Natural Sciences and Technology

Grade 5-A
Teacher's Guide

CAPS

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by the Sasol Inzalo Foundation in partnership
with Siyavula and volunteers.

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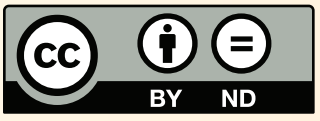
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AUTHORS LIST

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

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THIS IS MORE THAN JUST A WORKBOOK!

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

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

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

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

THE NATURAL SCIENCES AND TECHNOLOGY CURRICULUM

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

Natural Sciences and Technology complement each other

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

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

ORGANISATION OF THE CURRICULUM

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

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

Allocation of teaching time

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

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

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

Life and Living and Structures

Chapter	Time Allocation
1. 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 (5.25 hours)
5. Life cycles	2 weeks (7 hours)

Matter and Materials and Structures

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 (10.5 hours)
3. Energy and movement	1 week (3.5 hours)
4. Systems for moving things	3 weeks (10.5 hours)

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 rocks	2 weeks (7 hours)
4. Fossils	2.5 weeks (8.75 hours)


www.thunderboltkids.com

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Life and Living
and Structures

1 Plants and animals on Earth



KEY QUESTIONS



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

Teacher's Note

- 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!
- Consider labeling 5 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.
- ***Become an Expert***: Make enough labels for all the learners in your class. Write the 5 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.
- If you want to / can combine this with Home Language they can present their habitat as an Oral to the class.
- 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.

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 and their different habitats. This word is **BIODIVERSITY**. When you look at the biodiversity of a certain area you look at all the different kinds of habitats in that area including all the animals and plants in that area.

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 below.

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.

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, such as:

- 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 different kinds of habitats.

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!

Water habitats

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 all these kinds of aquatic habitats.

Our country has a very long coastline with different types of habitats and animals and animals live there. Many animals

live in and around the rock pools. They have to withstand the harsh sun and the constant pounding of the waves.



A rocky coastline with rock pools.



Starfish are found in rock pools along the coast.



Seagulls resting on a shore.

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.



A Southern Right whale with her calf off the coast of Hermanus, a popular breeding ground for whales in September. [1]

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! [2]

ACTIVITY: Identifying marine animals and plants

INSTRUCTIONS:

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



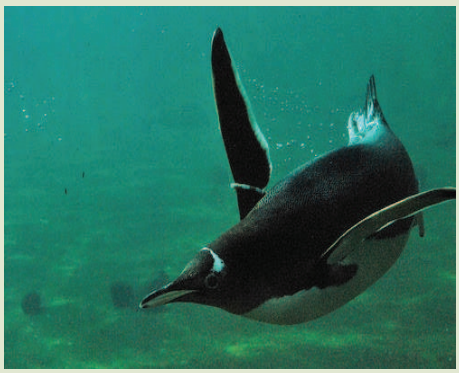
A crab. [3]



A school of fish. [4]



A crayfish in the shallow water. [5]



A penguin diving down under the water. [6]



Green seaweed flowing in the water. [7]



Mussels growing on the rocks. [8]



Sharks. [9]



Jellyfish. [10]



Kelp seaweed. [11]



Two turtles. [12]

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 this picture live on or near the rocks?

   Crabs, crayfish, seaweed, mussels

2. Describe at least 3 different ways that these animals protect themselves against the pounding waves.

   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. 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.

   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.

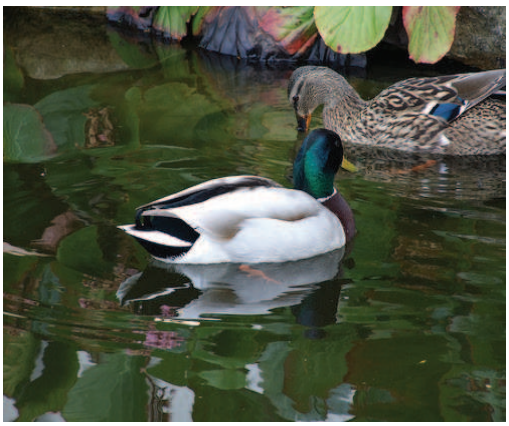
4. Many eco-tourists like to visit our country and see the sights. Some tourists like to go on tours where they enter into a cage which is lowered into the water. The tour operators often chuck small pieces of meat into the water to attract sharks which then swim around the cage. This is called shark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

   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.

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



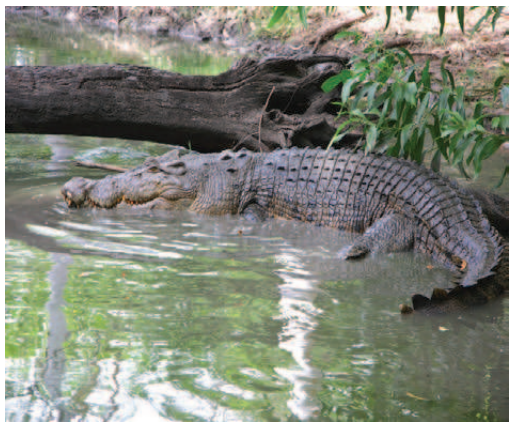
Ducks raise their chicks near plants where there are lots offood for their young in between the reeds and water plants.



Hippopotamus' live near to and in freshwater.

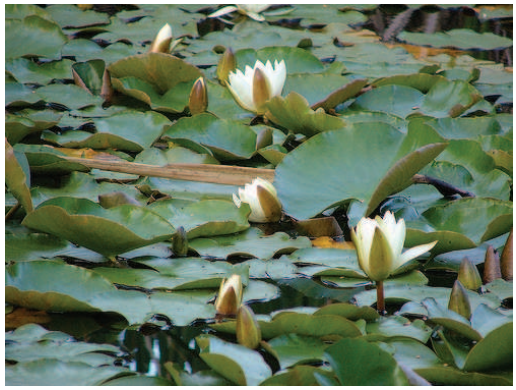


Can you see how this frog is resting on the lily pad?



A crocodile lies by the side of a river.

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 to eat.



Water lilies floating on the water. [13]

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 and 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: Studying an aquatic habitat

Work in groups of 3 or 4

MATERIALS:

- pencil
- paper
- clipboard
- sunblock and a hat

INSTRUCTIONS:

1. 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 3 different animals and 3 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 questions such as:

    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.
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 10 years!



The Namibian desert.

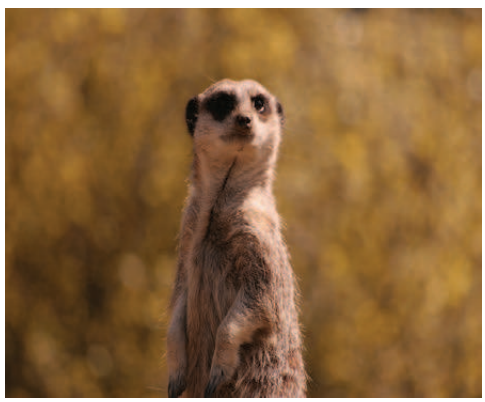
The desert may look dry, but there are many different plants and animals which are suited to living in these areas. Plants that can survive without much water in the desert are grasses, acacias, aloes, cactii and other succulents. Succulents are plants that can store their water in their leaves and stems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



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

Many animals live in the desert, 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 and 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, puffadders, cobras, lizards, geckos and iguanas
- A great many insects also live in the desert, such as bees and butterflies, grasshoppers and many more!



An alert meerkat looking for danger.



A huge nest for social weaver birds.



An eland.



A jackal looking for food.



A puff adder snake.



Two warthogs looking for food.

Grassland habitat

Grasslands are covered in grasses and 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 new animal babies are born as the new grass can feed the mothers to provide plenty of milk for the young.

QUESTIONS

List some of the animals which you think live in grasslands.

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

Forest habitat

A forest is a large area that is mostly covered in trees. Forests are extremely important to 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 and 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.



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 different kinds of plants and animals. We have a really diverse country!

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 oflitter 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 ofit.
- 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.

ACTIVITY: Counting plants and animals

Teacher's Note

After learners have identified the plants and animals in their areas, ask them to collect some flowers and seeds if there are any. Learners can then press the flowers by placing them between sheets of paper and then stacking a pile of books on top of the paper. You have to leave them to press for several days. Once they have pressed learners can stick the flowers onto pieces of paper along with the seeds they collected and provide the names of the flowers. These can be stuck up in the class.

MATERIALS:

- Something to mark out an area such as stones or sticks to make the corners and string to tie in between
- scrap paper
- pencil
- clipboard
- sunblock and hat
- measuring tape/ruler

INSTRUCTIONS:

1. Work in pairs.
2. Take a walk with your class to a park or nature area outside your school.
3. Choose an area where the two of you would like to work.
4. Carefully place the string around a section of your area.
5. Study the animals and plants in that area.
6. Make a drawing of the habitat inside your marked out area showing all the plants and animals that you see there. Use scrap paper for this.

7. 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 of these animals and plants next to each drawing.
8. Make sure that you have at least 5 examples of different plants and 5 examples of different animals in your picture.
9. Measure the heights of the plants and record these in the table below.
10. Collect leaves from two of the plants and make leaf rubbings on pieces of paper by placing the leaves underneath the paper and rubbing over with a pencil or crayon.
11. 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.
12. When you return to class copy your drawing from the scrap paper into your book. Make a neat drawing in your book and remember to add in the labels for all the different animals and plants.

The plants and animals I counted in my habitat area:

1.2 Interdependence in an ecosystem

Teacher's Note

Introducing this topic:

- 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

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 plants and rivers? Discuss this with your class.

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!

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.

1) 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.

2) Interdependence and pollination

Plants also depend on animals for pollination.

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. [15]

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 fertilize 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 below.

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

VISIT

Video on pollinators.
goo.gl/y7kAh



Bird feeding off the nectar and pollinating the flower. [16]



A wasp feeding off the nectar and pollinating the flowers. [17]



A beetle feeding off a flower. As it moves around the flower, it also pollinates the flower. [18]

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?

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



Without pollinators, we would not have blackberries and raspberries to eat. [19]



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



Lots of different types of nuts which form after pollination.[20]



Red and green apples are the fruits produced on apple trees after pollinators have pollinated the flowers. [21]

VISIT

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

3) 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: The honey badger and the honey guide

This is an example of interdependence between three different animals.

INSTRUCTIONS:

1. Read the story about the honey badger and the honey guide below.
2. Answer the questions which follow.

The honey badger loves to eat honey the honeyguide bird loves to eat the 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 honey guide then convinces the honey badger to follow it to the bee hive. The honey badger is able to use its strong legs and 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!



The honey badger follows the honey guide bird.



A honey badger. [22]

QUESTIONS:

1. Why can't the honey guide bird just eat some of the larvae without waiting for the honey badger?

   The bird will get stung to death and cannot break open the hive.

2. How does the honey badger break open the hive?

   It uses its legs, claws and teeth.

3. Why does the honey badger not get stung by the bees?

   It has a very thick coat which the bees cannot get through.

4. Explain in your own words how this is an example of interdependence between three animals.

   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 depend 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.

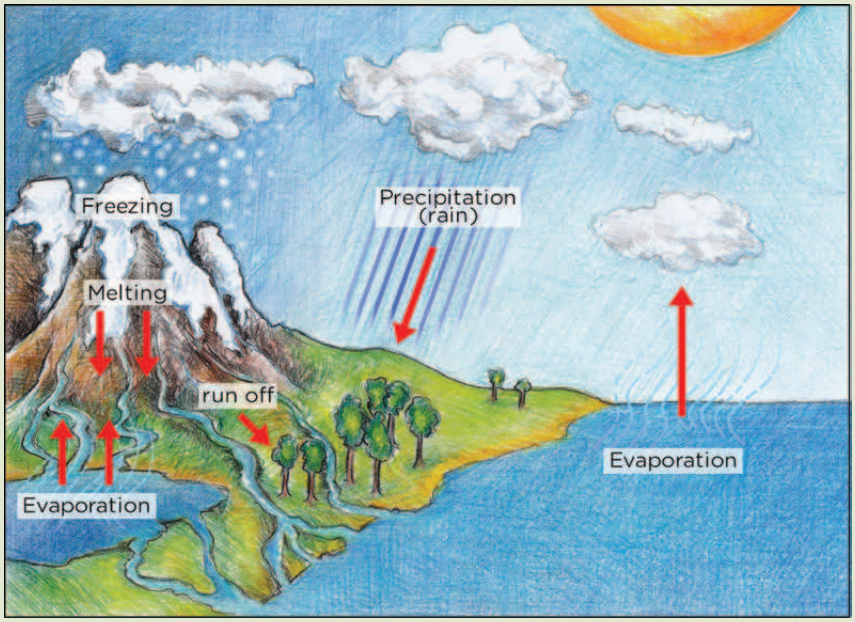
Teachers can use this as an opportunity to discuss learners' preconceptions of the water cycle and to ascertain what they know or misunderstand in order to address this in the following section.

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: The water cycle

INSTRUCTIONS:

1. This image of the Water Cycle shows all the processes which take place.
2. Revise these with your partner next to you.
3. Write a paragraph below where you explain the cycle.



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?

   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.

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: Describing Interdependence

Teacher's Note

Introducing this activity

After studying the interdependence ofliving 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.

INSTRUCTIONS:

1. Work in groups of 3.
2. Carefully study these animals and 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 picture have been provided. You need to match the picture with the description by writing the correct letter next to each picture.

Picture	Answer	Description of interdependence
		**A:** Clownfish and anemones. Clownfish do not get hurt by the poison from the anemone. The clown fish 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 protects the clown fish from predators.

		**B:** Earthworms in 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, and then 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 Shepherds and the herd of sheep they are protecting from cheetahs. The 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 Anatolian will chase them off. If Anatolian dogs are protecting a herd, the cheetahs are also protected because farmers will not kill them.

QUESTIONS:

1. In the pictures above, which interdependent relationship is between an animal and a plant?

   The weaver and the reeds it makes its nest from.

2. In the pictures, which interdependent relationship described is between an animal and the non-living things in its environment.

   The earthworm and the soil.

3. Which example in the pictures involves the interdependence between three animals, and what are they?

   The Anatolian Shepherds, the sheep and the cheetahs.

VISIT

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

1.3 Animal types

Now that we 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.

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.

Grouping animals

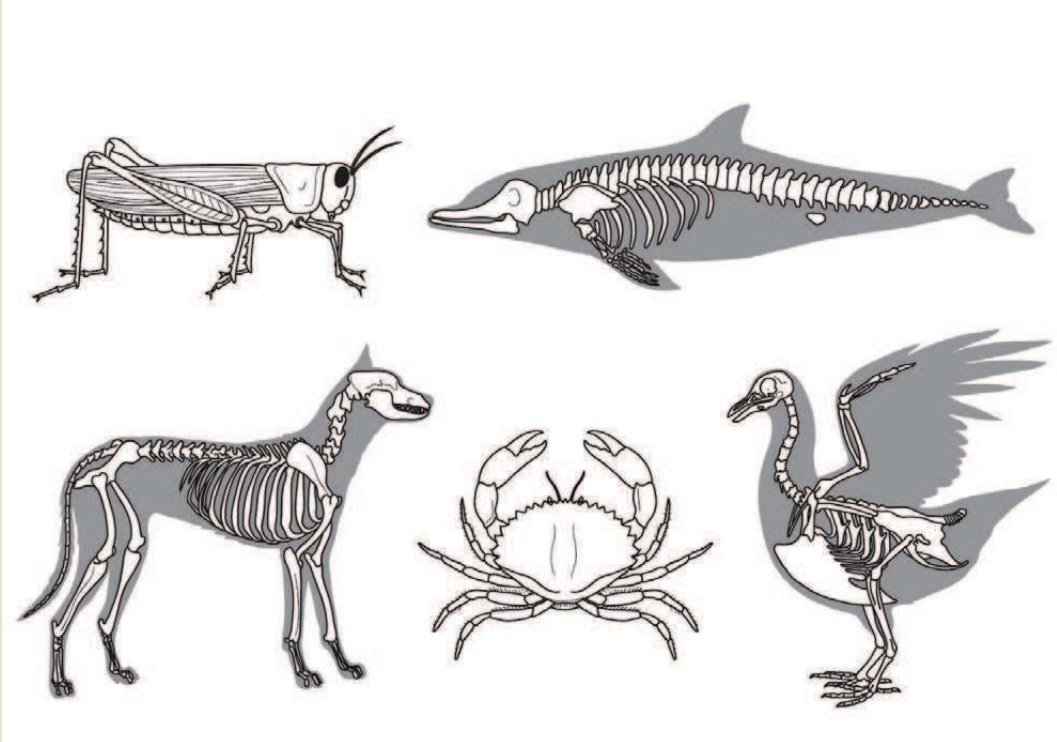
When we group similar things together, we call this classifying. When classifying animals, there are really two main groups of animals - those who have bones **inside** their bodies with a backbone, and those who do not have bones inside their bodies.

- Animals with a backbone are classified as **vertebrates**.
- Animals without a backbone are classified as **invertebrate**.

ACTIVITY: Classifying animals

INSTRUCTIONS:

1. A radiographer takes x-rays of people and animal's bones. Tracey the radiographer took some interesting x-rays of 5 animals. Carefully look at these x-rays and decide which animals are vertebrates.



Different vertebrates and invertebrates.

Animals that are vertebrates:

dolphin, dog, seagull

2. Why can you not see bones inside the crab or grasshopper's bodies?

   They do not have bones inside their bodies but have a hard outer bony skeleton.

3. What do we call animals like the grasshopper and the crab?

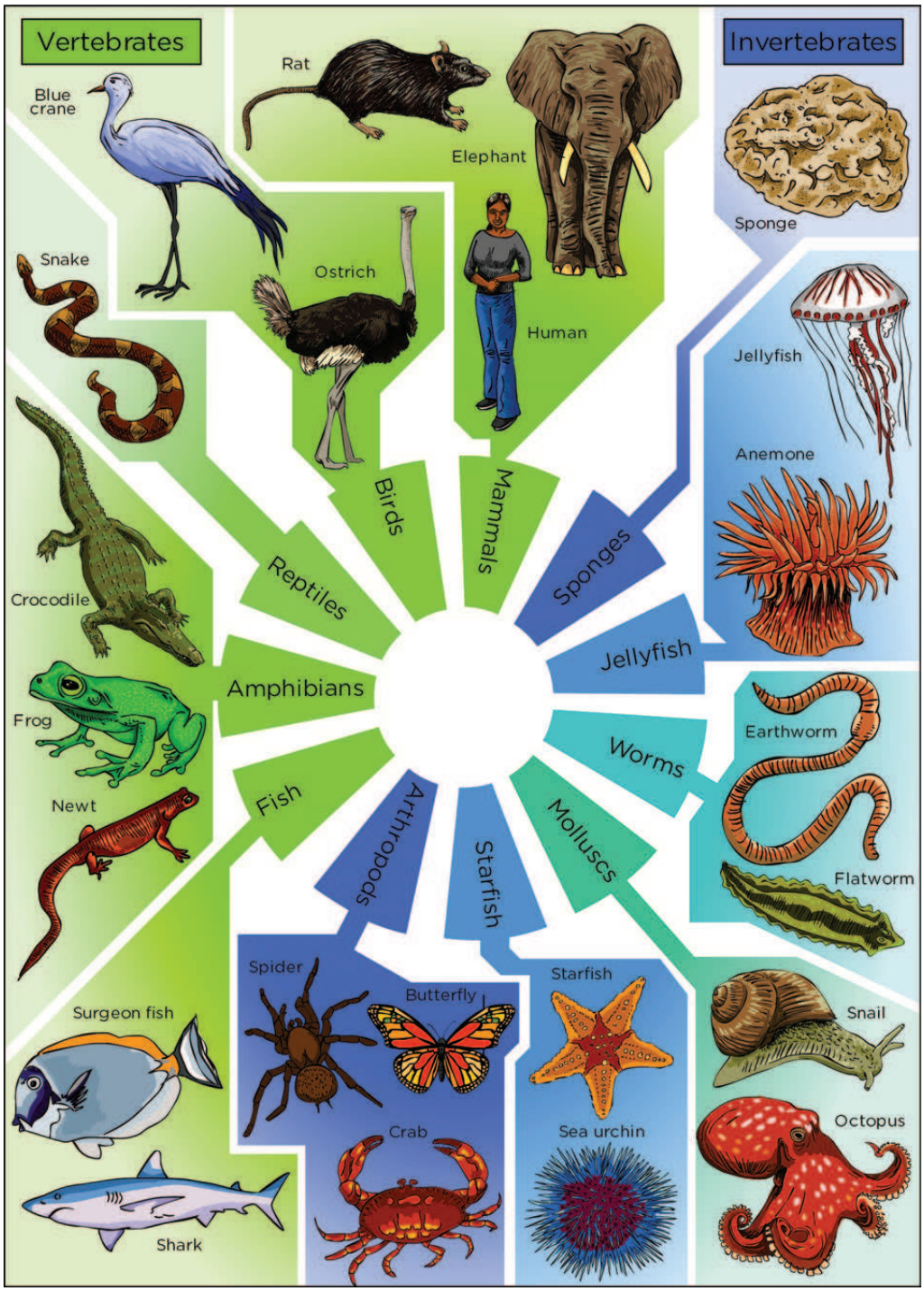
   Invertebrates.

4. Study the animals from the previous activity on interdependence. Decide if they are vertebrates with bones INSIDE their bodies, or invertebrates without bones INSIDE their bodies.

5. Write the name of each animal in the correct column below.

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

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.



Classifying animals

QUESTIONS

1. Have a look at the illustration of all these different groups. Why do you think the animals were put into a left group and a right group?

   This question is meant to reinforce the learner's understanding and recognition of vertebrates and invertebrates.

2. Vertebrates are divided into 5 groups, what are these groups?

   Mammals, reptiles, birds, amphibians and fish.

3. One of the birds in the illustration is our National Bird, which one is it?

   The Blue Crane

4. Give two examples of an arthopod.

   Spider, butterfly or crab

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 again. Can you find other examples of animals with no bones inside their bodies (endoskeleton) and with no hard outer skeleton (exoskeleton)?

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

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

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. [23]



A jellyfish has a hydroskeleton. [24]

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? Have a look at the previous illustration again if you need some ideas.

starfish, butterfly, millipede, crab, spider



Underneath a starfish. Can you see the little "legs" sticking out of the exoskeleton? [25]



Sea shells protect the soft bodies of invertebrates. [26]

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



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. [27]



The hermit crab now decides it is safe to walk around. [28]

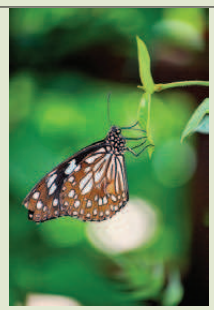
Insects are in an interesting group ofinvertebrates.

- 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, 2, 3, 4, 5 ...once I caught a bug alive!

INSTRUCTIONS:

1. Study the invertebrates in these photos.
2. Can you see if they have a head, chest and tail?
3. Carefully count their pairs of legs (if you can't see all their legs!)
4. Do they have any wings?
5. Write the amount of legs and/or wings each invertebrate has in the space below it.
6. Describe how each animal's body is covered.

	 29	 30	 31
Legs			
Wings			
Coverings			

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.

VISIT

Endoskeleton video:
goo.gl/I5lsz

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 5 smaller groups:

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

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

ACTIVITY: Identifying common characteristics

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 oflearners 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.



A frog. [34]



A person. [35]



A seagull. [36]



Sharks. [37]



A crocodile. [38]

QUESTIONS:

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

   Animals with endoskeletons all...

2. Give two examples of mammals from the above pictures.

   Elephant and dog

3. What type of bird is shown in the picture?

   A sea gull

4. Give an example of a reptile.

   Crocodile.

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

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.

ACTIVITY: Extension: Comparing endoskeletons and exoskeletons

INSTRUCTIONS:

1. Divide into groups of 5 - 7.
2. Carefully study the above section on Animal types and especially focus on the differences between exoskeletons and endoskeletons.
3. Brainstorm as many differences between exoskeletons and endoskeletons in your group as you can think of.
4. Once you have brainstormed in your group, share your ideas with the class and discuss these.
5. Record this comparison in the table on the next page.

	Exoskeleton	Endoskeleton
Type of animal	*crab, bee*	*lion, human, bird, frog*
Position	*outside the body*	*inside the body, fluid-filled*
Functions	*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 joints*	*various joints between the bones*
Mode of movement	*walking, jumping, swinging, flying*	*walking, running, jumping, swinging, swimming, flying*

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 ofindigenous plants and animals and their habitats.

REVISION:

1. Match the type of habitat in the left column to the appropriate description in the right column by drawing a line

between the correct pairs.

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.

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. Write a short description of the interdependence of the honey badger, the honey guide bird and the bees. Which animals benefit from this relationship and which do not?

   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. Name the different types of skeletons.

   Exoskeleton, hydroskeleton and endoskeleton

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?
 A grasshopper [39]		
 A bluebottle [40]		

 Cape sparrow		
 Tortoise [41]		
 Frog [42]		
 Crab [43]		

Grasshopper: Exoskeleton, invertebrate
Bluebottle: hydroskeleton, invertebrate
Cape Sparrow: Endoskeleton, vertebrate
Tortoise: Endoskeleton, vertebrate
Sea horse: Endoskeleton, vertebrate
Frog: Endoskeleton, vertebrate
Crab: Exoskeleton, invertebrate

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

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.

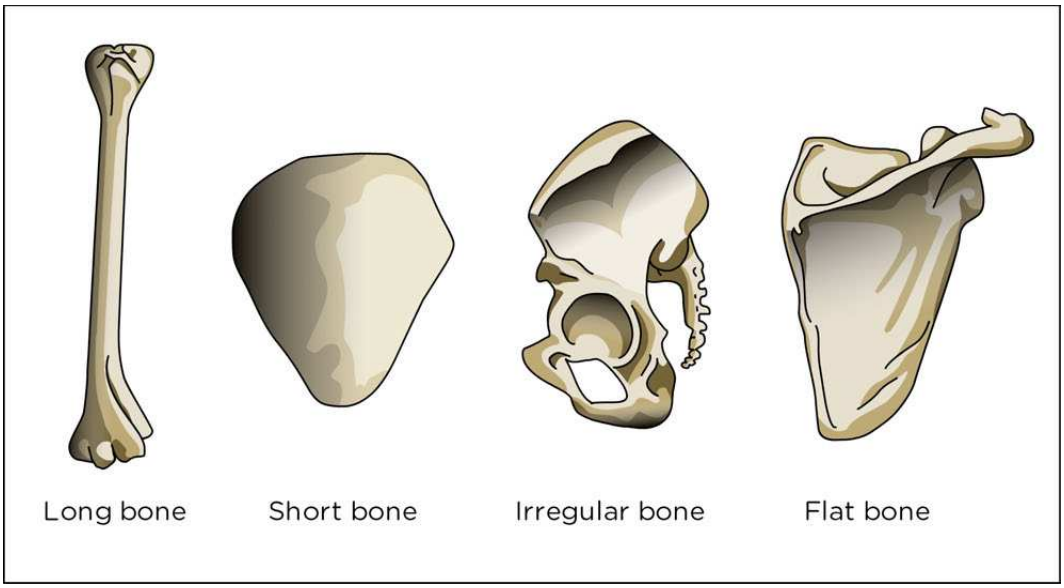
As you now know, all vertebrates have bones inside their bodies and invertebrates do not have bones.

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.

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.



Different kinds of bones.

VISIT

The skeleton song.
goo.gl/SPfw1

ACTIVITY: 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?
    - *It gives the body shape*
    - *Protects internal organs*
    - *Supports organs and flesh*
    - *Allows for movement by attaching to muscles*
2. Your teacher will hand out a jumbled puzzle of the human skeleton. Carefully cut out each piece along the dotted line.

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.

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.

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

1. Work in groups of 5 - 7.
2. Compose a rap rhythm and beat, compose your own tune or use an existing song to accompany these lyrics. Feel free to make or use instruments to accompany your singing.

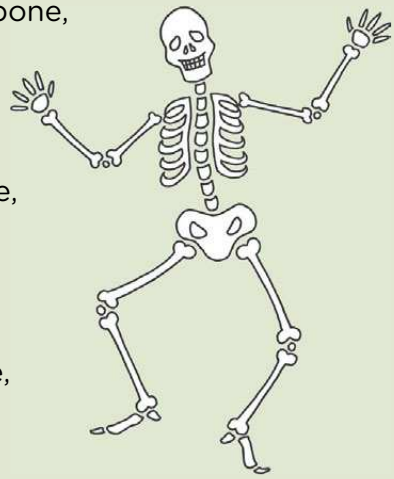
3. Present your song to the class.

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...



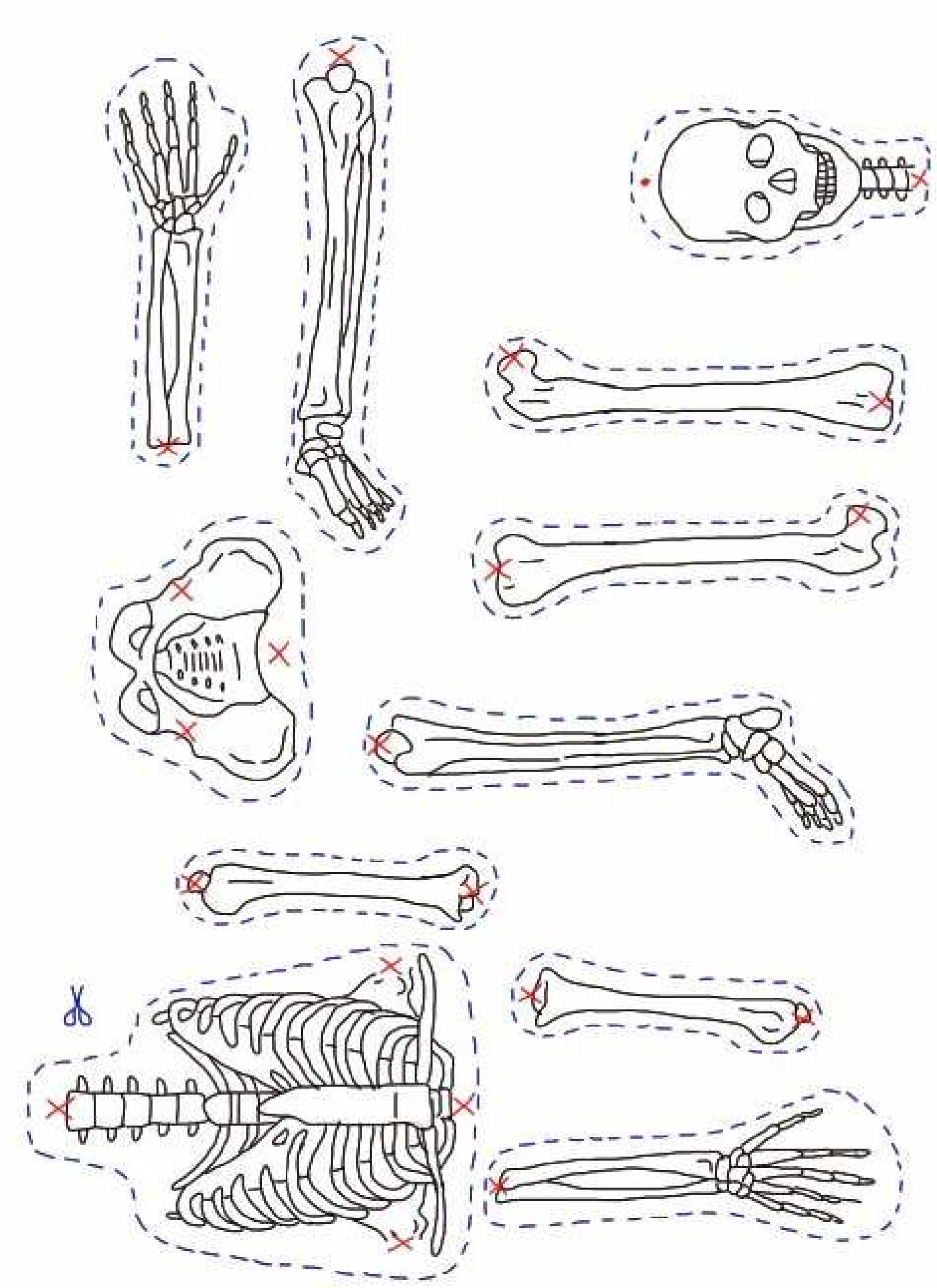
Teacher's Note

Photocopy the bones puzzle sheet 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 to their completed bones puzzles.

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.

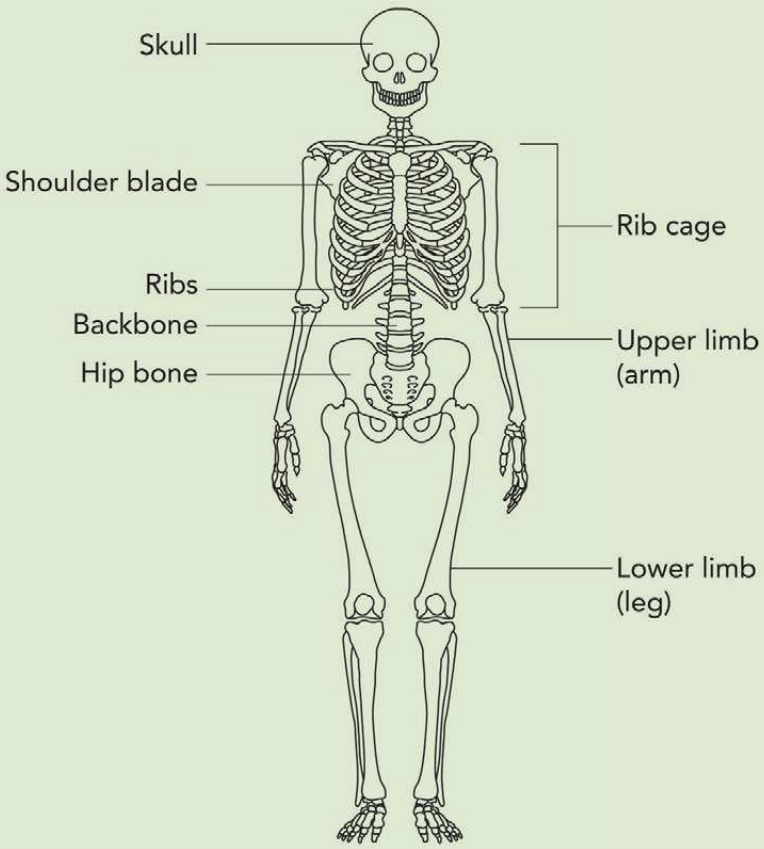


Now that you know where all the bones in the body are, you are probably wondering what exactly each bone's job is. Let's find out.

ACTIVITY: The bones in the human skeleton

INSTRUCTIONS:

1. Examine your skeleton puzzle. This illustration of the human skeleton 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.



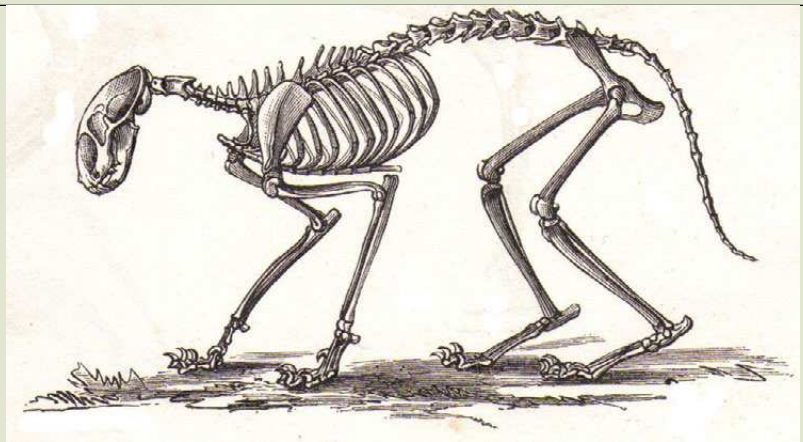
The human skeleton.

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	*vertebrae / backbone; jawbone*

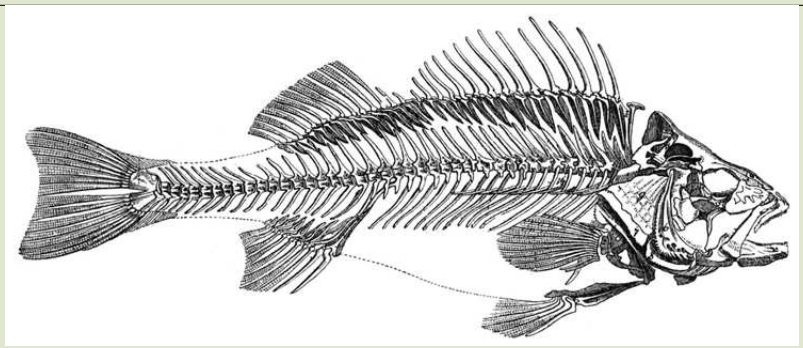
3. Now see if you can identify these bones in some other vertebrates' skeletons! Use this key to show on the picture of the skeleton where the different bones are :

   - L = Long bone
   - S = Short bone
   - F = Flat bone
   - I = Irregular bone

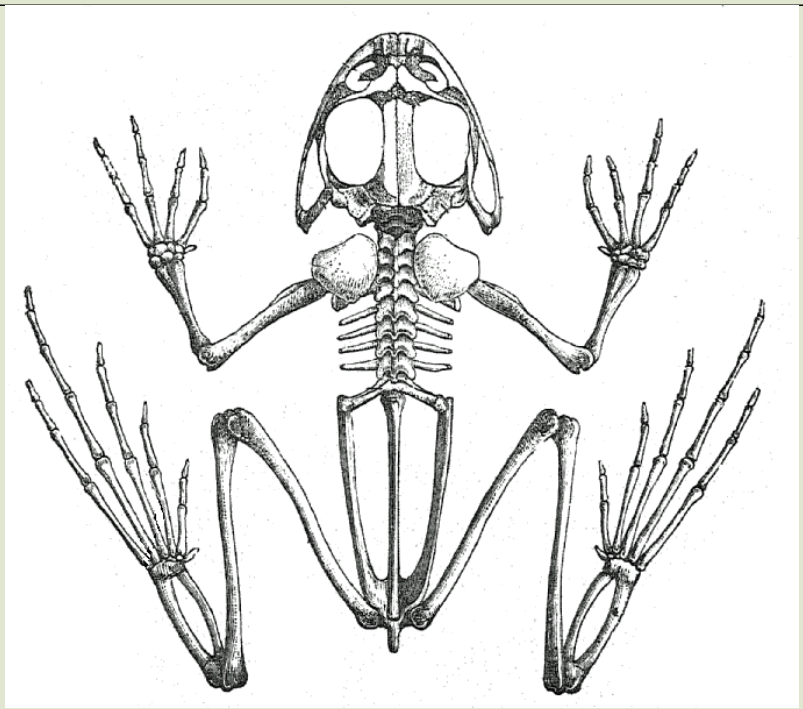
Cat skeleton



Fish skeleton



Frog skeleton



QUESTIONS:

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

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.

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.

Functions of the bones in a vertebrate skeleton:

1. The skull

Vertebrates' skull is made up of different bones that grow together to form a protective 'box' or 'shell' structure.

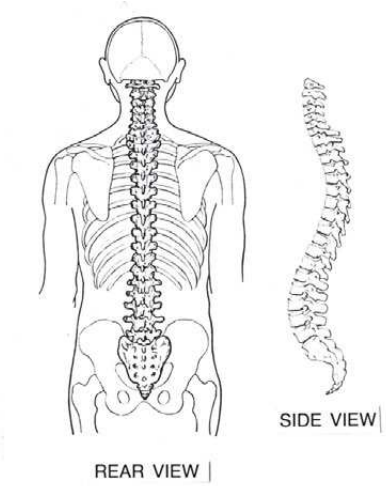
- The skull protects the eyes and ears, nose and mouth.
- It protects the brain.
- Vertebrates' teeth and lower jaw is also attached to the skull.

QUESTIONS

Can you identify the animals that each of these skulls belong to? Write the name in the space below each skull.

	
crocodile skull	*horse skull*
	
rhinoceros skull	*human skull*

2. The backbone

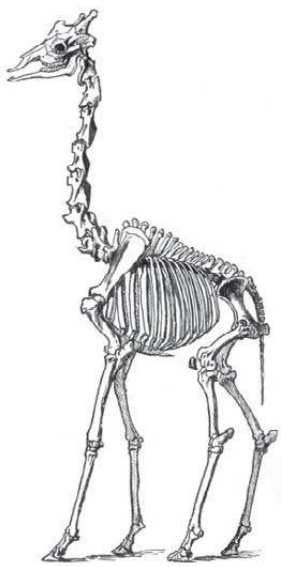


The human backbone and vertebrae.

- 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 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?

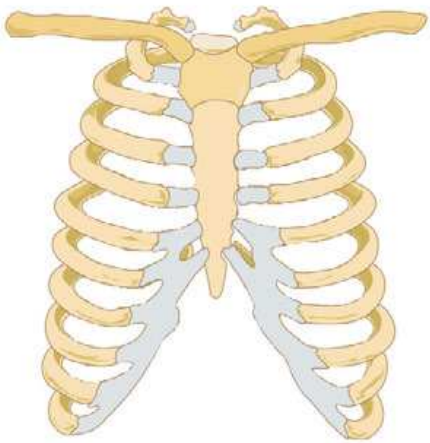


Giraffe skeleton.

3. The ribs

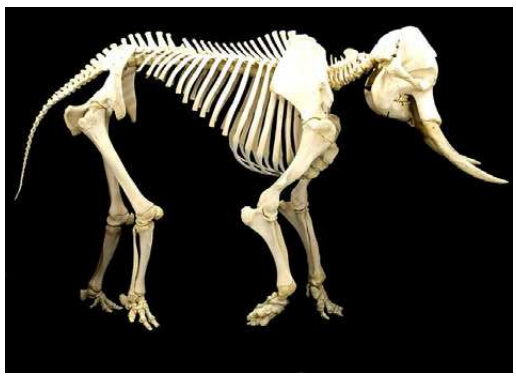
Vertebrates have long curved bones that we call ribs. These ribs are joined to the backbone and often to the front to form the rib cage.

- 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.

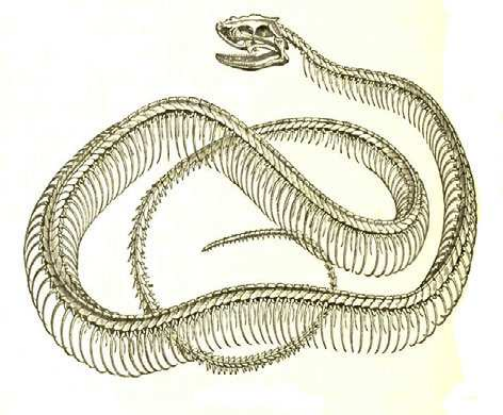


This is a human rib cage.

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?



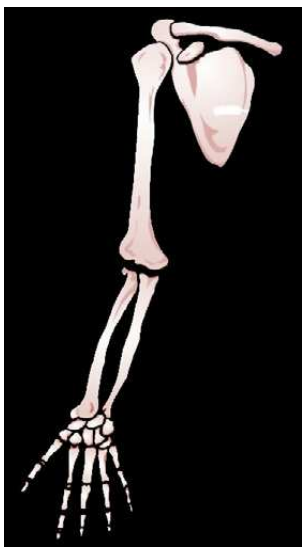
A snake's rib cage protects and supports almost the whole body.



A dolphin - do you see the front limbs look just like the other mammals' limbs?

4. Shoulder blades, arms, legs and hip bones

Vertebrates use their fore and back limbs for movement.



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

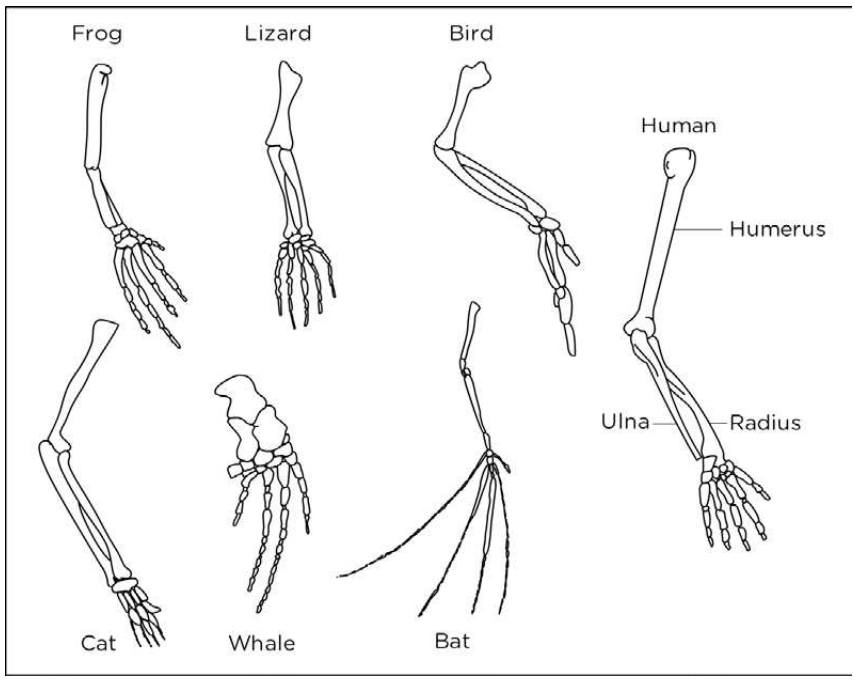
Many animals' limbs are attached to their bodies at the shoulder or hip joints. However not all animals have hip or shoulder girdles - like fish and snakes.

- 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 bones in different vertebrates' limbs look very similar. Look at the picture which shows the limbs of different animals.



Different forelimbs of vertebrate animals.

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 below.

- *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.*

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.

Teacher's Note

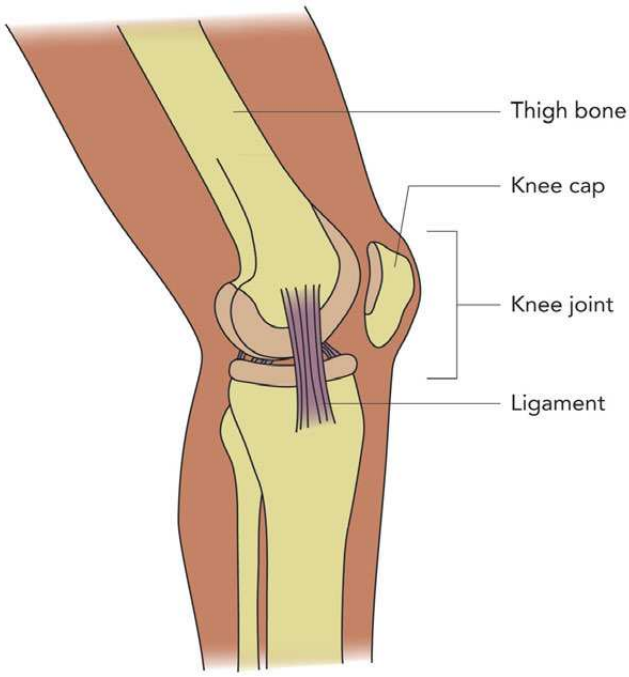
Introducing this topic

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.

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.



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

VISIT

Types of Joints Video:
goo.gl/5Bhal

QUESTIONS

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

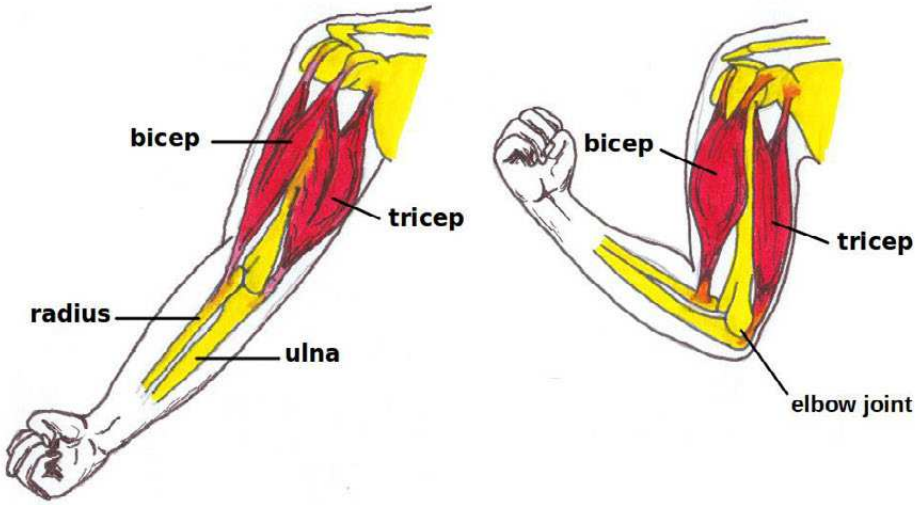
Elbow joint, shoulder joint, hip joint, joints between fingers, joints between toes, ankle joint, etc

How do the bones and the joints move?

Let us look at an example of the arm moving. Look at the picture. There are two muscles which 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.

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



The arm moves using muscles, joints and bones.

ACTIVITY: 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.
    - Your teachers will put the names of different animals in a hat.
    - A person from one team pulls an animal's name from the hat.
    - They may not make ANY NOISE or make any signals that will give the animal away!
    - They need to mime the movement of this animal to their group.
    - 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

Teacher's Note

This is a time-saving clause as this game can drag on and on if they are given multiple opportunities to mime. Everyone should be watching the first time.

- 2 points for the other team if someone gets it correct the first try. If they get it wrong then...
- 1 point for the least try - if they get it wrong then no points are awarded.

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.

2. Choose three (3) of the animal movements that your friends mimed and which you really liked. Write down for each of these:
   - The bones that were used to create that movement in the animal.
   - The joints that were part of the movement.
   - 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.

REVISION:

1. What type of skeleton do you have?

   Endoskeleton

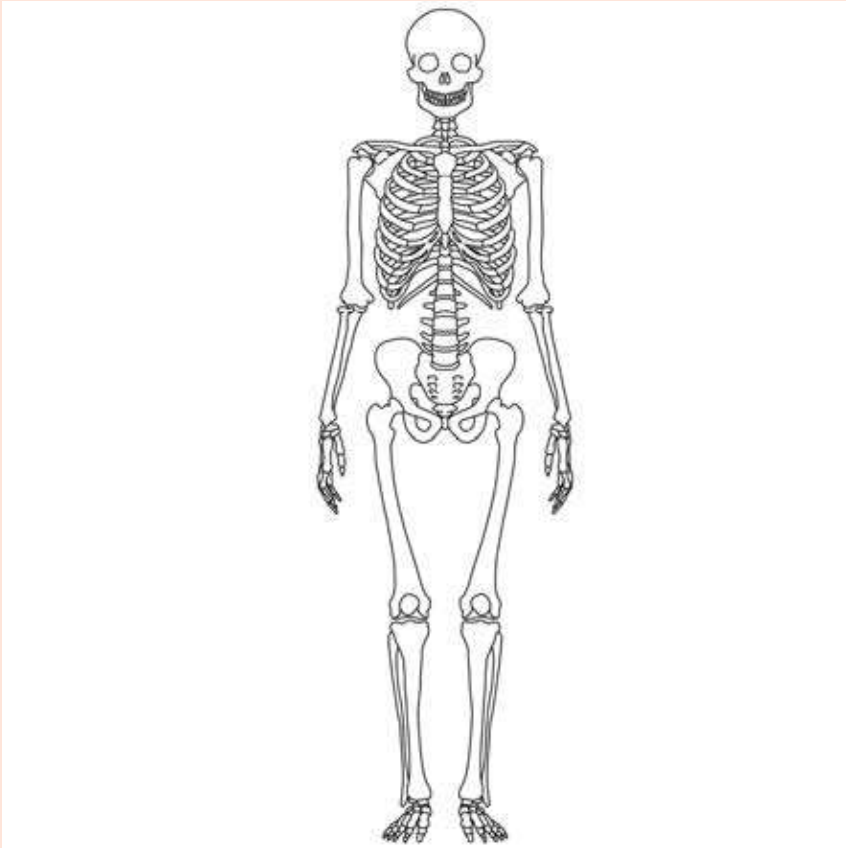
2. What do all vertebrate animals have that makes them vertebrates?

   Vertebrates have a backbone and skeleton inside their bodies.

3. What is a major difference between the skeletons of a mouse, a crab and an earthworm?
   - *A mouse has a skeleton and backbone inside their bodies. This is called a endoskeleton.*
   - *A crab has no bones inside its body but a hard shell outside its body to protect it. This is called a 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.*

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.



5. Joints help us to move. Look 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.

   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. 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.

   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?

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?

Once learners have gained a good understanding of these four points they are required to make a model of a vertebrate skeleton using these skills.

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

3.1 Structures



A jungle gym is a type of structure. [12]

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, that are put together in a special way.

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

Structures have different jobs or functions. They:

- support
- protect
- enclose - that 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 Gr 4 in Matter and Materials, 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 think about the words "Shell Structure" and "Frame Structure" and think what these could mean. Then think of examples of frame structures and of 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.

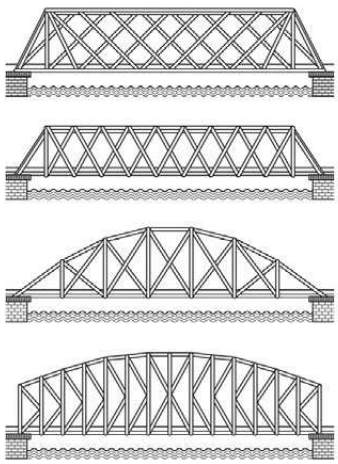
Teachers can use this question to assess pre-existing knowledge of shell and frame structures as similar work should have been covered in the previous year. Frame structures: burglar bars, palisade fences, cell phone towers, Eskom towers, sieve, jungle jim, etc. Shell structures: tortoise shell, hut,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

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 these photos of frame structures.



Construction workers use scaffolding. The scaffolding forms a frame.



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



The veins in a leaf form a frame structure. [3]



A spider's web is a frame structure. [4]



A pylon is a frame structure that supports electricity lines. [5]

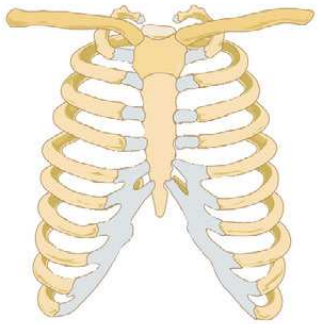
Teacher's Note

These photos are all examples offrame 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.

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



The rib cage is a frame structure.

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?

QUESTIONS

Which organs does the rib cage protect?

The heart, lungs and liver

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.

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.

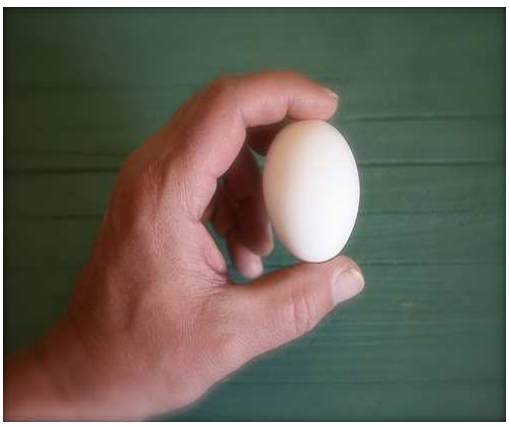


These guavas are contained in a basket which is a shell structure. [6]



A car has shell structure which protects the passengers inside. [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.



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

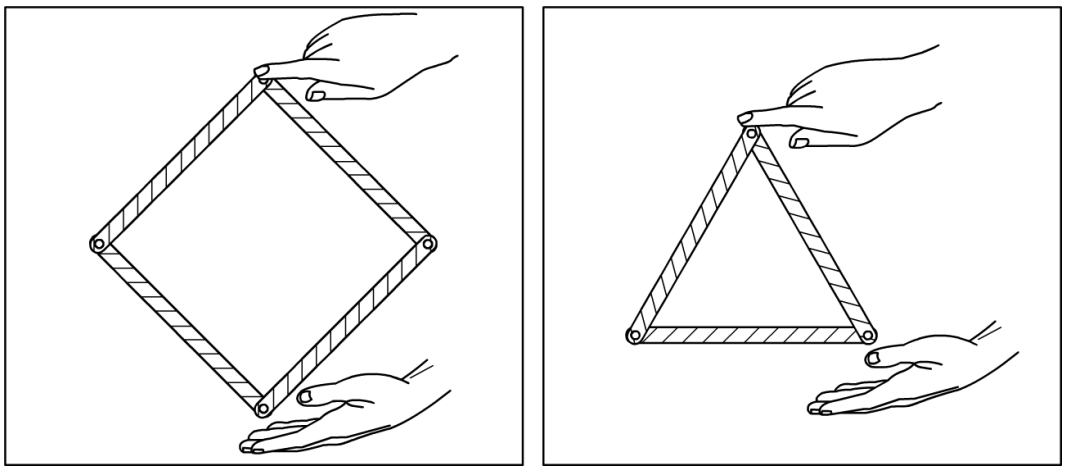


A crab has an exoskeleton which is a shell structure. [9]

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 Gr 4 Matter and Materials when we looked at whether a triangle or a square was stronger? Look at the picture to remind yourself.



Creating a square and a triangle shape.

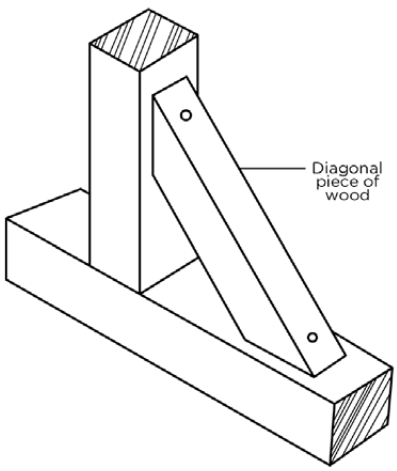
QUESTIONS

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.

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.

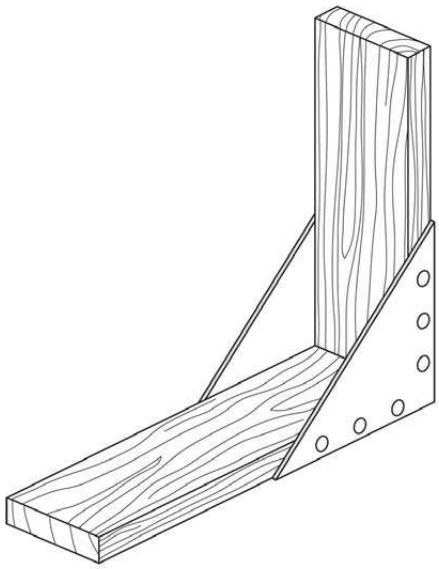
Corners in structures are very important because it is often the weakest point of a structure. To strengthen corners you can:

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



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

- 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: Making and designing a skeleton

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 Farrah 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.

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 ofinvestigating 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.

The local museum has asked your school if they have any models

of vertebrate skeletons for a display. Farrah has an idea. She loves making things and she also loves animals. So, Farrah has 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?

VISIT

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

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

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

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 3-dimensional
- It must look realistic
- It must have/show the basic parts, i.e. skull, backbone, ribs
- It must be strong and rigid and 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, sosatie 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 3 minutes.
3. What materials are you going to use to build your skeleton? Make a list of all the materials you will need.
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, use the space below to draw your final design. Label your drawing showing what materials you are going to use for the different parts.

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 3 minutes without your support?
2. What could you change in your skeleton to make it work better?
3. Did your skeleton fulfill 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 below where you tell Farrah about the skeleton that you built, what worked and what did not work, so that she can also 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 in nature.
- Structures can be strengthened.
- Struts can strengthen structures.

REVISION:

1. Complete the following table by stating whether the structures are frame or shell structures.

Structure	Shell or frame structure?
Jungle gym	*frame*
Eggshell	*shell*
Dog skeleton	*frame*
A cellphone tower	*frame*
A crab skeleton	*shell*
Scaffolding	*frame*
A car	*shell*
A basket holding fruit	*shell*

2. How would you strengthen a square shape? Give two different ways.

   Place a diagonal strut across from one corner to the next. Or put a gusset on the corners.

3. Give two examples of animals with skeletons that are frame structures. What is the name given to this type of skeleton?

   Endoskeletons - dog, human, birds, fish, etc

4. Give two examples of animals with skeletons that are shell structures. What is the name given to this type of skeleton?

   Exoskeletons - crab, insect, etc

5. What are the advantages to humans for having a frame structure as a skeleton? Explain your answer.

   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

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.

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!"

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!"

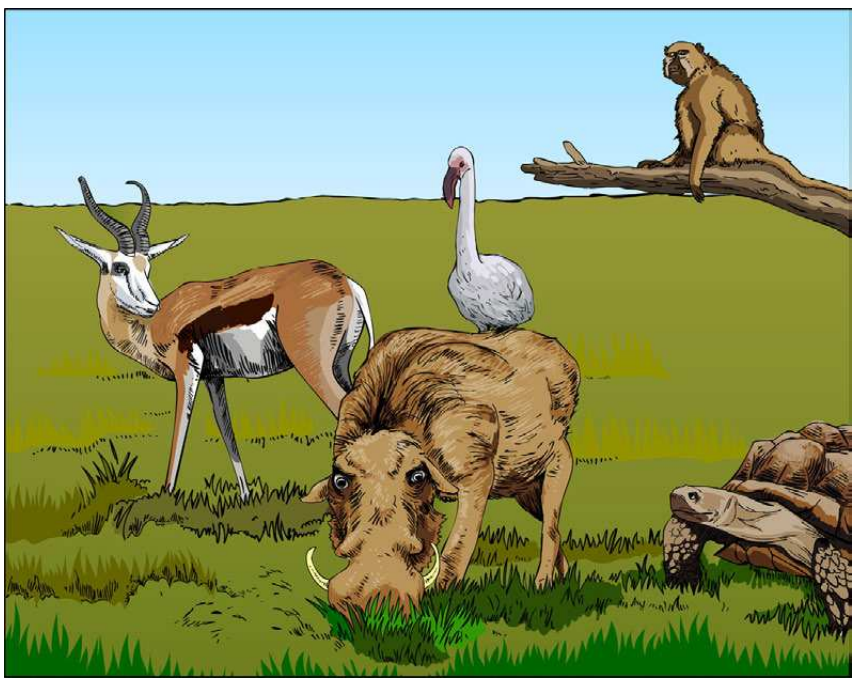
Warthog just *humfed* and scratched his back against the rough hard bark of a baobab.

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.

VISIT

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



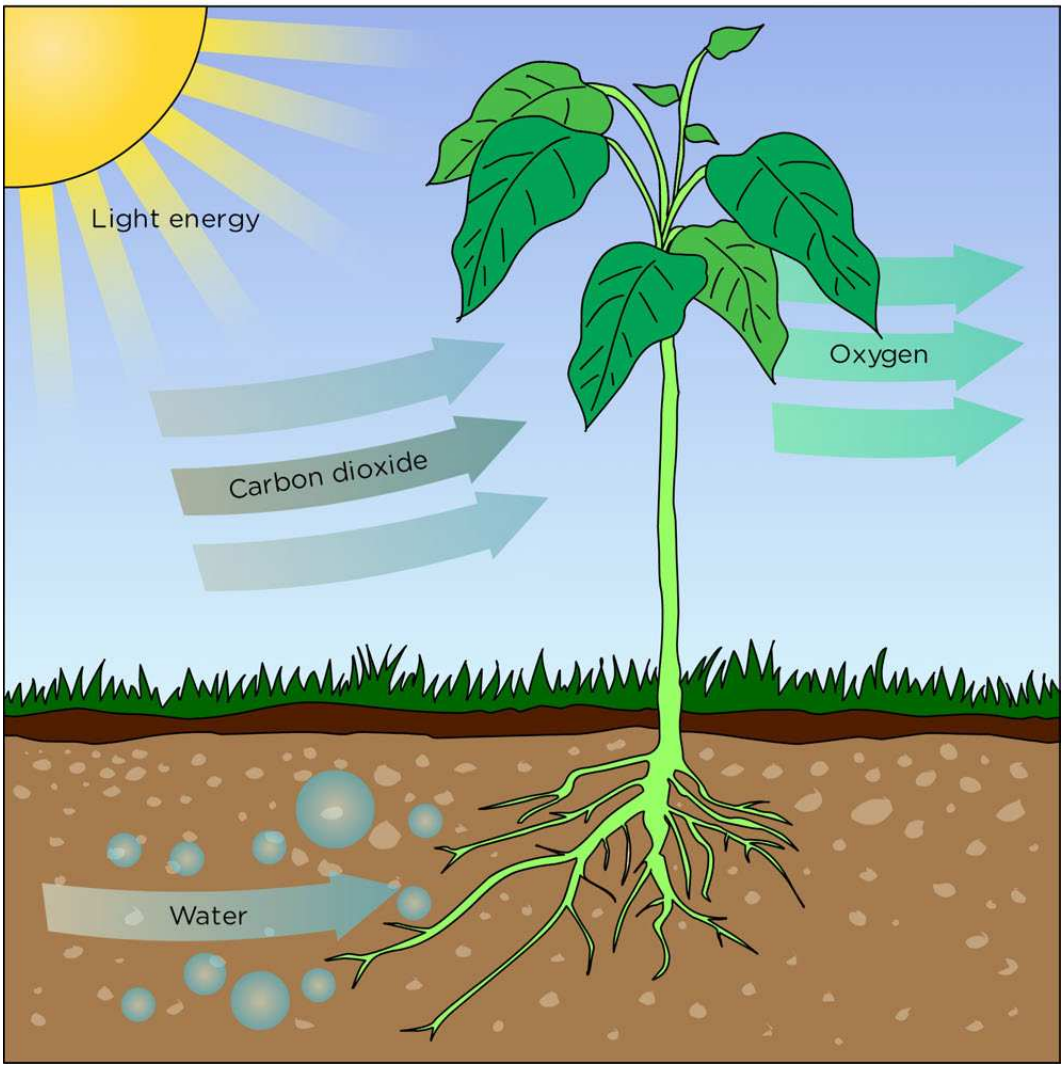
Teacher's Note

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.

Have you ever wondered if plants get hungry? If plants do not have mouths to eat with, how do they get food?

Plants do not need to EAT to get food - they make it themselves inside their 'factories'. Plants make their own food through a process called photosynthesis, like this:

- They absorb water and nutrients through their roots.
- The water travels to the leaf or stem where the plants make the food
- The plants use the gas carbon dioxide from the air.
- They also use sunlight energy from the sun for this process
- The plants use the water and carbon dioxide gas with the sunlight energy to make food that we call sugars.
- The plants give off the gas 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 to live. They store the extra food that they make in different parts of the plant.
- Animals then eat these parts of the plant (or the whole plant) to get food.



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.

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.

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.

QUESTIONS

What would you be prepared to pay for a day's worth of oxygen? Plants make this all for free for us!



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

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 can make their own food are called producers because they produce their own food.

QUESTIONS

Turn to a friend. Take turns to explain what 'ingredients' a plant uses during the process of photosynthesis and what the plants make or produce from this. Write your answer below.

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

If an animal wants to get energy it cannot use sunlight energy, 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 a plant or an animals are called consumers.

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.

- 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 can eat 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.

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.

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

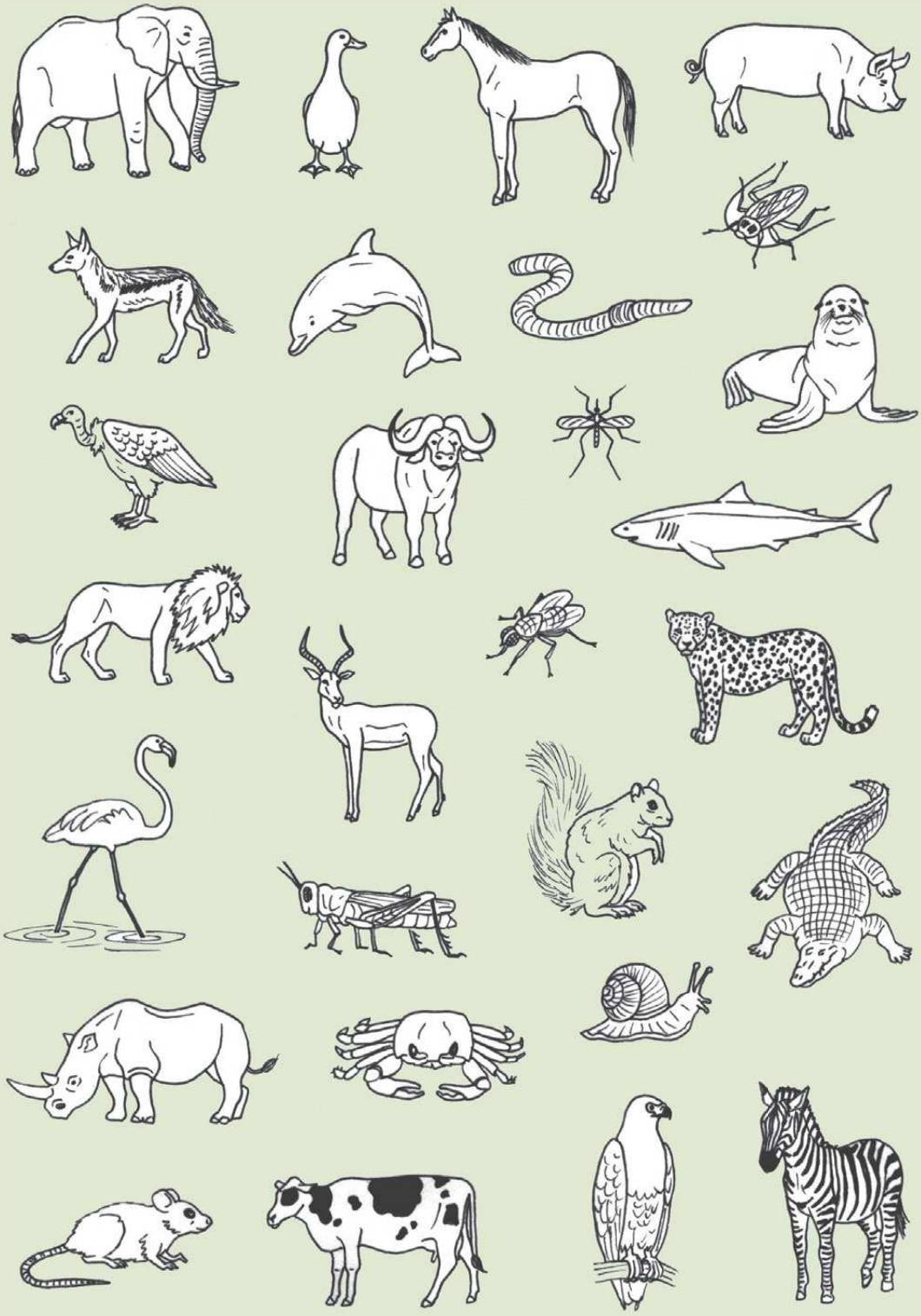
MATERIALS:

- Books and reading material on all sorts of animals displayed in class.
- Do research in your local library or on the Internet and bring information on one of the animals in the picture below to class.

INSTRUCTIONS:

1. Identify the different animals in the picture. Sit with a friend in class and see if you can name as many of the animals as possible.
2. Identify what the animals eat.
3. Classify the animals as a herbivore, omnivore, carnivore, scavenger or decomposer.

4. Select 3 of each and record them in the table below.



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

cockroach	
flamingo	*filter feeders - small plant and animal material*
3 scavengers are:	
fox	
vulture	
crab	
3 decomposers are:	
earthworm	
fly	
snail	

4.2 Food chains

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.

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 describes how each living thing gets food and **how energy is passed from one organism to the next**.

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 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.

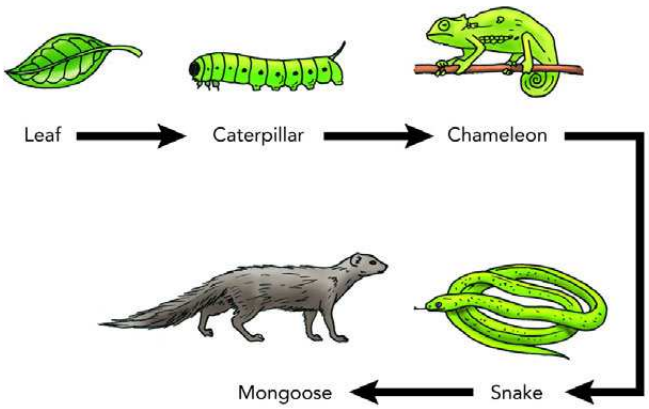
- When we draw a food chain we use an arrow (->) between

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 -> worms.
- Many food chains that are interdependent and linked are called a food web.

VISIT

The Food Chain song.
7



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

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.)

ACTIVITY: Making food chains

MATERIALS:

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

VISIT

Food chains (video)
goo.gl/MSO2f

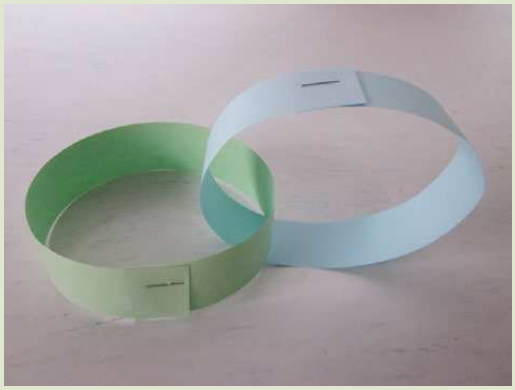
INSTRUCTIONS:

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/omnivores)
3. Design your own food chain in the space below. Remember to start with the producers then add in consumers. To show the flow of energy you must use an arrow (⊠).

4. Collect cut out 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:

    - 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 here.



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

- 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's web when everyone's chains are up.

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.

7. Use string/wool to show this interdependency, so you can see that food webs show the way that 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 which are broken.

ACTIVITY: 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.
4. You can even draw some pictures of the animals if you want to.

Grasshopper, Hawk, Snake, Grass

Grass > grasshopper > snake > hawk

Shrimp, Seal, Fish, Algae

Algae > shrimp > fish > seal

Bee, Daisy flower, Butcher bird, Spider.

Daisy flower > bee > spider > butcher bird

Mouse, Jackal, Leopard, Grass.

Grass > mouse > jackal > leopard

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?

Vegetarian

Let's look where humans fit into food chains.

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.

ACTIVITY: 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:

1. Order everything you ate and drank in a day into the following 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:	

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"?

ACTIVITY: 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".

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

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 Farrah lives!



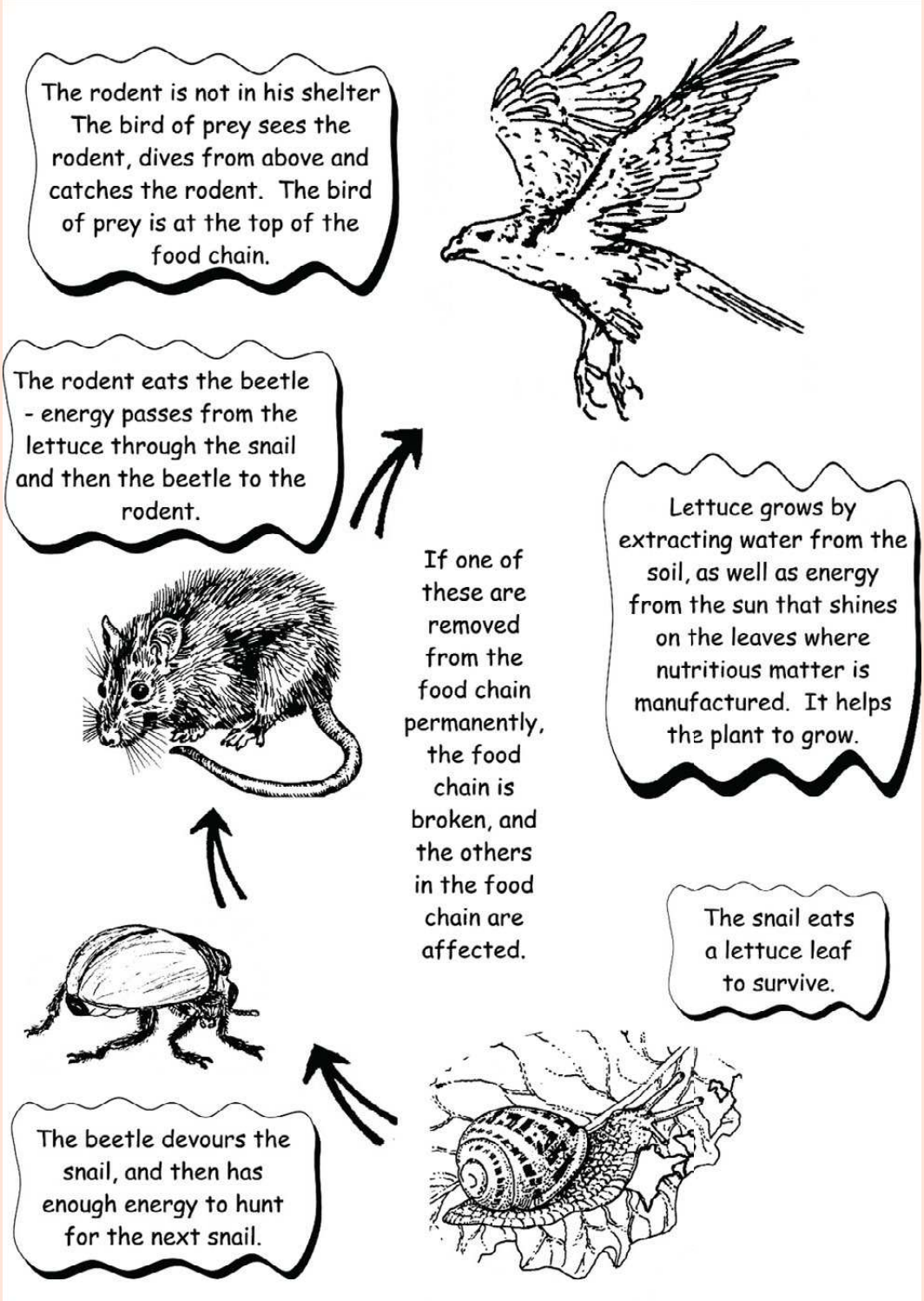
KEY CONCEPTS



- 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.



1. Write a five link food chain using the information and pictures above.

   lettuce > snail > beetle > rodent > eagle

2. Which organisms are herbivore?

   snail

3. Which organisms are carnivores?

   beetle, rodent and eagle

4. The energy flow in this food chain started with a main source of energy. What source of energy provided this source of energy?

   sun

5. Explain the interdependence in this food chain.

   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 ifit does not eat it directly.

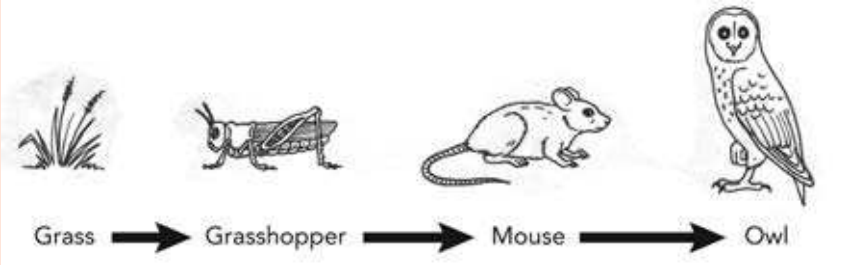
6. What would happen if the eagle was removed from this food chain?

   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. 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.

   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. Look at the following picture of a food chain. Name the producer, the herbivore and the carnivores.



Producer: Grass

Herbivore: Grasshopper

Carnivore: Mouse and owl

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

   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?

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.

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 oflife 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.

5.1 Growth and development

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.)

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.

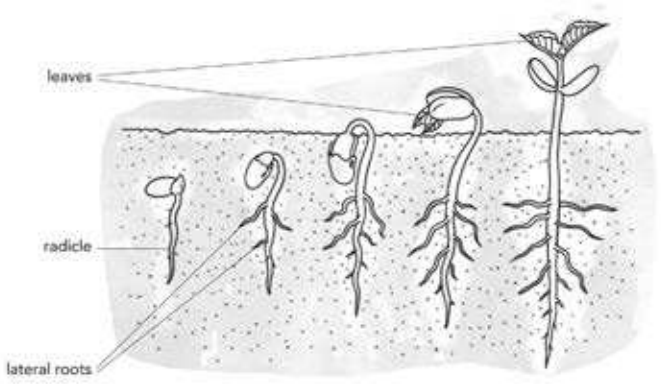
This question is meant to make learners think about growth and development in their own lives before requiring them to apply this knowledge to other plants and animals.

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

VISIT

Growth of a seed (video)
goo.gl/qj4M4

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 pictures below. What do you think the insects in these pictures are doing?

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

VISIT

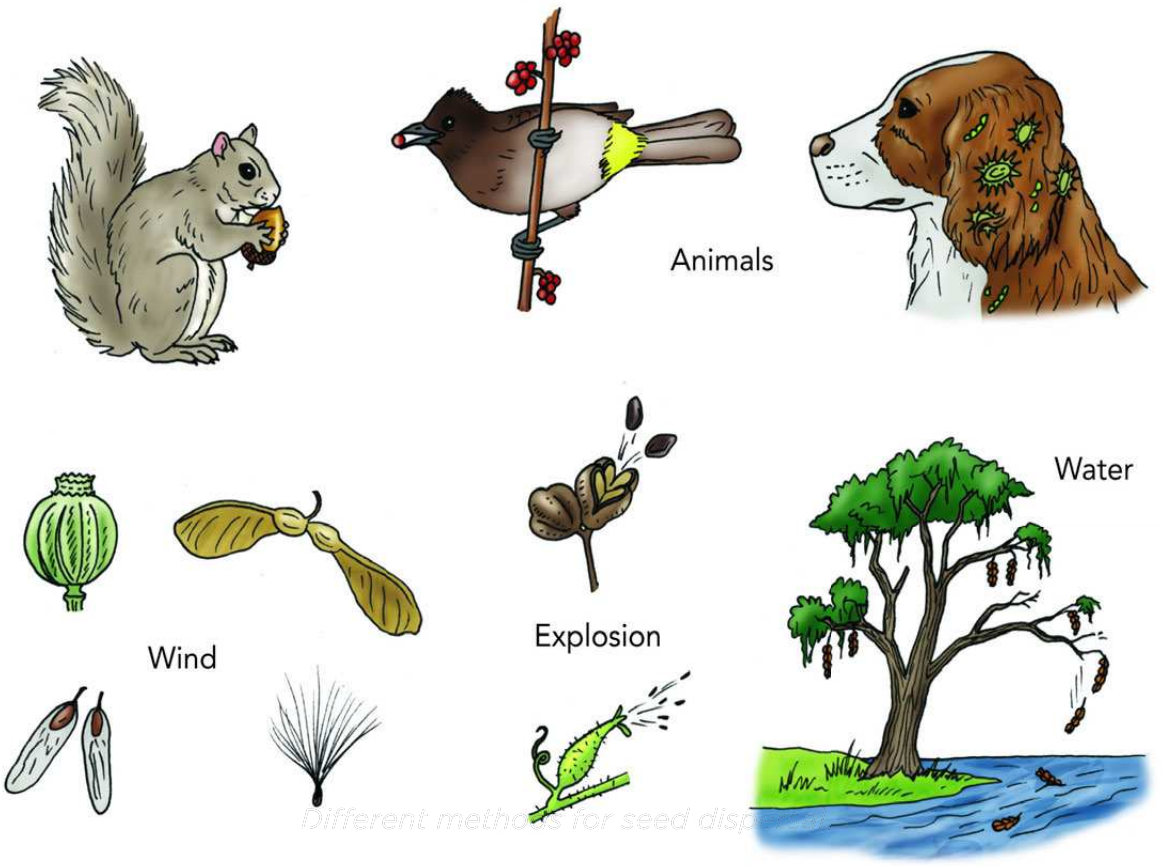
A video on pollination.
goo.gl/GWtMi

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

- The pollen fertilizes the ovules in the flower.
- The fertilized ovules now develop into seeds.
- The seeds are then dispersed and start to grow in a new place.
- Seeds can be dispersed in different ways.

VISIT

Video on seed dispersal.
goo.gl/YOoQ0



Different methods for seed dispersal

QUESTIONS

1. Why does a plant need to disperse its seeds?

   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 survival of the species therefore sends seeds to different places to 'minimize risk' should something happen at that

location.

2. 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.

   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.

When a seed lands in soil it can start to germinate all over again. The cycle begins again.

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).

ACTIVITY: The life cycle of a tomato plant

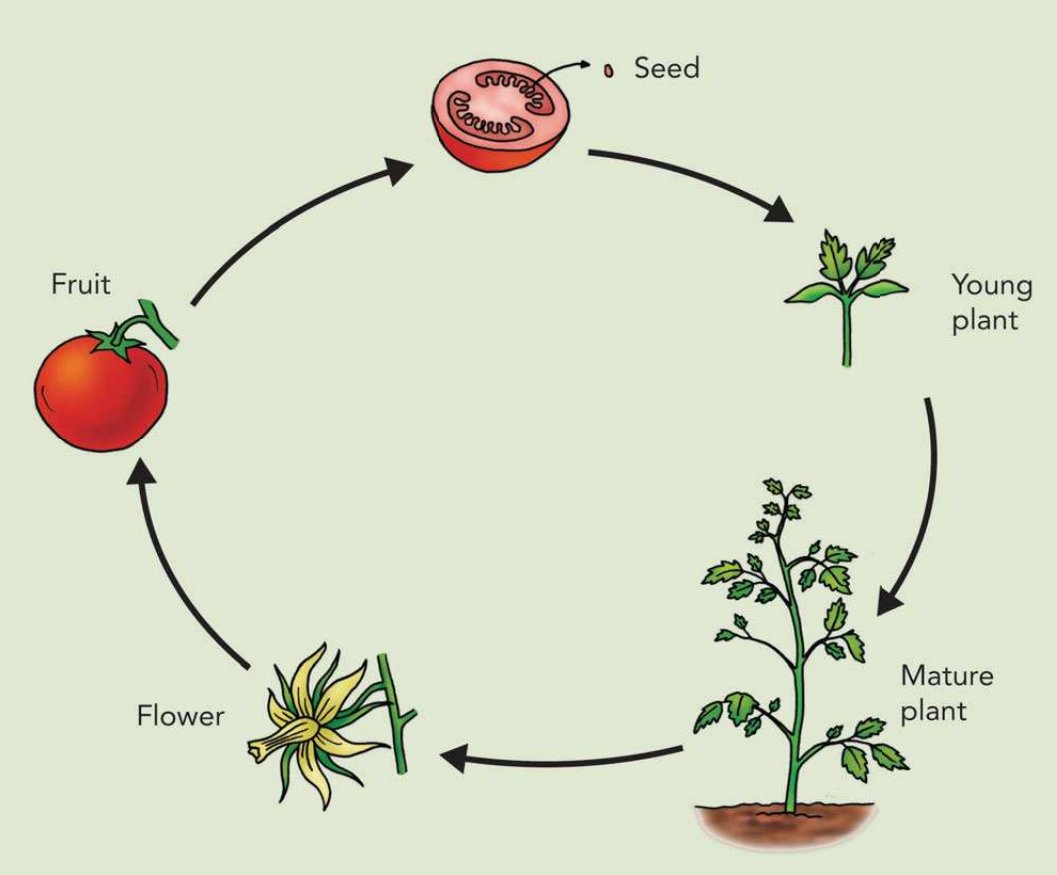
MATERIALS:

- Tomato plants in your classroom or in the garden
- The seeds of these tomato plants
- Some ripe tomatoes similar to the ones growing in your class.
- Picture below of the life cycle of tomato plants

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.

INSTRUCTIONS:



The life cycle of a tomato plant.

1. Study the life cycle of a tomato plant. List the developmental stages of a tomato plant starting at the seeds - you can use the illustration above to help you.
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 the space below. Remember to make a scientific drawing using the correct way oflabelling that you learnt in grade 4.

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.

4. Carefully examine the tomato seeds from the seed packet. Your teacher will cut open the tomato fruit. Compare the seeds from the fresh fruit with those from the seed packet. Write this comparison in the space below.

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

5. Look at the tomato plant in your class. Find the following plant structures on the plant and describe each of these in the space next to it. Then make a sketch in the space provided of each plant structure.

VISIT

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

	Describe the plant structure	Sketch the plant structure.
Stem		
Leaves		
Flowers		

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.*

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: Life cycle of a frog

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.

MATERIALS:

- a glass aquarium, a large glass or plastic container, or a 5 litre ice-cream tub
- chlorine free water
- water plants (if available)
- some large rocks that will stick out the surface of the water
- fish flakes

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

INSTRUCTIONS:

1. Prepare the habitat for the tadpoles using the materials above.
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 you prepared for them.
4. Change the water at least every second day.
5. Feed the tadpoles with fish flakes.
6. As a class, keep a diary of the tadpoles' growth and development over the next few weeks on large pieces of paper or something similar.

Date	Description of your observations	Sketch of your observations

Stages in an animal life cycle

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

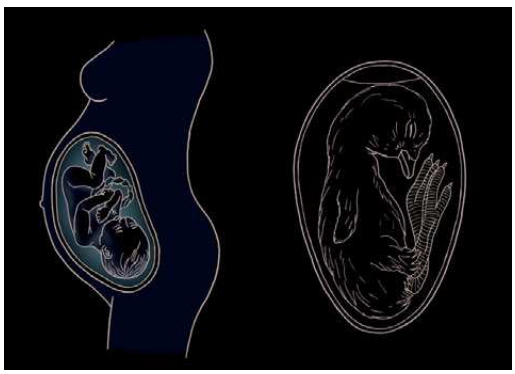
- Gestation - before birth
- Growth and development
- Maturation
- Reproduction

VISIT

Frog life cycle (video)
goo.gl/zUiJP

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

- **Born alive**: 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 embryo develops inside the egg before it hatches.
- **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..



Gestation - in a human 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 and go through a very big change in their life cycle. This change is called a **metamorphosis**. Look at the stages of metamorphosis of a monarch butterfly below.

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.
			

VISIT

Video on metamorphosis. goo.gl/uYjt4 and life cycle of a monarch butterfly. goo.gl/5SVbi

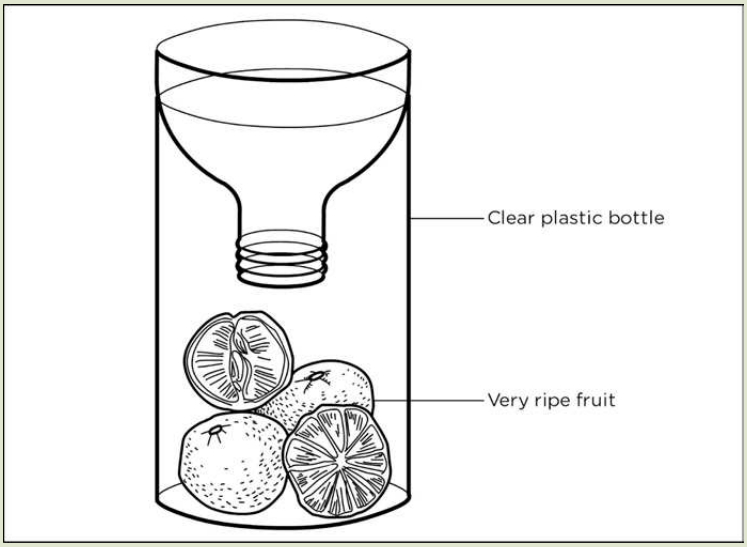
ACTIVITY: Observing fruit flies reproduce

MATERIALS:

- clear plastic bottle
- sharp knife
- ripe fruit

INSTRUCTIONS:

1. Cut the top part off a clear plastic bottle.
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.

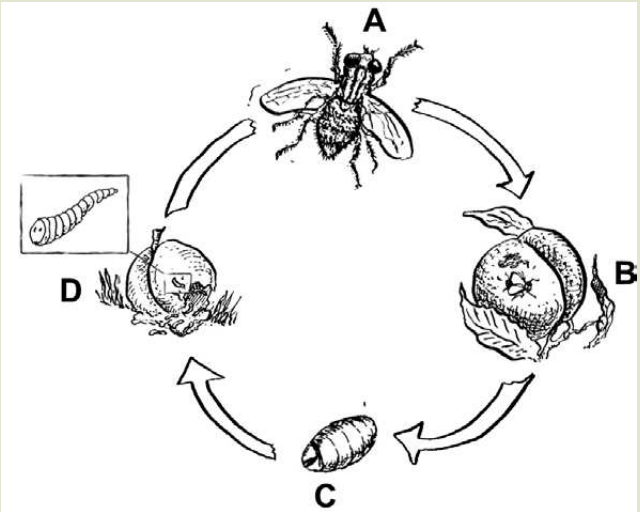
4. Keep a diary of all that you see happening inside the bottle over the next 2 - 3 weeks. Provide a short description and a neat sketch (not a scientific drawing). Keep your daily diary in the space provided below:

Date	**Description of your observations**	**Sketch of your observations**

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.

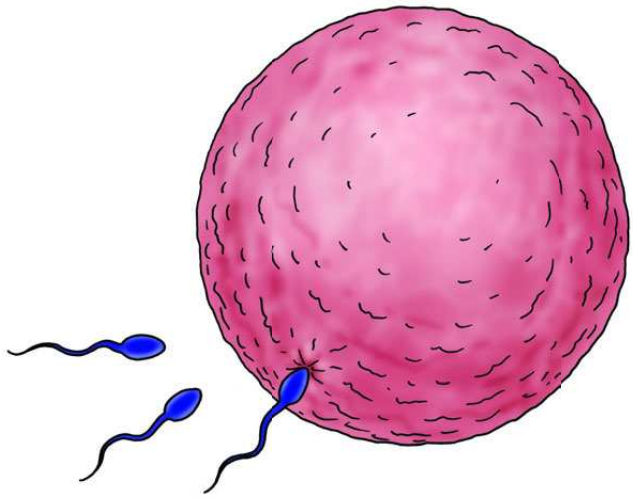
After keeping the fruit fly diary, carefully study the following diagram of the fruit fly's life cycle. Write a sentence or two explaining what is happening at each stage of the fruit fly's life cycle.



The fruit fly life cycle.

	Label the stage:	**Describe the stage:**
A		
B		
C		
D		

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



Fertilization 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.

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.

ACTIVITY: The Frog Life Cycle

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.

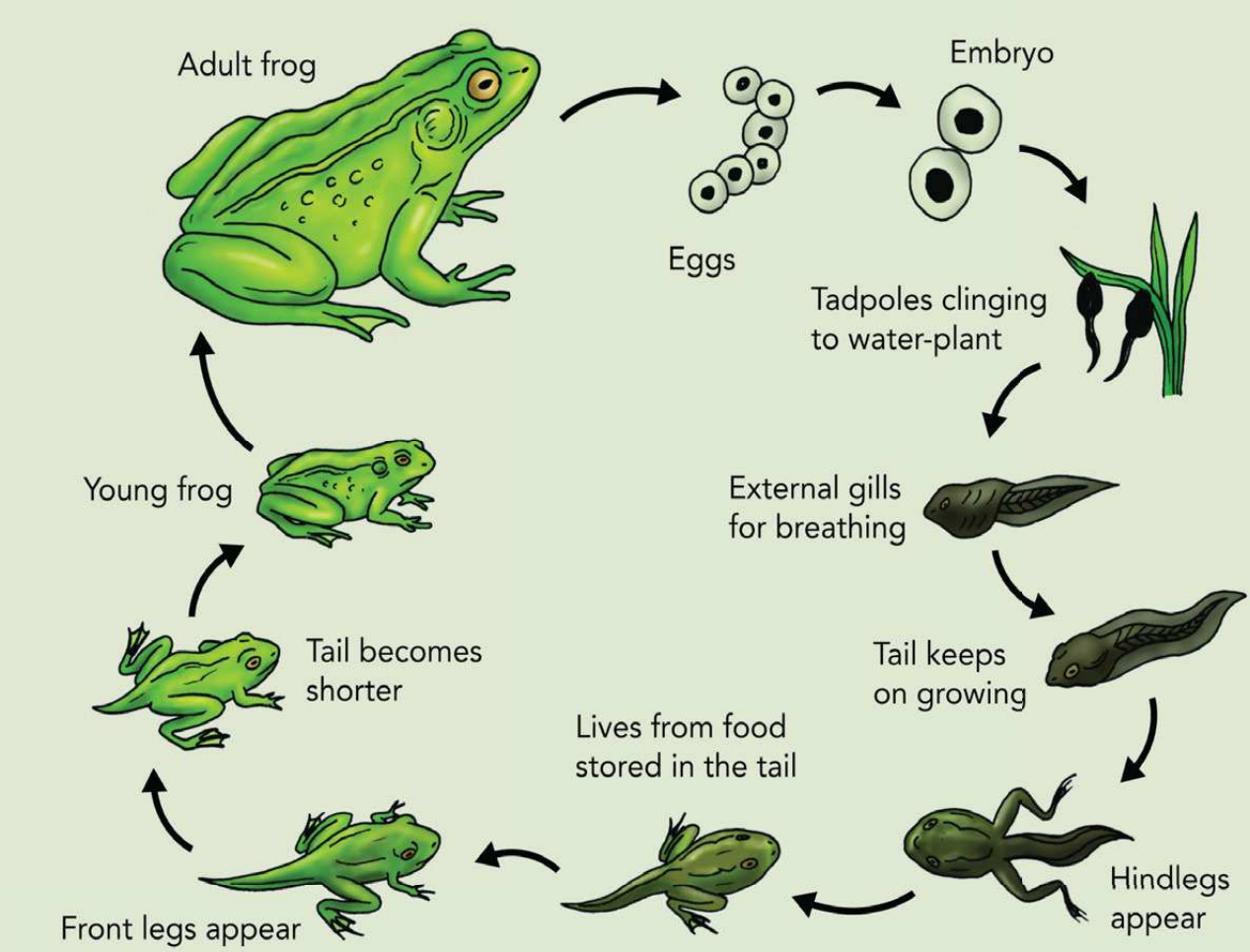
INSTRUCTIONS:

1. Hopefully you were able to see some tadpoles develop into frogs.

2. Let's revise the stages of a frog's life cycle.

3. Look at the life cycle of the frog in the illustration below.

4. Describe the various stages in the life cycle of this frog in the table on the next page.



The frog life cycle.

	Description of this stage:
Gestation stage	*Frog embryos develop inside the eggs and then tadpoles hatch from this.*
Larva stage	*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 stage	*The young adult doesn't have a tail anymore and the front and hind legs develop fully.*
Adult stage	*The frog matures and can reproduce.*

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 animals 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.

REVISION:

1. Explain what it means when we say that a plant or animal has a life cycle.

   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. Explain the 4 stages in the life cycle of a flowering plant - think for example of a tomato or bean plant.

   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 use their brightly coloured petals and their scent to attract animals. Why do they need animals to come to them?

   Plants need these animals to spread their pollen and receive pollen from other flowers.

4. Wind pollinated plants are much less attractive than plants that have to attract birds and insects. Why do you think this is?

   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. When plants disperse their seeds by means of water, what important features do these seeds need to have?

   The seeds need to be watertight.

6. Why do animals and plants have to reproduce?

   If they do not reproduce they will become extinct.

7. Use the following words to complete these 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.

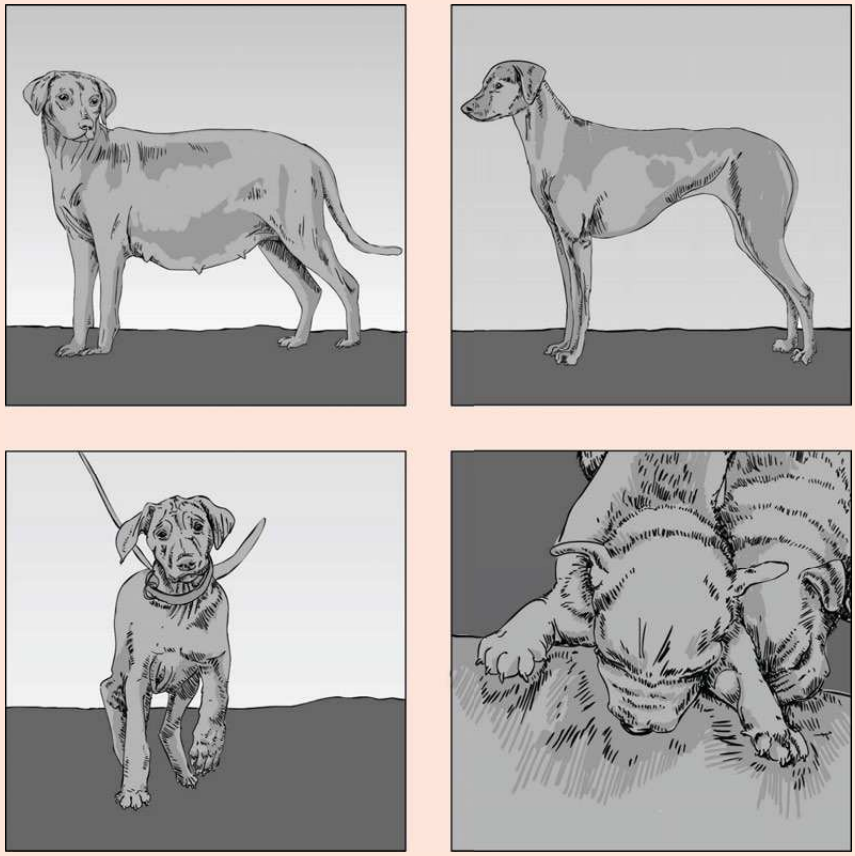
b. A chicken and snake embryo have an _____ type of gestation.

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 is attached to the mother's body.

- *A (life cycle)describes how reproduction takes place and shows the way in which a plant or animal changes as it grows.*
- *A chicken and snake embryo have an (egg laying) type of gestation.*
- *A puppy or kitten are (born alive) from the wombs of the female animal.*
- *While in the womb the embryo of a cow or horse receives nourishment through the (umbilical cord) that is attached 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.



The Life Cycle of a Dog

9. Describe the different stages in the life cycle of a cat and the processes that take place in the space below.

   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. When does an animal die?

    An animal can die at any time during its life cycle.

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?

    These animals spread the plants' seeds and if they are removed the seeds cannot often germinate or grow and develop as needed.

12. What possible dangers do crop sprays, pesticides and pollution hold for plants and animals?

    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.


HOT
WET
CEMENT


Matter and Materials
and Processing

1 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?

Teacher's Note

Introducing the topic

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**.

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 or 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 which would be the best material with which to make the object.

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?

   Wood

2. What material would you choose to make a spade for digging in the garden?

   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.

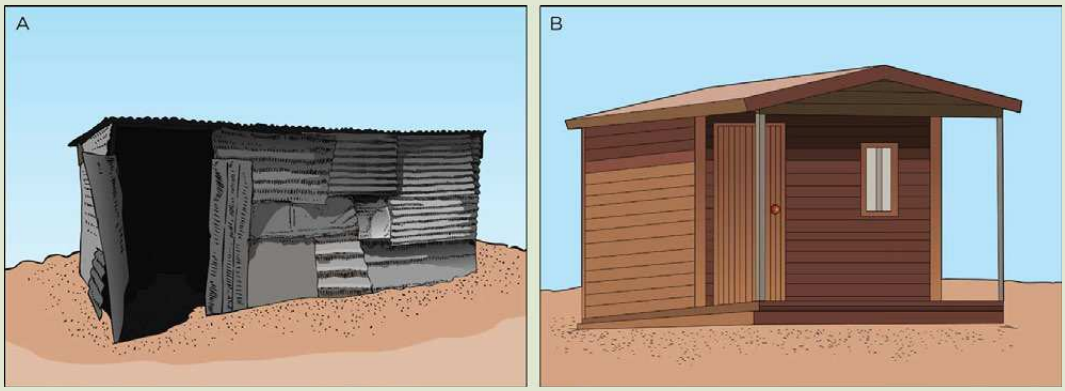
ACTIVITY: Choosing a material to build a house

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?

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?

   House A is made of corrugated iron (tin/metal).

2. What material was used to build house B?

   House B is made of wood.

3. If you had to build a house next to the ocean, which one would you choose, house A or house B?

   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. Write a reason why you would build this house next to the ocean, rather than the other one.

   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. Write down at least 3 other materials that could be used for building a house.

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

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

1.1 Properties of metals

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.



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

Good question Tom! 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 and 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 made 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

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.



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

Do not worry Tom! These are new, big words, but here is an activity in which we can investigate some of the properties of

metals. We will use our skills of observation (looking, listening and touching) during the investigation.

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.

INVESTIGATION: What are the properties of metals?

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 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.

Tom 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.

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

MATERIALS:

- coins

- metal spoon
- metal pencil sharpener
- metal nail or screw
- paper clip or thumb tack
- pin
- steel wool
- metal bottle top

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 below (you may use words from the box below or you may 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: 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.



A metal pot. [1]

3. Describe the properties of the metal that this pot is made from.

   The pot is shiny, strong and hard, it conducts heat, and only melts at very high temperatures

4. Why are some of the properties useful to the function of the pot.

   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.



A barbed wire fence.

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

   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?

   The spanner must be hard and strong.

7. How do the properties of metal help the functioning of a spanner?

   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. If the spanner was made from plastic, do you think it would work as well? Why?

   A plastic spanner would not work so well as it would easily break. Plastic is not as strong or hard as metal.



Coins are made from different metals.

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

   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.



A tank made from corrugated iron. [2]

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

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

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: How can dirty copper coins be cleaned?

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.

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?

   How can you make a metal object shiny again? How can you clean dirty copper coins or pots?

2. Write the list of materials that you needed for this activity. Write it in a bulleted list.

   - *cloths*
   - *Brasso*
   - *coins*
   - *old pots*

- *a bowl of water*

3. Imagine you have to tell the Thunderbolt kids how to do this activity to answer your question. Write down the steps below 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.

   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. What can you conclude was the best and quickest way to make dull metal shiny again?

   Something about the fact that rubbing with a cloth and brasso is the best way to make a dull metal object shiny again.

1.2 Properties of non-metals

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 oflight is not done at this level, but dullness can be defined as the scattered reflection oflight 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.



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

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?

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 of the outside 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.



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 the previous activity. This is so that we can compare metals and non-metals later on.

INVESTIGATION: The properties of non-metals

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

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

MATERIALS:

- paper or cardboard
- cotton wool

- fabric
- plastic spoon
- cork
- sponge
- piece of chalk
- small, strong glass (learners should 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 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 below (you may use words from the box below or you may use your own words).

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

OBSERVATIONS:

Fill in the observations from your investigation of different non-metals below.

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?

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?

Metals are (mostly):

- 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; and
- cold to 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.); and
- usually feels neither cold nor hot.



KEY CONCEPTS



- Every type of matter has its own set of properties.
- "Shiny", "brittle", "malleable", "dense" are all examples of 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?

   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. How can we tell if something is made of metal?

   Things that are made of metal is shiny, and hard and they can sometimes feel heavy.

3. What does it mean to 'use our skills of observation'?

   Skills of observation are looking, listening and touching. Smelling and tasting are also forms 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 and the apparatus. Rather, explain in a paragraph about the different types of tests you would do to determine if something is made of a metal or a non-metal.

   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 ifit 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. 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 non-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 and not a metal?

   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).

2 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 jewelry, coins, buildings, vehicles, furniture and utensils?

Teacher's Note

Introducing the unit

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 offridges 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.

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.

2.1 Special properties of metals

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.

ACTIVITY: Learning about magnetism

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**.

You should try to include at least one non-magnetic metallic object so that the learners discover that not all metals are attracted to a magnet. Aluminium (eg. kitchen foil), zinc or copper all fall in this category. The reason why South African copper coins are attracted to a magnet is because they are made ofiron (which is attracted to a magnet, of course), with a thin coating of copper on the outside.

MATERIALS:

- Metal objects: coins, spoon, metal 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 column named "Metal objects" in the table below.

3. Write the names of all the non-metal objects in the column named "Non-metal objects" in the table below.

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 objects	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 say decide whether the following statements are True or False. If the statement is true, you should draw a cross (X) in the 'TRUE' column; if the statement is false, you should draw a cross (X) in the 'FALSE' column.

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 magnet.		

2. One of the Thunderbolt Kids on the front cover for Matter and Materials for this term is holding a magnet. Who is it and what is stuck on the magnet? What must these objects be made from to be attracted to the magnet?

   Tom is holding a magnet with nails and screws made of metal (iron) stuck to it.

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.

   some, none

Word box: 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?

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 ofiron, making lots of the metals objects around us magnetic.

In the next activity we are going to test the magnetic properties of different metals. There is also a problem that Tom 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!

ACTIVITY: Using magnetism to solve a problem

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 Tom and another playing the role of Uncle. The group can solve the problem together and Tom 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.

MATERIALS:

- Metal pieces: iron, aluminium, and copper
- Magnet

The problem:

Tom likes to visit the junkyard to look for bits and pieces of rubbish 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 Tom about his problem.



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

Tom: "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 Tom's advice to Uncle will be?

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.

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.
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 below.
4. Hold each metal near the magnet. If the metal is attracted to the magnet, draw a cross (X) in the column "Magnetic". If the metal is not attracted to the magnet, draw a cross (X) in the column "Not magnetic".

Metal	Colour of the metal	Magnetic	Not magnetic

Write what Uncle should do in the space below. (It would help Uncle if you gave him step by step instructions on how to sort the metals.)

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.

Not all metals are magnetic and we saw how this meant that the property of magnetism can be put to use to sort metals.

Metals and heat

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.

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.

ACTIVITY: Learning about heat flow (thermal conductivity)

MATERIALS:

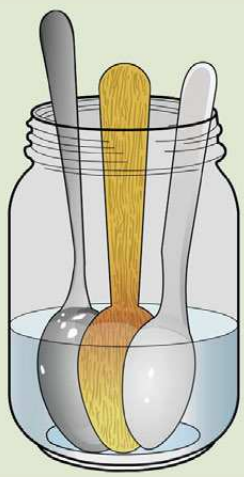
- Container (1 liter yoghurt tub, bottle or a 2 liter ice cream container)
- Warm water (not boiling)
- Ice cold water
- Metal spoon
- Plastic spoon
- Wooden spoon (a pencil or a stick will also do)

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 image.

Teacher's Note

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



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 below.

   The metal spoon feels the warmest.
5. Empty the container and rinse the spoons under the cold tap.

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.

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 below.

   The metal spoon feels the coldest.

QUESTIONS:

1. Did the metal spoon feel warm after it had been standing in the warm water?

   Yes it did. It felt the warmest of all three spoons.
2. Where did the heat (that you felt with your fingers) come from?

   The heat came from the hot water.
3. How did the heat reach your fingers?

   The heat travelled (moved) through the metal of the spoon.
4. Complete the sentence. Write the sentence out in full.

   The spoon feels hot because heat flows from _____ to _____.

   The spoon feels hot because heat flows from ***the water*** *to* ***my hand***
5. Did the metal spoon feel cold after it had been standing in the ice cold water?

   Yes it did. It felt the warmest of all three spoons.

6. Where did the cold (that you felt with your fingers) come from?

   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. How did the cold reach your fingers?

   Heat flows from my fingers into the cold spoon. That is why my fingers feel cold.

8. Complete the sentence. Write the sentence out in full.

   The spoon feels cold because heat flows from_____ to _____.

   *The spoon feels cold because heat flows from **my fingers** to **the spoon***

9. Which material (metal, plastic or wood) is the best conductor of heat?

   Metal is the best conductor of heat.

Metals and corrosion

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.

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]

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 statue?

INVESTIGATION: Learning about corrosion (rust)

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)

AIM: To find out how rust occurs

MATERIALS:

- 30 identical iron nails
- 3 small clean, dry containers (yogurt tubs or polystyrene cups)
- tap water
- salt water (made by dissolving 10 teaspoons of salt in a liter of tap water)
- plastic wrap to cover the containers

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 10 iron nails in each of the containers.
3. Pour enough tap water on the nails in container A to cover 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 10 days.

9. Write your results in the table below.

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			

Use the space below to draw a graph of how many nails had rust on them after each day.

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.

QUESTIONS:

1. In which cup did the nails start rusting first?

   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. 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 _____.

   a. water (and salt water).

b. water, air

Word box:
air , water, salt water

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

   We can paint the iron to protect it from rust.



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

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.

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: How can dirty copper coins be cleaned?

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.

MATERIALS:

- 20 dull, dirty copper coins
- 1/4 cup white vinegar
- 1 teaspoon salt
- A clear, shallow bowl (not metal)
- Paper towels, tissues or sheets of paper

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 10 seconds, then pull it out. What do you see?

Teacher's Note

If the coin is held with one halfin 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.

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 5 minutes, take half of the coins out of the liquid. Put them on a paper towel but do not rinse them or dry them.

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.

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.

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.

6. After about an hour, look at the coins on the paper towels. Write your observations in the table below.

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?

   The coins looked dull and dirty because they were covered with tarnish.

2. What happened to the coins in the vinegar-and-salt mixture? Why do you think this happened?

   The coins became shiny again. The vinegar-and-salt mixture took away the tarnish.

3. Taste a few drops of the clean vinegar. What does it taste like? **(But, NEVER taste chemicals unless your teacher says it is OK.)**

   The vinegar is sour.

4. Can you think of another liquid that could be used instead of the vinegar? (Hint: What other liquids taste sour?)

   We could use lemon juice (or orange juice) instead of vinegar.

5. What happened to the unrinsed coins? Did they also become clean and shiny?

   No, they turned blue-green.

Next, we are going to learn more interesting things about metals and what they are used for.

2.2 Uses of metals

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 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 or television, or telephones. (Next term we will look more at electricity!)

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.

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: The uses of metals in your home

Teacher's Note

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

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.

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 where you can see the Thunderbolt Kids are at a construction site for a stadium. Identify the objects that are made of metal and write them down below.

Bulldozer, tractor, cement mixer, Farrah's spade, stand for the sign saying "Wet cement", metal poles lying on ground, scaffolding and poles in the stadium, the pulley mechanisms Jojo is using, nails on the magnet, cranes, handles of buckets, wheelbarrow, the rims of Sophie's glasses.

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.

REVISION:

1. List as many properties of metals as you can think of.

   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. Are non-metals magnetic?

   No

3. Tom used magnetism to help his uncle. Which metal in the junkyard was attracted to the magnet?

   *Tom used a magnet to pick up all the **iron** scrap in the junkyard.*

4. Are all metals magnetic?

   No

5. Why are most pots and pans made of metal?

   Metal is a good conductor of heat and that makes it good for cooking things.

6. Why do some pots and pans have handles made of plastic or wood?

   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. Why does iron that is shiny when it is new become dull and blotchy when it stands outside for a long time?

   The iron rusts.

8. What does rust look like? (Describe what it looks and feels like.)

   Rust is reddish-brown and feels rough and flaky.
9. What is another name for rust?

   Corrosion.
10. Do all metals rust?

    No, only iron rusts.
11. Your dad is putting up a new iron fence in front of your hose. What would you tell him to do to make the fence last long?

    He can paint it as this will help prevent the iron from rusting.
12. Look at the picture below of a hammer. What is the head of each hammer made from and why do you think this material was used?



Different sized hammers. [3]

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. If 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 which have broken, what would you advise them are the best types of furniture for outside in the garden? Explain your answer.

    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 and why do you think some of these metals are so expensive.

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. 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?

    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. Below is a picture 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.

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.

3 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?

Teacher's Note

Introducing the unit

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 ofiron (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*

When we combine materials, new materials are made. The properties of the new materials 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 sometimes called *mixtures*.

We are going to have some fun Tom! And at the same time learn

about different ways to combine materials.

3.1 Combining materials

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.)

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: A research project to learn about stainless steel

Teacher's Note

This project is suitable for individuals or pairs of learners. If access to the library or internet is a problem, encyclopedias, 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.

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, and 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. [2]

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.
3. This process of finding out things about a topic is called *research*.
4. 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?
5. When you have gathered all your information, you should write a short story with the title: *Stainless Steel*.
6. You could use pictures to make it more interesting and present it either as a pamphlet or a poster.

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

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.

Mixing

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

ACTIVITY: Making glue

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.

MATERIALS:

- flour
- water
- 2 bowls for the flour and water
- a bowl for mixing
- pieces of paper

INSTRUCTIONS

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

   Dry, powdery, soft

2. How would you describe the properties of plain water?

   Wet, liquid, can pour, fills the container it is placed in, etc

3. After mixing the flour and water together, what are the properties of the paste that you end up with?

   Sticky, wet, more solid than water, etc

4. Do you remember learning about the states of matter? What state of matter is the flour and what state of matter is the water before mixing?

   Flour is a solid, water is a liquid.

5. What state of matter would you say the paste is?

   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.

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

Mixing and setting

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

To make jelly, we must dissolve 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.

ACTIVITY: Making Jelly

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!

MATERIALS:

- a packet of jelly powder
- a bowl
- a 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 onto 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. Write your findings in the table below.
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

Table of observations:

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?			

QUESTIONS:

1. What materials did you start with? (These are called the *starting materials*.)

   Jelly powder, water, fruit (optional).

2. What happened to the jelly powder when you mixed it with the water?

   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 ofit still existing? The jelly powder has coloured the water, which is evidence that it still exists.

3. Why is the water a different colour?

   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. How did the jelly mixture change when it cooled down?

   The jelly mixture was liquid at first but it became stiff when it cooled.

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 in your paragraph:

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

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 ifit 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.

In the picture 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.



Strawberry jelly. [3]

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.

In the previous activity we saw that jelly sets. Jelly is not the only material that sets. We are going to investigate another material that sets shortly.

Have you ever watched builders mix *concrete* when they want to build a wall or a house? Look at the people in the pictures below. What are they doing?

The people in the pictures 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 pavements and to plaster walls.

In the first picture people are using spades to mix the concrete. They are using the spades 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.



Mixing cement using spades.

Teacher's Note

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

VISIT

Mixing cement (video)

ACTIVITY: Making Bricks

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.

MATERIALS:

- plaster of Paris powder
- water
- clean sand (or sandy soil) (beach sand or builder's sand would work well)
- an empty ice cube tray
- ice cream sticks or plastic tea spoons for mixing and scooping
- 2 empty 1 liter yoghurt tubs: one for measuring and one for mixing

INSTRUCTIONS:

1. Look at all the starting materials and feel them with your fingers.

2. Write their properties in the table below.
3. Do NOT taste any of them! (Tasting is ONLY for food.)

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:

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.

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.
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.

    a. 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 and write your observations is the table below.

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?

    Sand, plaster of Paris and water.

2. How did the 'concrete' mixture feel after you mixed it? Did it get warmer or colder?

   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?

   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. Do you think that sand and water alone would be good material for making bricks? Say why (or why not).

   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. Did adding plaster of Paris to the sand make the bricks better? In what way?

   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. 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?

   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".

Real bricks are actually made by firing the bricks in a special oven called a kiln to bake them and make them hard. A potter is someone who makes objects such as pots out of wet clay. Once they have dried and then been fired the clay becomes hard.



These clay pots have been dried and they have just been loaded into a kiln to be fired. [8]

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. In the activity you have just completed the 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 pictures showing examples of how concrete can be reinforced. There will be some questions to help you think about each process.

ACTIVITY: Reinforcing concrete

INSTRUCTIONS:

Look at the picture 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. [9]

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?

   The stones were mixed into the concrete when it was still wet.
4. Why do you think the concrete was mixed with stones? (Hint: Is stone a strong material?)

   The stones were mixed into the concrete to make it stronger. (Here you may want to encourage the use of the word "reinforce".)
5. What is the process called when we make a material stronger by mixing it with another material?

   Reinforcing.

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



A piece of floor being prepared. [10]

1. 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?)

   The floor needs to be strong because the garage may be used to store a car or a truck or heavy equipment.

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



A new building. [11]

1. Can you see the steel bars that are sticking up into the sky? What do you think would be their purpose?

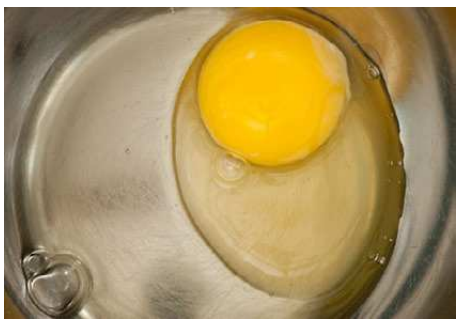
   The steel bars are there to reinforce the walls.

2. Why does the building need a structure that is extra strong?

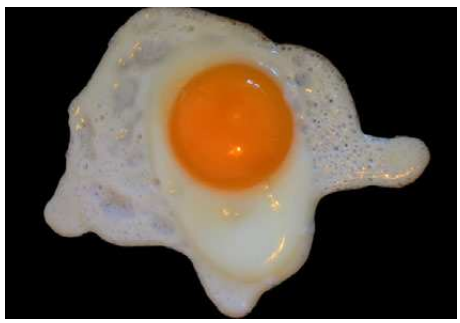
   (The purpose of buildings are to protect people and things. This looks like it might be large building, meant for holding many people and things, like equipment, computers and furniture.) Learners may write: The building needs to be extra strong to protect the people and the things, and to be stable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

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 pictures below.



A raw egg. [12]



A fried (cooked) egg.

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: Let's have fun making flapjacks!

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 offour, 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 ofintegrating 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'.

MATERIALS (Actually ingredients and cooking apparatus!):

- 2 cups flour
- 2 1/2 teaspoons baking powder
- 3 tablespoons sugar
- 1/2 teaspoon salt
- 2 large eggs
- 1 1/2 to 1 3/4 cups milk
- 2 tablespoons melted butter
- cooking oil
- 2 mixing bowls
- frying pan
- spatula
- hot plate for cooking

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?
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 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.)
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. Describe the properties of the prepared flapjacks in the table below.
15. Now you can enjoy them, sprinkled with sugar or drizzled with syrup! Yum yum!

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



A stack of flapjacks!

QUESTIONS:

1. What were the starting materials of this activity? Write them in the table below:

   Starting materials

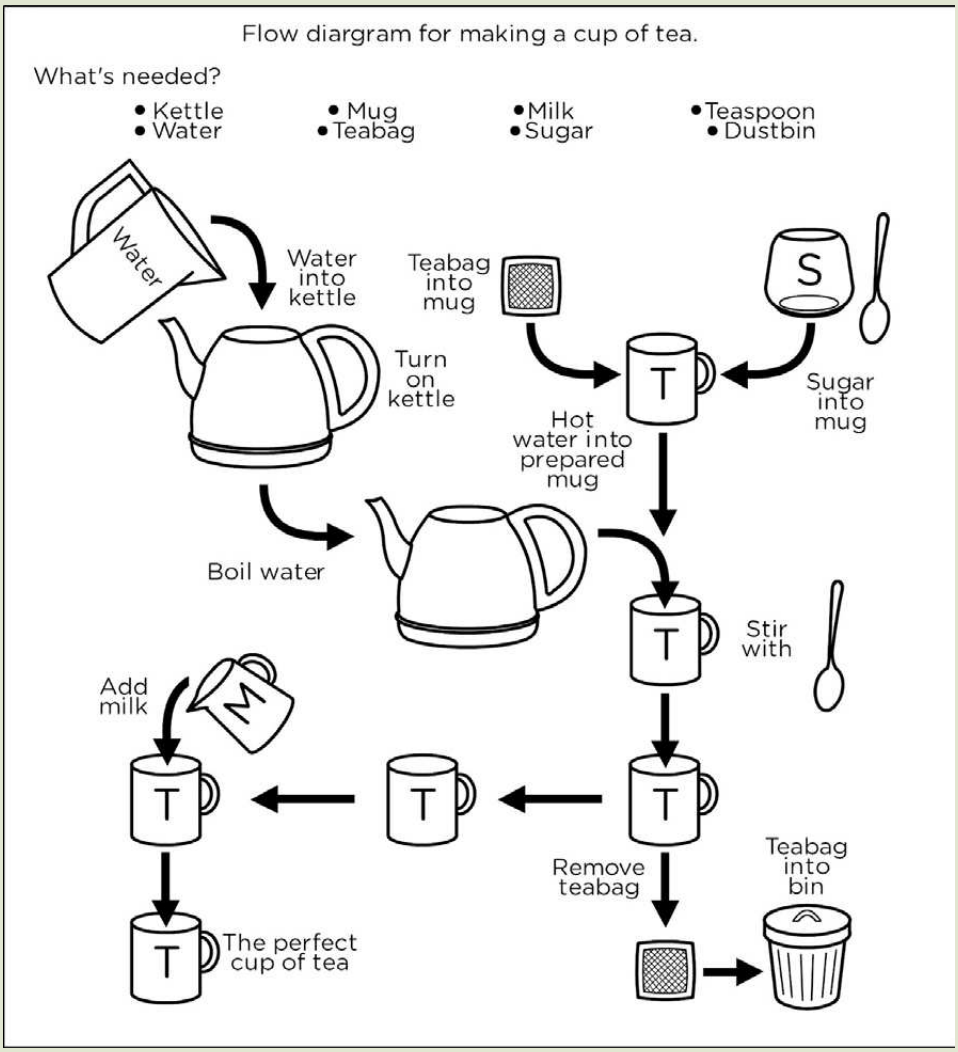
flour	*sugar*	*eggs*	*melted butter*
baking powder	*salt*	*milk*	*cooking oil*

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.)

   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.

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.





That was so good! I want to invite the other Thunderbolt Kids over to my house on the weekend and make us flapjacks!

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

ACTIVITY: How does the amount of material we start with affect the amount of new material we can make?

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.

Tom is making flapjacks for his friends, Sophie, Farrah and Jojo. He uses the recipe in the previous activity. He is very careful not to waste any of the batter. When all the batter is finished, he counts the number of flapjacks he has made. There are 12 large flapjacks. He is very pleased with himself because it means each one of them can have 3 large flapjacks.

QUESTIONS:

1. How many flapjacks could Tom make if he used only half of the batter?

Tom could only make 6 large flapjacks if he used half of the batter.

2. Tom decides to invite 4 more friends to eat flapjacks. That means there will be 8 people in total. How many flapjacks would he need to make if each person eats 3 flapjacks?

   Tom would need to make 24 flapjacks (3 x 8 = 24).

3. Tom needs to make enough batter for 24 flapjacks. Help him to work out how much of each ingredient to use. Write the amounts in the table below:

Ingredients	**Amount needed for 12 flapjacks**	**Amount needed for 24 flapjacks**
Flour	2 cups	*4 cups*
Baking powder	$2^{1/2}$ teaspoons	*5 teaspoons*
Sugar	3 tablespoons	*6 tablespoons*
Salt	$^{1/2}$ teaspoon	*1 teaspoon*
Eggs	2	*4*
Milk	$1^{1/2}$ 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 offood processing, because these are closer to learners' everyday experiences.

KEY CONCEPTS

- Materials can be processed in many different 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.

REVISION:

1. List three reasons why we process materials.
   We process materials to make them stronger, more durable, waterproof, fire-resistant, more beautiful (any sensible reason is correct).
2. Give an example of a *solution* from everyday life.
   Tea, coffee or any beverage, salt water, sugar water or any other sensible example.
3. What is stainless steel?
   Stainless steel is iron mixed with other metals to make it strong and to prevent rust.
4. Below are two pictures. Describe the properties of the materials in both pictures and what processes took place to get from Picture 1 to Picture 2.

Picture 1	**Picture 2**
	

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. 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. [13]

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

   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.

4 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?

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.

4.1 Properties and uses

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

ACTIVITY: 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.

INSTRUCTIONS:

1. Below is a list of different materials.

2. In your group, you need to sort the materials into two categories: Raw materials and Processed materials.

3. You will have to discuss the materials 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

All the materials in the list above have been placed into a table (below). 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? You can look at the table to guide you.

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*
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*

QUESTIONS:

1. Fill in the 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 below, 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?

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
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*

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 example.

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.



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



These pink gumboots are very waterproof!

Paint is a processed material. Some of the pigments used to make paint are natural materials. But the final product is a processed material.

QUESTIONS

Do you remember we mentioned pigments last term in Life and Living? What was the green pigment used in photosynthesis to make food for plants?

Chlorophyll.



Paint is a processed material.

QUESTIONS

1. What special properties of paint make it useful to us?

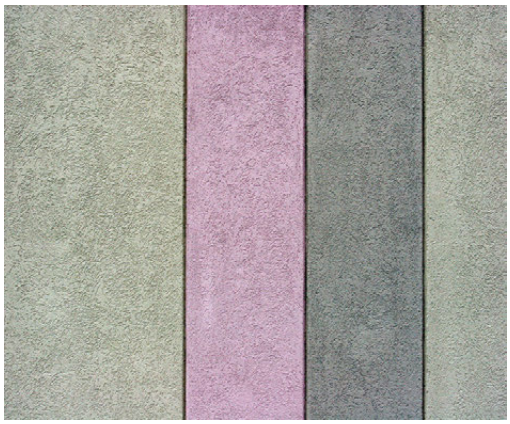
   Paint is in a liquid form so it can be easily painted on a surface. Paint also has colour so it can be used decoratively.

2. Think of all the cases where people use paint and write them down.

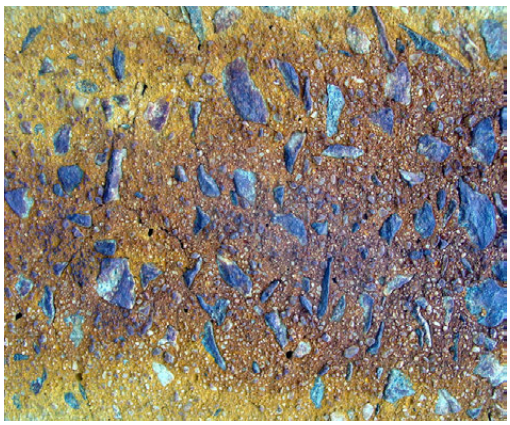
   We paint the walls in our houses, we paint the outside walls of buildings, we paint roofs, we paint fences (especially iron fences to stop them from rusting), artists use paint to make paintings, people use paint to make signs which are informative, we paint road signs on the road to tell cars where to go.

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 pictures which give some idea of the different textures of concrete and how it is used to make an interesting surface!










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.



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

That is right Tom! 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 and look at the materials around you with new eyes!

ACTIVITY: Investigating processed materials in the world around us

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).

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 and how its properties help it to function for us.
3. You must select two different locations to look for materials. One location can be the school or classroom, and another location could be your home or your community.
4. In Chapter 2, you did an activity looking at the uses of metals, but now you must focus on the uses of non-metals which 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 it is as a poster or a mini-book or 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 4 different processed materials in each location. The materials must be used for different purposes and have different properties.

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!

4.2 Traditional processing

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.

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.

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 their lifestyle.

Some of these traditional ways of processing materials are still used today. In this section we will learn more about them.

ACTIVITY: 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.

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 his uncles have taught him how to use the bow and arrow and the 'kierie' (or throwing stick) that 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 and 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, and it makes a beautiful sound when Uncle 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...

QUESTIONS:

1. In the story many different traditional materials used by the Khoikhoi people are mentioned. In the table below, you must fill in what material was used for each purpose in the middle column. In the column on the right 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	*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. What processing method was used to turn animal skin into soft leather?

   The skin was scraped with a blade to remove the hair and rubbed with animal fat.

3. What processing method was used to make wood harder so that it could be used to make an arrow tip or *kierie*?

   The wood was hardened in the fire.

4. What processing method was used to make bone harder so that it could be used to make arrow tips?

   The bone was hardened in the fire.

5. How did Heitsi keep his arrow tips sharp?

   Heitsi rubbed the tips against a special stone to sharpen them.

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, that is still seen today.

Some of the traditional homes in Africa are made of clay or mud. In the activity *Making Bricks*, we saw that mud (a mixture of soil and water) is not a very strong material. When it is dry, it can crumble and collapse. When it is reinforced, it can make a strong and durable building material that can be used to build a house. If it is built well, the house will last for many years.

ACTIVITY: Making a mud house stronger

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.

In this activity we are going to look at some videos and pictures 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 pictures. Many of these traditional building methods have become very popular amongst modern-day people who want to live in a sustainable way.

INSTRUCTIONS AND QUESTIONS:

Follow the link to the first video. Watch the video and then answer the questions. Alternatively, you could study the picture of the boy learning how to build a mud wall below.



A boy helping to build a mud wall.



The wall of a mud house with a stick frame. [2]

1. What material is the house in the video and in the pictures made of?

   Mud, sticks and cement

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 picture above of a close up photo of a wall to see how they strengthened the wall.

   He added cement to the mud, and he used sticks to build a framework for the house.

Follow the link to the second video. Watch the video and then answer the questions or look at the pictures below.



A close up photograph of a mud used to make the wall.



The mud mixture.

1. What materials are recommended to reinforce the mud?

   Dry grass and stones.

2. Why do you think the wall should be built thicker at the bottom than at the top?

   The wall will be more stable when it is built thicker at the bottom. It will not fall over easily.

3. Write a step-wise procedure for building a mud shelter.

   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 you boy is doing in the first picture. Then to leave the mud to dry.

Follow the link to the third video that shows how to build a mud wall. Alternatively you could look carefully at the pictures 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 picture 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?

   Straw, grass

2. What is this mixture called?

   Cob

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?

   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 pictures below.

Pouring water in to mix with the mud and straw.	
Putting the mixture into a mould.	
Packing the mud mixture into the mould.	
Removing the mould.	
Leaving the bricks to dry.	

1. Do the bricks contain straw or stones?

   In the video, they contain only clay/mud. In the pictures above they do contain straw and grass.

2. How does the man get all the bricks to look the same?

   He fills a box (mold) with the clay, then tips the wet clay out of the mold before it is dry.

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?

   The bricks are baked (fired) to make them hard.

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.

   - *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.*

You may remember from the story *Heitsi prepares for the hunt*, that Heitsi belongs to the Khoikhoi people from 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; the land belonged to everyone who lived on it. Imagine that!

Like all the early people, the Khoikhoi had to make everything they needed, because remember, 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 belonging every few months, when the seasons changed. This way they could always be close to good grazing. Fresh green grass and trees meant there would be leaf-eating animals around to hunt. It also meant there would be good food around for themselves, and for their goats to eat.

Read the story carefully for clues on which materials were used to make a traditional Khoikhoi house.

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?

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.



Women attaching the reed mats to the framework.

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: 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?
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. What does it mean when we say Heitsi's house is *portable*?

   A portable house is a house that can be broken down, moved and built again in another place.

3. Write a paragraph to describe the materials and methods used by Heitsi's family to keep their home warm and dry during winter.

   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. How does Heitsi's mother strengthen the floor of the *matjieshuis*?

   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. Look at all the pictures of modern "houses" below. Which one is the most like Heitsi's house? Why do you say so?



A brick house.



A caravan.



A tent.

   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.

6. Draw a picture of the floor plan of Heitsi's house.

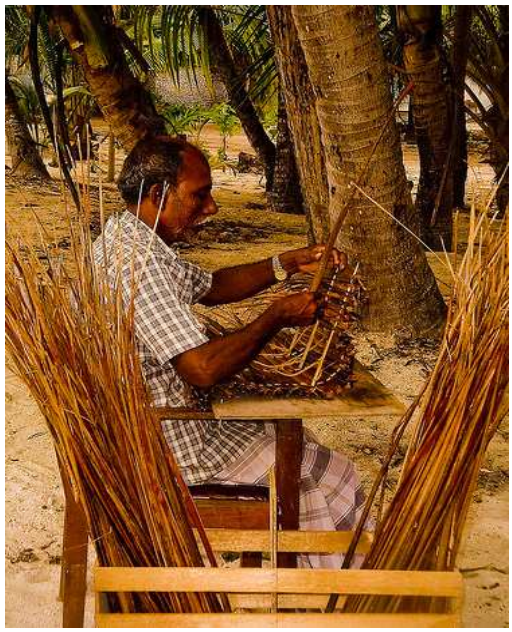
7. If you have time in class, build a model of Heitsi's house, using any suitable building materials.

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. [6]

ACTIVITY: Identifying objects made from plant fibre

INSTRUCTIONS:

1. Each of the following pictures 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**
 [7]	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.*
 8	*This person is wearing a straw hat to protect their face from the sun.*
 9	*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?

   Raw materials are materials that have not been processed.

2. What are natural materials?

   Natural materials come from plants, animals or the Earth.

3. What are processed materials?

   Processed materials are raw materials that have been changed or refined by humans.

4. Which processing method did the Khoikhoi people use to make wood and bone hard and strong?

   They used fire to dry the wood and bone slowly without burning it. This process is called fire-hardening.

5. Where did the Khoikhoi people find the material that they used to make their homes?

   All the materials were found in nature.

6. How can sand and clay be made stronger if we want to use it to build a house?

   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. Look at the picture of a *matjieshuis*. It is an old one and it was made differently to the one Hetsie's family made as 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. [10]

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. How is this woman 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.



A woman from Uganda. [11]

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.

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
 12	*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.*
	*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 ofleaves 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.*

Chapter 1 Plants and animals on Earth

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