tape and glue. Smaller straws, dowel sticks, sosatie sticks, etc.

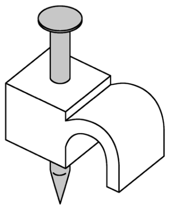


The board makes bearings for the axles which are fixed to the wheels. The axles turn in the holes.

The next picture shows you the other way to let the wheels turn. This time the axle remains still and the wheels turn on the axle. The axle is fastened to a wooden body with cable clips. Cable clips fasten telephone cables to walls. Can you see the blown up version of a cable clip? The clips may hold the axle tightly, so the wheels must be free to rotate.



How the cable clips can hold an axle.

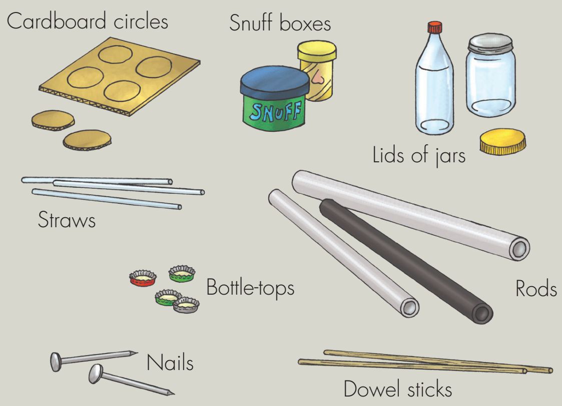


A clip to hold telephone cables to the wall.

ACTIVITY 13.4: Making and evaluating different wheels and axles

MATERIALS:

- Things to collect for wheels: shoe-polish tins, the lids of bottles, cut-out cardboard circles
- Things to collect for axles: sosatie sticks, plastic straws, dowel sticks, aluminium rods, nails or wire
- Scissors
- Glue
- Tape
- Pencils and crayons
- Small box



Things you can use for wheels and axles.

INSTRUCTIONS:

1. Bring the different materials that you have collected for wheels and axles to class.
2. You must now experiment with the different materials that you have to make wheels and axles. Attach the setup to the small box to test the wheels and axles.

This activity does not follow a Technology Design process with all the steps, but does involve investigating, making and evaluating different objects to make wheels and axles and then using their best option to make an improved tractor from what they first made in the beginning of this chapter. Ask learners to collect the materials for wheels and axles from home beforehand – tell them to also use their imaginations when looking for different materials to use. You will also need to supply some of the materials.

3. Remember what you learned about how to attach axles to the box and experiment with these different methods as well. (Hint: Bearings!)
4. Experiment with different sized wheels and find the best option. Test and evaluate the different setups you have made to see whether they move easily.
5. Select the best option and make an improved wagon from the one you made in Activity 13.3 with the pencils.
6. Evaluate how far your improved wagon can go if you give it a push with an object in the small box.

QUESTIONS:

1. Do a drawing of your final design for your improved wagon in your exercise books. Remember to label the different materials that you used.
2. What did you decide was the best material to use for the wheels and why?
3. What did you decide to use for the axles and why?
4. How did you attach the wheels to the axle in your final design?
5. How far could your wagon go after you gave it a push and it was carrying an object?
6. How would you improve your design if you had to do it again?

KEY CONCEPTS

- Many vehicles are systems that use wheels and axles.
- Different designs for wheels and axles are used to help vehicles move more easily.

Teacher's note

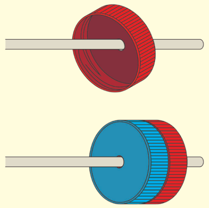
Set up a mini competition to see whose tractor can go the furthest after giving it one push and it is carrying an object (such as the board duster, or some other small, fairly light object). Use a tape measure to record how far each learner's tractor went.

Answers to Activity 13.4:

2. Learner dependent answer. Make sure they provide a reason for the chosen material.
3. Learner dependent answer. Make sure they provide a reason for the chosen material.
4. Learner dependent answer.
5. Learner dependent answer.
6. Learner dependent answer. Check that learners evaluate their designs.

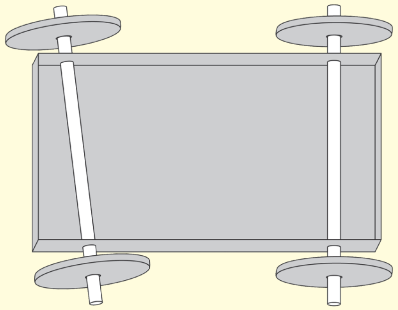
REVISION

1. List four different vehicles which make use of wheels and axles in order to move.
2. When Phumlani was experimenting with making wheels, he decided to use bottle lids. Look at the picture below. He decided that gluing two lids together was better than one lid. Explain why you think Phumlani did this.



Phumlani glued two lids together.

3. When Phumlani made the axles for his wagon, it looked like this underneath:



The axles under Phumlani's wagon.

   What is wrong with these axles and how do you think the wagon will move? What should Phumlani do to improve his design?
4. When looking to buy a pram, there are many different ones available. Some have big wheels and some have small wheels. Look at the pictures on page 215.

REVISION

1. Car, truck, bicycle, pram, motor bike, trolley, etc.
2. Phumlani did this because one lid was probably unstable and wobbled, whereas two lids are more stable and do not wobble.
3. The one axle is skew which will make the tractor move in a curve to the one side. He should improve the design by making the axles parallel to each other and perpendicular to the side of the tractor. (Perhaps explain the words parallel and perpendicular to your class by drawing pictures on the board)

This pram has small wheels.

This pram has big wheels.

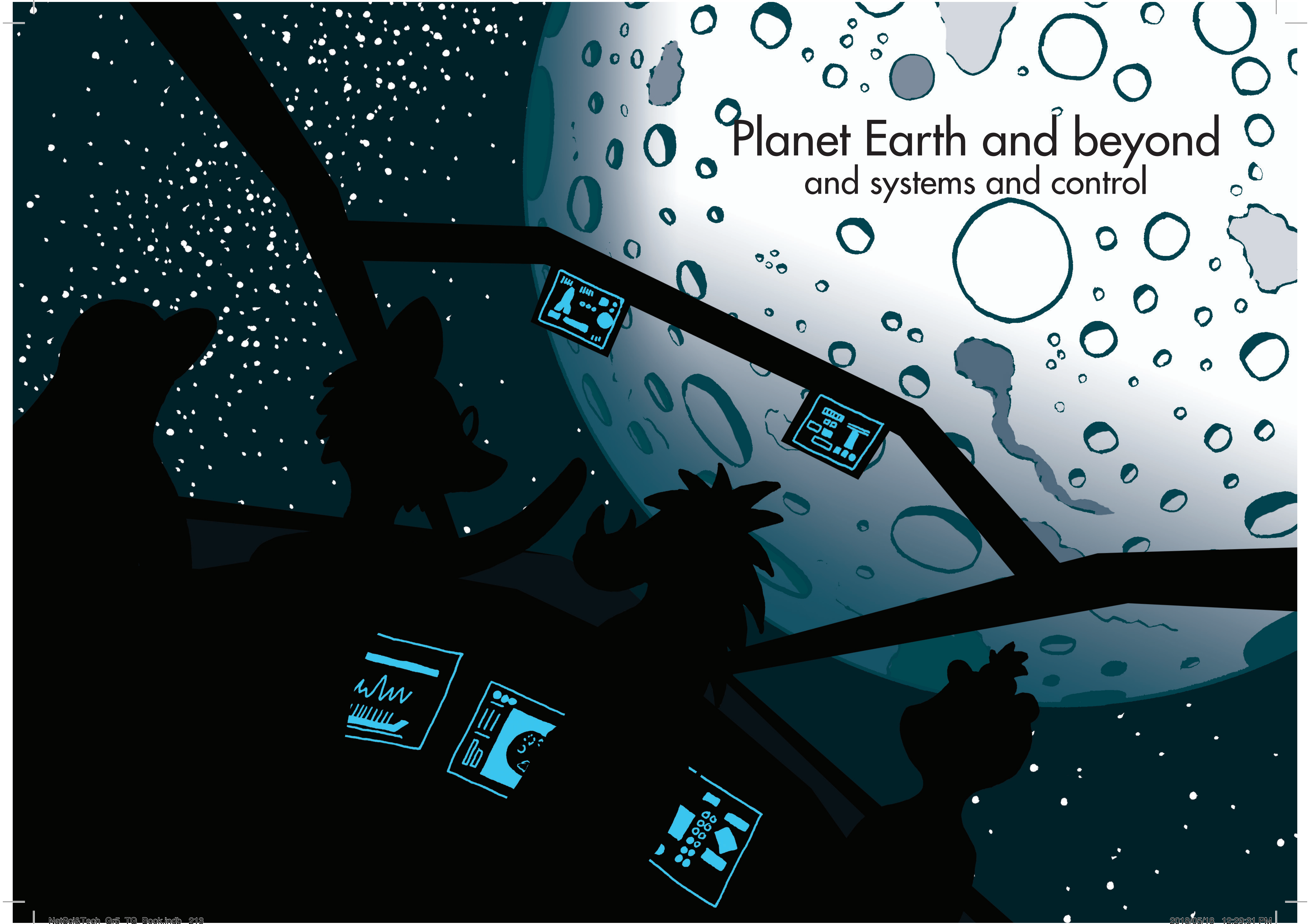
When do you think it would be best to use a pram with small wheels, and when would a pram with big wheels be used?

That's all for Energy and Change! I hope you enjoyed it, as I sure did!

4. Small wheels – over smooth ground, in homes, shops etc. Big wheels – over rougher ground, to move more easily, go faster

Planet Earth and beyond

and systems and control



14 Planet Earth

KEY QUESTIONS

- Why does the sun appear to move across the sky?
- How long does it take the Earth to move around the sun?
- How long does it take the Earth to spin around once on its axis?

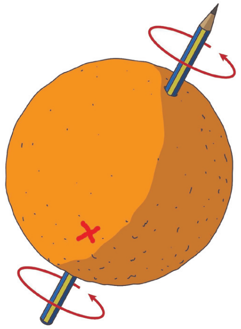
14.1 The Earth moves

In Grade 4 we learnt that the Earth moves in two different ways. The Earth orbits the sun and the Earth also spins on its own axis. Let's revise these concepts again.

The Earth spins to give us day and night

In Grade 4 you learned that the Earth spins on its axis. But what does this mean? Imagine an orange with a pencil stuck through it. Look at the picture. If you hold the pencil in your fingers, you can spin the orange around. The pencil is the axis of the orange.

The Earth does not really have a pencil through it, but it does spin around. We can imagine a big pencil through the middle of the Earth.



The Earth is like the orange and the pencil is like the axis. The curved arrows show which way the Earth spins.

Teacher's note

How to introduce this topic

Remind them of the lessons in the last term of Grade 4, when they learned about the Earth, Sun, Moon and planets. Use Figure 1 to start them thinking about what is on the surface of the Earth and under the surface of the Earth.

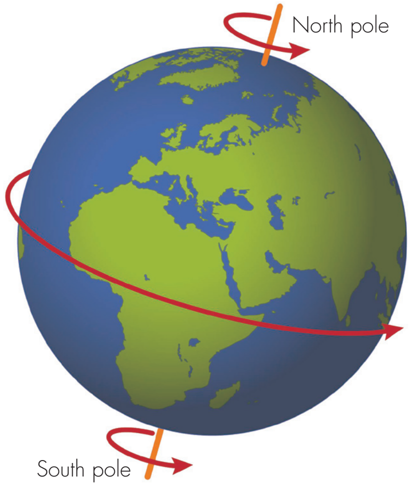
Begin "**Activity 15.7: Begin to make soil**" (making compost), in the first week of the term, because the compost needs time to break down You need compost out of the column by week 3 or week 4.

You will need a globe in the classroom and atlases that show South Africa in large enough scale to find names of towns. The cognitive development issue is that children need the ability to mentally move from the physical place where they are to another place on the planet, and that means being able to handle models of those places in the form of globes and maps. Also read through all the "What you will need" sections today, because some of the things take time to collect. the learners can help with collecting many of the items you will need.

We are on the Earth. Let us imagine we are at the point where you see the red 'X' on the orange on the previous page:

- The sun shines on the Earth and so we, at X, see the sun. We call that day-time.
- But the Earth never stops spinning. So we, at X, move around into the shaded part of the Earth. Then we cannot see the sun any longer and it is night-time for us at X.
- The Earth spins right around in 24 hours, so it will take 24 hours for us to come around to the same position you see in the picture.
- We call the 24 hours a day. When we say 'a day' we really mean a day-and-night. Together they last 24 hours.

If we are at position X, we move past the sun. But to us, it looks as if the sun is moving. The sun seems to move from the east to the west. In the east it rises (comes up), goes across the sky at lunch-time and moves to the west where it sets (goes down). But the sun does not actually move.



The Earth has an axis from the north to the south pole.

Teacher's note

Use an orange and do this as a demonstration. You can set up a mirror or a big sheet of white paper, outside, to shine the Sun into the classroom.

ACTIVITY 14.1: Who is having daytime?

MATERIALS:

- Classroom globe of the Earth

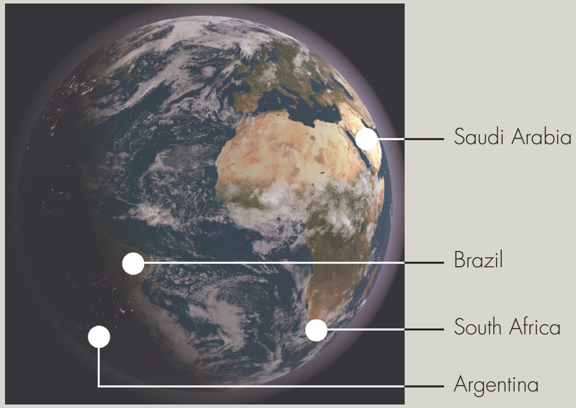
This is a globe. A globe is a model of the Earth.

INSTRUCTIONS:

1. There are two images of the Earth below.
2. Look carefully at the photos and use them and the globe to answer the questions.

QUESTIONS:

Picture A



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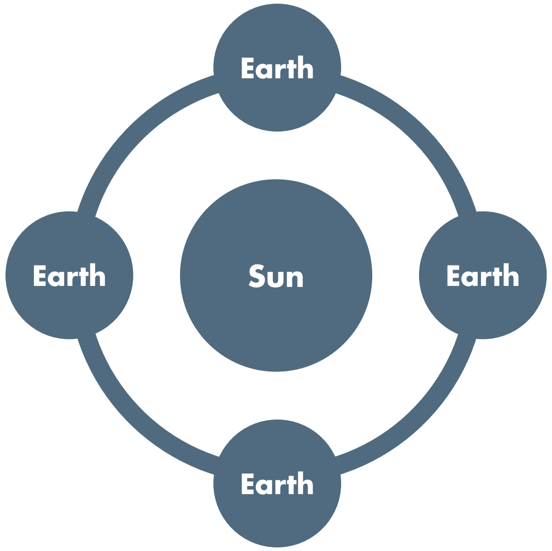
Alternative activity for modeling day and night

Materials and apparatus:

- Torch or lamp (to represent the sun)
- Learners (to represent the movement of the earth around the sun)

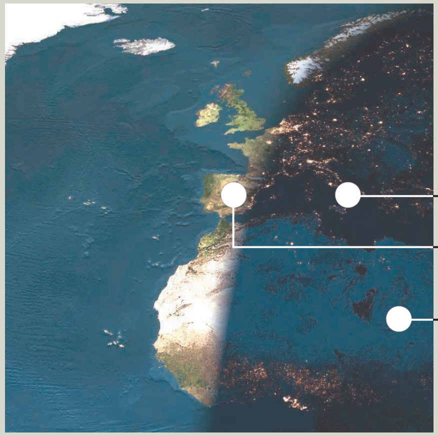
Instructions:

1. Learners all start facing the source of light.
2. Learners then rotate about a fix point.
3. Can you see the light source after the following rotations:
   - 90° rotation,
   - 180°,
   - 270°,
   - 360°



1. You are in South Africa. Find South Africa on the globe. Find South Africa in Picture A.
2. Was it daytime in South Africa, when the spacecraft took the photo?
3. Was it daytime in Saudi Arabia? Hint: Use your globe to find Saudi Arabia and then find it in Picture A to see if it is day or night.
4. Was it day time in Argentina when this photograph was taken? Use the globe to help you locate Argentina. Explain your answer.
5. The tip of Brazil is in the sun in Picture A. Is it morning or afternoon in Brazil? Why?

Picture B



1. Look at Picture B. What part of the Earth is this picture showing?
2. Can you see the lights on in Italy? When it is dark in Italy, is it still light in Spain?
3. Is it late afternoon or morning in Spain in Picture B?

We have looked at photographs of the Earth as it changes from day into night as the Earth rotates. Let's make a model of Earth using our heads to explain this.

Answers to Activity 14.1:

Picture A

2. Yes the sun is shining on South Africa
3. Yes, there is sunshine on Saudi Arabia.
4. No, it was night time in Argentina; in the photo, Argentina is on the darkened side of the Earth, and there are lights showing.
5. It is morning, because Argentina is moving towards the east and into the part of the Earth that is in the light.

Picture B

1. Europe and the top of Africa.
2. Yes
3. It is late afternoon.

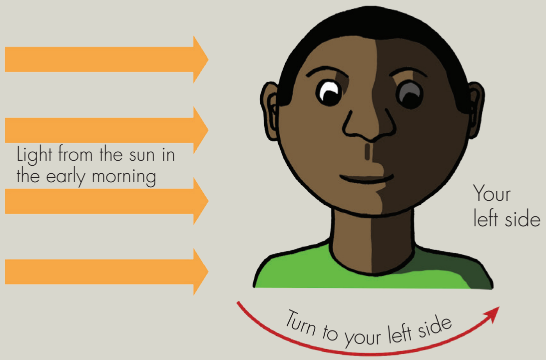
ACTIVITY 14.2: Your head can be a model of the Earth

MATERIALS:

- Yourself
- Sunlight coming from one side

INSTRUCTIONS:

1. This model will help you to understand why we see the sun move across the sky. Do this in the early morning when the sun is still low.
2. We will say that your nose is Africa. You are on Africa. Look at the picture below.
3. Now stand so that bright light from the sun shines across your right cheek.
4. Turn slowly to your left. Turn your eyes towards the bright place where the sun is. You will see the sun move to your right while you move to the left.



Using your head as a model of the Earth.

5. Move your feet and turn further; you will see the sun 'go down' over your right cheek.
6. When you have turned your back to the sun, you cannot see the bright light any more. That is like night-time in Africa.

Teacher's note

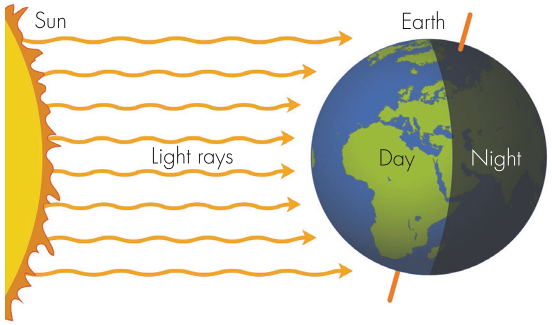
They must move their whole bodies round, not just their heads!

7. Turn further to your left and you will see the sun 'rise' over your left cheek. That is like sunrise in Africa.

QUESTIONS:

1. Which of your cheeks is like the west? That is where the sun appear to go down.
2. Which cheek is like the east, where the sun appears to come up?

We see the sun rise and move across the sky every day. But the sun does not really move – it only seems to move. Earth is spinning round and round, and we are moving around with the Earth. The Earth takes 24 hours to complete one full rotation.



Can you see how the light from the sun only reaches one half of the Earth as it rotates?

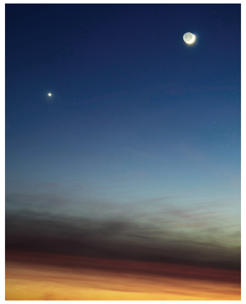
The Earth moves in an orbit around the sun

The Earth moves around the sun. The Earth moves around the sun while it is spinning. It spins round 365 times while it completes one orbit of the sun. That means 365 days pass and we call that a year.

The Earth is called a planet. There are seven other planets also moving around the sun. You can see one of the other planets on most evenings, or early in the morning. This planet is called Venus or *iKhwezi* or *Naledi ya Masa*. It is not a star.

Answers to Activity 14.2:

1. The learner's right cheek; that is where she saw the Sun disappear.
2. Their left cheeks are like the east. You can chalk an "E" on their left cheeks to remind them

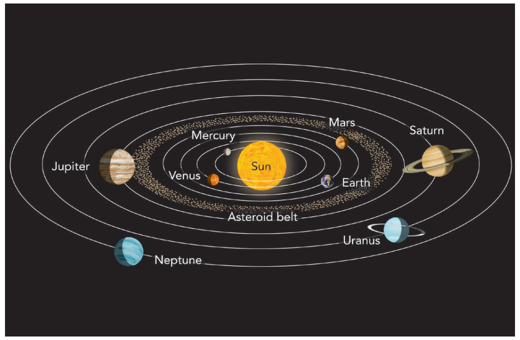


You can see the planet Venus just after sunset or just before sunrise below the moon.

Venus also moves around the sun but its orbit is a smaller circle than Earth's orbit. Venus takes 225 Earth days to go once around the sun.

Mars is another planet you can see on some nights. Mars appears as a small, orange dot in the sky. Mars takes 687 Earth days to go once around the sun.

You can also see Mercury, Jupiter and Saturn in the sky, but they are harder to see than Venus and Mars. All the planets seem to move along the same path that the sun and moon seem to move.



The planets move in orbits around the sun. The orbits lie on the same plane, as if they were on a big flat plate.

Teacher's note

The days referred to here are Earth days; Venus has its own day-length but it's very much longer than an Earth day.

Teacher's note

Explain to learners using this picture that all the planets lie on the same plane – as if they were all lying on a plate. The "plane" does not mean an aeroplane; it means a flat surface like the top of your table or a big flat plate. also, make sure they understand the next concept of this diagram not being drawn to scale – the orbits of the outer 4 planets are much larger than shown here. But, this is difficult to represent using an image in a book as if it were to be drawn to scale, the outer rings would not fit on the page.

The orbits of the outer planets are actually much bigger than what is shown in this image. But, if we tried to draw the orbits to scale, they definitely would not fit on this page!

Let's make a scale model of the solar system using our bodies to understand what it means to orbit the sun!

My model of the solar system is not to scale. If we want to make one to scale, we will need a really big area!

ACTIVITY 14.3: Making a scale model of the solar system

MATERIALS:

- 100 m heavy string
- Nine pieces of heavy cardboard
- Scissors
- Permanent marker

INSTRUCTIONS:

1. Learners are divided up into eight groups and each group is assigned a planet.

Teacher's note

In the image of Felicity, her model of the solar system should have all planets on the same plane to be correct. Perhaps ask your learners what Felicity should do to make the model correct if they compare it to the previous diagram of the solar system? She can rotate the rings so that they all lie in the same plane.

Teacher's note

This activity is useful to help learners understand the structure and scale of the solar system, especially how far apart the planets are from the sun. The activity requires a large open space, such as a school field. The model only uses 9 learners at once, so swop the learners so that each one gets a chance to be one of the celestial bodies. The teacher can be the sun in the middle and the learners can be divided into 8 groups, each group assigned to a planet. The teacher should note that as each learner/planet revolves around the Sun, he/she also rotates! This is even trickier to get right, but let the learners attempt to do so.

2. Each group must cut a piece of string to represent the distance of their planet from the sun, using the lengths indicated in the table on page 226. The actual distance of the planets from the sun is given in gigametres (Gm) and the length of the string is in metres (m).

   One gigametre is one million kilometres, which is 1 000 000 000 metres.

Planet	Distance from sun (Gm)	Length of the string (m)
Mercury	58	0.4
Venus	108	0.7
Earth	150	1.0
Mars	228	1.5
Jupiter	779	5.2
Saturn	1 434	9.6
Uranus	2 873	19.2
Neptune	4 495	30.0

3. Each group must cut a circle out of the cardboard and write the name of their planet and the actual distance from the sun on it.
4. Make a hole at one edge of the cardboard and tie the length of string to it.
5. Now it is time to go outside to a big open space, like the school field!
6. Your teacher will be the sun in the centre. She/he does not move as the sun does not move.
7. One member from each group must hand the 'sun' the end of their length of string and then stretch out their length of string.
8. Do this one at a time starting from Mercury and going out to Neptune. You do not all need to be in a straight line but can be in different positions around the 'sun'.
9. Place the strings on the ground, all stretched out in different directions.

10. Walk around so that you can all see the scale model of the solar system.
11. Now comes the tricky part – making the planets orbit the sun.
12. Select one learner from each group to be the planet.
13. He/she must pick up the planet and walk in a circle around your teacher, all going in the same direction. Try and walk at the same speed.
14. Swop with other learners in your group so that you each have a turn to be a planet orbiting the sun.

KEY CONCEPTS

- The Earth spins on its axis. This is the reason we have day and night.
- The Earth also moves through space, around the sun.
- The Earth's path through space around the sun is called its orbit.

Teacher's note

(Instruction 10) Explain to learners that on this scale, the nearest star (other than the Sun), would still be 2 748 km away!

Teacher's note

(Instruction 13) Hold all the ends of the strings in one hand above your head so that you are like a maypole and the learners will revolve around you.

Teacher's note

(Instruction 14) Make sure to point out to learners about the length of time it takes each learner to orbit the Sun. When Neptune has completed one revolution, Mercury will have completed many more as it is closer to the Sun. Point out the big gap between Mars and Jupiter – the space between the inner and outer planets. Mention to learners that there is actually a ring of asteroids (giant rocks) that also orbit the Sun in this space.

REVISION

1. How many hours are there in a day?
2. How many hours pass from sunrise until the next sunrise?
3. How many days pass between your 10th birthday and your 11th birthday?
4. How many times must the Earth spin around between your birthdays?
5. Which planets have smaller orbits than Earth?
6. Write out the whole paragraph and complete it. Use some of these words to complete the sentences. You do not need all the words:
   - the orbit of Mars
   - the orbit of the Earth
   - 687 earth days
   - 365 days
   - sun
   - Earth

   If I lived on Mars, I would have to wait much longer for my birthday. The reason is that __________ is much bigger than __________, and Mars takes __________ to go around the __________ once.

Let's now find out more about our Planet Earth.

REVISION

1. 24 hours
2. 24 hours
3. 365 days

Teacher's note

The answer is actually 365.25 days. When a day is defined in terms of the spinning of the Earth learners will be able to appreciate the quarter of a day as well, and thus an 'extra' day during leap year. '365 days' makes things manageable only for short term.

4. 365 times
5. Mercury and Venus
6. If I lived on Mars, I would have to wait much longer for my birthday. The reason is that the orbit of Mars is much bigger than the orbit of the Earth, and Mars takes 687 earth days to go around the sun once.

15 Surface of the Earth

KEY QUESTIONS

- What would you find if you could dig a very deep hole?
- Where does soil come from?
- If you were going to buy a farm, what kind of soil would you look for?

15.1 Rocks

What will you find if you dig a hole, as deep as it can go?

QUESTIONS

Look at the photo of the Earth on page 220. What is on the surface of the Earth? Name all the features (parts) you can think of. What do you think is under the surface?

ACTIVITY 15.1: Digging a hole in the Earth

Look at the picture of a digging machine on page 230 and imagine you are driving it.

QUESTIONS:

1. What is under the floor of this classroom?
2. Imagine that you use the machine to dig as deep as you want. You drive it down into the Earth. What do you find as you go down?
3. Do a drawing of yourself, the digging machine and the hole. In your drawing, show (a) the Earth (b) the digging machine with you inside (c) the hole (d) what you find at the deepest part of the hole.

Teacher's note

Chapter 15 deals with the rocky crust of the Earth; we aim to teach the children where soil comes from: soil is broken-down rock plus organic matter from plants and animals. However, we can't just teach about the crust because that would leave a hanging question – the crust of what? So we spend a little time looking at what the crust is covering, and so we look at the structure of the Earth.

QUESTIONS

Look at the photo of the Earth on page 220. What is on the surface of the Earth? Name all the features (parts) you can think of. What do you think is under the surface?

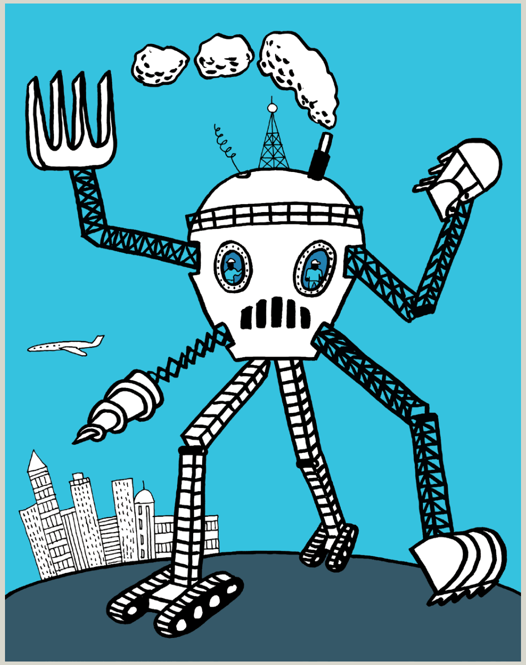
Answers may include land, sea, forests, rivers, deserts, air, clouds. Learners may correctly include animals and people though they cannot see them in the picture. Answers may include soil, rocks, mines, bones, roots, drainpipes, and many more. Encourage them to think of as many ideas as they can.

Answers to Activity 15.1:

1. This question is for discussion.
2. Let the learners discuss this before they write. If they cannot write, let them draw pictures of what they think they will find under the Earth.
3. Give the learners enough time to think while they do their drawings. Look at the learners' drawings but do not correct them. If you give them the right answer, you will stop them thinking about the

New words
- topsoil
- subsoil
- bedrock
- humus
- crust
- mantle
- core
- cross-section

Did you know?
Geomorphology is the study of the Earth's surface features.



Imagine that you have a powerful digging machine.

So what do we find as we dig deeper?

When we begin to dig, we first dig though topsoil. Good topsoil is usually a dark colour.

Topsoil is very important for life. As you can see in the picture on page 231, plants and animals depend on topsoil.

If we dig deeper, we find subsoil. This layer is often sandy and orange in colour. When we dig deeper, we come to rock. This layer of rock underneath the soil is called bedrock.

problem. At the end of the Chapter they will get a chance to change their ideas – see Activity 15.3: So what is under our feet?

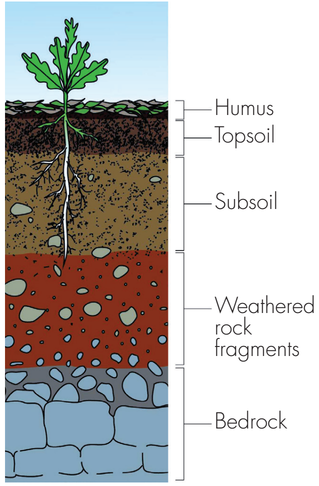
Some learners' drawings might show the hole going down through soil and rocks and underground water and volcanoes. Other learners' drawings might not show any of these things; it depends on how much general knowledge they have by Grade 5. Correctness does not matter at this stage: we are raising their curiosity by asking the question "what is deep down under our feet?"

If they are thinking about that question, then the next section will make more sense to them.

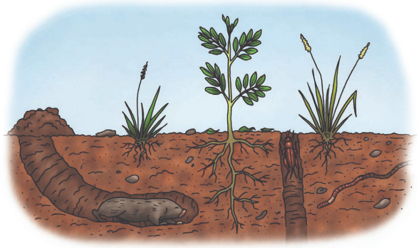
Teacher's note

The purpose of this drawing task is to make learners grapple with the idea that they are on a ball-shaped Earth. Most learners have no problem with saying that the Earth is shaped like a ball and most have seen pictures of the ball-shaped Earth like Figure 1. But this concept is not easy to think with, when you are actually standing on the ball. So the question, "what would you find if you could dig a hole right through the ball?", makes them move mentally between the ground they can see and the view of the ball-shaped Earth as seen from Space.

Look at the illustration below and find the topsoil. Find the subsoil underneath the topsoil and the bedrock at the bottom.



Topsoil is usually darker than the soil underneath.



Plants and animals depend on topsoil.

When we dig through the bedrock, a few hundred metres deep, we may find different layers of rock. We may even find water in cracks in the rock in some places. We may find coal in a few places.

Deeper down, about a kilometre deep, we may find oil and gas. Still deeper, we will find very hard rock and the rock will feel hot to touch. In Gauteng and the Free State, in a very few places, we will find rock that has gold in it.

Look at the picture on page 232. Can you see a hand cutting a slice out of the Earth?

Did you know?

The deepest mines in the world are in South Africa, in Gauteng. Those mines are 4 km deep and the miners are digging deeper every month.

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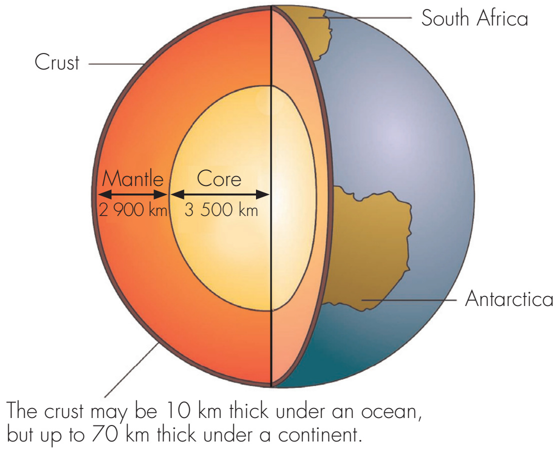
Imagine we could cut a slice out of the Earth.

In the next picture you see what the Earth is like inside.



Visit
Video showing the structure of the Earth.
goo.gl/YXUFE

If we cut the slice out of the Earth, the Earth could look like this inside.

The land is made up of rocks, subsoil and topsoil.

The surface of the Earth is the crust

People have not really gone very deep into the Earth. We are in rock that is called the crust of the Earth. The crust is the outer layer of the Earth's surface. Find the crust in the previous picture. The crust consists of rock and soil.

The crust is about 70 km thick, so we have not gone very far yet. Humans have only gone 5 km deep, and the hole that they excavated is so small that you cannot see it in the crust.

Miners in the deep gold mines suffer from heat. The deeper they go, the hotter the rock is.[1]

Does the crust go under the sea also? Look at the picture of the rocks and sea below.

This is where the ocean meets the land. Does the land go under the ocean?[2]

QUESTIONS

If you dig a hole in the beach sand what will you find if you dig very deep? If you went down under the sea water, what would you find down there?

The sea is very deep if you go far from the beach. The sea may be kilometres deep.

The deepest part of the sea is called the Marianas Trench. It is near the Marianas Islands, south of Japan. You can find this place on the classroom globe or a map. It is a trench (like a valley with steep sides) that is 11 km deep. The sun's light cannot reach down to the bottom and it is pitch-dark. The water presses down with a pressure that is like the weight of three buses pressing on your thumbnail!

Three scientists have gone down there in small submarines, and taken pictures and collected rocks. The submarines had bright lights, and the scientists were amazed when they saw animals that live down there. You can see an animal called an anemone in the picture.

The people in the submarines saw anemones like this in the deepest part of the ocean.[3]

They found rocks that look like those in the photograph. So the crust rock lies under the oceans as well as under our feet. The crust is a layer of rock all around the Earth, like the shell of a hard-boiled egg.

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QUESTIONS

If you dig a hole in the beach sand what will you find if you dig very deep? If you went down under the sea water, what would you find down there?

Rocks, if you dig deep. Children who have dug holes in sand will also tell you that sea water flows through the sand and flows into the hole. Sand near the beach, but further out to sea you find fine mud and under it you find rock.

It must be such an interesting world in the depths of the oceans. I wonder what it is like?

Soil, air, water and sunlight support life on Earth

Life on Earth exists on the very thin layer around the planet – the crust. The soil is a thin layer and all the plants need soil to grow in. The plants use energy from the sun to grow, and they make the oxygen we and all the animals need to breathe. You already learnt about this in Life and Living.

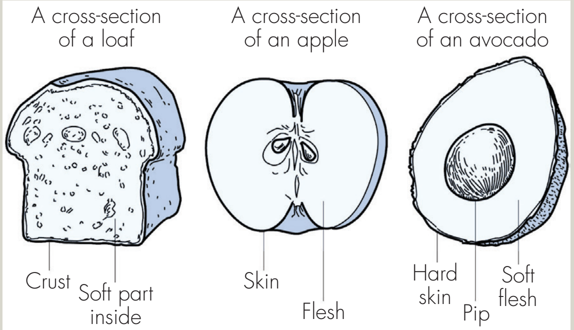
ACTIVITY 15.2: Thinking about the layers of the Earth
(For enrichment only)

QUESTIONS:

1. What is the diameter of the Earth?
2. The Earth is really a ball, so how deep can the hole be?
3. If the digging machine went as far as it can go, what is the last layer of the Earth that it would dig through?
4. Which is the best model of the Earth – a loaf of bread, an apple or an avocado? Look at the three pictures on page 236. Which of those is most like the Earth? Explain your answer. Remember that the Earth has a hard crust, a hot sticky mantle and a hot core.
5. Although the model you chose is most like the Earth, it is not exactly the same. In what way is this model not like the Earth?

Answers to Activity 15.2:

1. Think of the Earth as a circle; then the diameter means the distance across the middle of the Earth. The diameter is 72 900 km. They can read this off the diagram.
2. Only 72 900 km, because after that the hole will come out of the other side of the Earth!
3. It will dig through the crust, but from underneath and then it will come out into the air.
4. The bread has a crust, but no core. The apple has a peel or skin and a core, but the core is not one solid thing. The avocado has a tough skin or peel, and a solid core, so it is quite a good model of the Earth.
5. For example, the avocado pip is not hot, but the core of the earth is very hot.



Three different possible models of the layers of Earth.

Soil comes from rocks

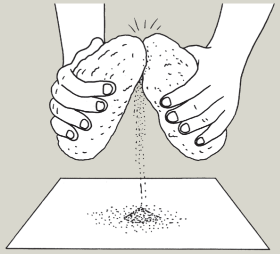
Rocks do not last for ever! They may seem very hard and indestructible, but let's have a look.

ACTIVITY 15.3: Can hard things like rock and stone wear away?

Stones are hard. People say that a thing that is made of stone will last for ever. But is this true?

MATERIALS:

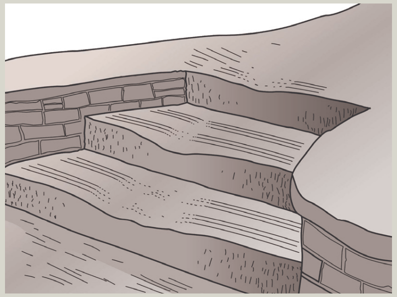
- Two stones (pieces of rock)
- Sheet of paper



Rubbing rocks together to make sand.

INSTRUCTIONS

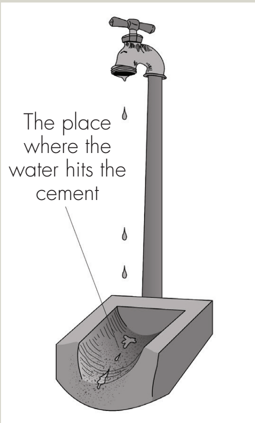
1. Find a cement step that everyone at the school walks on. Sweep the step clean and then look carefully at the step.



Why are these steps wearing away?

New words
- expand
- contract
- weathering
- soil
- microogranism
- erosion

2. Can you see where people put their feet? What has happened there?
3. Find a piece of cement under an outside tap. Look carefully at the cement, where the water falls on it. You might see that the cement is rougher just where the water hits it. The cement has lost little pieces.
4. Find out how long the cement has been there. Perhaps it was put in when the school was built. So how many years did it take to wear away (weather) the cement?
5. Find another object that is being worn away. Tomorrow, tell the class about what you have found.



Look at the place where the water hits the cement. How is the cement changing?

INSTRUCTIONS:

4. The learners have to find out when the school was built.
5. The learners could report that they found a Door edge; corner of building; pencil point; piece of board chalk; bottom of spoon; sole of shoe.

6. What do you think is wearing away the object?
7. When a small bit breaks off the object, where do you think it goes?
8. Are the small bits still lying somewhere, do you think?
9. Now rub the two rocks together for three minutes. Let all the little pieces fall onto the paper.

In nature, rocks turn into sand. But how does it happen?

Did you know?
The volcanic rock known as pumice is the only rock that can float in water.

Big rocks break up into smaller rocks

We know that we can break big stones into small stones. But when we see small stones lying on the ground, it is hard to think how they were broken up.

In nature, rocks break up in many ways. We will look at just three of those ways.

1. Bigger rocks break up into smaller rocks

Over time, rocks can get cracks in the surface. Water gets into the cracks and causes the cracks to get bigger. Pieces of rock then break off when the cracks get bigger. Smaller and smaller pieces of rock form as the rocks break up more and more.

Visit
Rocks erode to form soil (video).
goo.gl/6Rd6D

This rock cracked and broke to form two smaller rocks.

2. Water breaks up the surface of rocks

In the soil, we can find a little water. The roots of plants can change this water so that the water becomes an acid. Vinegar has acid in it, and that is why vinegar tastes so sour.

6. Many shoes wear away the step, or many shoulders that rub against the object. Or paper that the pencil rubs on wears away the pencil.
7. Learners may not have the idea that small bits break off. Find out whether they really think this.
8. If they do think of small pieces breaking off, learners may believe the pieces no longer exist. Here we are dealing with conservation of matter, which is a mental operation the learners must develop.
9. Make a pile of the pieces and look carefully at them. They look like a pile of sand. You are changing the two rocks into sand!

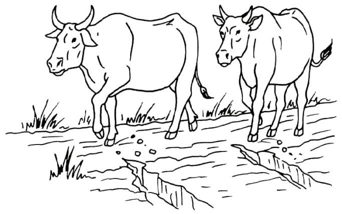
Acid can work on stones to break them up. The acid water breaks the surface of the stone and then the stone can break more easily.

Rain water can also break up and wear down the surface of stones, causing small pieces to break off. We saw an example of this with the water from the tap breaking up the cement.

Rain wears down rocks and causes smaller pieces to break off.

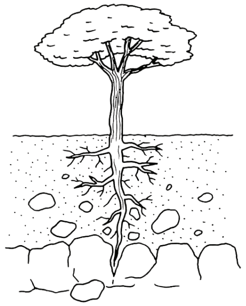
3. Stones rub together, and their surfaces break up

Stones rub together when water moves them, or when wind blows them against bigger stones. People and animals walking on a path kick stones and break off little pieces. Small stones become even smaller, and the small pieces become sand.



People and animals break stones into smaller stones when they walk over them.

The constant impact from heavy tractors driving through will break larger rocks up into smaller pieces.[4]



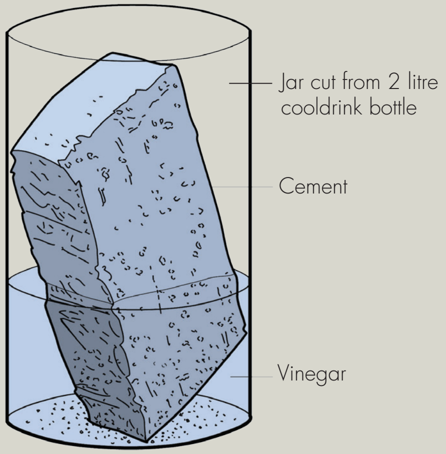
The roots of plants also cause stones in the soil to rub together and break up into smaller pieces.

In real soil this change takes many years. We can make it happen in the classroom in a week. Look at the diagram on page 241.

ACTIVITY 15.4: Make a model of acid water breaking up rocks

MATERIALS:

- Cement brick (not the shiny dark red or orange bricks)
- Large plastic container (bottom half of a plastic cooldrink bottle)
- Bottle of white vinegar



Vinegar acid is working in on the surface of the cement brick. Parts of the brick are falling off.

INSTRUCTIONS:

1. Put the cement brick into the container.
2. Pour enough of the vinegar into the plastic container to cover half of the brick.
3. Put the container in a place where everyone can observe it every day for two weeks.
4. Cover the container and make sure the mixture does not evaporate and leave the brick dry.

QUESTIONS:

1. Draw the brick as it looks on day 1.
2. Draw the brick as it looks on day 14.
3. What changes have happened to the brick?
4. Has the part of the brick that is above the vinegar changed in the same way as the part that is below the vinegar?
5. Have any parts of the brick fallen off and sunk to the bottom of the container?
6. Write out the sentences in your workbook and complete them with some of the words from the word box:

Answers to Activity 15.4:

4. The vinegar moves up the brick and reacts with substances in the brick. You may find white whiskers of a new substance that has formed from the reaction between the brick and the vinegar.
6. Represents . . . . represents the real

This equipment is a model of rock, not the real rock. The brick ________ a real rock and the vinegar ________ acid water around the roots of plants.

- represents
- represents the real

Making soil

Rocks break down and slowly change into sand. This change needs thousands of years to take place because soil, wind and water do it very slowly. But sand is not soil. More changes must happen to sand before it can be soil.

ACTIVITY 15.5: Look at different kinds of soil

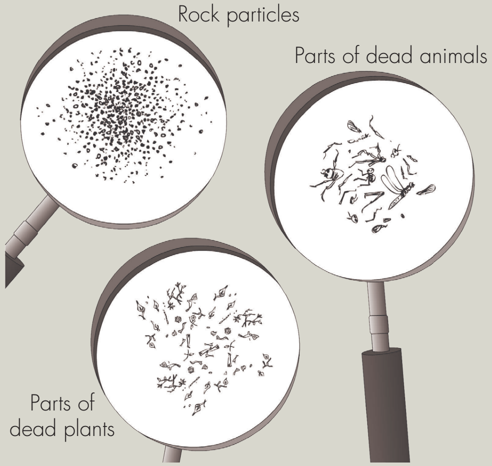
MATERIALS:

- Tin-can half full of moist topsoil (moist means it is not dry)
- Magnifying glass
- Sheet of white paper
- Toothpicks, matches or pieces of dried grass (for moving little pieces of soil)

INSTRUCTIONS

1. Smell the soil in the tin. Does it have a smell?
2. Put a teaspoonful of the topsoil on the white paper and spread it out.
3. Use your stick to move the small bits of soil that you find there. Look at the soil with the magnifier. Make piles of bits that look the same.
   - One pile will be rock grains. You will find very small pieces of rock and some pieces that are not so small. There will also be some grains that are almost too small to see.
   - Another pile will be small bits of plants. You will find very small pieces of sticks, leaves and roots.

- Another pile will be small bits of animals. You will find very small pieces of beetle shell or legs, or wings of flies.
- You may even find a small live animal! If you do find one, do a drawing of it on your paper and then let it go on the soil outside.



Look closely at the soil. What pieces do you find there?

QUESTIONS:

1. What colour is your soil? Use words like "dark brown", "grey" "orange" or "yellow".
2. Complete the sentence: Soil has sand but it also has ...
3. Draw some of the grains of rock (sand) that you find. Draw any small bits of plants or bits of dead animals that you see in the soil. Draw any small living animals that you find in the soil. Then let them go outside.

We can make soil in a few weeks, but only a small amount of soil. In this activity you begin the slow process of making soil. Your class perhaps started the compost column in the first week of the term.

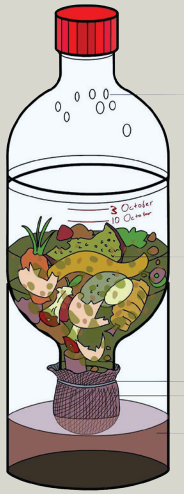
Answers to Activity 15.5:

2. Rock particles, organic matter such as pieces of plants and dead animals, etc.

ACTIVITY 15.6: Begin to make soil

MATERIALS:

- Three big cooldrink bottles
- Old stocking
- Strong rubber band
- Felt-tip pens that will write on plastic
- Big needle and scissors
- Tin can
- Scraps of vegetables and fruit, leftover porridge, cut grass (enough to fill a big bottle to the top)
- Cup of water



Cut and join the cooldrink bottles together.

INSTRUCTIONS:

1. Cut the plastic bottles and join them together.
2. Cut a piece of stocking to fit over the neck of the bottle that is upside down. The stocking will stop the vegetable peels falling through the hole, but it will let water go through.

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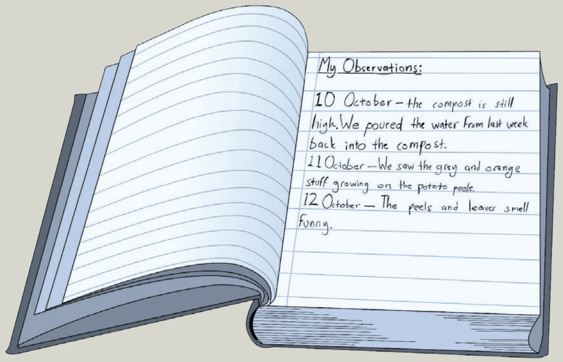
Teacher's note

The class should begin this activity on the first day of the 4th term, because it needs about 3 weeks to be complete.

3. Add the vegetable peels, old bread, and leaves.
4. Now slowly pour in the cup of water. Let the water go down through the stocking, into the bottom container.
5. Now use the needle to make air holes in the top bottle, as you see in the picture.
6. Mark the height of the compost column on the plastic. Write the date next to the mark.
7. Each Friday, mark the height of the compost column again, and write the date on the bottle.
8. Then take out the bottom container with the water in it, and pour the water into a tin.
9. Then, use the tin to pour all the water slowly back into the compost. This will stop the compost from drying out.
10. Begin a class logbook. A logbook is a book in which you write down what happens on a day. Look at the example below which shows Felicity's log book from when the Quantum Club did the experiment in their class.



This is what you may see in Felicity's logbook.

In the beginning, you might think the compost looks ugly, and is just a lot of rotting food and leaves. It might have a smell. But as the weeks go by, you will see changes in the colour and the size of the small pieces. You will also see some things begin to grow in the compost. The smell will change. You may also see insects appear from the compost.

QUESTIONS:

1. Did you notice any changes in the compost? Did you see anything begin to grow in the compost?
2. What happens to the colour of the water that you pour back in every week?
3. What do you think is in the water?
4. Why must you use the same water each week and not take fresh water?
5. Why does the compost column become lower as the days go by?
6. Where do you think the insects come from?

The grey hairy things that you see growing in the vegetable peels are fungi, and they help to break down the peels. There are many kinds of fungi and they have different colours.

When you see insects in the compost column, they may be fruit flies that can get in through the air holes, but they may also be hatching from eggs that insects laid in the peels and leaves before you put them into the plastic bottles. Do you remember in the first term when we observed the life cycle of fruit flies in Life and Living?

After about four weeks, your compost will be a dark colour and the big pieces will have broken down into small pieces. You can pour out the compost and mix an equal amount of sand with the compost. Now you have made a little soil!

Microorganisms in the soil

When you looked at soil, you found sand grains, small bits of plants and small bits of animals. But there was another group of things you could not see, because they are too small. They are microorganisms. They are alive and they are busy in the soil, changing dead plant and animal material into substances that plants can use and absorb through their roots.

If we work hard, we can make a small amount of good topsoil in a term. But a farmer needs good topsoil all over the farm. Nature works all over the Earth but it works very

Answers to Activity 15.6:

1. Dependent on activity – possibly fungi.
2. It should get darker and more “muddy” in colour.
3. Possibly fine bits of broken down organic material from the plants and other matter.
4. This is so that you do not lose the nutrients from that water, because if you use fresh water, then you are washing out and losing the fine bits that have been broken up and beginning to form in the compost.
5. As the days go by, the organic matter is broken down into smaller particles which can pack closer together and take up less space. So the compost column decreases in height.
6. Possibly from eggs/larvae that were present on the organic matter before putting it into the compost column.

Teacher’s note

Real soil is more complex than this mixture, and the living things in the soil make substances that bind the grains of sand together, or break down the grains into smaller pieces. But for Grade 5, it is enough to help the learners understand that soil is not just sand.

Teacher’s note

When introducing microogranisms, start off with a discussion about them and ask learners whether they think microorganisms are living or not.

slowly. Nature needs about 1 000 years to make topsoil just 10 cm deep. If rain washes away the topsoil, the farmer cannot grow good crops on that land. Look at the photo below.

The topsoil has gone from this land, and the farmer can never grow food here again.[5]

Even if the farmer stops the erosion, it will be about 1 000 years before nature can make new topsoil to replace the soil that has gone.

If there is too little topsoil, then there will be too few plants for animals to eat. So all animals depend on the topsoil, even animals like lions that only eat meat.

QUESTIONS

We can say that lions depend on topsoil for their food, although they do not eat topsoil. Why do lions depend on the topsoil for their food? Explain your answer.
Hint: Think back to what you learned in the first term in Life and Living about food chains.

This section is for enrichment only.

The mantle and the core lie under the crust

If we go deeper than the crust, we go into rock called the mantle. The mantle is the layer that lies underneath the crust. Mantle rock is much hotter than the rock that is found in the crust. The rocks are so hot that they are soft

QUESTIONS

We can say that lions depend on topsoil for their food, although they do not eat topsoil. Why do lions depend on the topsoil for their food? Explain your answer.
Hint: Think back to what you learned in the first term in Life and Living about food chains.

Lions eat other animals, such as impala, zebra, giraffe, etc. these animals are herbivores which eat grass and other plants. The plants that these animals eat need topsoil to grow in. So the lions are indirectly dependent on topsoil by their feeding relationships.

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in some places, like toothpaste. If there is a weak spot in the crust, the hot rock pushes upwards and it might burst out. This is how volcanoes happen. The mantle is 2 900 km thick, so we still have a long way to go down.

QUESTIONS

Find the mantle in the diagram of the Earth cut open on page 232. How could you get to the mantle? Which way do you have to go?

The core is still deeper than the mantle. It is very hot, as hot as the surface of the sun, and made of mostly iron.

ACTIVITY 15.7: So what is under our feet?
(For enrichment only)

INSTRUCTIONS:

1. In Activity 15.1 at the beginning of this chapter you drew pictures of yourself digging a hole into the Earth. You had to imagine you were making the hole as deep as a hole can be.
2. Perhaps you feel your picture is correct, or perhaps you want to change your idea about the Earth.
3. Look at that picture now, and do the activity again.

QUESTIONS:

1. If you could make a hole into the Earth, through the floor of your classroom, what would you find down in the Earth?
2. Imagine you have that machine that can dig as deep as you want. You drive this digging machine as far as it can go. What do you find?
3. Do you think the same as you did, when you began this chapter? Have you changed your ideas about the Earth?
4. Use the classroom globe to answer this question: If you dug a hole straight down into the Earth from South Africa, and went through the core of the Earth, where would the hole come out? Draw a picture in your exercise book.

QUESTIONS

Find the mantle in the diagram of the Earth cut open on page 232. How could you get to the mantle? Which way do you have to go?

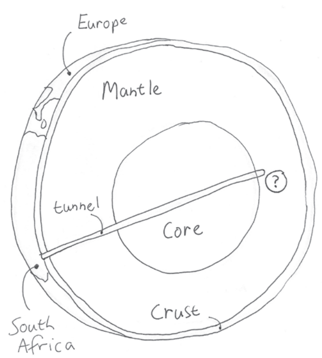
You would have to dig a very deep hole down into the centre of the Earth.

Teacher's note

Iron melts at those temperatures, but the iron is being pressed so tightly by the mantle all around it that it cannot melt.

Answers to Activity 15.7:

2. The hole will come to of the other side of the Earth.
4. In the Pacific Ocean, near Hawaii, about 26 degree north of the equator, and about 150 degrees west of the Greenwich meridian. Check this for yourself on your globe. Let the learners work with the globe until they solve this for themselves. However, they are not allowed to poke a pencil into the globe!



An example of the drawing learners should draw.

This is what the hole would look like. Let the learners draw their own ideas before you draw this on the board.

15.2 Soil types

Have you ever noticed how many different colours of soil and textures of soil there are? Even if you are just walking around your school grounds, you may come across many different types of soil.

This is because there are different particles that make up soil. These particles can vary in amounts and therefore make up different types of soils.

Some particles are bigger, others are smaller and some are in between. A soil sample normally has a lot of particles either bigger, smaller or in between, and a smaller portion of the other sizes.

New words

- sample
- clay
- loam
- silt
- funnel
- hypothesis

Soil particles – Sand, silt and clay

There are three main types of particles which make up soil:

- Clay
- Silt
- Sand

If the soil was formed from a very hard rock, then it has bigger particles, if it was formed from a soft rock then the particles will be smaller.

INVESTIGATION 15.1: Different amounts of sand, silt and clay

AIM:

To find out how much sand, silt and clay there is in soil from two different places.

PREDICTION (What you think you will find out):

The soil from __________ will have more __________, and the soil from __________ will have more __________.

NatSci&Tech_Gr5_TG_Book.indb 245 2018/05/18 12:29:38 PM

MATERIALS AND APPARATUS:

- Soil from two different places, such as near the top of a slope or hill and near the bottom. Or take soil from under a tree and other soil in an area with wild grass. The soils should look different.
- Sheets of newspaper to keep the desks clean
- Two large see-through jars the same size.

INSTRUCTIONS:

1. Collect two tins of soil from the places you chose. These are samples of each kind of soil. (A sample is a little bit to study.)
2. Feel the two samples in your hand. How do they feel different? Do they smell different?
3. Spread a teaspoonful on the white paper and look at each – in what ways do they look different?
4. Then put your soil samples into the glass jars. Pour in water to make the jar almost full, cover the top and shake each jar to mix the soil and water.
5. Now leave the two jars to stand until tomorrow. The water must not move.
6. In the morning you will see something like in the picture on page 251. In each jar, the water has let the large grains settle at the bottom, the very small grains are on top, and the clay grains are so small they are still mixed with the water. You may see some plant parts floating on the water.
7. Your two jars will show different layers. In one jar, you might see a lot of sand, and in the other jar you might see less sand.

OBSERVATIONS:

Draw the two jars showing the layers in your two sand samples. Give your drawings labels and a heading.

How could you do this investigation better?

CONCLUSION (What you learnt):

The difference between our two soil samples is that ...

Teacher's note

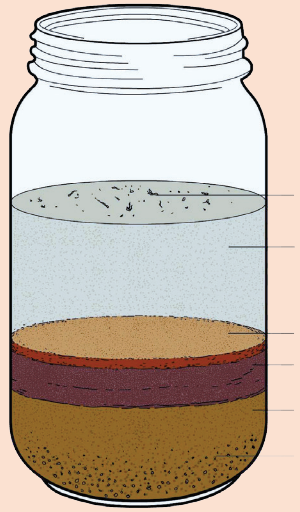
(Instruction 2) Ask for oral answers, no written answers.

Teacher's note

(Instruction 3) Ask learners for oral answers. Make sure you get answers from different learners and it is not just the same learners each time.

How could you do this investigation better?

Learner's own answers. They should think critically about the process, the collection of data and the measuring of results. Then they should make suggestions on how to improve on the investigation.



You will have two jars like this. The parts of your soil will settle in layers.

You will see that your soil has some grains that are grains of sand, some grains that are smaller and some that are so small you can't see them.

- Sand, which feels rough and grainy between your fingers.
- Silt has much smaller grains but you can still feel that the silt is a bit rough.
- Clay has such small grains that when you rub it between your fingers it feels like paint. In fact you can paint with it. When clay dries, it becomes hard.

QUESTIONS

Can you make pots with sand? What kind of soil is good for making pots?

QUESTIONS

Can you make pots with sand? What kind of soil is good for making pots?

Sand is not good for making pots. To make pots, we use clay.

Soil types – Sand, clay and loam

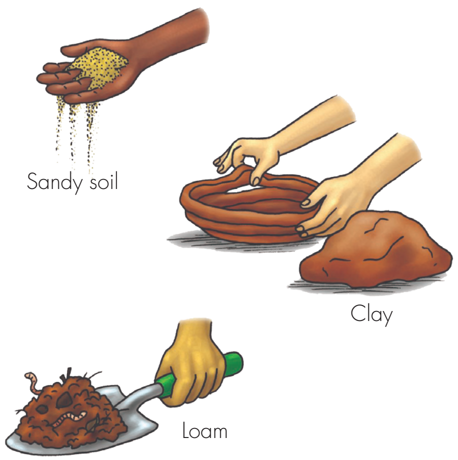
As we saw previously, different soil samples collected from different places have different size particles. Imagine running along the beach and feeling the sand beneath your feet. Now imagine running through a forest over the soil. Can you see there are big differences in these types of soil?

The mixture of particles and the size of particles determines the soil type. There are three different types of soils:

- Clay
- Loam
- Sand

Let's look at the characteristics of the soil types.

Sandy soil is the soil you find at the beach. It consists of large gritty particles and very tiny bits of rock, which we call grains of sand. The grains of sand are coarse and the soil is loose. Sandy soil does not retain water.



The types of soil

Other characteristics of sandy soil are: it does not retain fertilisers. It is easily washed or blown away. It becomes warm quickly on a sunny day. Plants do not grow well in sandy soil.

Sandy soil has lots of coarse grains of sand.[6]

QUESTIONS

Why do you think plants do not grow well in sandy soil?

Have you ever made a pot out of **clay**? If you are lucky enough to have done this or seen someone do it, you will know a bit about the properties of clay.

Clay can be moulded. This is because it consists mainly of very fine particles, which cling together. Clay gets sticky when wet. It retains fertilisers for a very long time. It is difficult for clay to be blown away or washed away. It does not become as warm as sandy soil.

Clay soil consists of lots of very fine grains of clay and can be moulded into pots.

QUESTIONS

Why do you think plants do not grow well in sandy soil?

Sandy soil does not have any nutrients. It is easily blown away so plants can not form roots or roots become exposed. Sandy soil does not retain water.

QUESTIONS

Do you think plants will be able to grow in clay?

Loam is a very funny word! But this is also a type of soil. Loam is actually a mixture of clay, sand and humus. Humus is organic material from plants and animals, which is decomposing.

Loam is fairly loose and fertile. It retains fertilisers longer than sandy soil. It is not easily blown or washed away. It is much cooler than either sand or clay soil. Loam soil is the best type of soil for plants to grow in!

Visit

Interesting website about soil types.
goo.gl/QMnsG

Loam soil is rich with humus.[7]

QUESTIONS

What are the differences between loam and sandy soil? Name three things that you find in loam but you do not find in sand.

Each soil type also has air and water in it, and sometimes the remains of dead organisms and very small living organisms.

How do some plants live when no rain falls?

We do know that many plants can live through the dry season, even though no rain falls for eight months. How do they do it?

QUESTIONS

Do you think plants will be able to grow in clay?

No, not if the soil only consists of clay. This is because the clay can become waterlogged and it could pack too tightly around the roots.

QUESTIONS

What are the differences between loam and sand soil? Name three things that you find in loam but you do not find in sand.

Plant material, animal material, living organisms (microorganisms).

Answers:

	Sand	Loam
1	Does not hold water	Holds water
2	Sand particles big	Loam mixed with humus and small particles.
3		

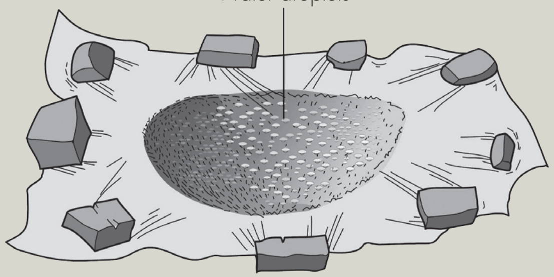
ACTIVITY 15.8: Look at how soil holds water

MATERIALS:

- Spade
- Large sheet of clear plastic
- Few bricks or rocks

INSTRUCTIONS:

1. Look at the picture below.
2. Dig a hole in the soil outside, like this.
3. Cover the hole with a sheet of clear plastic and hold it down with some bricks or rocks.
4. After a short time, you will see drops of water on the plastic.



Dig a hole in the soil, and cover it with a clear plastic sheet.

QUESTIONS:

1. Are the drops on the top or the bottom of the plastic?
2. Where is the water coming from?
3. How did the water get into the soil?
4. Some plants can live even when no rain falls. How do they live?

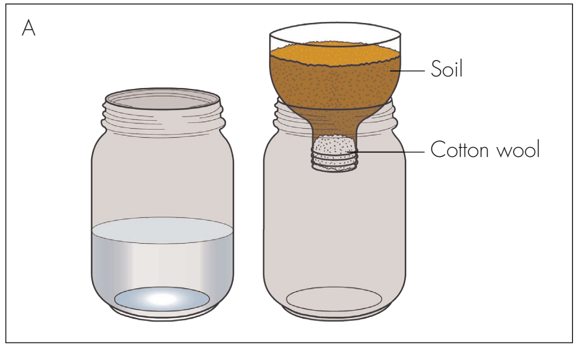
Farmers know that soils are not all the same. They know that some soils hold water well, and other soils do not hold water well.

Answers to Activity 15.8:

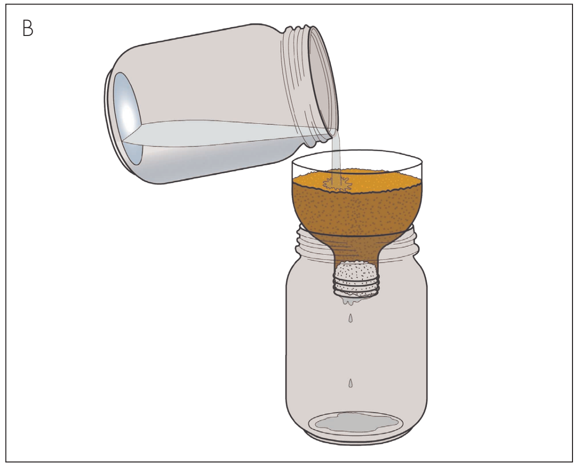
1. On the bottom, near the soil
2. From the soil
3. From the rain
4. There roots can absorb water in the soil some plants have roots that do this very, so they can live in dry places.

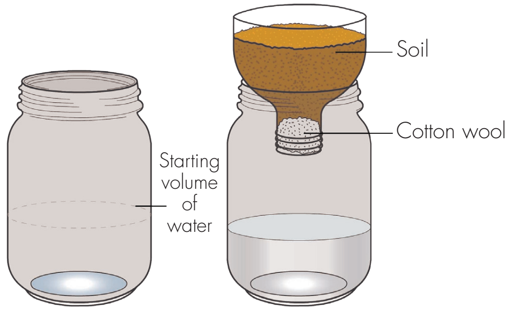
An easy way to see how well soil holds water is to pour some water into soil and let it run through into a bottle. Look at the first picture below. These two bottles are the same size. In the next picture, the water is poured into the jar with the soil in it. Look at the last picture on page 257. Has all the water run through the soil?

Put the soil in a funnel, like this. Use two jars of the same size. One with water and one with soil.



In the next picture the water is poured into the jar with soil. Slowly pour the water onto the soil and wait five minutes.





Has all the water run through the soil?

Let us do an investigation to see how much water the different soil types can hold. For this investigation activity you need two different kinds of soil, from two different places. Let us call them Soil A and Soil B.

Plan an investigation to compare two types of soil named as Soil A and Soil B, and then do the investigation. The main question you must answer is: Which soil holds more water?

INVESTIGATION 15.2: Which soil holds more water?

MATERIALS AND APPARATUS:
- Soil sample A and B
- 4 bottles
- Two funnels

PROCEDURE:
1. Transfer the same amount of soil (sample A and B) to the funnels. See the figure below:
2. Do not fill the funnel with soil.
3. Pour equal amount of water in each and observe.

What will you do to make sure you are being fair?

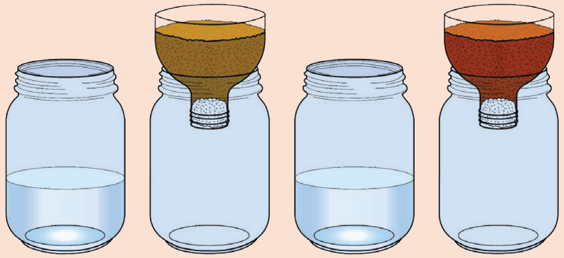
Teacher's note

Try and get soils of different soil types – ie. sand, clay and loam soil. For the following investigation, the learners will have to plan some of it themselves and will not be told step-by step what to do. If you want to, you can make the investigation include all three different soil types if you manage to get samples from each, and then you will have Soil A, B and C.

When you compare things, you must be fair. For example, if we want to compare runners in Grade 5 athletics, we must let them run on the same track. It is not fair if we let some of them run through bushes but the others can run on a smooth track! We must treat all the runners in the same way, to be fair when we compare them.

Teacher's note

The learners should realise that the amount of water and the amount of soil in each case should be the same to make it a fair test.



Set up the soils in two funnels like this.

AIM: What do you want to find out?

PREDICTION: What do you think will happen?

MATERIALS AND APPARATUS:

Look at the pictures above to help you write a list in your exercise book.

METHOD:

Write out the instructions for how to carry out this investigation. Remember to number the steps.

RESULTS AND OBSERVATIONS:

1. What did you observe when doing this experiment?
2. Draw a bar graph to show your results from this experiment. Remember to label the axes of your graph and give it a heading.
3. How could you do this investigation better?

CONCLUSION:

Write a sentence where you give a conclusion about what you learnt from this investigation. See if you can identify what types of soil A and B were.

Teacher's note

A bar graph is used as we are comparing two different things (soil A and B) and they are not related to each other. The "Soil type" will go on the x-axis and the "Amount of water held by soil" will go on the y-axis, probably measured in millilitres.

CONCLUSION:

For example, I learned that the soil from the bottom of the hill holds more water than the soil from the top of the hill. Also ask learners to identify what type of soil they think Soil A and B.

Sandy soil does not hold much water. Clay soil holds too much water. Clay holds water because it has very small grains. The grains fit together tightly. Loam soil has a mixture of sand and clay, along with composted plant and animal substances. So, loam soil holds water well but does not become waterlogged like clay soil.

QUESTIONS

Why does sand let the water run through quickly?

Which soil type do plants grow best in?

Now that we have looked at how different soil types hold different amounts of water, let's compare how well plants grow in the different soil types. In Life and Living, you might have grown seedlings before, but let's try again and this time focus on the type of soil.

INVESTIGATION 15.3: Compare how well plants grow in different kinds of soil

AIM: What do you want to find out?

PREDICTION: What do you think will happen?

MATERIALS AND APPARATUS:

- Three large jam tins
- Packet of radish seeds or bean seeds or maize seeds
- Some sand, enough to fill one tin
- Some loam soil, enough to fill a tin (You can find loam soil in a vegetable garden.)
- Some clay soil, enough to fill the last tin (if you have access to clay soil)
- Ruler
- Measuring cup
- Tablespoon

QUESTIONS

Why does sand let the water run through quickly?

You are asking the children to make a hypothesis based on the information about the size of the grains. Sand grains are much larger than clay grains, and so they don't fit together so tightly and so there is more space for the water to run through.

Teacher's note

We use radish seeds because they germinate very quickly. Also, they are so small that they soon need substances from the soil to continue growing. In the tin with sand, they will not get those substances and they will soon begin to die. In the loam soil, your learners may get several good radishes. A radish is a root vegetable that has a sharp hot taste. If you cannot find clay soil, then just do the investigation using sand and loam soil which are easier to obtain.

METHOD:

1. Make five small holes in the bottom of each tin, so that water can drain out if there is too much water in the tin.
2. Fill one tin with sand, one tin with the loam soil, and the last tin with clay soil.
3. Plant ten radish seeds in each tin. Cover the seeds by sprinkling a little of the sand or soil over them.
4. Pour a cup of water into each tin. Remember to keep the amount of water constant to make it a fair test.
5. Now let the seeds begin to grow, perhaps on the windowsill in the classroom to make sure that they have a light source.
6. Each day, give each tin a tablespoon of water.
7. Observe the radish seeds growing for a week, and compare them.
8. Measure the height of the radish plants growing in each type of soil. Calculate the average seedling height for each soil type.
9. Record your results in a table.

RESULTS AND OBSERVATIONS:

1. Use your exercise books to draw a table to record your results from measuring the height of the seedlings each day. Give your table a heading.

   Average height grown by seedlings in different soil types:

Date	Loam soil (mm)	Sandy soil (mm)	Clay soil (mm)

2. Now draw graphs to compare your results. A table is one way of presenting results, but a graph gives a visual representation, which is sometimes easier to quickly understand and compare the results from an experiment.
   a. First draw a bar graph to show the change in average height of the seedlings grown in loam soil over time.

Teacher's note

To calculate the average height, learners must measure the height of each seedling for a soil type, add all the heights together and the divide by the number of seedlings that have grown for that soil type. they must do this for each soil type.

Teacher's note

Learners may need help with this. Perhaps draw a table on the board like the one given here.

Average height grown by seedlings in different soil types:

Date	Loam soil (mm)	Sandy soil (mm)	Clay soil (mm)

Teacher's note

A line graph is used as we are showing the change over time of one thing. The input, independent variable is the day and this goes on the x-axis. The output, dependent variable is the average height grown and this goes on the y-axis.

b. Next, draw a bar graph to compare the average height of the seedlings on the last day of your investigation for each soil type used.

3. How could you do this investigation better?

CONCLUSION:

Write a conclusion for this investigation. Remember, in a conclusion you must answer the question which you set out to investigate at the start.

KEY CONCEPTS

- The rocks on the surface of the Earth form a crust that covers the whole planet.
- The continents are part of the crust, and the bottom of the oceans are part of the crust too.
- Rocks break up into small grains.
- The remains of living things mix with the grains and together they form soil.
- Three types of soil are sandy soil, clay soil and loam soil.

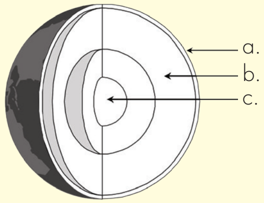
Teacher's note

As with the previous bar graph, a bar graph must be drawn as there are 3 different things being tested which are not related to each other (the different soil types). Soil type goes on the x-axis and Height grown goes on the y-axis, in centimetres or millimetres.

REVISION

Answer all the questions on the answer book.

1. Label the layers of Earth on the diagram:

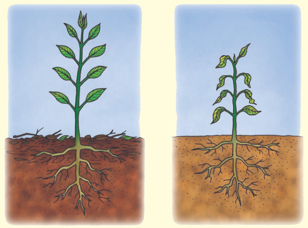


2. What is the crust of Earth made of?

   Use some words from the word box to complete the sentences in questions 3 – 6. Write out the whole sentence each time:

sand, clay, silt, photosynthesis, animals, topsoil, subsoil, food, loam

3. The weathered rock becomes part of the soil. The big and small grains of rock mix with parts of dead plants and ________. This mixture is called topsoil. ________ can hold water that plants need.
4. Loam soil is topsoil. It has a good mixture of ________, ________ and ________ soil. ________ holds enough water for most plants, not too much and not too little.
5. Plants need the nutrients in topsoil to make food by the process of ________. Plants are food for most animals. Some of these animals are food for meat-eating animals. So without ________ there will be no plants and no animals.
6. We have to stop top-soil washing away when it rains because we need ________ to grow ________.
7. What is humus and where would you find it?
8. Look at the picture below of two different plants growing. Why do you think the one plant is healthier than the other plant? Explain your answer.



REVISION

1. a. crust
   b. mantle
   c. core
2. Rock and soil
3. Animals, topsoil
4. Sand, silt and clay, loam
5. Photosynthesis, topsoil
6. Topsoil, food
7. Humus is the remains of dead organisms (plants and animals) that have started to decay. It is found in the topsoil, particularly in loam soil.
8. The difference is to do with the type of soil that each plant is growing in. The plant on the left is growing in rich loam soil. It can therefore get nutrients from the soil and also water as loam soil has a high water holding capacity. The plant on the right is growing in poor sandy soil which does not have many nutrients. Sandy soil also cannot hold water well as it has coarse particles so the water just runs through. The plant therefore is not getting enough water and is wilting.

16 Sedimentary rock

KEY QUESTIONS

- Why does the Earth have mountains and valleys?
- Have mountains always looked like they look now?
- Why can you sometimes see layers in rock that are different colours? How did these layers form?

We saw in Chapter 15 that the surface of the Earth is made up of rocks and soil. There are different soil types, but did you know that there are also different types of rock? We classify rocks depending on how they were formed.

We are only going to look at sedimentary rock in this chapter, and find out how it is formed and used.

Visit
Different rock types (video)
goo.gl/yD3qd

16.1 Formation of sedimentary rock

In Chapter 15, we saw how rocks break up into smaller and smaller pieces, until we have grains of sand. Now we find out what happens to the sand.

First, rocks break up into smaller pieces, until the pieces are grains of sand. Next, wind and moving water carry the sand and mud away. Then, the wind or the water may drop the sand and mud in one place. Finally, the sand grains might get stuck together again over time and make **new rock**. This new rock is called sedimentary rock.

New words

- sedimentary rock
- sediment
- deposition
- limestone
- shale
- chalk
- sandstone
- new rock
- erosion

Erosion and deposition

When wind or water move the pieces away from the rock, we call this **erosion**. The wind and water erode the rock as they carry away the sand.

Teacher's note

Chapter 16 deals with one kind of rock – sedimentary rock. This does leave one wondering what other types of rock there are. The main other type of rock is igneous rock. That is rock that has been hot and molten, and pushed up from deep in the mantle. Mostly it hardens under the ground and we see it only millions of years later when erosion has removed the ground over it. Sometimes it breaks through the crust as molten lava, and we have a volcano. The top of the Drakensberg is the remains of a huge outpouring of lava long ago. Nature is always breaking down rock and eroding it, so mountains are always changing. They change so slowly that we cannot notice it in a person's lifetime, but the changes are happening all the time.

Formation of sedimentary rock

Sedimentary rocks are formed over a very long time in the following way:

- first, rocks break down into small grains
- then, mud and sand is moved by wind and water
- after that, mud and sand gets deposited in low lying areas
- over time, new layers of mud and sand are deposited on top of existing layers
- after a very long time, these layers become compacted and hardened and form sedimentary rock
- sedimentary rocks always have visible layers within the rock
- examples of sedimentary rock are shale, sandstone and limestone

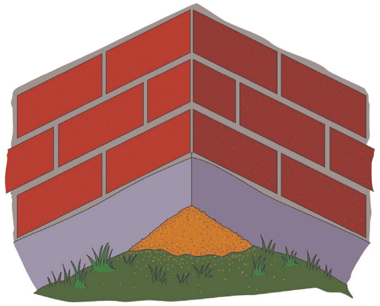
Uses of sedimentary rock

- limestone is used to make cement
- sandstone and shale are used in buildings

A large valley is forming due to soil erosion.[1]

Soil erosion due to water.[2]

When the wind and water put the sand grains down, we call this deposition. The wind and water deposit the sand.

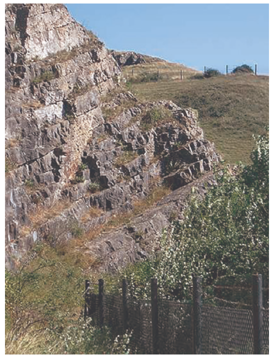


The wind is depositing sand in this corner of the school. Deposition is happening here.

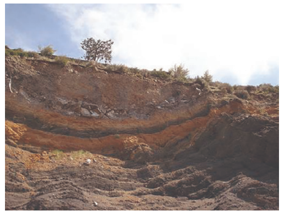
Sediments

When the sand grains collect on top of each other, they form a sediment. Over time, new layers of of mud and sand are deposited on the previous layers. Over a very long time, these sediments become compacted and hardened, and become sedimentary rock. This happens because the grains of sand become glued together, and other heavy sediments press down on the grains of sand. Sediments lie on top of each other. We can actually see these layers in sedimentary rock and they are sometimes different colours. Find the sediments in the following photos.

Sandstone rock in the Cederberg in the Western Cape.



Layers of limestone sedimentary rock.[5]



Can you see the different coloured layers in this sedimentary rock?[3]

Look at these layers in this sedimentary rock known as shale.[4]

Let's have a look at how sediments are deposited over time. Except, we do not have thousands of years so we are going to pretend each day of the week is actually about 1000 years!

ACTIVITY 16.1: Depositing sediments

MATERIALS:

- A large see-through jar (cooldrink bottle)
- Different places to collect sand and soil

INSTRUCTIONS:

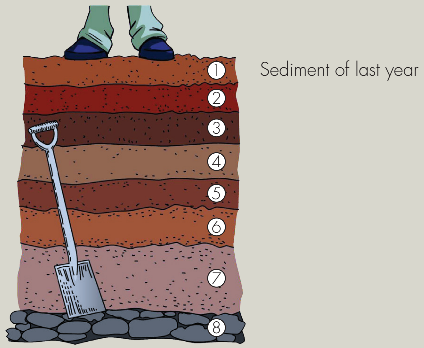
1. Work in groups. Put the jar in a place where everyone can see it.
2. Group 1 must collect a large jam-tin full of sand and on Monday they pour their sand into the jar.
3. Group 2 must collect sand or soil from a different place. On Tuesday, someone from Group 2 pours that sand into the jar.
4. On Wednesday, Group 3 pours in sand or soil from a different place.
5. By Friday, the jar will have different layers.

QUESTIONS:

1. Which sand sediment was put in on Tuesday?
2. Which is the oldest sediment?

ACTIVITY 16.2: Which sediment is the oldest?

People who dig holes in the riverbed to access underground water sometimes see the sand sediments. The Quantum Club decided to dig a hole down in the river bed just outside their school. Look at the picture below where you can see Felicity's feet standing on the top and the layers of sediment going down below.



This is what you might see if you dig down in a riverbed.

Teacher's note

For this activity, divide the class up into 5 groups – one for each day of the school week (Monday to Friday). Each group must collect sand or soil from a different place so that the different layers are evident by the end of the week. At the beginning of each lesson for the week, you can ask the group for that day to pour their sediment in and then carry on with the rest of the lesson. By the end of the week you can look at the layers of sediment that each group added. Explain to the learners that you are speeding up the process.

Answers to Activity 16.1:

1. The sediment second from the bottom
2. The bottom sediment.

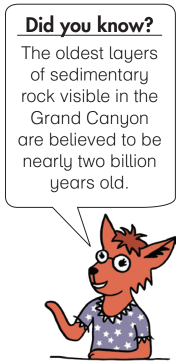
The river is dry now, but last year the river deposited a sediment. This river deposits a sediment every year when the rains come.

QUESTIONS:

1. Find the sediment of sand that washed down last year. Read the number next to it.
2. Find the sediment that washed down the year before last year. Read the number next to it.
3. On the picture, complete the label, sediment of last year, 20___.
4. On the picture, where must you write the sediment of the year before Question 3?
5. Next to sediment 5, write I was ___ years old when the river brought this sediment.
6. In sediment 4, imagine we find the bones of a bird.
   a. How could a bird get into this sediment?
   b. Write a short story about the bird.
   c. Explain why we find its bones under four sediments of sand.
   d. Work out in what year the bird fell into the mud.
7. What will you find if you dig deeper than sediment 8?

Look at the photo below of the Grand Canyon – can you see old sedimentary rock? Look at the sediments of rock. The rock is very hard now. It has been compressed for millions of years.

Look at the layers of the sedimentary rock in the Grand Canyon.[6, 7]



Teacher's note

Sediment 5 was deposited in 2008. Let the learners count backward to 2008 and work out how old they were.

Answers to Activity 16.2:

1. Number 1
2. Number 2
3. The previous year's number at number 1
4. At number 2
5. The person's age minus 4 years
6. a. A bird would have ended up in the river (maybe it was already dead, maybe it drowned). The bird's carcass would have sunk down to the riverbed. The sand and soil that the river washes down in the new flood season, will eventually cover the bird completely.
   b. Learner's own writing
   c. It is because the bird fell into the river four flood seasons ago (i.e. four years ago).
   d. The number of the year four years previous to the current year. If the current year is 2022, the answer is 2018.
7. Rock. The deep layer of rock is called the bedrock.

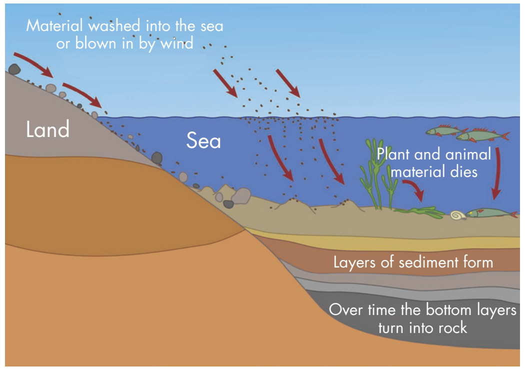
QUESTIONS

Show with your finger which sediment of rock is the oldest. Show where you can find soil, in the picture.

Sedimentary rocks are also eroded and broken down into grains of sand again.

The sedimentary rock in the Grand Canyon formed a very long time ago. The layers of sediment were once deposited in warm shallow seas and over millions of years they compacted to form rock. The wind and rain have eroded it until it looks like it does in the photo.

Look at the diagram below which summarises how sedimentary rock is formed, mostly under the sea or in lakes and rivers.



The formation of sedimentary rock

QUESTIONS

Use the diagram above to write a summary paragraph explaining how sedimentary rock is formed.

QUESTIONS

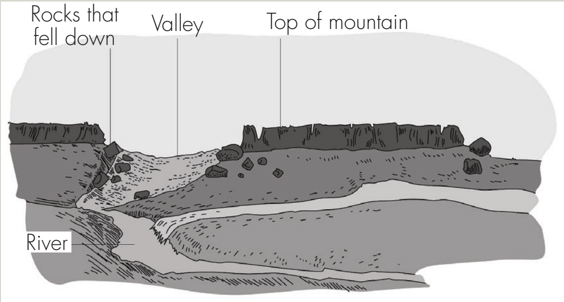
Show with your finger which sediment of rock is the oldest. Show where you can find soil, in the picture.

The lowest sediment/layer of rock they can see in the photo. Above the top most sediment, where the plants grow.

ACTIVITY 16.3: Rebuild the mountain the way it was

INSTRUCTIONS:

1. Look at the diagram below, which shows a mountain being eroded.
2. The mountain did not always look like this.
3. Answer the questions below.



This is how the mountain looks now.
What did the mountain look like millions of years ago?

QUESTIONS:

1. The rock and sand are being removed from the mountains. How does this happen?
2. Where does the rock and sand go?
3. Draw a diagram to show how the mountain might have looked many years ago, before the rock and sand were eroded.

Different kinds of sedimentary rock

There are many kinds of sedimentary rock. Here are three kinds:

1. **Sandstone** is made from grains of sand that are cemented together.
2. **Shale** is made from grains of clay that are cemented together. Shale is quite soft and you can use it to write with, like a piece of chalk.

Did you know?

Chalk is a soft, white form of limestone.

Answers to Activity 16.3:

1. This is due to erosion rain water and the wind over many millions of year.
2. It is washed down the mountain in the river and deposited on the banks lower down or in the sea.
3. Learners should draw a higher mountain without valleys and rocks crumbling away and falling down.

3. **Limestone** is made of layers of shells of sea animals that died and sank to the bottom of the sea. Other kinds of limestone are made from sea water evaporating.

16.2 Uses of sedimentary rock

You just saw that there are different types of sedimentary rocks. These rock types are used in different ways.

Limestone

Limestone is a very common sedimentary rock and it has many uses, mostly as building materials.

Limestone is cut into blocks and used in buildings. Look at these photos below of different buildings made from limestone.

Can you see the blocks of limestone in this building?[8]

The city hall in Cape Town is built with limestone.

Limestone is crushed and used to make cement. Limestone is often used in sculptures, as it can be carved easily.

A sculpture made from limestone.[9]

Glass is made from molten sand, and limestone is mixed with the sand to make the glass stronger. Farmers use limestone to improve their soil, if the soil is too acidic.

Limestone is even used in some medicines and cosmetics, and as a white pigment in toothpaste, paints and plastics.

Sandstone

Sandstone has been a popular building material since ancient times, especially in houses and cathedrals around the world. This is because it is quite soft and easy to carve. Houses in Lesotho and the Free State were built from sandstone blocks.

The Union Buildings in Tshwane is an example of sandstone structures.

Sandstone comes in many different colours and so it is often used decoratively, such as in decorative stones, in fireplaces, in decorative columns and pillars in buildings and cathedrals, and to make statues and fountains. Since sandstone is easy to carve, but does not weather, it is often used as paving stones and to make walkways.

Decorative columns made from sandstone in India.[10]

Decorative carvings and columns made from sandstone on a building.[11]

Paving blocks made from sandstone[12]

Shale

Shale is also used in buildings, especially as a raw material to make bricks. Shale also splits very easily into thin sheets, and is therefore used as tiles for floors and roofs. Shale is used for floors in some houses in South Africa.

Shale splits easily into thin tiles which can be used in flooring and roofs.[13]

Cement is also made from shale. The shale is crushed to a powder and heated in a kiln (a kind of stove). Black shale rock is also a very important source of oil and natural gas all over the world.

KEY CONCEPTS

- Sedimentary rocks form when small grains of rock, mud and sand form layers and become compacted over a very long time.
- Rock breaks into small grains through the process called weathering.
- Sedimentary rock can be identified as it has visible separate layers.
- Examples of sedimentary rock are shale, sandstone and limestone.
- Sedimentary rocks have different uses.

REVISION

Complete the following sentences using words from the word box. Write the sentences out in full.

• grains	• sandstone
• wind	• limestone
• water	• shale
• sediment	• weathering

1. ______________ breaks grains of rock off of big rocks. ______________ and ______________ move these grains and deposit them on top of each other in layers. A layer of rock grains is called a ______________.
2. Over many years, the ______________ became stuck together and we get sedimentary rock. Three types of sedimentary rock are, ______________, ______________ and ______________.
3. Explain how you would identify sedimentary rock in the natural world around you.
4. Explain the difference between erosion and deposition. Provide a drawing to accompany your answer.
5. Draw a series of diagrams to show how a rock is broken down into smaller grains over time. Label your diagrams to explain the processes that are taking place to break down the rock.

Now comes the section I am most excited about – learning about fossils and how they formed. Let's get started!

REVISION

1. Wind, water, sediment
2. Grains, sandstone, limestone, shale
3. Sedimentary rock has visible layers which are often different colours, so look for rock which has these layers in it.
4. Erosion is when something, normally rock, is gradually worn away over time by wind, water or other animals. Deposition is when wind or water carries sand along and then drops it (deposits) in another place where it also gradually builds up over time.
5. Learners drawings will vary, but there should be more than one drawing. The first drawing should show a big rock, then subsequent drawings should show smaller and smaller rocks, until there are coarse grains. Labels to include could be Erosion due to wind, Erosion due to water, Weathering due to wind and water, Weathering due to impact from animals.

17 Fossils

KEY QUESTIONS

- What are fossils?
- Why were the animals long ago different to animals we can see today?
- How do fossils form in rocks?
- Why are fossils so important?
- What is the Cradle of Humankind in South Africa? Why is it a World Heritage site?

17.1 Fossils in rock

These old photographs below are of fossil hunters. These people are splitting open pieces of shale. They are looking for fossils in the rock. The layers of shale split apart and the shape of a leaf or an animal can be seen in the rock. The shape we see is called a fossil.

New words

- fossil
- evidence
- preserve
- ice age

All over the world, people find fossils of leaves and bones in the layers of sedimentary rock. These leaves and bones came from plants and animals that lived millions of years ago. They were not like the plants and animals we see today.

Did you know?

A paleontologist is a scientist who studies prehistoric life, mostly by looking at fossils.

Teacher's note

Chapter 17 deals with fossils – the shapes that are left in the rock when a plant or animal has died there and been covered with mud, or else body fossils where the remains have been preserved over time. This chapter also deals with the importance of fossils and is a good chance to highlight the significant role that Africa and particularly South Africa has played in documenting life's history on Earth, and the important fossils which have been found in South Africa. If you are based in Gauteng, it is a wonderful opportunity to go on a school tour to the Cradle of Humankind at Maropeng and visit the museum which delights children and adults with its interactive display.

Fossils are rock shapes of dead plants and animals

A fossil is not the real leaf or bone you see; the rock has kept the shape of the leaf or the bone. This rock shape is called a fossil.

Below you can see a photo of a fossil of the head of a dinosaur, and the next image shows you what scientists think this dinosaur looked like.

The fossil shape of the head of Massospondylus, a dinosaur that lived in the eastern Free State about 200 million years ago.[1]

Paleontologists think that Massospondylus looked like this.[2]

This fossil of the dinosaur's head is not the actual bones, but it is actually now a rock in the shape of the dinosaurs bones. Over millions of years, the bones turned into rock. So, a fossil is the remains of an ancient plant or animal which has been preserved in a rock. Most of the organisms that paleontologists study are now extinct. This means that they are no longer alive today.

Why are fossils so important?

The Earth's past is fascinating to us! Imagine being around when all the dinosaurs were walking on Earth. As humans, we want to find out about Life's History on Earth.

In recent history, we have books written to record what happened. We can look up in a book and read what someone who lived long ago wrote about that time period. But no human was around millions of years ago to record what happened then.

So we have to use other ways to find out about what life was like on Earth millions of years ago. To do this, scientists use fossils. Fossils are actually our most valuable source of information about the ancient past.

What can fossils tell us about life long ago? Fossils tell us about the organisms that lived long ago. Imagine the first scientists that discovered a dinosaur's bones. These bones are much bigger than the bones of any other animal on Earth today. This immediately told the scientists that the animals from the past were really big!

Tyrannosaurus rex's name means 'tyrant lizard king' and it was an enormous predator.

Fossils can tell us much more than just which organisms lived millions of years ago. By studying fossils of plants and animals, scientists can also work out information on how these organisms grew, what they ate, the environment they lived in, and even some aspects of their behaviour and how they interacted.

For example, studying fossilised feaces of an animal can give evidence about what an animal used to eat.

By working out which plants used to grow during a particular time period in Earth's history, scientists can work out what the climate was like during that time. We now know when there were ice ages where the whole Earth was covered in ice for thousands of years, and when it was warmer and there were droughts.

This may just look like a colourful rock, but it is actually fossilised wood. It was created millions of years ago when a forest was buried under mud.[3]

This is a fossilised tree trunk. It is not wood anymore, but has turned to stone over millions of years. Can you see the rings?[4]

Did you know?

Ferns are actually prehistoric plants! Ferns are some of the oldest surviving organisms on Earth as they were around when dinosaurs walked on our planet.

This is a fossilised fern.[5]

A fossilised footprint can tell lots of things about a prehistoric animal, such as how much it weighed, how big it was, and even at what speed it could run.

Can you see the dinosaur tracks?[6]

The layers of rock that are lower down will be the oldest as they were deposited first. So the fossils in these layers will be from earlier times than fossils in rock layers which are closer to the surface.

How did the bodies of animals and plants get into the rock?

Have you perhaps seen the body of a dead bird? Dogs, flies, ants and beetles all take away the parts of the body. The wind blows away the feathers and soon there is nothing left to see.

But sometimes it does not happen like that. Imagine an animal died near a river. There was a flood and the river quickly covered the body with sand. In years after that, more floods brought more sand and put it on top. The heavy sand pressed down on the bottom sediments. Slowly, the bottom sediments became sedimentary rock.

Let's try to make our own model to understand how fossils are formed in sedimentary rock.

Visit
How are fossils formed?
goo.gl/qyZTC

ACTIVITY 17.1: How to make a model of a body fossil

Fossil hunters look for fossils in sedimentary rock. They never know whether they will find a fossil or not. They have to split open the rock layers to see if there are any fossils. You are going to make a model of some rock that you will split open.

MATERIALS:

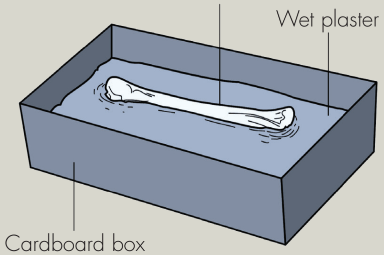
- Small container (plastic dish or bottom of a milk carton)
- Leaf with ribs that stand out or an animal bone (chicken bone)
- Vaseline
- Plaster of paris

INSTRUCTIONS:

Each group must make a model rock with a fossil.

Day one:

1. Spread Vaseline over the back of your leaf or your chicken bone.
2. Take your container to your teacher. Pour the fresh plaster of paris mixture into the container. The plaster of paris will begin to set hard in about 10 minutes, so you must be ready with your bone or leaf.



Press the bone only halfway into the plaster.

Teacher's note

You will need to mix the plaster of Paris and get it ready for the learners. Show the learners how you do it, because this is part of their technology knowledge in the processing strand. Mix enough for two or three groups at a time, because it starts to set (= harden) quite soon after you add the water. If you cannot get plaster of Paris, then get screed mix from a building supply shop. This is cement, mixed with very fine sand. Another material you can use is putty, also from a building supply shop or hardware store. Mix cement powder or Polyfilla with the putty to make it harden quickly. A fourth material you can use is salt dough. You mix a cup of cake flour with ½ cup of water and add a teaspoon of salt. Mix the flour and water until you have a stiff dough that you can shape. Finally, a material you can use is river clay; make it stiff so that it can keep the shape of a bone or leaf. Let it harden in the sunshine.

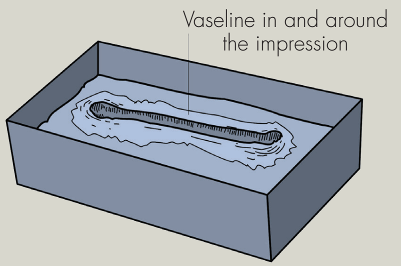
Teacher's note

Of course, it's much more fun if every child can make his or her own fossil, so try to arrange the lesson for this to happen.

3. Now put your leaf or bone onto the top of the wet plaster of paris, and press it gently into the plaster. The bone must go in only halfway as you see in in the picture below. The leaf must go only far enough to leave the shape of its ribs in the plaster.
4. Leave the plaster to set (to get hard). Notice how hot your container becomes while the plaster is setting.

Day two:

5. Pull out the leaf or the bone. It will come out easily because the plaster does not stick onto the Vaseline.
6. Now you have an impression of the leaf or the bone. An impression is like a footprint in mud.
7. Spread a very thin layer of Vaseline into the impression and around the impression, as you see in the picture below.

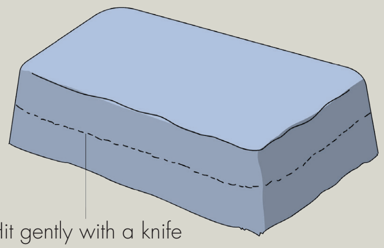


When you pull the leaf or bone out, you leave an impression in the hard plaster. Smear Vaseline into the impression and around it.

8. Collect some runny wet plaster of paris from your teacher and pour it over the Vaseline to cover the old plaster and fill the container almost to the top. Let the new plaster set for a day.

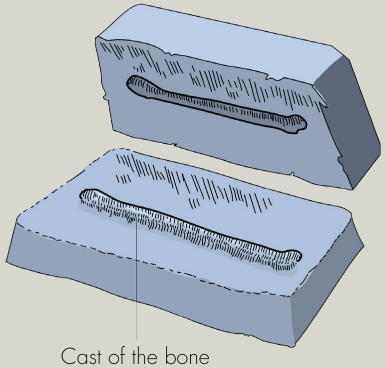
Day three:

9. Tear off the cardboard or cut off the plastic container from the plaster rock you have made. The fossil is hidden inside. You can paint the plaster to look like a rock.



Get a plaster rock from another group, and tap gently on the side of their rock.

10. Now give your rock to another group and get a different rock from them. Do not tell the other group what fossil is in your rock.
11. Use the knife to tap gently on the edge of the rock. Use a stick to tap on the back of the knife blade, so that you do not hit too hard.
12. Your rock should split open if you tap in the right place. When it splits open, you will see a cast of a leaf or a bone on the top layer. The cast has the shape of the impression, but the impression goes inward and the cast stands up.



You should find a cast of the bone.

Teacher's note

Note that the mould has been turned upside down to get this out.

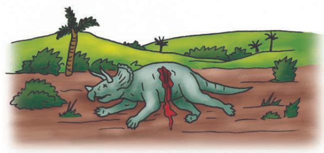
QUESTIONS:

1. Look carefully at the cast and try to draw the leaf or the bone as it really was.
2. Try to work out what kind of plant the leaf came from, or what kind of animal the bone came from.
3. Is the cast (the shape) really a bone, or really a leaf?
4. Do you remember learning about plaster of paris in the second term in Matter and Materials? What properties of plaster of paris make it useful in this activity?

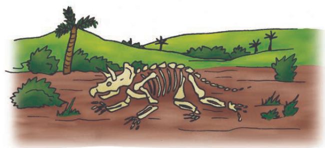
Now that you have seen an impression of an object can be made by using plaster of paris, let's have a closer look at how a dinosaur fossil were made millions of years ago.

Look at the pictures below and read the explanations for each stage of the fossil formation process.

Long, long ago, a dinosaur dies on the banks of a river, such as this Triceratops in the picture.



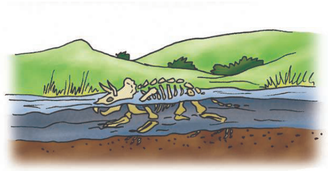
The flesh of the dinosaur decomposes, or other animals eat it. So, only the skeleton remains.



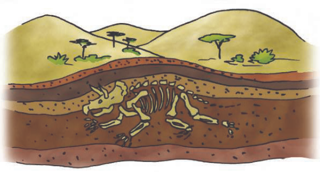
There was a flood and the river rose and covered the skeleton with mud and sand.

Answers to Activity 17.1:

3. No, it has kept the shape of the bone or leaf.
4. The plaster of paris is first wet and soft when you first mix the powder and water together. This is useful as it allows you to mould the plaster of paris around the bone as the mud from long ago would have done. The plaster of paris then sets and becomes very hard just as the mud and rock did over time. This is useful as it forms a cast of the bone which is hard and set.

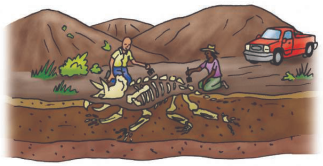


Over time, more floods deposit more layers of sand and mud over the skeleton. Over thousands of years, the bottom layers start to become compacted and turn into sedimentary rock. Under the ground, water carried substances from rock into each little space where a bone had been. Rock took the place of bone. We say the bones were fossilised. A fossil bone has the same shape as the original bone, but is much heavier.



Millions of years later, the conditions of the environment above the skeleton may change. The rock is eroded and weathered over time by wind and water and the fossil is exposed on the surface. A scientist sees the fossil and a great discovery is made!

Other scientists join in and they excavate the fossil by carefully removing the rock and sand around the skeleton. The fossils will be carefully packed and taken to a museum or research centre. Here the scientists will study them to see what they can learn about prehistoric life. They will try to reassemble the bones into a full skeleton – this may take many months to do!



Visit

Fossilisation video.
goo.gl/b906Z

17.2 Body and trace fossils

We have seen many different fossils so far in this chapter. These fossils can be divided into two groups:

- Body fossils
- Trace fossils

New words

- body fossil
- trace fossil

A body fossil shows you the shape of the body of the plant or animal. Body fossils include teeth, bones, shells, stems, leaves and seeds.

Sometimes an animal left only a sign that it has been there. For example, if you walk across wet cement you might leave a footprint, which will be preserved in the cement when it hardens. Look at the photos below.

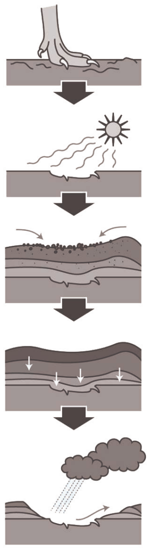
A footprint which has hardened in the cement.[7]

A dinosaur left its footprint in the mud, and the mud turned to rock. This is a trace fossil.[8]

Some ancient animals, like dinosaurs, may have walked across wet mud and left footprints in the mud, like in the picture below. The dinosaur leaves a trace behind. Over millions of years, this footprint can be preserved and become a trace fossil.

QUESTIONS

Use the diagram below as well as your previous knowledge of how sedimentary rock forms to write captions for each stage of the formation of a trace fossil.



Trace fossils were also made from animals' nests, eggs and droppings.

Some fossils of ancient organisms look similar to plants and animals that are alive today.

Teacher's note

A body fossil would be in the form of the organism that has fossilized. A trace fossil indicates evidences other than a fossilized body part, that indicates the existence of an organism, such as burrows, trails, eggs, nests, and faecal matter (dinosaur poop).

Marine fossils that look very similar to the shells we get today.[9]

17.3 Importance of South African fossils

Did you know that South Africa is world famous when it comes to important fossil finds? South Africa has a very rich fossil record of plants, animals and early humans. Let's take a look at some of these.

QUESTIONS

Do you know of any important fossil findings in your area? If not, find out where the nearest fossil finding is to you.

Earliest life forms

Some of the most ancient fossils that are known to exist were found in rocks in the Barberton area in Mpumalanga.

Do you know where this is in South Africa? Look it up on a map. These fossils are more than 3000 million years old! They look like blue-green bacteria.

QUESTIONS

What are bacteria? Find out and write down a short explanation.

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QUESTIONS

What are bacteria? Find out and write down a short explanation.

Bacteria is a large group of microorganisms made up of only one cell. They are microscopic and some cause disease.

Earliest plants

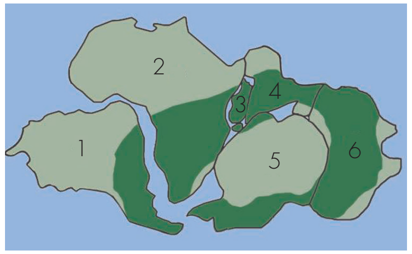
New words
- Pangaea
- glossopteris
- therapsids
- ancestor
- coelacanth
- hominid

Do you know where Grahamstown is in the Eastern Cape? Grahamstown is famous in the archaeological world for having some of the oldest and best preserved fossils of early plants from millions of years ago.

Look at the shape of Africa and South America on the classroom globe. The shapes could fit together like in this picture below. This diagram shows how scientists think the continents of Earth used to look millions and millions of years ago. This was called Pangaea.

A South African scientist thought that perhaps Africa and South America had been joined together long ago. But nobody knew if this was true.

Then scientists found fossils of a plant called glossopteris in rocks in South Africa and they found fossils of the same plant in South America. This made more people think that perhaps Africa and South America were once joined, very long ago. The image below shows how scientists think the plant glossopteris used to grow in Pangaea.



Pangaea, showing the growing of glossopteris in dark green.

QUESTIONS

Which number represents South America and which number represents Africa today in the image above?

QUESTIONS

Which number represents South America and which number represents Africa today in the image above?

South America = 1, Africa = 2.

These are fossils of glossopteris leaves.[10]

QUESTIONS

Do you think this fossil of glossopteris leaves is a trace or body fossil? Explain your answer.

Dinosaurs

Fossils of dinosaurs have been found all over the world. But one of the best places in the whole world to find dinosaur fossils is the sedimentary rock in the Drakensberg Mountains and the Maluti Mountains in southern Africa.

QUESTIONS

Where are the Drakensberg Mountains located in South Africa? Write down the names of the provinces.

Mammal-like reptiles

Reptiles came before mammals, but the fossil records shows us animals that were similar to mammals as we know them today, even though they were actually reptiles. These in-between animals are called therapsids. Fossils of these animals have been found in the Karoo in South Africa.

QUESTIONS

Do you think this fossil of glossopteris leaves is a trace or body fossil? Explain your answer.

This is a body fossil as the leaf was covered in mud and then over time turned into a fossil. It is not an imprint, but the actual hard part of the plant has been preserved.

QUESTIONS

Where are the Drakensberg Mountains located in South Africa? Write down the names of the provinces.

Mostly in Kwa-Zulu Natal and Mpumalanga

Fossils of some of the first mammals on Earth were also found in the Drakensberg rocks in the Eastern Cape and in Lesotho.

A fossil of a therapsid found in the Karoo. A therapsid is a small dinosaur with some features of mammals.[11]

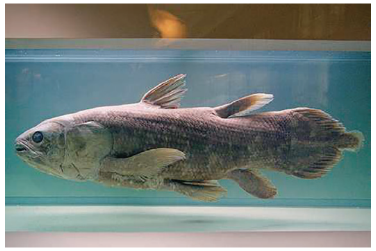
QUESTIONS

Where is the Karoo? A town in the Karoo is Graaff Reinet. Find this town on the classroom globe. Find it on a map. Name some other towns found in the Karoo.

A strange fish that lives in the sea near South Africa

Look at the photo below of a fish that was caught in the sea near East London. The fish is called a coelacanth.

Visit
Finding the coelacanth (video).
goo.gl/pu6la



A preserved coelacanth in a museum.[12]

QUESTIONS

Where is the Karoo? A town in the Karoo is Graaff Reinet. Find this town on the classroom globe. Find it on a map. Name some other towns found in the Karoo.

Somerset East, Willlowmore, Jansenville, Aberdeen

Scientists from other countries rushed to South Africa to see this coelacanth fish. They could not believe that any coelacanths still lived in the sea. The scientists knew about coelacanths because they had studied their fossils in England and Germany, but the fossils were 80 million years old. They thought that coelacanths had all died millions of years ago! We now call coelacanths 'living fossils'!

QUESTIONS

How is this fish different from other fish? Look at its tail and its front fins.

The Cradle of Humankind

The Cradle of Humankind is a World Heritage Site. It is called the 'Cradle of Humankind' as many people and scientists now believe that this was where humans first evolved. The birthplace of humans is right in our country!

Visit
Coelacanth discoveries (video).
goo.gl/clYvX

I just love learning more and more about what makes our country so special and wonderful. We can be proudly South African!

QUESTIONS

What does it mean if a place is a World Heritage Site? Find out and write your answer in your exercise book.

QUESTIONS

How is this fish different from other fish? Look at its tail and its front fins.

The tail is thick and fleshy. Four of the fins have flesh and scales on them; they look almost like legs. Scientists who had studied the fossils wondered about these "legs". They wondered whether this fish was the ancestor of four-legged animals that live on land.

QUESTIONS

What does it mean if a place is a World Heritage Site? Find out and write your answer in your exercise book.

It is a natural or human-made site, area, or structure recognized as being very important internationally and must therefore be protected.

The Cradle of Humankind is found in Maropeng, just outside of Johannesburg in Gauteng. The name Maropeng, a Setswana word, means ''return to place of origin''.

The museum at Maropeng, Cradle of Humankind.[13]

In the Cradle Of Humankind about 1 000 fossils of pre-humans have been discovered, dating back millions of years.

Altogether there are 15 major fossil sites in the Cradle of Humankind. The Sterkfontein Caves is the most famous. Swartkrans and Bolt Farm are also sites at the Cradle of Humankind where fossils have been found.

The entrance to Sterkfontein Caves is down a long, winding staircase.[14]

The fossils of Mrs Ples and Little foot were both discovered at Maropeng, as well as thousands of hominid fossils (human ancestors), as well as plants and animals.

The cranium of an australopithecus africanus found in Sterkfontein caves at Maropeng

Tourists come from all over the world, including South Africa, to view the caves and fossils at the Cradle of Humankind, and to get immense knowledge on the history of humankind. If you live in or near Johannesburg, maybe you have been lucky enough to visit Maropeng and the Cradle of Humankind!

ACTIVITY 17.2: Thinking about the Cradle of Humankind

Use the information above on the Cradle of Humankind to answer the questions below.

1. Why is the Cradle of Humankind famous?
2. Explain why you think it is called The Cradle of Humankind.
3. Give the names of two of the most famous hominid fossils that have been found at the Cradle of Humankind.
4. Explain why you think the fossils at Maropeng are protected by the country's laws.
5. Which of the following is not one of the fossil sites in the Cradle of Humankind?
   - Sterkfontein Caves
   - Cango Caves
   - Swartkrans
   - Bolts Farm
6. What does Maropeng mean?

Answers to Activity 17.2:

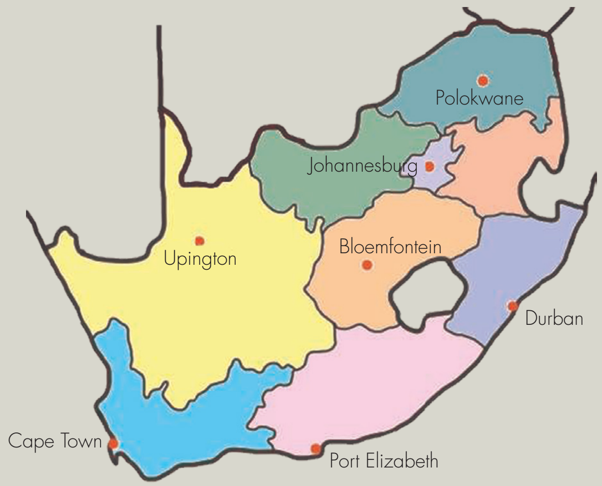
1. Important fossils in the history of mankind have been found there.
2. This is because Maropeng is thought to be the birthplace of modern humans. Humans are thought to have evolved from Africa.
3. Mrs Ples and Little Foot.
4. The fossils are very important as they help explain the evolution of humans, hence they have to be protected lest they be moved or destroyed.
5. Cango Caves
6. Return to place of origin

As we have seen, there are many important fossil findings all over South Africa. Let's put all these places on a map in the next activity.

ACTIVITY 17.3: Plotting the important fossil sites in South Africa

INSTRUCTIONS:

1. Identify all the places that have been mentioned in this chapter which are important archaeological sites in South Africa.
2. Find these places on the map of South Africa and write them in your workbook.
3. Next to the place names, write down the important fossils which were found there.



Model answer:

Place	Type of fossil
Baberton, Mpumalanga	Ancient fossils that look like blue-green bacteria
Grahamstown, Eastern Cape	Oldest and best preserved fossils of early plants
Drakensberg Mountains in the Eastern Cape	Dinosaur fossils, fossils of some of the first mammals
Maluti Mountains in Lesotho	Dinosaur fossils, fossils of some of the first mammals
The Karoo	Animals similar to mammals (therapsids)
East London, Eastern Cape	Coelacanth (living fossil)
Cradle of humankind, Maropeng, Gauteng	Human fossils

KEY CONCEPTS

- Animals and plants sometimes died in mud, and the mud keeps their shape or preserves their remains.
- These remains of ancient plants and animals are called fossils.
- There are two main types of fossils – body and trace fossils.
- Fossils provide us with a record of the history of life on Earth.
- South Africa has a very important collection of fossils.

REVISION

1. Are animal fossils made of bone? Explain what a fossil is.
2. Which type of rocks are fossils normally found in?
3. Why do you think we only find fossils in this type of rock?
4. Fossilised wood does not burn. What is the reason?
5. Some rock comes out of a volcano. It is red hot and then it cools and becomes hard. Can you find fossils in rock like this? Why?
6. Name two fossils that show us the kinds of living things that lived long ago in South Africa.
7. Explain how you think fossils can help us understand what life was like long ago on Earth.

That's all!
We are finished with
Grade 5!!

REVISION

1. A fossil is stone in the shape of the bone. Substances from rock have taken the place of each little part of the bone.
2. Sedimentary rock
3. Sedimentary rocks can contain fossils because, unlike other rocks, they form at temperatures and pressures that do not destroy fossil remains. Dead organisms can become sediments which may, over time, become sedimentary rock. Other rock types will destroy the fossils, such as magma.
4. Fossil wood is made of stone.
5. No, because the red-hot rock would burn up any bone or plant that it fell on.
6. Massospondylus, therapsids, glossopteris, etc.
7. Fossils give us a record of what life was like millions of years ago. We do not know what it was like as no one was there to write it down. So, fossils give us information such as what types of plants and animals lived long ago, how these organisms have changed over time, the effect of climate change on the Earth, we can even tell what animals ate from their fossils by studying their teeth and droppings.

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:				

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Notes

Chapter 1 Plants and animals on Earth

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Chapter 3 Skeletons as structures

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Chapter 4 Food chains

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Chapter 5 Life cycles

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Chapter 6 Metals and non-metals

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Chapter 7 Uses of metals

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Chapter 8 Processing materials

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Chapter 9 Processed materials

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Chapter 10 Stored energy in fuels

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Chapter 12 Energy and movement

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Chapter 13 Systems for moving things

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Chapter 15 Surface of the Earth

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Chapter 16 Sedimentary rock

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Chapter 17 Fossils

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Glossary

Abdomen Posterior segment of an insect that has the heart, reproductive organs, mid-gut and other digestive organs.

Absorbent A material that is able to soak up liquid easily.

Adapt To become adjusted to new conditions.

Amphibian Cold-blooded vertebrate animals like frogs that have aquatic gill-breathing larval stage followed (typically) by a terrestrial lung-breathing adult stage.

Ancestor An ancestor is any person from whom one is descended.

Apparatus The equipment you will need to carry out a Science investigation or experiment.

Aquatic To do with water, from the Latin word *aqua*.

Asteroid belt Asteroids, which are solid, rocky irregular bodies, orbit our sun between the orbits of Mars and Jupiter.

Atmosphere The envelope of gases surrounding the earth or another planet.

Axle Rod or spindle (either fixed or rotating) passing through the centre of a wheel or group of wheels.

Backbone The series of vertebrae extending from the skull to the pelvis; also called the spine.

Battery A container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.

Bearing Machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts

Bedrock Layer of rock underneath the layers of soil is called bedrock.

Binder A substance used in construction that sets, hardens and adheres to other materials, binding them together.

Biodiversity The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.

Body fossil The most common type of fossil found across the world, which are formed from the remains of dead animals and plants. Most are of hard parts such as teeth, bones, shells, or woody trunks, branches and stems.

Breeding ground An area where birds, fish, or other animals habitually breed.

Brittle When a material is not bendy or flexible, the opposite of malleable. This means that they will break when we try to bend them with enough force.

Calories and joules The energy of food is measured either in calories or kilojoules.

Carnivores An animal that only feeds on other animals.

Catapult A catapult is a fork stick with elastic band used for shooting small stones.

Cell A device that generates electricity from chemical reactions.

Cement Powdery substance made by calcining (burning) limestone and clay.

Chalk White soft earthy limestone (calcium carbonate) formed from the skeletal remains of sea creatures.

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.

Clay A stiff, sticky fine-grained type of soil that can be moulded when wet, and is dried and baked to make bricks, pottery and ceramics.

Coal A combustible black or dark brown rock consisting chiefly of carbonised plant matter, found mainly in underground seams and used as fuel.

Coelacanth Large bony marine fish with a three-lobed tail fin and fleshy pectoral fins. It was known only from fossils until one was found alive off South Africa in 1938.

Combine To join or merge to form a single unit or substance. In Science a compound is a pure chemical substance made of two or more different chemical elements combined.

Combustion The process of burning something; burning taking place.

Common properties General properties or physical properties that can be observed or measured without chemically changing the material or substance.

Compression An external force (stress) that tends to crush a material, or push down on the material and squeeze its particles closer.

Conclusion Summary of what was learnt from the results of a Science investigation.

Concrete Building material made from a mixture of broken stone or gravel, sand, cement, and water, which can be spread or poured into moulds and forms a stone-like mass on hardening.

Conduction Process by which heat or electricity is directly transmitted through the material of a substance when there is a difference of temperature or of electrical potential between adjoining regions, without movement of the material.

Conductivity The degree to which a specified material conducts electricity or heat.

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.

Consumers Organisms that need to eat (consume) something else as food to get their energy.

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.

Core The inner part of the Earth, which may consist of a liquid outer core of iron and nickel, and a solid inner core. No one knows exactly what the core is made of but scientists keep doing experiments. The outer core has a magnetic field. The inner core may rotate slightly faster than the rest of the planet.

Corrosion The deterioration of a metal as a result of chemical reactions between it and the surrounding environment.

Corrugated Material shaped into a series of parallel ridges and grooves so as to give added rigidity and strength.

Cross-section A surface or shape exposed by making a straight cut through something, especially at right angles to an axis.

Crust The thin outermost solid rocky shell of the Earth, which includes the thicker continental crust and the thinner oceanic crust. Its thickness varies between 5 km and 30 km.

Data Facts and information collected during a Science experiment.

Decomposers Organisms that break down dead or decaying organisms, and in doing so, they carry out the natural process of decomposition.

Deposition Process where sediments, soil and rocks are added to a landform or land mass. Wind, ice, water and gravity transport previously weathered surface material, which is deposited elsewhere, building up layers of sediment.

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.
Developmental stages	The four stages of the life cycle of all animals, which are gestation, growth and development, maturation and reproduction.
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.
Ductile	When a material like metal is pliant and can be drawn out into a thin wire. When a material can be reformed without losing toughness or becoming brittle.
Dull	The opposite of the quality of being shiny or lustrous.
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.
Ecosystem	A system, or a group of interconnected and interdependent elements, formed by the interaction of a community of living organisms with their natural environment.
Electrical circuit	A path in which electrons from a voltage or current source flow.
Electricity	A form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.
Embryo	An unborn or unhatched offspring in the process of development, in particular a human offspring during the period from approximately the second to the eighth week after fertilisation (after which it is called a foetus).
Enclose	To surround or close off on all sides.
Endoskeleton	An internal support structure for vertebrate animals made of bone and cartilage
Energy value	The energy value of a food indicates its value to the body as a fuel. It uses a single factor for each of the energy-yielding foods (protein, fat, carbohydrate).
Erosion	The process of the soil, rock or land gradually being worn away by wind, water, or other natural agents.
Estuary	The tidal mouth of a large river, where the tide meets the stream.
Evaluate	To decide how successful the product design and construction was in solving the problem identified or meeting its specifications.
Evidence	Scientific evidence is evidence that serves to either support or counter a scientific theory or hypothesis.
Exoskeleton	Rigid external protective covering for the body in some invertebrate animals like grasshoppers, crabs, snails and cockroaches.
Expand and contract	Heat causes most substances to expand and become less dense. When cold, most substances contract and become denser.
Experiment	Scientific procedure done to test a prediction, answer a question or prove a known fact.
Extinct	When a certain species of animal or plant no longer has any living members.
Extinguish	To cause a fire to stop burning; to put it out.
Fertilisation	To cause an egg, female animal or plant to develop a new individual by introducing male reproductive material.
Fire extinguisher	Portable device used to extinguish (put out) fires inside a building.
Fire resistant	Materials, especially fabric, which have been treated so as to be non-flammable.
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.
Food chain	A series of organisms each dependent on the next as a source of food and energy.
Food web	A single food chain is a series of organisms each dependent on the next as a source of food and energy. Many food chains that are interdependent and linked are called a food web.
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.
Fossil	The remains or impression of a prehistoric plant or animal embedded in rock and preserved in petrified rock form.
Fragile	The property of a material where it can be easily broken or damaged.
Frame structure	A type of structure that is made up of different parts joined together, the skeleton is an example.
Funnel	A tube or pipe that is wide at the top and narrow at the bottom, used for guiding liquid or powder into a small opening.
Gas	Gas is a property of matter where the particles are far apart.
Gestation	Process or period of developing inside the womb between conception and birth, which differs in length for various animal species.
Gills	The paired respiratory organ of fish and some amphibians, by which oxygen is extracted from water flowing over surfaces within.
Glossopteris	The largest and best-known type of extinct seed ferns.
Grassland	Large open area of countryside covered with veld grass.
Habitat	The natural home or environment of an animal, plant or other organism.
Hardness	The property a material has of being hard.
Herbivores	An animal that only feeds on plants.
Hominid	Ancestor primates of the *Hominidae* family, which includes humans and their fossil ancestors, and also some of the great ape.
Humus	Humus is the dark organic matter that forms in the soil when plant and animal matter decays. Humus contains many useful nutrients for healthy soil, nitrogen being the most important of all.
Hydroskeleton	A skeleton supported by fluid pressure that is common among simple invertebrate organisms, such as earthworms and jellyfish.
Hypothesis	A prediction or proposed explanation made on the basis of limited evidence as a starting point for further investigation.
Ice age	Periods of time in the distant past when the temperature was very cold and glaciers (large masses of ice) covered most of the Earth.

Indigenous	Coming from or originally occurring naturally in a particular place.
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.
Insulator	Non-metals do not conduct electricity or heat well. We call them insulators.
Invertebrate	Animals like spiders and worms that are grouped by if they do not have a backbone or spinal bones.
Joint	A structure in the human or animal body at which two parts of the skeleton are fitted together.
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).
Life cycle	The series of changes in the life of an organism including reproduction.
Ligament	Short band of tough, flexible connective tissue, which connects two bones or cartilages or holds together a joint.
Limestone	A hard sedimentary rock, composed mainly of calcium carbonate or dolomite, used as building material and in the making of cement.
Load	A weight or source of pressure borne by someone or something.
Loam	A fertile soil of clay and sand containing humus.
Lustre/lustrous	Metals are usually shiny. The shine that we see when light reflects off the surface of a metal is called the lustre of the metal.
Magnetic	Exhibiting or relating to magnetism, a fundamental property of some materials.
Magnetism	Fundamental property of some materials. A physical phenomenon produced by the motion of electric charge, which results in attractive and repulsive forces between objects.
Mains electricity	Term used to refer to the electricity supply from power stations to households.
Malleable	When a material can be hammered or pressed into shape without breaking or cracking.
Mammal	Warm-blooded vertebrate animals grouped by having hair or fur, with females that secrete milk for feeding the young, which are born live.
Mantle	The Earth's thickest layer between the crust and the core. Earth's mantle is a solid rocky shell with an average thickness of 2 886 km. Temperature and pressure increases between the outer mantle and the inner mantle.
Manufactured material	The result when raw materials have been processed, meaning humans have changed it.
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.
Maturation	Stage in the life cycle when a living organism has matured and is ready to produce offspring.
Melting	A physical process that occurs when a material is heated and changes form from a solid to a liquid.
Metal	Solid material which is typically hard, shiny, malleable, fusible and ductile, with good electrical and thermal conductivity (e.g. iron, gold, silver, and aluminium, and alloys such as steel).
Metamorphosis	Change of the form or nature of a thing or person into a completely different one. In an insect or amphibian it is the process of transformation from an immature form to an adult form in two or more distinct stages.
Method	Systematic procedure or steps for doing something, like carrying out a Science investigation.
Microorganism	A living organism too small to be seen with the naked eye. A microscopic organism, especially a bacterium, virus, or fungus.
Mixture	A substance made by mixing other substances together.
Molluscs	Invertebrates like snails, mussels and slugs, which have soft unsegmented bodies, live in aquatic or damp habitats, and most have an external calcareous shell.
Mould	A hollow container used to give shape to molten or hot liquid material when it cools and hardens.
Natural resources	Materials or substances occurring in nature which can be exploited for economic gain.
Nectar	A sugary fluid secreted within flowers to encourage pollination by insects and other animals, collected by bees to make into honey.
Nitrogen	The chemical element that occurs as a colourless, odourless unreactive gas, which forms about 78% of the earth's atmosphere.
Non-metal	An element or substance that does not have the properties of metal. Materials that tend to have properties such as being dull and brittle. They make good insulators because they do not conduct electricity or heat well.
Observations	What you observe or see during or after the investigations. Observations are usually recorded or written down.
Offspring	Living organisms make copies or offspring of themselves through sexual reproduction (male and female) or by splitting.
Omnivores	An animal that feeds on both plants and animals. Omni is a combining word from the Latin for 'all'
Orbit	The regularly repeated elliptical course of a moon around a planet or planet around a star.
Ovule	The part of the ovary of seed plants that contains the female germ cell and after fertilisation becomes the seed.
Pacemaker	Device for stimulating the heart muscle and regulating its contractions.
Pangaea	Was the supercontinent that existed approximately 335 million years ago, which began to break apart about 175 million years ago.
Paraffin	Also known as kerosene, it is a colourless, flammable, oily liquid similarly obtained and used as fuel.
Photosynthesis	Process by which green plants use sunlight to synthesise nutrients from carbon dioxide and water. In plants the process involves the green pigment chlorophyll and generates oxygen as a by-product.
Pigment	The natural colouring matter of animal or plant tissue.
Plaster of paris	A hard white substance made by the adding water to powdered and partly dehydrated gypsum, used for holding broken bones in place and making sculptures and casts.
Pollination	The transfer of pollen to a stigma, ovule, flower, or plant to allow fertilisation.
Potential energy	The energy possessed by a body because of its position relative to others, stresses within itself, electric charge, and other factors.
Prediction	When you make a good guess what the result of an investigation or experiment will be.
Pregnancy	The condition or process of a human being in gestation, which is the process or period of developing inside the womb between conception and birth.

Preserve The process that keeps organic things from decomposing.

Process A series of actions or steps taken in order to achieve a particular end.

Producers Plants that make their own food, by taking energy from the sun, and with the help of water, converting that energy into useable energy in the form of sugar.

Properties The traits or attributes of a substance or material, which are used to describe it and understand how it behaves in different situations.

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Pupa An insect in its inactive immature form between larva and adult, e.g. the chrysalis of a butterfly.

Radicle The small root that grows out of a seed when it germinates.

Raw material Basic unprocessed material from which a product is made. This material in its natural state.

Reinforce To strengthen or support (an object or substance), especially with additional material.

Report A written account of something that one has observed, heard, done, or investigated.

Reproduce The production of offspring by a sexual or asexual process.

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.

Resist To withstand the action or effect of something.

Results What you found out, in other words the outcome of a Science investigation or experiment.

Ribs Series of curved bones that are articulated with the vertebrae and occur in pairs, on each side of the vertebrate body. Certain pairs are connected with the sternum to form the rib cage.

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.

Rust Reddish- or yellowish-brown flaking coating of iron oxide that is formed on iron or steel by oxidation, especially in the presence of moisture. Iron oxide is a chemical compound of iron and oxygen.

Sample Small part or quantity intended to show what the whole is like.

Sandstone Sedimentary rock consisting of sand or quartz grains cemented together, typically red, yellow, or brown in colour.

Scavenger An animal that feeds on dead organisms, especially a carnivorous animal that eats dead animals rather than or in addition to hunting live prey. Vultures, hyenas and wolves are scavengers.

Scrap metal Discarded metal for reprocessing.

Sediment Matter that settles to the bottom of a liquid; silt.

Sedimentary rock Rock that has formed through the deposition and solidification of sediment, especially sediment transported by water (rivers, lakes, and oceans), ice (glaciers), and wind. Sedimentary rocks are deposited in layers, and frequently contain fossils.

Seed dispersal The movement or transport of seeds away from the parent plant.

Segmented A segmented body is a division of an animal's body plan, whereby the body is divided into functional units.

Shale Soft finely stratified sedimentary rock that formed from consolidated mud or clay and can be split easily into fragile plates.

Shell structure Shell structures generally hold or protect things inside the structure, and are made to resist a load, like the shell of a crab or an egg.

Shoulder blades Scapulas are large, flat triangular bones that lie against the ribs in the upper back and provide attachments for the upper arm. In other four-legged mammals it is on the side of the body.

Silt Fine sand, clay or other material, carried by running water and deposited as a sediment, especially in a channel or harbour.

Skull Bone framework enclosing the brain of a vertebrate; the skeleton of a person's or animal's head.

Soil General term for the upper layer of Earth in which plants grow, a black or dark brown material typically consisting of a mixture of organic remains, clay and rock particles.

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.

Solidify A physical process that occurs when a material is cooled and changes form from a liquid or gas to a solid.

Solution A liquid mixture in which the minor component (the solute) is uniformly distributed within the major component (the solvent).

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.

Sperm cells The male reproductive cell (gamete) for which the name comes from the Greek word *sperma*, meaning seed.

Spinal cord Cylindrical bundle of nerve fibres that is enclosed in the spine and connects nearly all parts of the body to the brain, with which it forms the central nervous system.

Stainless steel Metal mixture (alloy) of iron with a minimum of 10.5% chromium, which prevents corrosion. It also has carbon, silicon and maganese. Other elements like nickel can be added to enhance malleability and corrosion resistance.

Starting materials Raw materials or intermediate substances that are used in producing a new substance.

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.

Stretch and compress The states of being stretched tight (tension) and pushing down on the material.

Subsoil The layer of soil under the topsoil on the surface of the ground. Like topsoil it is composed of a variable mixture of small particles such as sand, silt and/or clay, but it lacks the organic matter and humus content of topsoil.

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.

Substation Stored equipment for reducing the high voltage of electrical power transmission to that suitable for supply to consumers in their homes, offices, etc.

Succulents Plants that have thick fleshy leaves or stems, and are adapted to storing water for living in dry conditions.

Sustainable	For systems to remain diverse and productive indefinitely; to be renewable and to be used without being completely used up or destroyed.
Tarnish	Thin layer of corrosion that forms over certain metals like copper, brass and silver, as their outermost layer undergoes a chemical reaction. It is a surface phenomenon that is self-limiting, unlike rust.
Technology process	The process followed in designing and making products and structures.
Tendon	A flexible but inelastic cord of strong fibrous collagen tissue attaching a muscle to a bone.
Tension	The state of being stretched tight.
Therapsids	The fossil reptile of a group of prehistoric animals, the members of which are related to the ancestors of mammals.
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.
Thermal	Of, relating to, or caused by heat or temperature.
Thorax	Middle section of the body of an insect, between the head and the abdomen, bearing the legs and wings.
Topsoil	The upper, outermost layer of soil (5–20cm) with the highest concentration of organic matter and microorganisms, and where most of the Earth's biological soil activity occurs. Topsoil has sand, silt or clay, mineral particles, organic matter, water and air.
Toughness	The property a material has of being strong enough to withstand adverse conditions or rough handling.
Trace fossil	Fossils of footprints, trails, burrows, or other traces of a prehistoric animal rather than of the animal itself.
Traditional	When something is part of a particular culture and has been done the same way for a long time.
Transmission lines	Conductors designed to carry electricity over large distances with minimum losses and distortion.
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.
Vertebrate	Animals like mammals and snakes that are grouped by if they have a backbone or spinal column.
Water vapour	Water in its gaseous invisible state-instead of liquid or solid (ice).
Waterproof	A material that keeps out water.
Weathering	Wear away or change the appearance or texture of (something) by long exposure to the atmosphere.
Wetland	Land consisting of marshes or swamps and water saturated land.
Womb	Organ in the lower body of a woman or female mammal where offspring are conceived and in which they gestate before birth; the uterus.