Natural Sciences and Technology

Grade 6

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Natural Sciences Grade 6 Learner's Book

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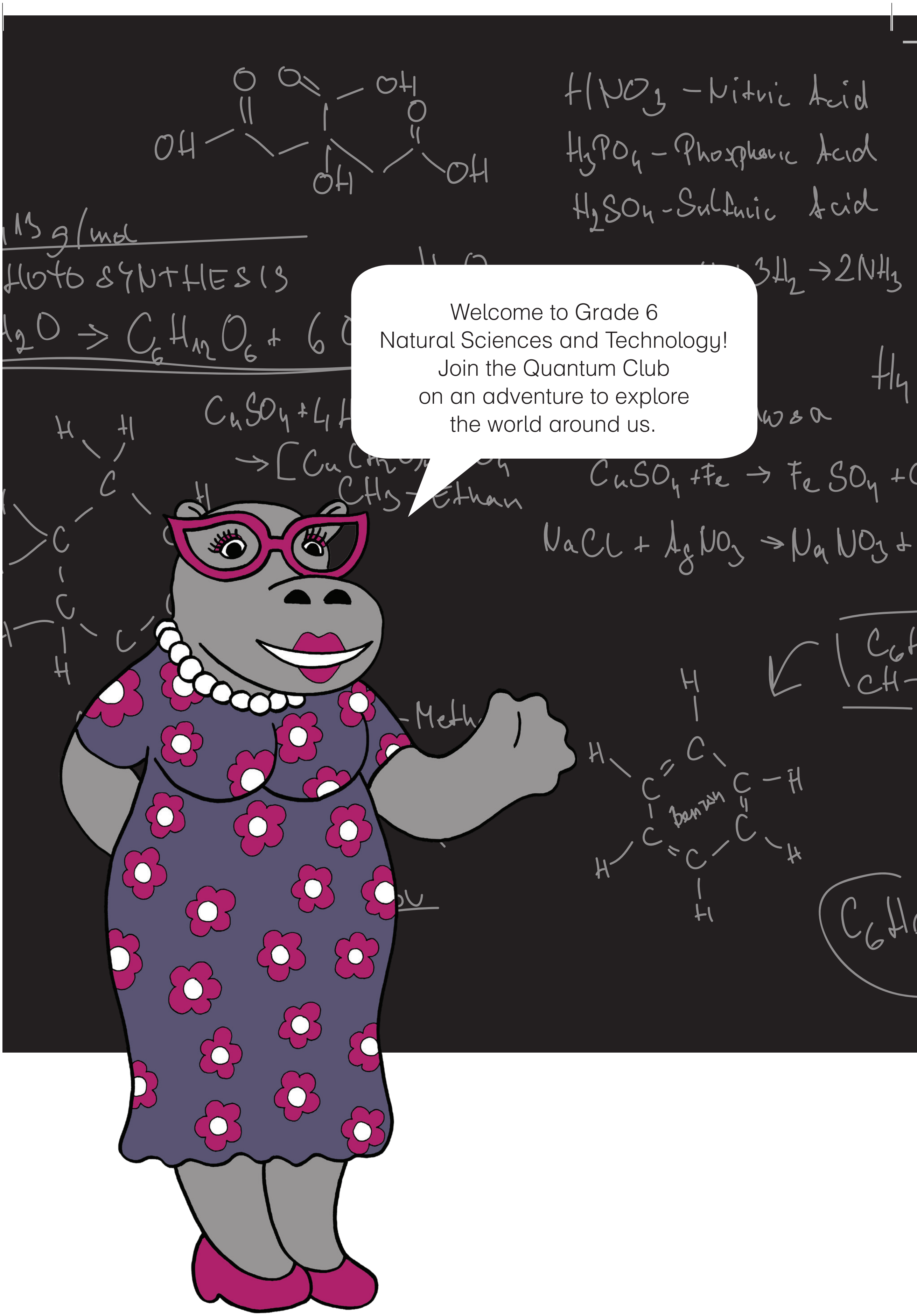
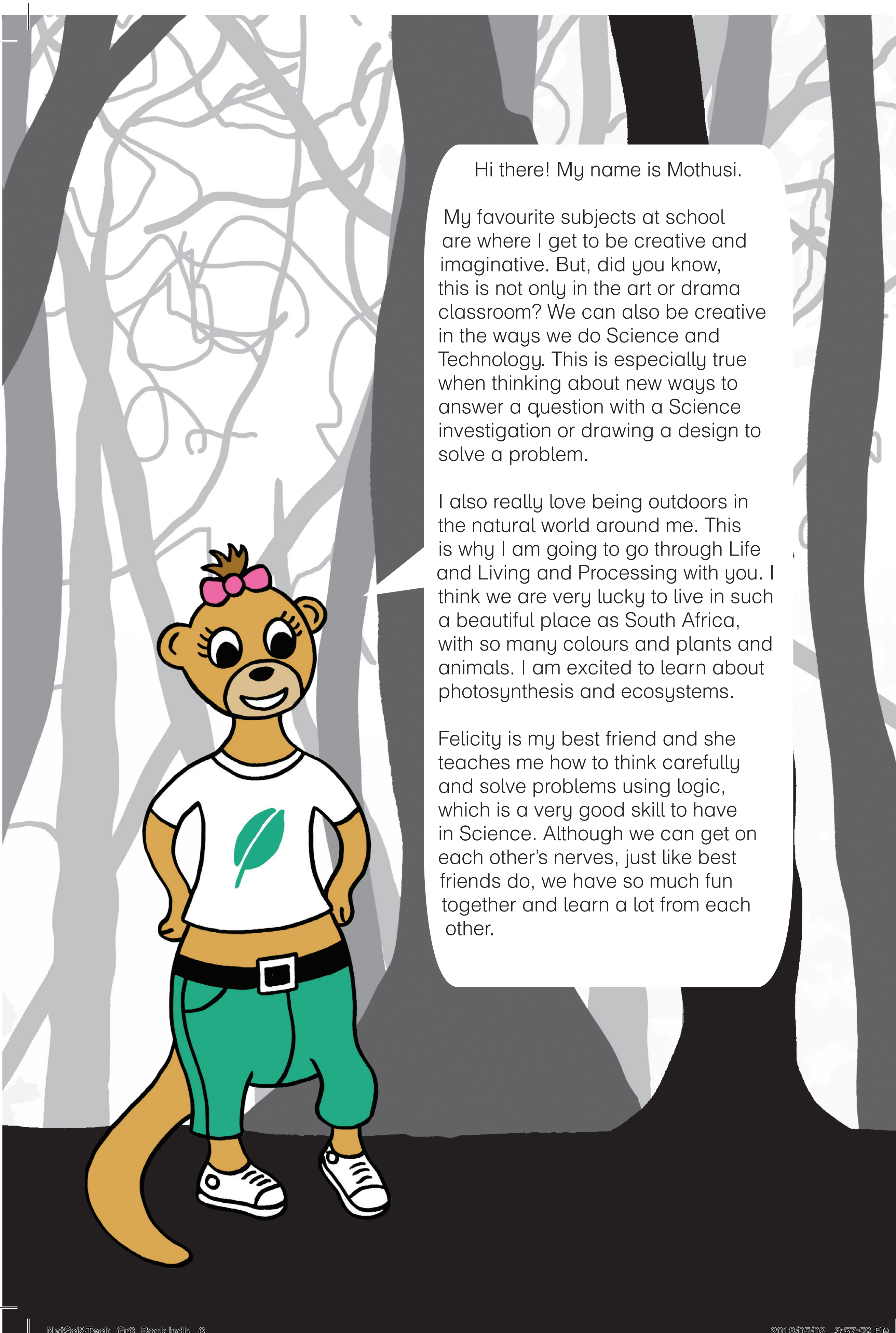

Welcome to Grade 6
Natural Sciences and Technology!
Join the Quantum Club
on an adventure to explore
the world around us.


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


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

What's up! My name is Phumlani.

I just want to dive straight into this year, and especially Natural Sciences and Technology. Sometimes though, I find it hard to sit still in class as I just want to get up and do things! My teacher often says I have too much energy and I battle to sit still in class. Maybe that's why I am going through Energy and Change with you this year.

I am really looking forward to learning about electric circuits and mains electricity! And, we also get to make an electric circuit this year. The best part about Natural Sciences and Technology is that we get to learn actively. We have goals and questions that we want to answer and I am always the first to leap into action!

Walt and I make a very good team because he is very good at thinking and planning, and then following a method. But I think I can also help as sometimes Walt wants to think too much, whereas in Science and Technology you also have to get involved in the subject and start experimenting.


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

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Life and living
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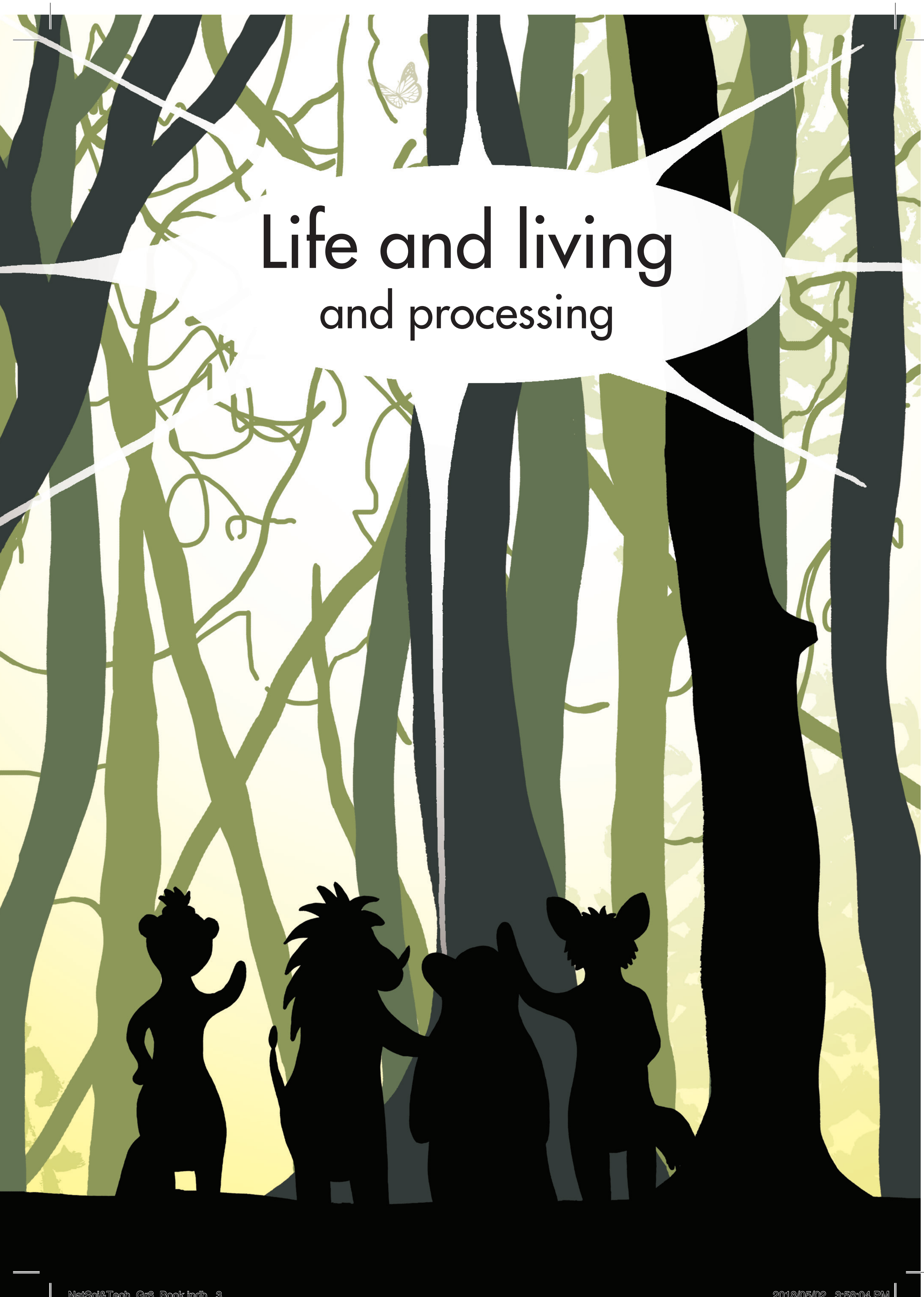
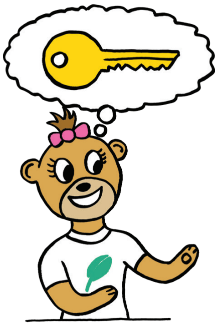


1 Photosynthesis

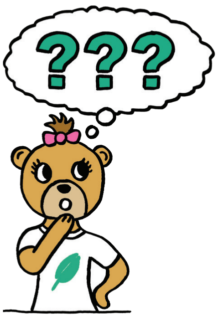


KEY QUESTIONS

- Why can a plant make its own food but an animal cannot?
- What is needed for photosynthesis to happen?
- How do plants make food and store food?
- Why do plants need so much water?
- Can plants live in the dark?
- Why are plants mostly green?

1.1 Plants and food

Green plants are just like factories! They make food for themselves and every animal on Earth using sunlight energy, water and carbon dioxide. They also recycle the air and make oxygen for us to breathe.



QUESTIONS

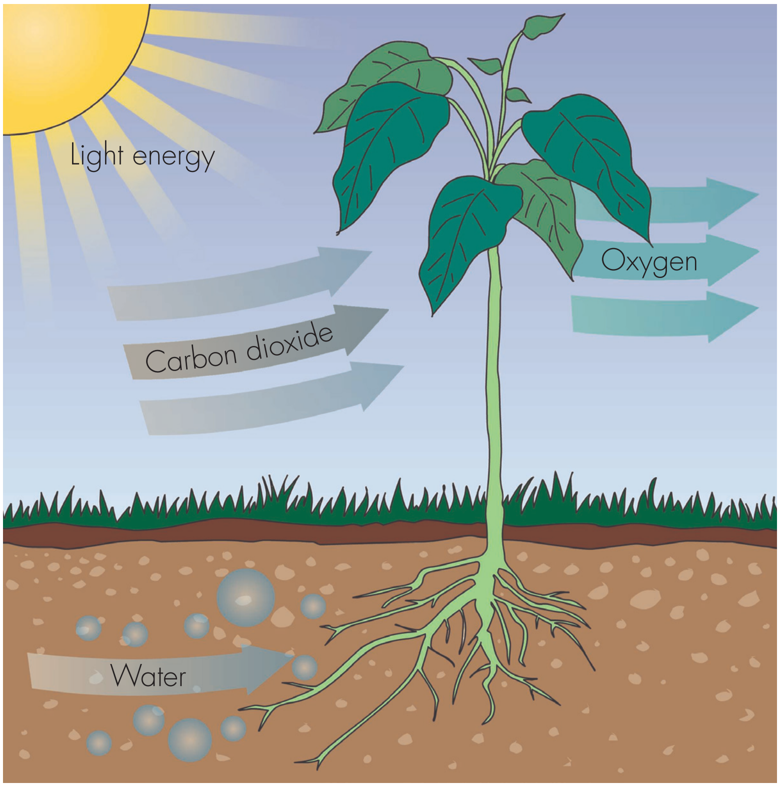
1. What happens in a factory? Why do you think we can say plants are like factories?
2. Why can we say that plants make food for themselves and every animal on earth?

Scientists have found out exactly how plants are able to do all these things. Let's take a closer look at how plants make food for themselves and us.

The process of photosynthesis

Photosynthesis is the process that plants use to change the energy from sunlight into energy for food. Plants change light energy from the sun into food energy. Photosynthesis happens in all green parts of a plant.

Leaves are usually the greenest parts. So plants do this mostly in their leaves.



Do you remember learning about photosynthesis in Grade 5? Plants need certain elements to photosynthesise.

There are some important requirements for photosynthesis to happen:

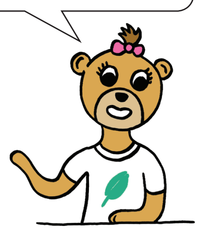
1. **Chlorophyll:** Chlorophyll is a green substance that plants use to capture light energy from the sun. Chlorophyll is very important. Without chlorophyll plants cannot use the sunlight energy to make food.
2. **Sunlight:** Sunlight has energy. Plants use this energy to make sugars from water and carbon dioxide.
3. **Water:** The roots of a plant absorb water and nutrients from the soil. Water is a solvent in all living things. Dissolved substances are moved around the body to where they are needed. Just like you, plants have veins for this movement. They move minerals from the

New words

- photosynthesis
- chlorophyll
- solvent
- stomata
- starch
- glucose
- molecule
- microbes

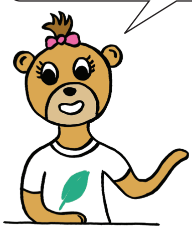
Did you know?

The word photosynthesis actually has two parts: photo = light and synthesis = to make or put together. So it means to use light to make something (in this case, food).



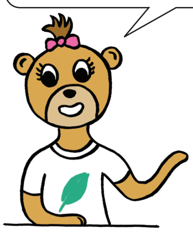
Did you know?

Scientists have a term for substances like chlorophyll that have a colour. They call them pigments. There are other pigments in plants. Can you think of their colours? There are pigments in your body too! Where do you find them? What do they do?



Did you know?

Stomata also allow other gasses and water to enter or leave the plant. They do the same job as your mouth and nose when you breath! It is the same job that the pores in your skin do when you sweat!



roots upwards. They move sugars from the leaves downwards. Photosynthesis can only happen in a water solution. Water is also important because it provides support to the plant to keep it upright. Like you, plants have skeletons. But unlike you, many plants have water skeletons!

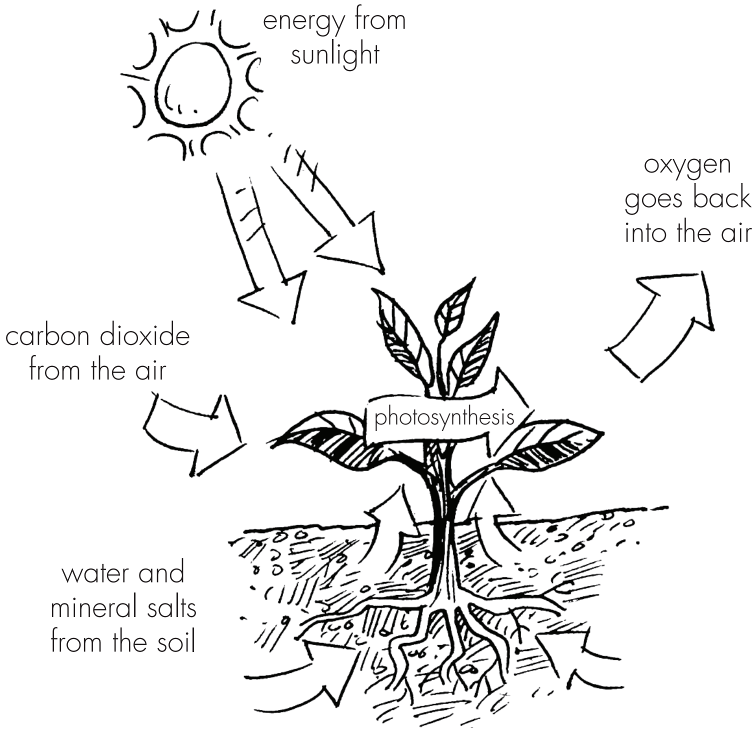
4. **Carbon dioxide:** The plant absorbs or takes in carbon dioxide from the air through little holes called stomata. Stomata are found all over the plant, but mostly under the leaves.
5. **Soil:** The soil provides mineral nutrients and water for the plant that are essential during photosynthesis. Soil also provides anchorage to the plant, otherwise the plant cannot stand up straight.

How does photosynthesis occur?

Plants use chlorophyll, sunlight, water and carbon dioxide to make food:

- Chlorophyll captures the sunlight energy.
- This energy splits the water into hydrogen and oxygen.
- The oxygen is released into the air.
- The hydrogen is used with the carbon dioxide to make glucose (sugars).
- The sugars are moved from the leaves to other parts of the plants where they are stored.
- The water in the plant veins carries the sugars. When the sugars reach the storage parts they are changed into starch.
- Plants can store the starch in these places:
  - leaves (cabbage, spinach, lettuce)
  - fruit (apples, banana, peaches)
  - stem (sugar cane)
  - seeds (wheat and mealies)
  - flowers (nasturtiums, broccoli, cauliflower)
  - roots (carrots and beetroot)

Here is a simple illustration to show how this process occurs:



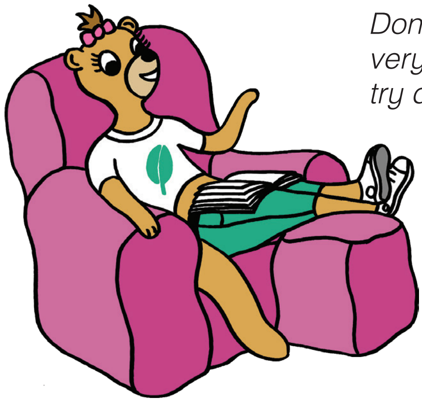
The process of photosynthesis

Visit

The photosynthesis song.
goo.gl/PLk0G

Photosynthesis video.
goo.gl/oFp5v

A game on growing plants!
goo.gl/RpHpV



Don't you think this all sounds very technical? Why don't we try act it out?

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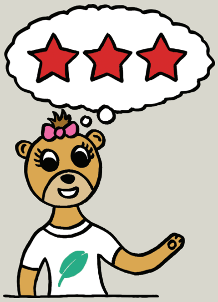


ACTIVITY 1.1: Dramatise the process of photosynthesis

INSTRUCTIONS:

1. Your teacher will explain to you how to act out the process of photosynthesis.
2. Characters needed for this dramatisation:
   - **Narrator** to describe the process. This can be a teacher or a learner. It might be a good idea to make short notes from the information on page 6, to remember in what order everything is happening.
   - **Sun** – this learner can dress in yellow. Perhaps get some old tin foil or shiny paper to decorate your head or body to show the light and heat energy that the sun produces.
   - **Plants** – a few learners can dress in green and perhaps tie a few strings to their feet to represent roots. They need to hold some rice or shiny glitter in their hands or their pockets to show that the water evaporates after photosynthesis.
   - **Rain or water** – a few learners can dress in blue and perhaps have some rice, shiny glitter, small pieces of tin foil or something similar to represent the rain falling.
   - **Carbon dioxide** – attach signs to the learners' chests that say 'Carbon dioxide' and dress in purple.
   - **Oxygen** – attach signs to the learners' chests that say 'Oxygen' and dress in orange.
   - **Glucose energy** – learners dress as fruit and vegetables. Dress up or make posters from scrap cardboard to show large carrots, apples, potatoes, or something similar.
   - **Animals** – who breathe out carbon dioxide and eat the plants. You can make masks out of paper plates and scrap cardboard.

QUESTIONS:

1. Why do plants die when there is a drought?
2. Design a poster for your Grade 4 friends to explain the process of photosynthesis to them. You can use sentences and short paragraphs but make sure you use many illustrations.

1.2 Food from photosynthesis

Photosynthesis is the process inside plants that changes the energy from the sun's light into a form of energy that animals can eat and use to carry out their life processes.

Plants changes the glucose into starch, for example mealies (mealies and maize flour), rice (rice flour and rice) and wheat (flour).

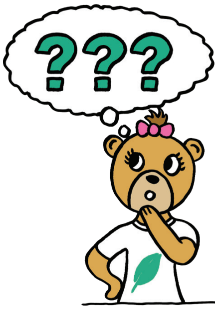
Plants then store this food in different plant structures, which animals will eat. They can store it in their leaves, stems, roots, flowers, fruits or seeds.

New words

- iodine
- indicator
- test

QUESTIONS

Look at the photos below of different plant products. For each photo, identify which part of that plant we eat. (For example: When we eat an apple, are we eating the leaf, the stem, the root, the fruit or the seed of the plant?) Draw a table for your answers.



Cabbage[1]

Tomatoes

Potatoes

Broccoli[2]

Celery

Carrots

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Sunflower seeds


Lettuce


Sugar cane

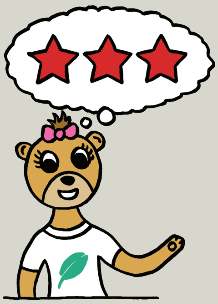

Hazelnuts


Mealies


Bananas

Glucose and starch

We know that plants make glucose (a sugar) but they store starch. Let's now find out what the difference is.



ACTIVITY 1.2: What is the difference between starch and sugar?

MATERIALS:

- Maize flour (mealie meal)
- Flour
- Cooked rice, potato and bread
- Glucose sweets
- Sugar
- Sugar cane (if possible)
- Fresh fruit
- Blindfold
- Clipboard

INSTRUCTIONS:

1. Work in pairs. One partner must be blindfolded.
2. On a piece of paper list the numbers 1–10.
3. The other partner must let the blindfolded partner taste each of the foods marked 1–10. If it is flour, use a teaspoon to spoon the flour into your partner's mouth. If it is a kernel like a rice or mealie kernel, or a cube of fruit, put it in the palm of their hand and let them eat it themselves.
4. After each taste your blindfolded partner must guess if it is a sugar or a starch based on the taste.
5. Record your partner's answers on the piece of paper containing the numbers 1–10. Swap with your partner and repeat the test.

QUESTIONS:

1. Was it easy to distinguish between the sugar and the starch each time? Which foods did you find difficult to classify?
2. What can you say about the difference between a starch and a sugar based on taste?

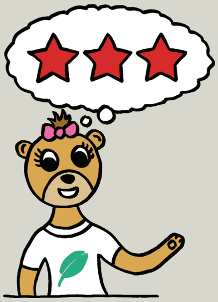
Iodine starch test

Using taste to check if a food is a sugar or a starch is not very reliable.

There is a special test that scientists use to see if a food product is a starch or not. It is called the iodine starch test.

Iodine solution is a special solution that is normally a brown liquid. When iodine solution is dropped on starch, the iodine and starch combine and produce a blue colour. We use this to test whether there is starch in a food product.

Let's see how this works!



ACTIVITY 1.3: The iodine starch test

IMPORTANT!: There will be no tasting in this activity.

MATERIALS:

- Iodine
- Same foods used in the taste test (they should be marked 1–10)
- Include some other foods, such as cheese and a boiled egg

INSTRUCTIONS:

1. Copy the table below in your exercise books and complete it following the instructions below.
2. Write the food or plant product that you chose in the first column.
3. You are going to test whether this food product is a starch or not. When the iodine solution turns blue-black you will know it is a starch.
4. Use a dropper and drop iodine solution onto each food group.
5. Put a ✓ next to the food product that turns blue-black – this is a starch. Put a ✗ next to the food product that stays brown – this is not a starch.

	Name of food product	Starch or not?
1		
2		
3		
4		
5		
6		
7		
8		
9		

	Name of food product	Starch or not?
10		
11		
12		

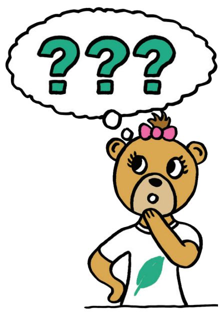
QUESTIONS:

1. Which test do you think is more accurate to test for starch – the taste test or the iodine starch test?
2. Did the animal products, such as cheese and boiled egg, contain starch? Why do you think so?

1.3 Plants and air

All animals and plants need oxygen to live and carry out their life processes.

Animals take in oxygen throughout the day and night, and breathe out carbon dioxide. Oxygen releases energy from food inside the body for the life processes.



QUESTIONS

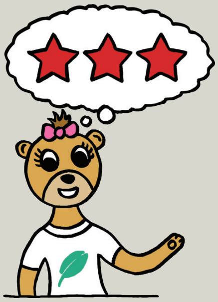
Do you remember what the seven life processes of living things are? Write them down.

Plants use oxygen throughout the day and night, like every other living creature. Oxygen is used for plant growth and the development of new plants, seeds, leaves and shoots for example. Therefore, they also produce carbon dioxide as a waste product once the oxygen has been used.

New words
- cell
- waste product
- cycle
- organic
- inorganic

Plants do not photosynthesise through the night because there is no sunlight energy available to do that. So they only need carbon dioxide during the day for photosynthesis.

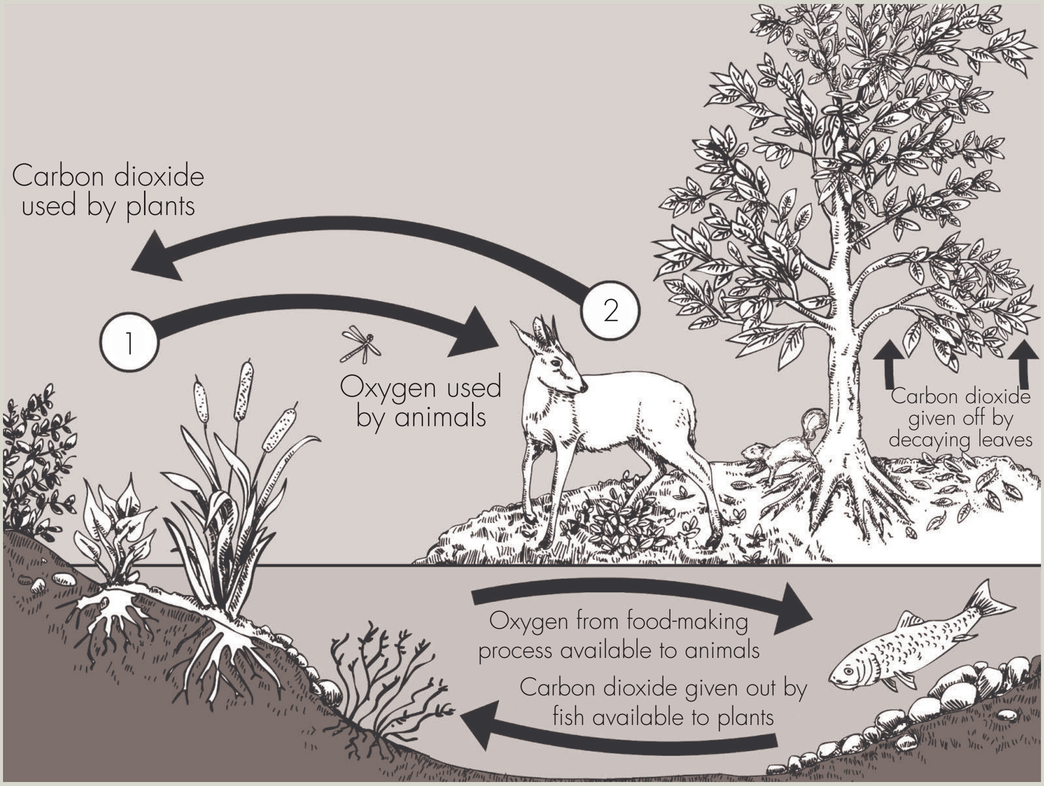
This cycle of oxygen production and use, and carbon dioxide use and production, is very important to life on Earth.



ACTIVITY 1.4: The oxygen and carbon dioxide cycle

INSTRUCTIONS:

1. Carefully study the following illustration.
2. Answer the questions that follow.



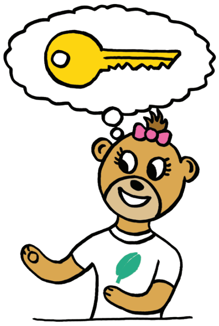
The oxygen and carbon dioxide cycle

QUESTIONS:

1. Make a list of living organisms that produce both oxygen and carbon dioxide in this picture.
2. Identify three living organisms that cannot produce oxygen in this picture.
3. Predict what you think would happen if all the animals were removed from this habitat.
4. What two life processes are involved in the carbon dioxide and oxygen cycle?
5. Complete this cycle by filling in the missing information for the two arrows on the left hand side of the illustration. Supply full labels for arrows 1 and 2.
6. Explain why animals would not survive if all the plants on Earth were to suddenly die.
7. Why do we say that oxygen and carbon dioxide are in a cycle?

KEY CONCEPTS

- Plants produce their own food (glucose) by a process called photosynthesis.
- Photosynthesis takes place mainly in the leaves.
- During photosynthesis the plant uses chlorophyll, sunlight energy, carbon dioxide (from the atmosphere) and water to make glucose.
- Plants change some of the glucose (sugar) into starch, which they store in their leaves, stems and roots, flowers, fruits and seeds.
- Animals take in oxygen from the air and produce carbon dioxide when they breathe.
- Plants recycle carbon dioxide and make oxygen during the process of photosynthesis.



REVISION

1. List the four things that are vitally important for plants and photosynthesis.
2. Choose words from the word box to complete the following sentences. Write the sentences out in full.

• organic and inorganic material • photosynthesis • water • air • roots • sand and rocks

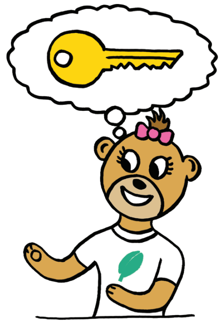
   a. The process when the green parts of plants make food is named ___________.
   b. Water and minerals are absorbed by the ___________ of plants.
   c. Soil is made up of ___________, ___________, ___________, ___________.

3. The seedlings that were planted in the newspaper cuttings or cotton wool did not grow very well at all, even though they had sunlight and water. What could they not get from the newspaper or cotton wool that plants normally get from soil?
4. Where does photosynthesis usually take place? Explain your answer.
5. Do you think photosynthesis takes place at night? Explain your answer.
6. What is the name given to the sugar that plants produce during photosynthesis?
7. What do plants store glucose as? List some places where it is stored.

2 Nutrients in food

KEY QUESTIONS

- Why do I have to eat so many different things – why can't I just eat what I like?
- I have heard that people say: "You are what you eat". What does that mean?
- What is so bad about sugary sweets – why shouldn't I eat lots of them?
- What is the difference between a fat and an oil?



2.1 Food groups

All living plants and animals need to feed or eat to give them energy to carry out the life processes. Plants make their own food from sunlight, water and carbon dioxide through the process of photosynthesis. Animals cannot make their own food, and need to eat plants or other animals to get energy. People also have to eat plant or animal products to get energy to grow and develop.

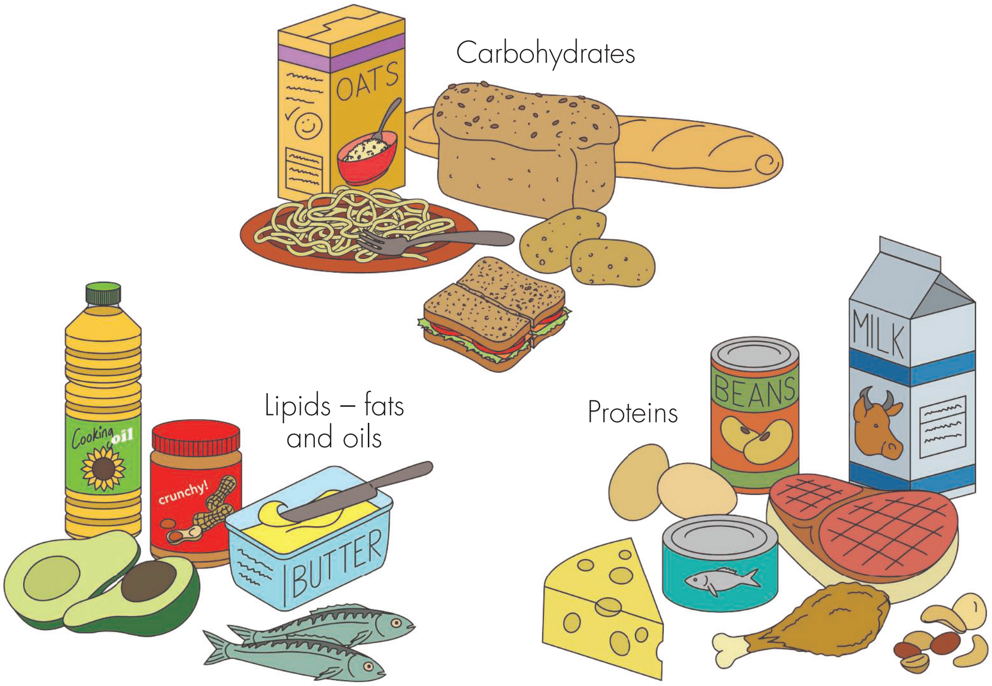
New words

- carbohydrates
- proteins
- sodium
- calcium
- insulate
- vitamins
- immune system
- phosphate
- additives

Classification of food groups

The food we eat can be grouped or classified into different types or groups. We call these food groups. There are four main food groups and each food group does a different job in the body:

- Carbohydrates
- Proteins
- Fats and oils
- Vitamins and minerals



Examples of the foods in the food groups, carbohydrates, proteins and fats and oils.

We classify food according to these food groups, although most foods contain a mixture of more than one nutrient group.

Let's look at each food group separately and see why each one is important.

1. **Carbohydrates:**
   - They are the most important source of energy for the body.
   - They store energy for the body.
   - Carbohydrates are an important part of the body structure.
   - Foods that contain carbohydrates are: pasta, samp, potatoes, cereal, mealie meal, porridge and bread.

Bread

Rice

Pasta

Potatoes

2. **Proteins:**
   - Proteins are the building blocks for our body – they build the body's muscles.
   - They also help to repair hurt or broken tissue.
   - Proteins can be used as reserve energy if there is a shortage of carbohydrates.
   - Foods that contain proteins are: meat, fish, chicken, eggs, beans, milk and cheese.
   - Protein is also found in many plant products: chickpeas, beans, lentils, nuts and soya.

Meat

Lentils

Almond nuts

Cheese

3. **Lipids – fats and oils:**
   - Fat is stored around organs like the kidneys to protect them from injury.
   - Fat is also stored under the skin to insulate us (keep us warm).
   - Fat can be used as reserve energy, if there is a shortage of carbohydrates.
   - Foods that contain fats and oils are: butter, margarine, sardines, cooking oils, nuts, peanut butter and avocado pears.

Mixed nuts

Cooking oil

Peanut butter

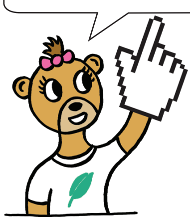
Margarine

4. **Vitamins and minerals:**
   - Vitamins and minerals are essential to the human body and yet we produce very few of them ourselves.
   - Many important minerals are contained in the food we eat. Two of the most important are sodium and calcium:
     - **Sodium** helps to keep the correct balance of water in the body and is found in most food except fruit.
     - **Calcium** is important for strengthening bones and teeth. Calcium can be found in fish, green vegetables, milk and cheese.
   - Most vitamins are manufactured by plants, so we get vitamins from the food we eat or from vitamin supplements.
   - There are specific foods that contain specific vitamins.
   - The next table shows some important vitamins, their natural sources and/or the foods that contains them, and some of their functions in the human body.

Name of vitamin	Sources	Functions
Vitamin A	Egg yolk, liver, deep-yellow and deep-green fruits and vegetables, fish liver oils	Enables the eyes to produce a pigment that helps us to see in dim light.
Vitamin B	Brown rice, wholewheat bread	There are several types of vitamin B and they have many functions, e.g. they are important in the chemical reactions of breathing.
Vitamin C	Citrus fruit, strawberries, tomatoes, peppers	Strengthens the body's immune system by increasing its ability to fight infections.
Vitamin D	Egg yolk, fish liver oils Can be made in the skin when the ultraviolet rays from the sun convert cholesterol in the skin to vitamin D.	Helps the absorption of calcium and phosphate. These nutrients are used for the making of strong bones and teeth.

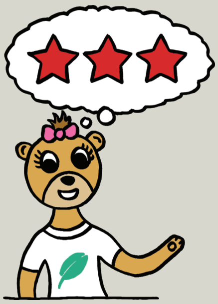
Visit

A simulation about eating and exercise: goo.gl/7APcr



Milk is a source of calcium.

Fruit and vegetables are sources of vitamins.



ACTIVITY 2.1: Classify foods into the different food groups

MATERIALS:

Collect wrappers and packaging material, like boxes and tins, of the foods you eat and bring them to school.

INSTRUCTIONS:

1. Work in groups. Choose the three foods that you think are the most healthy to eat from the wrappers and boxes that you have in your group.
2. Write a reason next to each of these three choices for why you think they are really healthy.
3. Locate the list of ingredients on each food container. You should have at least ten different containers. (If you have too few, swap with another group when they are finished with theirs.)
4. Sort the different foods into the main food groups.
5. Copy the table below in your exercise book and record your work.

Carbohydrates	Proteins	Lipids	Vitamins and minerals

Additives

Very often food manufacturers add different preservatives, flavourings and colourings, as well as salt and sugar, to make the food look or taste more attractive to their customers. These are called additives.

ACTIVITY 2.2: Reading food labels

1. Read the ingredients on your ten packaging labels again. Copy and complete the table below in your exercise books.
2. In the first column, write the name of your product.
3. Indicate with a ✓ under each column if your product has any of these additives added to it. The first one is done as an example.

	Food	Additives		
		Salt	Sugar	Others
Example	Bread	✓	✓	✓
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

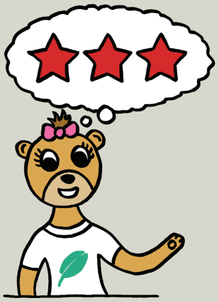
4. Make a list of the main flavourings that were used in your products.
5. What preservatives are used most often by the food manufacturers?
6. Look at the three foods you said were the healthiest at the beginning of this activity, and why you said they were healthy options.
   a. Read their packaging details – which additives do they contain?
   b. Do you think these additives make these products healthier or less healthy to eat?
   c. After reading the labels do you still think these are the three healthiest foods? Explain your answer.
   d. Compare the other labels and decide if there are perhaps other healthier foods on your list.

After doing this activity, did you notice a difference between foods which are naturally occurring (such as meat and vegetables) and foods which have been processed?

The natural foods contained a mixture of more than one nutrient group. For example, nuts are a source of protein and fat. Milk is a source of calcium and protein. Vegetables contain many nutrient groups.

The foods which have been processed, or manufactured, often contained additives, such as salt, sugar, preservatives and flavourings.

Let's have a look at some different meals to see if we have all the food groups.

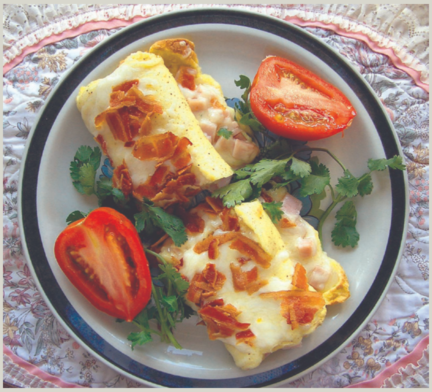


ACTIVITY 2.3: Sorting foods in a meal into the food groups

INSTRUCTIONS:

1. Below are pictures of five different meals.
2. Study each meal and classify each food on the plate into one of the food groups (protein, carbohydrates, fats and oils, vitamins and minerals).
3. Remember, some foods may fall under more than one food group.
4. In your exercise books, write out each food in the meal in a table, and write the food group it belongs to next to it.

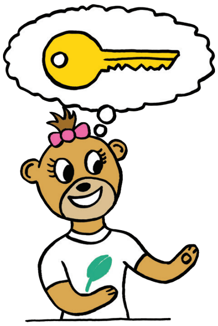
Meal	Food groups
a. 	

Meal	Food groups
b. 	
c. 	
d. 	
e. 	

QUESTION:

Which meal do you think is the healthiest? Explain your answer.

In the next chapter we will look more at what makes up a balanced meal.



KEY CONCEPTS

- There are four main food groups.
- Foods for energy – carbohydrates.
- Foods for growth and repair – proteins.
- Foods for storing energy (in the form of body fats) and providing insulation and protection for nerves and organs – fats and oils.
- Foods for maintaining a healthy body and immune system – vitamins and minerals.
- Most natural foods contain a mixture from more than one food group.
- Most processed (manufactured) foods have additives like added salt and sugar, preservatives, flavourings and colourings.

REVISION

1. Write out the sentence below in full by filling in the missing words.

   Foods are classified into the following food groups: carbohydrates, ____________, proteins and ____________.
2. Name three reasons why lipids are important in our diet.
3. List three sources of proteins.
4. Why is it necessary to supplement our diets with vitamins?
5. Copy and complete the table below, which shows some important vitamins, their natural sources and functions.

Name of vitamin	**Sources**	**Functions**
Vitamin A		Enables the eyes to produce a pigment that helps us to see in dim light.
	Brown rice, wholewheat bread	There are several types of this vitamin and they have many functions in the chemical reactions of cellular respiration.
Vitamin C		Strengthens the body's immune system by increasing its ability to fight infections
Vitamin D	Egg yolks, fish liver oil Can be made in the skin when the ultraviolet rays from the sun convert cholesterol in the skin to vitamin D.	

6. What are some of the additives that processed foods contain?
7. A vegetarian is someone who does not eat meat. What other foods, besides meat, should they be eating and why?

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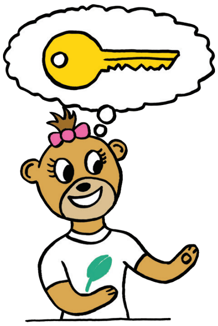
3 Nutrition

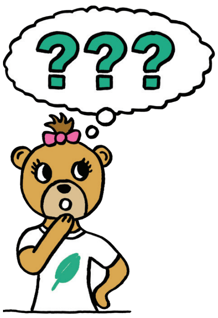


KEY QUESTIONS

- I love eating fast foods but why does my mom say it is not good for me?
- Why must I eat my vegetables if I just want to eat protein, bread and pasta?
- Can I get sick if I do not eat the right foods or not enough of a certain type of food?

3.1 A balanced diet

Now we know that there are different foods that are classified into the four food groups. The next step is to see what amounts of each food group we need to eat regularly to stay healthy. This is called a balanced diet. What is a diet?



QUESTION

Discuss the word 'diet' with your class and come up with a definition for this word. Write it down in your exercise books.

New words

- nutrition
- pyramid
- balanced diet
- dairy products

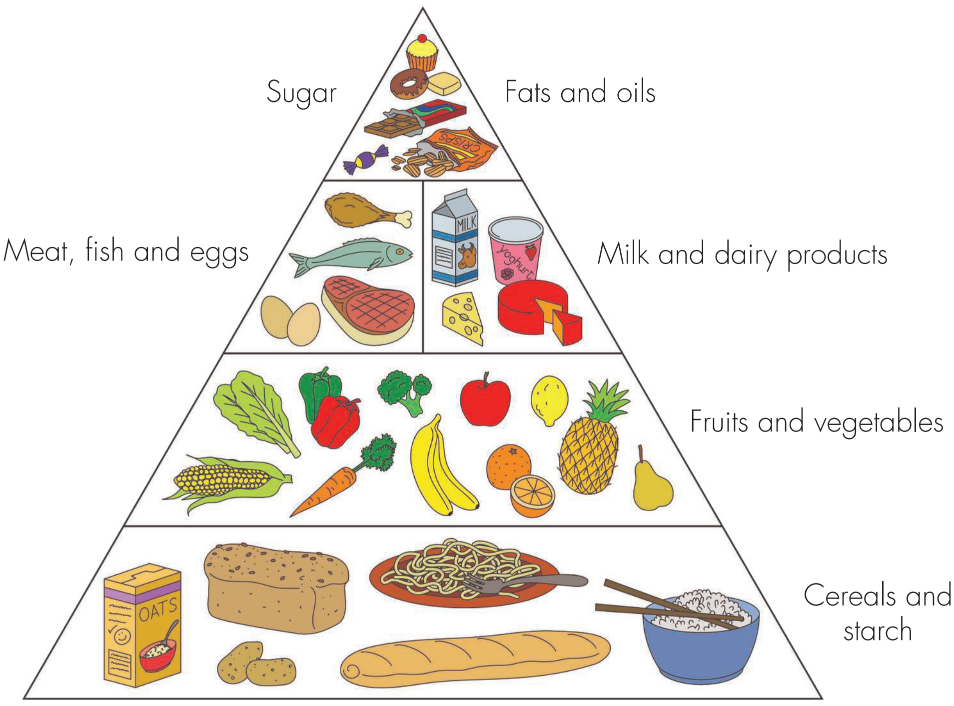
Food pyramids

A food pyramid provides a guide to a healthy balanced diet. It shows how to classify food types into different levels. A balanced healthy diet will include servings from each level of the food pyramid and will show the correct quantities you need to eat:

- You need to eat a little of the food at the top. (oils, sweets, etc.)

- You should eat less meat, chicken, fish and dairy products than vegetables and fruit.
- The food in the middle of the pyramid, fruit and vegetables, must also be eaten in fair amounts.
- You need to eat more of the food at the bottom of the pyramid. (breads, pastas, rices, etc.)

Here is an example of a food pyramid:



Some people eat a very unhealthy diet and turn the food pyramid upside down! They eat far more sweets, cakes, fatty rich food and far less vegetables and starches!

Mmm... I think I have a very balanced diet and I love being healthy! But I am not so sure about my brother. I kept a record of what he ate for a week.

ACTIVITY 3.1: Evaluating a diet

INSTRUCTIONS:

1. Carefully study Rajesh's weekly diet.
2. Answer the questions that follow.

	Breakfast	**Lunch**	**Supper**
Monday	Toast with peanut butter, coffee with milk and three teaspoons of sugar	Two-minute noodles, cream soda, jelly (while watching TV)	Spaghetti bolognese (with chopped carrots in the mince) with cheese sprinkled on top, fruit juice, tea with milk and two teaspoons of sugar

	Breakfast	Lunch	Supper
Tuesday	Toast with peanut butter, coffee with milk and three teaspoons of sugar	Two-minute noodles, Coke, toast with peanut butter, popcorn (while watching TV)	Mom and Dad worked late – scrambled egg on toast with baked beans, coffee with milk and three teaspoons of sugar
Wednesday	Late for school – didn't eat	Two eggs and toast with cheese, tea with milk and three sugars, more toast with jam and peanut butter later (while watching TV)	Hawaiian pizza, coke, cream soda, chocolate milkshake
Thursday	Toast with peanut butter, coffee with milk and three teaspoons of sugar	Indoor hockey practice after school – pie from tuckshop, coke, a chocolate, packet of hot chips	Roast chicken, butternut, baked potatoes, salad, fruit juice, coffee with milk and one teaspoon of sugar
Friday	Toast with butter (peanut butter is finished), coffee with milk and three teaspoons of sugar	Band practice after school – pie from tuckshop, coke, sweets	Takeaway chicken in a bucket, hot chips, coke, tea with milk and three teaspoons of sugar, popcorn

QUESTIONS:

1. Reading only this table showing Rajesh's weekly diet, do you think he has a balanced diet? Why do you think so?
2. Now let's use our knowledge of a food pyramid to see how healthy Rajesh's diet for the week was. Use the tallying method to keep score of everything he ate: To tally up results you make one line down for every item you count and when you get to the fifth item you draw a diagonal line through the other four. That makes it easy to count in fives and count the few left over at the end.

Total fats and oils	Total proteins	Total vitamins and minerals	Total carbohydrates

3. List the times and days when Rajesh ate fruit or vegetables.
4. What important food group is Rajesh missing from his diet if he does not eat enough fruit and vegetables?
5. Can you predict what will happen if Rajesh continues with this diet?
6. Now that you have tallied up the different food groups that Rajesh ate in a week, do you think he ate a balanced diet? Why do you say so?
7. Do you think Rajesh is a very active person? Why do you say so?
8. Takeaways are known for being fatty and oily because restaurants often deep fry the food. Rajesh and Mothusi's family ate takeaways twice in the week and the mom cooked twice. Compare the cooked meals with the takeaways, specifically focusing on the amount of oil used to prepare the meals.
9. What advice would you tell Mothusi to give to her brother?
10. Now that you have completed this activity, explain why different portions of the different food groups are necessary for a balanced diet.

ACTIVITY 3.2: Comparing meals

INSTRUCTIONS:

1. On the next page are photographs of different meals for breakfast, lunch and dinner.
2. One of the meal options is unhealthy and the other is healthy.

3. Choose the healthier option and write a paragraph explaining why. List the food groups that are missing from the unhealthy option, compared to the food groups that are present in the healthy option.

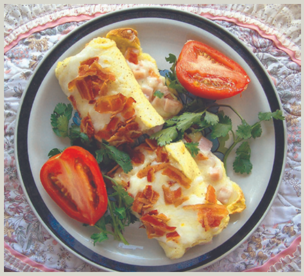
Breakfast:

Option 1: Fruit loops	**Option 2: Fruit salad**
	

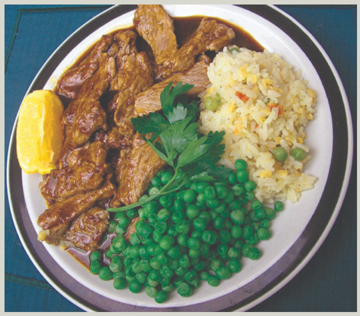
Option 1: Oats with raspberries	**Option 2: Flapjacks with syrup**
	

Lunch:

Option 1: Egg salad	**Option 2: Fried chips**
	

Option 1: Hamburger	Option 2: Omelette with salad
	

Supper:

Option 1: Chicken pieces	Option 2: Beef, peas and rice
	

New words

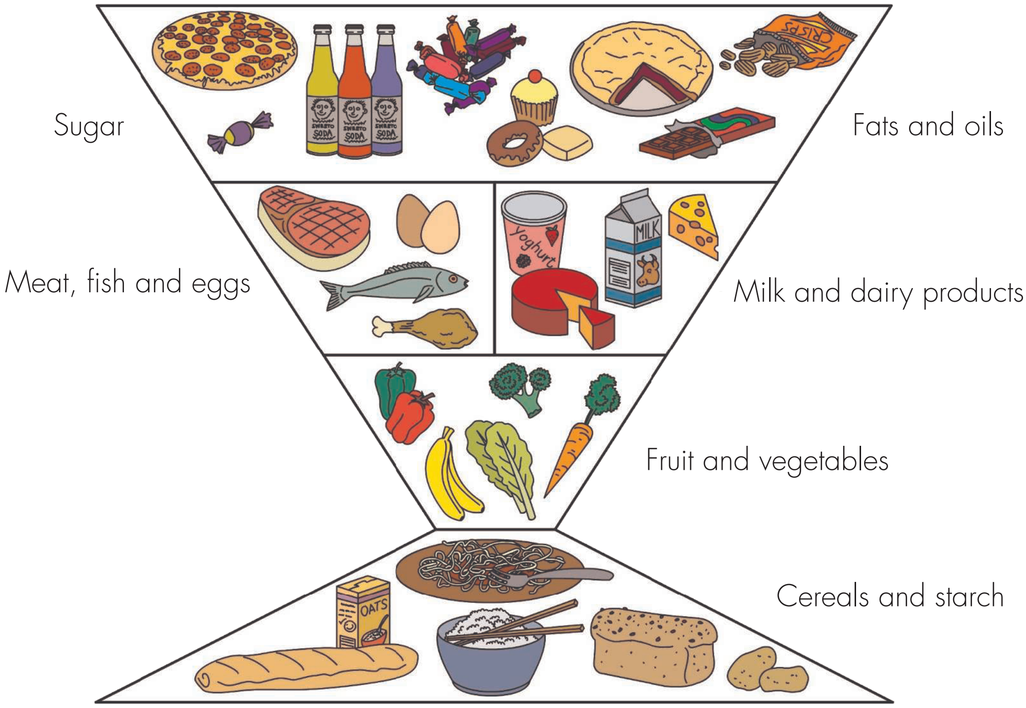
- chronic illness
- overeat
- obesity
- diabetes
- refined carbohydrates
- poultry

3.2 Diseases caused by an unhealthy diet

There are many people in the world that do not or are not able to eat a healthy, balanced diet. Many choose to eat an unhealthy diet while others do not have a choice.

Many people live in cities and can afford to buy takeaways often, or to eat hastily prepared meals, which do not always include foods from the four food groups.

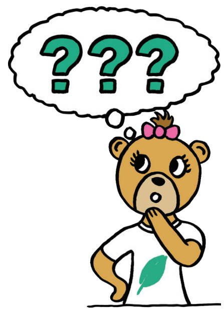
Remember the food pyramid we saw before? On page 35 is a picture of the food pyramid of someone with an unhealthy diet.



The food pyramid of an unhealthy person's diet.

QUESTIONS

Discuss in your class why you think this kind of food pyramid is unhealthy. Compare it to the healthy food pyramid on page 29 and write down the differences in your workbook.



Other families have to eat what they can afford. They do not have the privilege of choosing what their food pyramid looks like, but eat what they can buy with their small incomes. This would mostly consist of carbohydrates and some vegetables, and rarely includes meat and enough proteins and other vitamins.

Let's look at the causes of a poor, unhealthy diet and then at possible diseases caused by unhealthy diets.

Causes of a poor diet

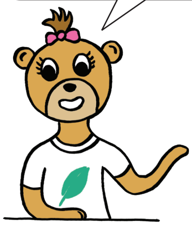
There are many causes of a poor diet.

1. **Diseases and infections:** When someone has a chronic illness, such as HIV/Aids, they are sick for a very long time. Their bodies become weak and they cannot take in nourishment from the food they manage to eat, resulting in a poor diet.
2. **Dietary practices:** In many countries, people have a preference for certain foods, for example rice, samp or mealie meal. People eat a lot of this particular food type and do not get enough protein or fats and oils in their diet. They also often cannot afford other food types, especially in developing countries. However, some families in developed countries do not eat enough fruit and vegetables out of choice, and eat a lot of refined carbohydrates, which also leads to disease and illness.
3. **Poverty and high food prices:** Poverty and high food prices stop many people from enjoying foods such as milk, meat, poultry (like chicken) and fruits. This has made it almost impossible for poor families to afford certain food groups. Some families can only afford one type of food group.
4. **Food shortage:** Sometimes famine occurs in a country where drought, poor farming knowledge and skill, and a lack of technology limits the yield of crops and herds of animals. This results in a food shortage in that country.

In these situations, people will eat whatever food is available to them, often leading to an unhealthy diet.

Did you know?

A balanced diet also means drinking water throughout the day!



An unhealthy diet can lead to many health problems because the body does not get the right amount of the different food groups, and therefore cannot function properly.

Some diseases and conditions

Often we get diseases and conditions because our bodies do not get the necessary nourishment. Some of these diseases are:

- **Tooth decay:** When you eat or drink too much sugar, the bacteria in your mouth makes acids that eat away at the tooth surface (called enamel), and causes cavities to form.

Too many sweets can cause cavities to form in your teeth.[1]

Remember to brush your teeth to help prevent tooth decay![2]

- **Rickets:** This is a condition mostly seen in babies and children. When children do not get enough fruit and vegetables, and do not get enough Vitamin D, their bodies cannot absorb calcium and they cannot grow strong bones.
- **Constipation:** This is a painful condition (not a disease) that occurs when bowel movements become difficult and take place days or even weeks apart. An unhealthy diet is often to blame, but there are other causes too. The best way to treat constipation is to eat a healthy diet with lots of fibre in the carbohydrates, to exercise regularly and to drink plenty of water.
- **Obesity:** This is a condition (not a disease) where a person's body weight is more than 20% that of the average weight for other people the same age and height as that person. The best prevention for obesity is to follow a healthy, balanced diet.

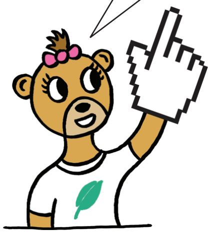
Obesity is a condition which is becoming more common all around the world.[3]

Visit

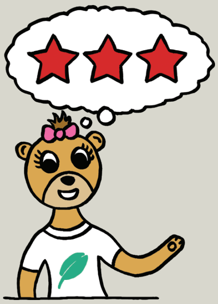
e.tv news story on obesity in South Africa.
goo.gl/h6MgU

Visit

What is diabetes? (video)
goo.gl/FxJOU



- **Diabetes:** This is a disease that affects the body's ability to use blood sugar for energy. Diabetes symptoms may include an increased thirst and urination, blurred vision and excessive tiredness.
- **Anorexia nervosa:** This is life-threatening eating disorder where the patients starve themselves and deprives their bodies of nourishment to cause themselves to lose a large amount of weight.
- **Kwashiorkor:** This is a disease that affects many children. It is caused by a lack of protein and iodine in their diet. Children suffering from this may have swollen hands and feet, and especially a very large stomach, many ulcers on the skin and their hair might discolour.



ACTIVITY 3.3: Identify possible diseases and conditions

What diseases or symptoms could Mothusi's brother, Rajesh, develop from his diet?

INSTRUCTIONS:

1. Carefully read through Rajesh's diet again.
2. Evaluate his activities in the afternoon as well.
3. Use the information about these diseases and disorders and suggest possible diseases or conditions that Rajesh might develop if he does not change his diet drastically. Tabulate them in your exercise book as in the table below.

Disease or condition	What in Rajesh's diet could cause this disease?

ACTIVITY 3.4: Research one of the diseases

MATERIALS:

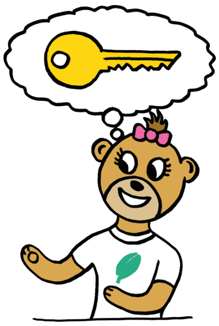
- Books from the library, information from the internet
- Sheets of paper
- Coloured pens and pencils

INSTRUCTIONS:

1. Choose one of the diseases that is related to an unhealthy diet and do some extra reading and research around the topic.
2. You must prepare a poster about this disease or condition.
3. On your poster, you must include information about:
   a. the causes of the disease
   b. which people are most likely to suffer from it and why
   c. the symptoms
   d. the health risks
   e. any possible treatments
4. You might have to present your poster to the class, depending on your teacher.

KEY CONCEPTS

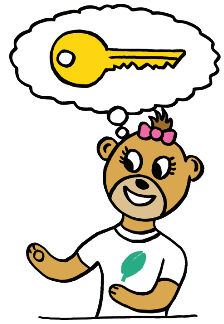
- A diet refers to the selection of food we eat every day.
- A balanced diet contains sufficient quantities of food from all four food groups, as well as water and fibre.
- Some diseases and conditions can be related to diet.



REVISION

1. What do you understand by the term ‘balanced diet’? Write a description in your exercise books.
2. Draw a food pyramid of the food that you eat and assess whether it has the correct shape of a balanced diet.
3. Rajesh thinks that he can get enough water in his diet by drinking coke and coffee with sugar in it. Explain to him if this is true or not, and why.
4. Write a paragraph where you explain some of the possible causes of a poor diet.

4 Food processing



KEY QUESTIONS

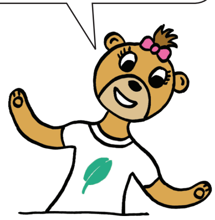
- How do we make food last longer?
- Is it possible to stop food from going off?
- What can you do to prevent bacteria and germs getting into food?

4.1 Why do we need food processing?

People have been processing food for thousands of years. Before the invention of fridges and freezers, people had to collect food in summer and store it because in winter food is often scarce. They found out that they could preserve food like meat and fish by salting and spicing, and then drying it – this is called curing the meat. In South Africa biltong and bokkoms are examples of cured meat and fish.

New words

- processing
- preserve
- cure (curing)
- survey
- artificial sweeteners
- preservatives

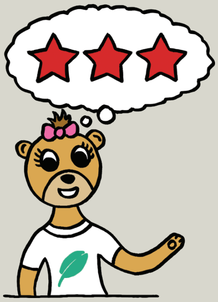


Bokkoms (cured fish)[1]

Pieces of meat hung up to dry and turn into biltong.[2]

Visit

Drying foods (video).
goo.gl/3LTE2



ACTIVITY 4.1: A really old role play

Imagine you are a group of time-travellers and you are joining the Quantum Club for your first jump through the wormhole! You may not take anything non-organic with you. So no metal tins or plastic containers, and certainly no computers, cell phones or laptops!

Come on! Follow the Quantum Club and go back in time!

Imagine being transported 350 years back into history and arriving with only the clothes you are wearing and whatever you have learnt in your head in *exactly* the same place you are right now. It is late summer and you need to spend a year wherever you are and survive until the wormhole opens again at that exact spot and allows you to return to 'the future'.

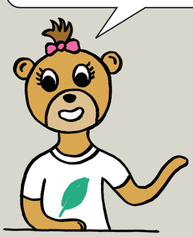
Your mission: Gather information on the local inhabitants and the food they eat, their ways of living, and how they survive the elements and natural dangers in their environment. When you return you will need to explain how they preserved and processed different foods to last them through winter. How did they package and protect this food from scavenging animals and pesky insects?

Brainstorm these problems with your group. List as many different questions or problems that you can think of that will affect you:

- Immediately
- In about a month's time
- In six months' time
- Right at the end of your stay – a week or so before you return to the present time.

Did you know?

Biltong was invented by the Voortrekkers who travelled by ox-wagon during the Great Trek. They needed to preserve meat for the long journey. The raw meat was preserved using salt, vinegar and spices.



Think especially of food and shelter, and specifically how you will collect, preserve and process any food that you collect. Remember you are not allowed to take anything that is not organic so no pocket knives, nylon rope or even lighters can go with you!

Design: Design the following items, which you can make and use when you land:

1. Something that you can collect and carry water in, and store it in for future use.
2. Something that you can collect and carry food in, and specifically something that you can store it in to keep it away from scavenging animals and insects.
3. Something that you can use to cut with, as you will need to make a shelter to sleep in and keep safe from wild animals. You will also need to cut material for your food and water containers.
4. Something that you can use to hunt animals or catch fish, if you are going to eat meat while you are there.
5. A device that you can use to preserve meat or fish, or perhaps fruit and vegetables for the winter months.

Give each person in your group one of these items to design and make, and bring to class. Make sure you do not use any modern tools, or any metal, glass or plastic.

QUESTIONS:

1. List the possible dangers that you will face in your new home.
2. Can you predict how the locals will look and how they will treat you?
3. Describe your first night there.
4. Explain how you will decide what you can and cannot eat on your first day.
5. Complete this sentence: If I want to preserve some of the fish I catch I will ...
6. The local indigenous people use different methods to preserve their fresh fruit and vegetables. Find out about these methods and use one method to preserve some fruit of your own. At the end of this chapter, bring your preserved fruit to show the class. You have two weeks.

Did you know?

In the 1790s, Napoleon Bonaparte launched a competition in France for scientists to develop ways to preserve foods for France's armies! This led to the invention of canning.

Food processing – then and now

Hundreds of years ago explorers like Columbus, Da Gama and Diaz, had to pack supplies for their crews to last a very long time should they not find food and water on their expeditions. They too had to take as many preserved food and drink as they could.

Many of the foods we eat today cannot be eaten in their raw form – we need to process the food to make it edible.

Sometimes food is also processed to add to its nutritional value. For example, when we ferment dairy products to make yogurt, cheese and buttermilk.

QUESTIONS

1. There are many reasons to process food. Can you think of any? Write them down.
2. When you get home today ask your parents, family members and maybe your friends' parents if they think processed food is good or bad, and why they say so. Write the results of what you learnt from this quick survey in your exercise book.

Benefits of food processing

Food processing adds many benefits to our modern lives:

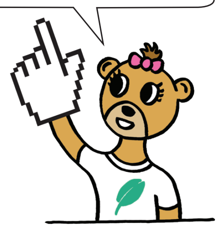
- Transportation of fresh food is quite difficult. If producers can process the fresh fruit and vegetables in some way, the food is easier to transport. Delicate products like grapes, strawberries and peaches can be transported much easier. The processing also helps the fruit and vegetables to last longer.
- Today people can eat fresh fruit and vegetables all year round. They do not depend on seasonal availability because of modern methods to process and transport these products. Therefore food processing and transportation makes the modern balanced and varied diet possible.

This truck collects the pear and apple boxes and transports them.

- Many times food and beverage producers add extra vitamins and nutrients to their food to make it healthier for their clients.
- Buying and preparing processed food is also more convenient and less time-consuming.
- Foods are processed to preserve them, such as when fruits are preserved to make jam, or pickled, such as pickled onions.

Visit

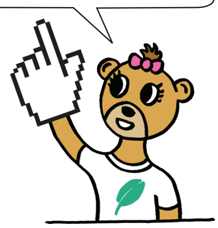
Making cheese at home (video). goo.gl/EVLhG



This ginger has been pickled and preserved so that it lasts longer.

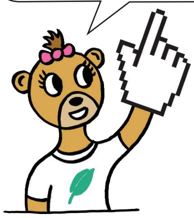
Visit

Pickling vegetables (video). goo.gl/6rLA9



Visit

Making plum jam (video).
goo.gl/6vNyq



- Food processing is lastly very important to people with allergies and diabetes because they are able to eat a greater variety of healthy food. An allergy for cow or goat milk is a very common allergy among small children. They are able to drink 'milk' only because modern food processing has found a way to make milk from rice, oats or soya.

Rice or soya milk are processed foods and an alternative to cow's milk for people with allergies.

ACTIVITY 4.2: Describing processed foods

INSTRUCTIONS:

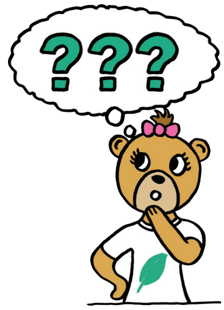
1. Look at the following photographs of various foods.
2. Each one has either been processed in some way, or needs to be processed before we can eat it.
3. Briefly describe in your exercise book why and how each food has been processed, or will be processed.

Food	Why and how it is processed
 *Raw meat*	
 *Yoghurt*	
 *Pickled gherkins*	
 *Glace cherries*	

Food	Why and how it is processed
 *Fried eggs*	
 *Cheese*	
 *Butternut*	
 *Frozen meals*	

Possible drawbacks of processed food

We have seen that processed foods have many advantages in our modern lives, but processed foods also have drawbacks (disadvantages), especially if they have been over processed.



QUESTION

Write down some possible reasons why people think processed food is not good for you.

ACTIVITY 4.3: Class discussion

INSTRUCTIONS:

1. We are going to have a class discussion about some of the possible drawbacks of processed foods and why some people do not like the idea.
2. This is an opportunity for you to practice taking down notes from what was said in class.
3. Your teacher will lead the discussion and also write some things on the board.
4. You must take notes in your exercise books.

4.2 How are foods processed?

There are different levels of food processing. The key question is to ask: Has any process occurred from when this plant or animal was in its natural habitat to where it is now? If you can say yes then you know that it has been processed in some way or another.

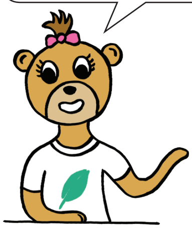
New words

- curdle
- shelf-life
- commercial

Minimally processed foods:

- Fruit and vegetables, nuts, meat and milk undergo very little processing from when the plant or animal product was in its natural state to the point where it lands on your table.

Did you know?
The Xhosa people leave milk to curdle in a hide sack or calabash to form a favourite semi-solid sour yoghurt drink.



- They need to harvested, washed and sometimes peeled, chopped, juiced or cut to remove inedible parts, before they are sold. These have a very short shelf-life.
- Animal products like eggs and milk must be collected or harvested from the animals, while meat products need butchering.

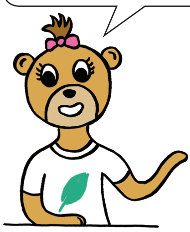
Milk and juice are minimally processed.

Vegetables are washed, cut and cooked. This is minimal processing.

Processed food ingredients:

- Products with a longer shelf-life, like flours, oils, fats, sugars, syrups, margarine, sweeteners and starches, fall into this category.
- The original product has been changed and the ingredient does not look like the original kernel or grain, or oil seed or beans.
- These processing techniques often break down any nutrient values and the manufacturers often add in extra nutrients, vitamins and minerals to their foods.

Did you know?
The Swazi people make marula beer by placing the ripe fruit in large traditional pots and letting them ferment.



Highly processed foods:

- Highly processed foods include snack foods and desserts, biscuits, cereal bars, chips, cakes and pastries, as well as fizzy soft drinks, breads, pastas, breakfast cereals and infant formula.
- Animal products that are highly processed include processed meats (smoked, canned, salted or cured), nuggets, fish fingers, viennas, many sausages and boerewors, and burgers.

Polony is a highly processed food.

Did you know?

Mealie meal, made by grinding maize, forms a huge part of the diet in many indigenous cultures in southern Africa.

The table below shows how a raw product is processed to make an ingredient, which looks very different to the original raw product. Then the processed ingredients are used to make highly processed foods, such as bread.

The raw product: Wheat	The processed ingredient: Flour	The highly processed food: Bread
		

ACTIVITY 4.4: Learning how to summarise

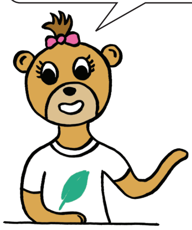
Sometimes we are presented with a lot of information, and we need to condense it to make it easier to remember. This is called summarising and it is a very useful skill.

INSTRUCTIONS:

1. Draw a table to summarise the information about the levels of food processing.
2. Include a short description of each level of food processing and examples.

3. Think about how many columns and rows you will need.
4. Give your table a heading.

Did you know?
Dr J.H. Kellogg invented a type of granola cereal in 1860 – it was meant for Seventh Day Adventists who were following a very strict diet. Later his brother joined him and they started their company Kelloggs! Do you think they were successful?

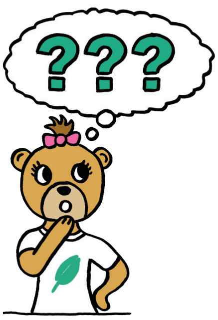


Food processing methods

As you can see, the degree in which food is processed determines many of the processes involved.

Processing methods have changed in many ways, but the basic principles are still applied. Food is still dried or heated to preserve it, just like people did 300 years ago, but there are many modern methods that are also used today:

- Sun drying, freeze drying and spray drying.
- Fermenting barley, grapes or dairy into cheese, buttermilk (*amasi*) or yogurt.
- Pickling vegetables (onions or gherkins, for example).
- Salting and spicing meat to preserve it (then drying it).
- Adding sugar to berries and/or fruit to make preserves.
- Pasteurisation: Using just the right amount of heat to warm up milk or juice for example, to extend the shelf life.
- Cooking by roasting, smoking, baking, frying or toasting.
- Freezing or refrigerating.
- The making of juice concentrates.



QUESTIONS

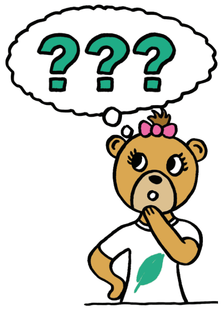
When you go home from school today, make a list of the food products that you have at your house (whether they are in the cupboard, the fridge or the freezer). Next to each item, write down the type of processing it might have gone through, using the list above as a guideline.

No matter what food processing method is used, there are five extremely important performance parameters that all food processing must adhere to:

1. Hygiene
2. Energy efficient
3. Minimal wastage
4. Labour efficient
5. Minimal factory shutdowns

QUESTIONS

Discuss why you think each of these five points are important in food processing. You might need to do some extra reading and have a class discussion.



We have learnt a lot about food processing methods in our modern lives. However, the indigenous people of southern Africa have been preserving and processing food for many generations, and still use some of their traditional methods today.

ACTIVITY 4.5: Comparing traditional and commercial food processing methods

INSTRUCTIONS:

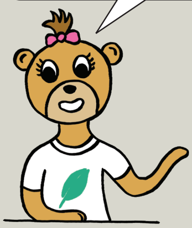
1. Read the following description of how beer is made in the Zulu culture.
2. Then answer the questions that follow.

Zulu beer making

Beer (*utshwala*) forms an integral part of the Zulu culture, especially at social gatherings and traditional ceremonies. Zulu beer is traditionally made by the women. To brew the beer, the women soak coarse sorghum and maize in water for one day, typically in a big drum-like *imbiza* pot. The following day, the broth is boiled over a fire and more dry sorghum is added to the mixture. After this, the mixture is mashed together and then allowed to cool for the rest of the day. The next day

Did you know?

The Ndebele people of southern Africa eat a plant called *umrorho*. It is cooked or dried by spreading it out in the sun so that it can be stored for the cold winter months.



(day 3 of the brewing process), the mixture is filtered through a sieve to remove the big fibres. The sieve is made from palm fronds and the brew is poured from the big *imbiza* vessel into the serving vessel, *iphangela*, made from clay. The beer is now ready to be served. The iphangela is carried from brewery in the kraal (a semi-thatched hut that allows the smoke from the fire to escape and ensures a good supply of oxygen to ferment the mixture) to the drinking assembly. A woman scoops the beer into a drinking vessel, *ukhamba* (a small, round clay pot decorated with traditional patterns) using a dried gourd and presents it on her knees to the men. She will first taste the beer to show the head of the household that she has brewed the beer properly, and then hand him the *ukhamba*, before passing it around to the rest. The beer contains 3% alcohol and it is nutritious, as it is made from plant products without modern additives or colourants.

This watertight, handwoven basket, called iquamba, is used to store any leftover beer.[3]

QUESTIONS:

1. What are the ingredients used to make *utshwala*?
2. What are the Zulu names for the three different pots (vessels) used in the beer-making process?
3. What are these vessels made from?

4. Why does the brewery hut only have a semi-thatched roof and not a fully enclosed roof?
5. Draw a flow diagram to illustrate the Zulu beer-making process. Remember to include arrows to show the direction.
6. For the following task, you need to do some research, using books and the internet. Find out how beer is made in a modern brewery, such as the South African Brewery in Newlands, Cape Town. Write a paragraph where you compare this modern beer-making process to the indigenous method of the Zulu people.

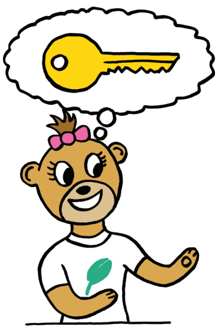
You now have a better idea of the different ways that raw food can be processed. Choose one particular method that you found really interesting to further research. Then process the food at the end.

ACTIVITY 4.6: Food processing project

INSTRUCTIONS:

1. You need to read as much as possible about your chosen method of food processing.
2. You will need to interview at least one person who uses this method of food processing. Before your interview you will need write down at least ten different questions to ask during the interview. Include these questions and the person's answers in your project's presentation.
3. After your research and interview you need to include a few paragraphs headed: What I learnt about food processing. This must be a summary of the information you learnt.
4. Present your findings in a visible form that you like – perhaps a poster, PowerPoint slideshow or in a flip-file as a brochure. Be creative and present your information in a lively and interesting way!
5. Use the knowledge and understanding that you gained and process the food using this method.

6. You will need to do a presentation to the class. Include the steps you followed to process your chosen food. Bring some of your processed food to class so that you can all enjoy what everyone has made.
7. When you choose a processing method make sure you have food that you will be able to process using this method! If you cannot find fresh (raw) peaches to poach because it is winter, then consider choosing another processing method.



KEY CONCEPTS

- Food is processed to make it edible, by cooking or preparing it for example.
- Food is processed to make it last longer – we say to preserve it.
- Food is processed to improve its nutritional value by fermenting it for example.
- During processing many foods may lose some of their nutrients.
- Various methods are used to process food.

REVISION

1. Write a definition for 'food processing' that will explain what it means.
2. There are three main reasons why we process food. Explain what is meant by the following words in relation to food processing:
   a. preserving
   b. cooking / frying
   c. fermenting
3. List three drawbacks why many people believe that food processing is not good for their health.
4. Describe how you would preserve extra fish that you had caught while on an overnight camping trip.
5. A farmer wants to export some green (white) table grapes to Australia from his farm near Worcester in the Western Cape. Suggest the best form of transport that you know of that he should use, and explain why you gave him this advice.
6. The lives of many diabetics and people with severe food allergies have been drastically improved with the invention of many processed foods. Explain why you think this is so.
7. Write the degree to which the raw materials were processed for each item.

Food	Degree of processing
a. Mealie bread	
b. Fresh mealies washed and packaged	
c. Sunflower oil	

8. Explain why many people believe that highly processed food is bad for your health.
9. Write a short paragraph summarising what you have learnt about food processing. Why do you think it is important in your daily life?

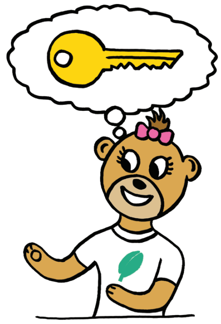
I really enjoyed that, especially learning about traditional food processing.

I am now going to give my strawberry preserve that I made during our food processing project to my grandmother for her birthday!

5 Ecosystems and food webs

KEY QUESTIONS

- What is an ecosystem?
- How often does it rain in a rainforest or in a desert?
- Now that I know how people eat, how do animals get their food?
- Why can animals only eat one type of thing? For example: Why won't a great white start eating kelp, or why won't a tortoise hunt a mouse?



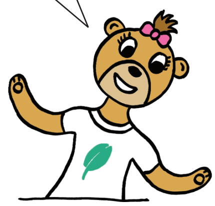
5.1 Different ecosystems

Nothing in the world can live truly on its own. No plant or animal, and certainly no human. Living things are connected to each other, they depend on each other, and on the non-living things in their environments.

In this chapter we will take a closer look at ecosystems and examine the different kinds of ecosystems that we get around the world, see how animals, plants and microorganisms depend on each other, and learn about food webs and feeding relationships in an ecosystem.

New words

- ecosystem
- tundra
- permafrost
- savanna
- fynbos
- biome
- dependent
- interdependent



Types of ecosystems

An ecosystem is an area where living and non-living things depend on each other in many different ways. There are many different types of ecosystems on our planet:

- Rivers
- Mountains
- Sea and the rocky shores
- Ponds and wetlands

- Arctic and alpine tundra are in extremely cold regions close to the North and South poles. There are no trees but some shrubs and dwarf plants grow in wet, spongy soil if it is not permanently frozen (they call this permafrost).
- Grasslands: tropical savannas and temperate grasslands.
- Forests, including tropical rainforests, and forests of coniferous and/or deciduous trees in moderate climates support many kinds of herbivores and carnivores.
- Deserts and semi-deserts

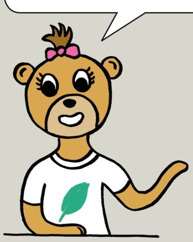
ACTIVITY 5.1: Describing different ecosystems

INSTRUCTIONS:

1. Study the photos of different ecosystems in the table below.
2. Identify the type of ecosystem in each photo.
3. Then write a description of each ecosystem:
    - Identify some important physical features and structures, such as rivers, mountains, rocks, etc.
    - What type of climate do you expect where this ecosystem is found?
    - Identify the types of plants and animals you would expect to find in the ecosystem. Why might they benefit from living in these conditions?

Did you know?

In America grasslands are prairies and in Asia they are called steppes. In South America they call it *pampas* and in South Africa we often call it bushveld or savanna.

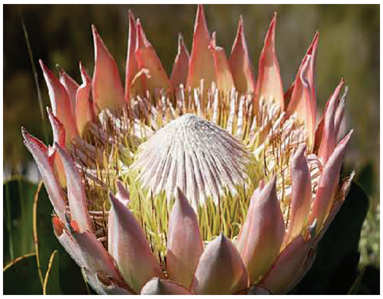


Ecosystem	**Type of ecosystem and description**
a. 	

Ecosystem	Type of ecosystem and description
b. 	
c. 	
d. 	
e. 	
f. 	

A unique South African ecosystem

South Africa's fynbos region is unique – it produces an incredible array of plants and specifically flowers. Our national symbol, the Protea, grows wild here and *nowhere* else in the entire world!



The king protea, our national flower[1]

Typical Fynbos at Cape Point Nature Reserve[2]

South Africa is famous for its fynbos. It does not grow naturally anywhere else in the world! Fynbos plants are especially adapted to survive the climatic conditions and frequent fires. The low bushes can survive the harsh windy conditions, and the plants produce seeds that can very often only germinate once they had been scorched by fire.

A fire passed through this fynbos area. A year later the indigenous fynbos had regrown but the pine trees that are not indigenous were all dead.

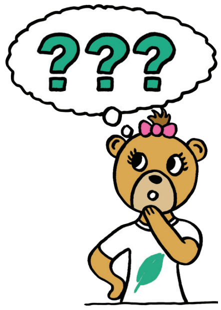
The fynbos biome in South Africa has a huge biodiversity in plants and animals.

5.2 Living and non-living things in ecosystems

In an ecosystem, there are certain relationships between the living things and the non-living things in a particular area.

QUESTIONS

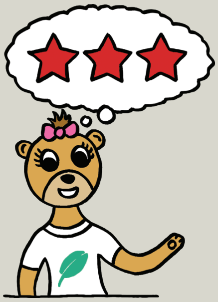
1. What are some of the non-living things in an ecosystem?
2. What does biodiversity mean?



A healthy ecosystem is one in which there is a balance between the non-living and living things. A healthy ecosystem also depends on sufficient biodiversity of plants, animals and their habitats.

We saw at the beginning of the term that plants depend on air, water and sunlight in order to make their food. Do you remember what this process is called?

Animals also depend on the non-living things in their ecosystem. All animals need oxygen from the air to breathe and to drink water. Some animals also use the non-living things to make their shelters. For example, ants rely on the soil and sand to build their nests in.



ACTIVITY 5.2: Assessing the balance between living and non-living things

INSTRUCTIONS:

1. Look at each of the following photos of different ecosystems in which the balance between living and non-living things has become upset.
2. Answer the questions on each picture.

A dried river bed.

In this river ecosystem, the water has dried up due to a drought. How does this affect the biodiversity of the plants and animals in this ecosystem?

The soil has started to erode.[3]

In this photograph the soil has started to erode. Why do you think this happened?

A pine tree plantation

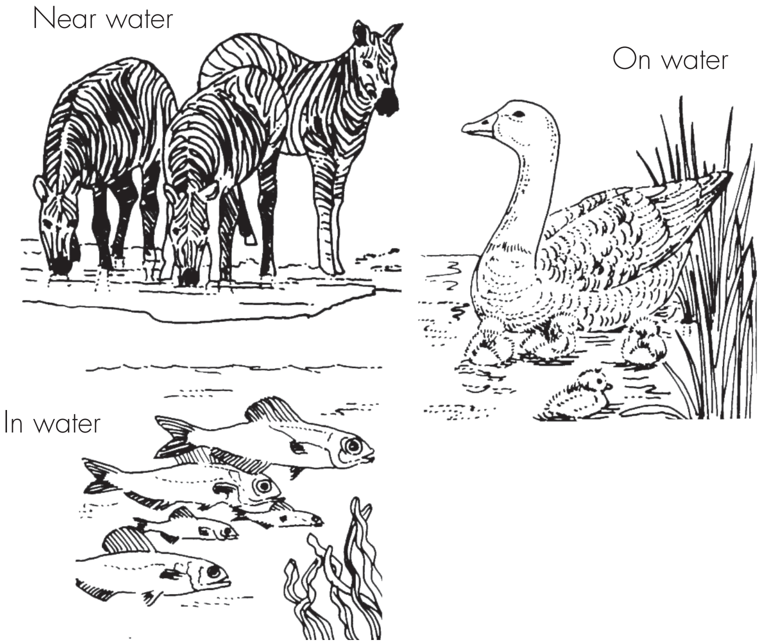
In this man-made forest, there is not much life under the canopy of the trees. Why do you think this is so?

As you have seen from this activity, the living things depend on the non-living things in an ecosystem. There is also a very fine balance, and if something is upset, then the ecosystem will begin to deteriorate.

The importance of water in an ecosystem

Without water life as we know it cannot exist.

- Water provides a habitat for many different organisms and allows plants and animals to survive and breed.
- Water is a universal solvent and allows important chemical reactions to take place. It is a key ingredient for photosynthesis, where plants create glucose (sugars) from sunlight, water and carbon dioxide.
- Water plays an important role in plant reproduction as some seeds need to be dispersed by water. (Try and remember which seeds get dispersed by water.)



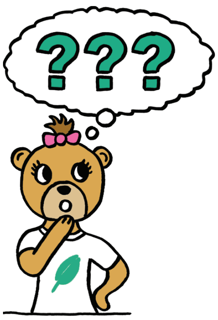
Animals depend on water in their ecosystems.

New words

- food web
- microorganism
- insectivore
- field work
- environmental disaster

5.3 Food webs

We have now had a look at what makes up an ecosystem and that there are relationships between the living and non-living things. In an ecosystem, plants and animals are also connected to each other due to their feeding relationships. The plants in an ecosystem are called the producers and the animals are the consumers.



QUESTIONS

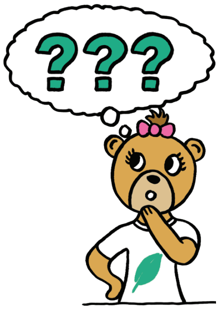
Do you remember what a producer and a consumer does in an ecosystem? (From Grade 5 work but also from the photosynthesis work you started this term with.) Write an answer in your exercise books.

There are different types of consumers:

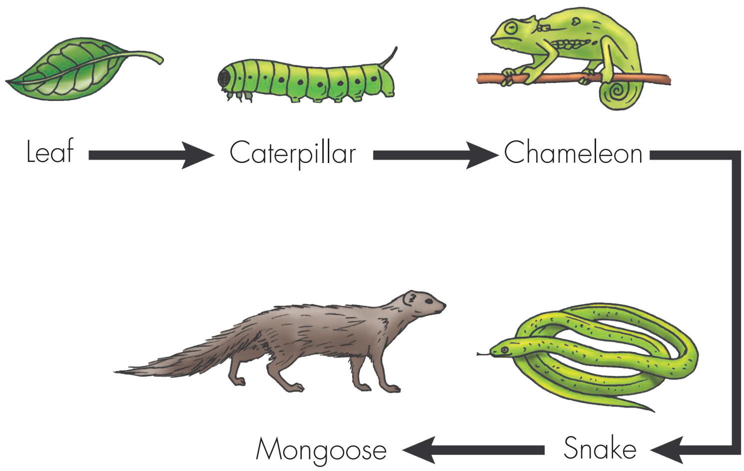
- Herbivores only eat plants and plant products.
- Carnivores only eat meat and meat products (eggs).
- Omnivores eat plant and animal products.
- Insectivores only eat ... Can you guess what?
- Scavengers eat dead animal matter.
- Decomposers are micro-organisms like bacteria and fungi, as well as mushrooms, that break down animal and plant material into tiny particles, and recycle it into the ground ready for the plant to use.

QUESTIONS

What do you call a human herbivore?



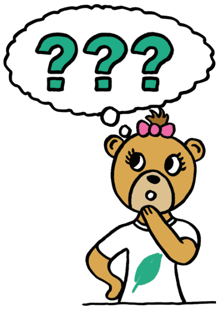
Do you remember in Grade 5 when we looked at food chains? Here is an example of a food chain:



A simple food chain

QUESTIONS

Work with a friend and design your own food chain consisting of four organisms. Remember a food chain always starts with plants (producers) and ends with decomposers.



In a whole ecosystem, the feeding relationships between plants and animals are much more complex than a simple food chain.

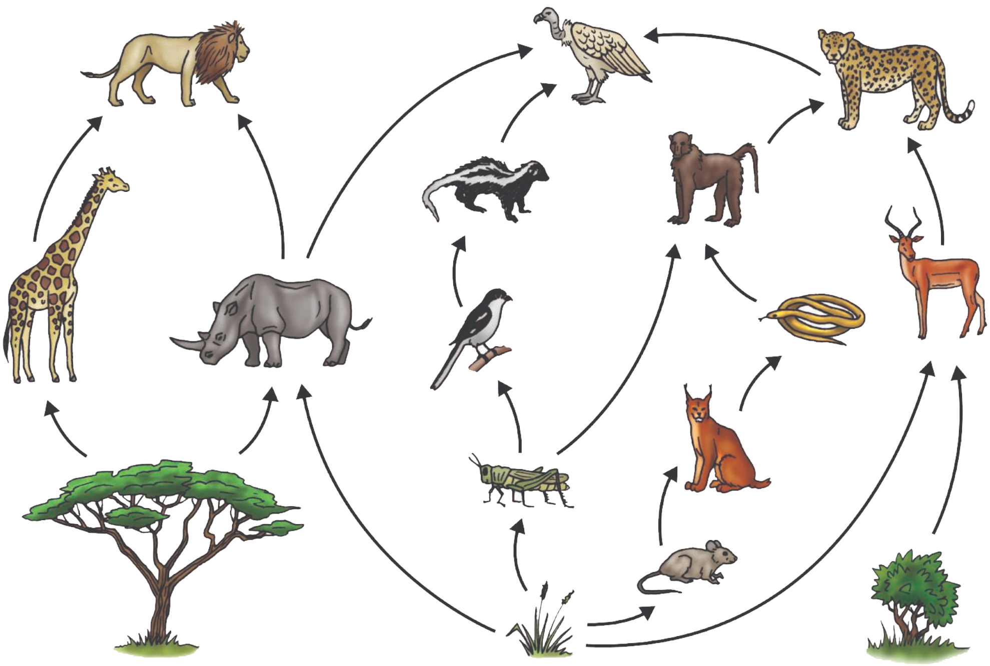
For example, in the food chain on page 67, the chameleon might also eat flies or butterflies. The snake does not only eat chameleons, but also lizards and mice, and the mongoose also eats small birds and eggs.

What is a food web?

When we join many different food chains in an ecosystem together, we get a food web.

A food web consists of many thousands and thousands of food chains that are connected to each other.

A food web in a savanna ecosystem is shown below.

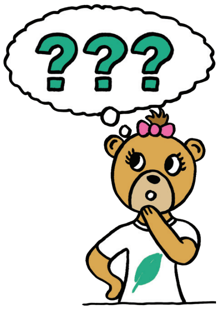


A food web in a savanna.

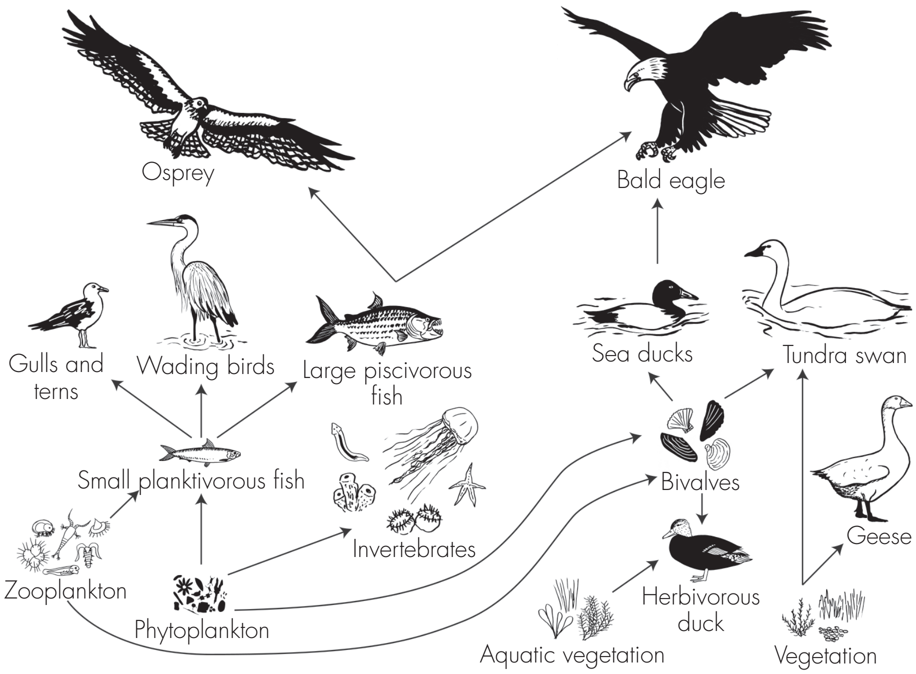
There are also different levels of consumers in an ecosystem:

- Primary consumers are the herbivores that eat the plants, such as the mice and grass in this savanna food web.
- Secondary consumers eat primary consumers.
- Tertiary consumers eat the secondary or primary consumers.

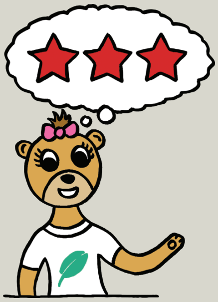
QUESTIONS



1. Study the food web on page 68 again and identify the producers and the consumers. Distinguish between the primary, secondary and tertiary consumers.
2. Below is another food web consisting of plants, fish and birds. What kind of ecosystem do you think this food web describes?



A food web consisting of plants, fish and birds.



ACTIVITY 5.3: Drawing food webs

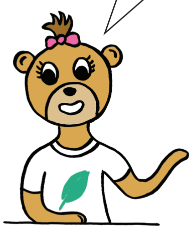
INSTRUCTIONS:

Use the following lists of organisms in a sea and forest ecosystem to draw a food web for each ecosystem.

1. **Sea ecosystem:** phytoplankton, sea weed, zooplankton, crab, lobster (scavenger), prawn, small fish, large fish, turtle, seal, dolphin, killer whale.
2. **Forest ecosystem:** grass, small plants, seeds, beetle (herbivore), butterfly, tree frog, rabbit, mouse, seed-eating bird, insectivorous bird, snake, fox, owl.

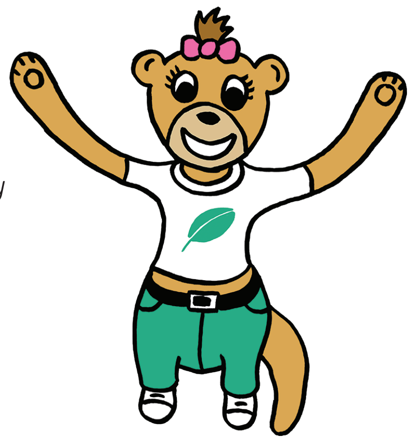
Did you know?

When a scientist, such as a botanist, zoologist or ecologist, goes outside to do their work and experiments, this is called field work.



Now that we have learned about the living and non-living things in an ecosystem, and the relationships that exist, let's investigate an ecosystem in or near the school.

I love going outside to study the world around us! Come on, let's go!



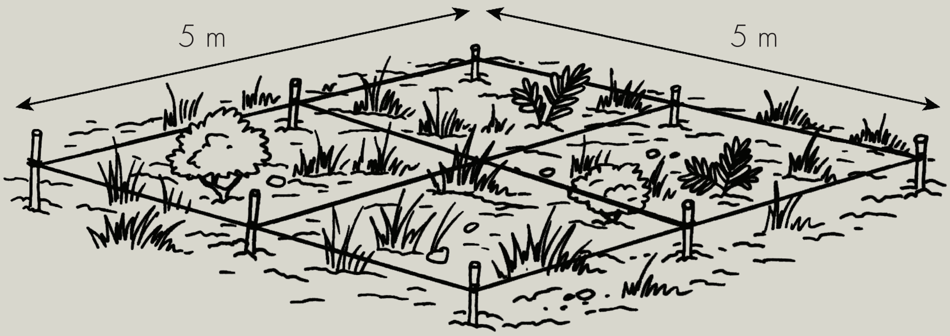
ACTIVITY 5.4: Studying an ecosystem

MATERIALS:

- Eight sticks
- String (about 30 m)
- Clipboard
- Scrap paper
- Pen and pencil
- Reference books for identifying species names

INSTRUCTIONS:

1. You will work in groups for this activity. Go outside with your teacher and identify an ecosystem on your school grounds, or near to the school, which you can study.
2. You will need to mark out the area with the sticks and string using the quadrant method. Look at the picture below to get an idea of how to set up your quadrant. The area must be 5m x 5m.
3. Once you have marked out the square, divide it up into four smaller squares with the string so that you have a quadrant with four squares as shown in the picture.



A 5m x 5m quadrant

4. When marking out your ecosystem to study, be careful not to damage any of the plants and animals that are there as this is what you will be studying.
5. For each of the four quadrants in your ecosystem, count the number of different species of plants and animals.

6. See if you can identify the names of the different plant and animal species using reference books. Copy the table below in your exercise books and fill this out when you get back to class.
7. Study the non-living things in your ecosystem. For example, what type of soil is present? Are there any rocks? Is there perhaps a stream running through your ecosystem? What is the sunlight like, shady or full sun? Are there any animal shelters present? Make notes about this as you will have to answer questions when you get back to class.

QUESTIONS:

1. What type of ecosystem are you studying?
2. What is the total area of your square?
3. Copy the following table in your exercise books and fill out each quadrant:

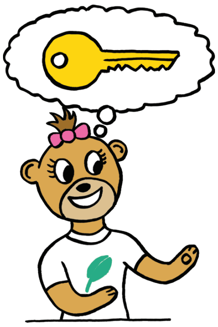
	Quadrant 1	**Quadrant 2**	**Quadrant 3**	**Quadrant 4**
Number of plant species				
Number of animal species				
Total organisms in each quadrant				

4. What is the average number of plant species in the whole square? (Hint: To work out average, add up the number of plant species for each quadrant and divide by the number of quadrants).
5. What is the average number of animal species?
6. What is the average number of total organisms in your ecosystem?
7. What is the number of organisms per unit of area? This is quite tricky – your teacher might need to help you!

8. Copy the table below in your exercise books and fill in the names of three species of plants and three species of animals that you identified. Do a simple drawing of each organism and write a short description of each species.

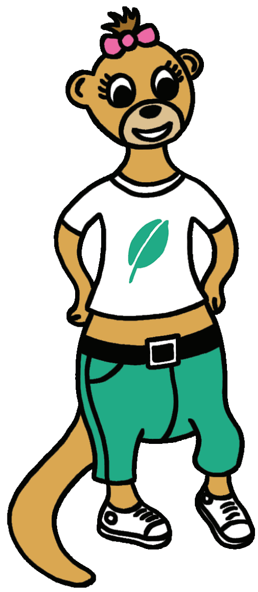
Names of species	Drawing	Description
Plant species:		
1:		
2:		
3:		
Animal species:		
1:		
2:		
3:		

9. Write a description of the non-living things in your ecosystem. Explain the availability of food for the animals, the water availability, the type of soil (sandy or rich organic soil, for example) the amount of sunlight (shady or full sun, for example), and describe if there are any natural shelters for animals.
10. Your ecosystem will contain animals and plants which are interdependent and they are connected by their feeding relationships. Draw a food web for your ecosystem in your exercise books.
11. Ecosystems are often destroyed due to the impact of humans or other environmental disasters, such as a flood or drought. Identify some possible threats to your ecosystem. Write about them in your exercise book and why they could destroy your ecosystem.
12. Brainstorm possible ways to prevent these threats to your ecosystem from destroying it. Record your ideas in your exercise book.



KEY CONCEPTS

- There are different ecosystems where living and non-living things depend on each other.
- Living and non-living things share an ecosystem.
- Food webs show how plants and animals are connected by their feeding relationships.
- Plants are producers of their own food.
- Animals are consumers and eat plants or other animals.
- Microorganisms are decomposers and break down dead plant and animal material and return the nutrients to the soil.



I found it really interesting to learn about how everything in an ecosystem is interdependent. Now I also know a bit more about healthy living!

It is time now to join Walt to learn more about Matter and Materials!

REVISION

1. Provide a definition for an ecosystem.
2. Why is the feeding relationships between plants and animals in an ecosystem called a food web?
3. What is the term given to animals that break down dead plant and animal material?
4. Read this blog entry made by a Grade 6 pupil in Limpopo province reporting on their environment.
   " I live in the Waterberg area in northern Limpopo. This is the first area in South Africa to be named a biosphere reserve. During the stone age indigenous people lived in this area. They brought in cattle that overgrazed the grasslands and caused a terrible outbreak of tsetse flies. Then in the 1900s Dutch farmers brought in more cattle. All the cattle, goats and sheep of the farmers and the indigenous people almost destroyed the natural bushveld vegetation. Luckily the people realised the problems in time and started to re-introduce and protect original species of animals and plants in the area. White rhino, giraffe, hippopotamuses and different species of antelope and smaller buck returned. Eco-tourism is now very popular and farmers try really hard to stop soil erosion, and to introduce original grass species. Farmers also started to take away fences between their farms to allow animals to walk free."
   a. Describe what happened to the land when all the cattle, sheep and goats were grazing on it.
   b. Explain what happened to the original, indigenous animals that lived on the land after the cattle farmers arrived.
   c. Can you predict what would have happened if the people did not change the way they used the land?
   d. What factors did they have to change to protect and conserve their land?
   e. If the farmers instead of removing the cattle and goats, rather planted crops on the land, what do you think would have eventually happened?
   f. What choices do you need to make, or what do you need to change or improve in your community, to stop similar types of environmental destruction from happening there?

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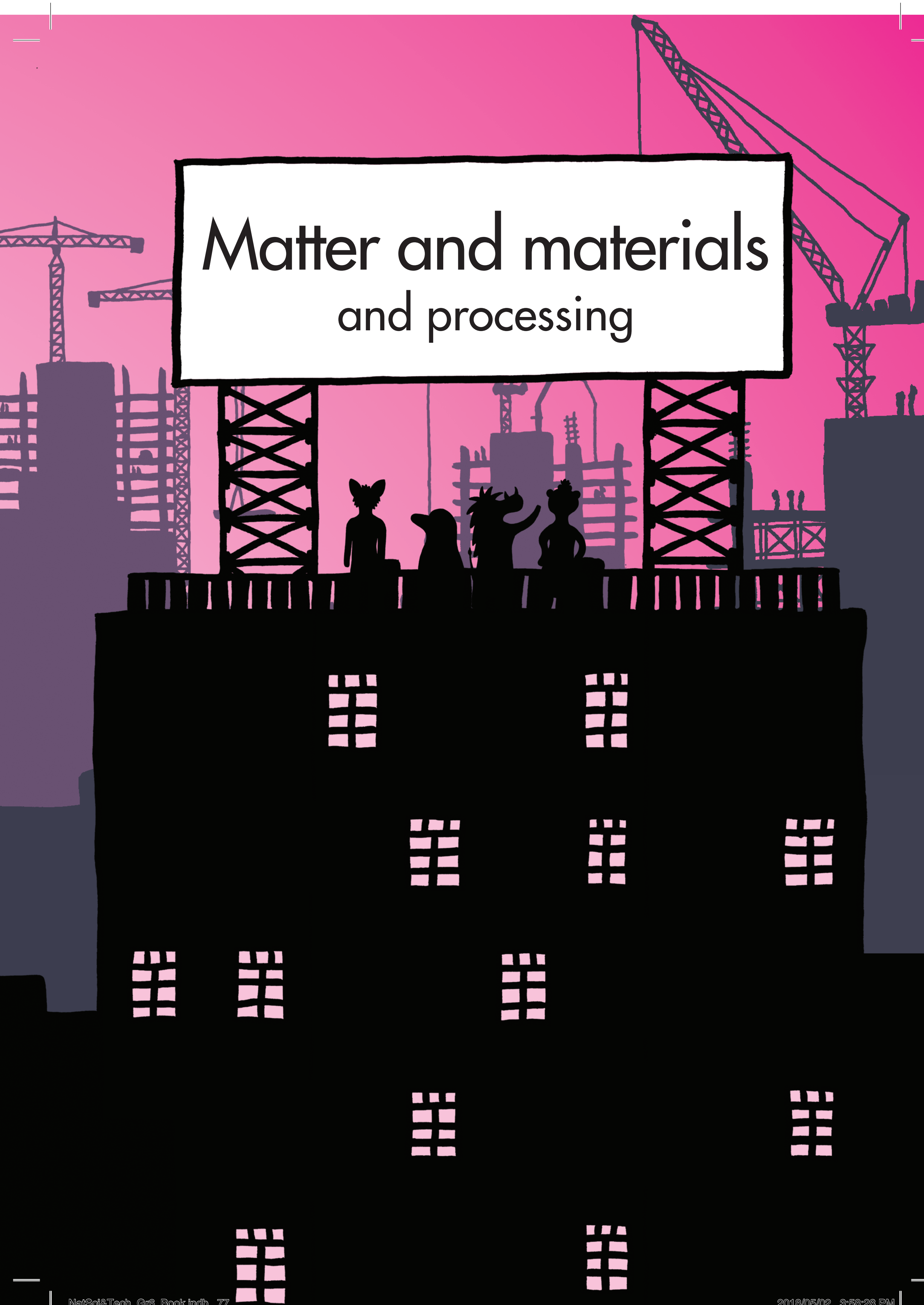
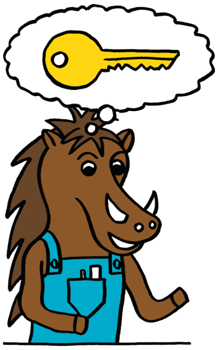

Matter and materials
and processing

6 Solids, liquids and gases



KEY QUESTIONS

- How are the states of matter different from each other?
- How can we draw pictures of the three different states of matter, that show how the particles in the matter behave?
- When matter changes from one state to another, do the particles themselves change, or only their behaviour?
- What is needed to make matter change from one state to another and back again?

6.1 States of matter

New words

- states of matter
- particles
- atoms
- molecules
- microscope
- vacuum

We have learnt that matter can exist in three different states: solids, liquids and gases. All the materials around us are in one or more of these three states. For example, you have all three states in your body! There is bone in your skeleton. There is water in your blood. There is air in your lungs. We have also learnt that each of the states have unique properties:

- Solids keep their shape.
- Liquids flow and take the shape of their container. They fill up a container from the bottom up to a certain level. They take up a fixed amount of space in the container.
- Gases also flow and take the shape of their container. They always fill up the whole space of the container and will escape if the container is open.

We know when we have a solid or a liquid. It is easy to see a solid or a liquid. We cannot normally see gases. We can still check that gases are present by seeing their effects.

Why do solids keep their shape but liquids and gases flow? Why does a liquid stay inside an open container (unless it is poured out), but a gas escapes?

We have to look deep inside each state for the answers to these questions. We will have to use our imaginations like never before!

6.2 Arrangement of particles

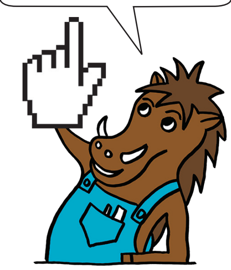
Did you know that all matter is actually made up of very small particles? These particles are called atoms and molecules, and we will learn more about them much later. For now, we are going to use the term particle to describe the smallest 'building blocks' that matter is made of.

The particles that matter is made of are very, very small. Much, much smaller than a tiny grain of sand. Much, much smaller even than a speck of dust! Do you have any idea how small that is?

Mmm, that is quite hard to imagine. I am not so sure.

It is hard to imagine, isn't it Walt? Most people find it very hard to think about, so do not worry, we will go through it slowly.

Visit
Particles of matter (video).
goo.gl/qbccF



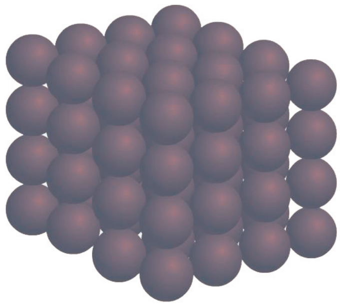
The particles that matter is made of are much too small to see with the naked eye. They are even too small to see with a strong microscope. So how do we know they exist? Scientists, with special microscopes and other special scientific instruments, have collected evidence that they exist. It is now a well-known and accepted fact that all matter is made up of particles.

The particles in a solid

Let's imagine that we can shrink ourselves down to the size of such a particle of matter. What would we see if we could look around inside a solid?

We would see the particles in the solid are *packed tightly together*. This explains why solids cannot be squeezed into a smaller shape – solids *cannot be compressed*.

We would also see that the particles in the solid have fixed positions – they cannot move from their positions. This explains why solids keep their shape.

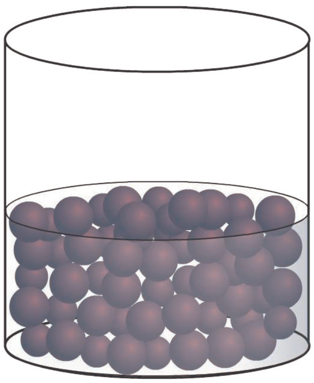


Particles in a solid

The particles in a liquid

If we could shrink ourselves down to the size of a particle, and we could look around inside a liquid, what would we see?

We would see that the particles in the liquid are also very *close together*. Like solids, liquids *cannot be compressed* either.



Particles in a liquid

Unlike solids, the particles of a liquid *do not have fixed positions*. They are always moving around. This explains why *liquids flow*, to take the shape of their container.

Did you know?

Even when it looks like the water inside a glass is still, the water particles are constantly moving!

The particles in a gas

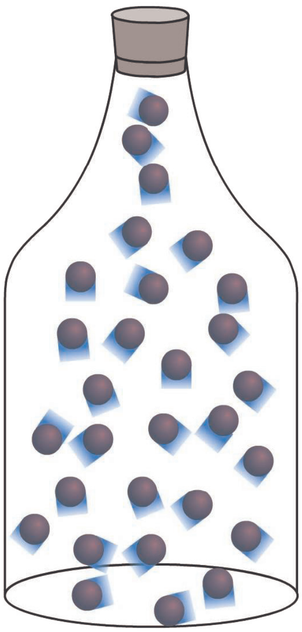
If we could shrink ourselves down to the size of a matter particle, and we could look around inside a gas, what would we see?

We would see that the particles in the gas are *far apart*. The spaces between the particles are huge compared to the size of the particles themselves. These spaces are empty! We call this a vacuum. This explains why gases *can be compressed* – they can be squeezed into a smaller shape by pushing their particles closer together. We can make the spaces between them smaller.

Visit

Acting out the states of matter (video).
goo.gl/dN8NX

The particles of a gas are always *moving freely*. If they are in a closed container, they will *spread out* to fill the whole container. If they are in an open container they will not stay inside for long. They will *flow out* of the container, and *disperse* or *diffuse* (disperse means to spread out over an area or space).



Particles in a gas

ACTIVITY 6.1: Pretending to be particles!

In this activity we are going to pretend to be particles! We are going to behave in the same way that particles do in the three different states of matter.

Your teacher will divide the class into groups and then we will go through the different states pretending to be the particles!

INSTRUCTIONS:

Solid:

1. Since you are the particles in a solid, you should sit or stand as closely as possible to (touching) each other, in neat rows, and move your body, but without moving your feet.
2. If we wanted to move these particles from their fixed positions, what should we give them?
3. If we wanted these particles to move into fixed positions again and not move around, what must we take away from them?

Liquid:

1. Now let's pretend to be the particles in a liquid. Stay in the same group.
2. Since you are the particles in liquid, you should now move around but stay in contact with each other all the time.
3. If we wanted to move these particles further away from each other, what should we give them?
4. If we wanted these particles to move into fixed positions and not move around, what must we take away from them?

Visit

Solid, liquid and gas particles (video) goo.gl/CcDTr

Gas:

1. Now let's pretend to be the particles in a gas. Stay in the same group.
2. Since you are the particles in gas, you should now move around and be as far from each other a possible.
3. If you should come into contact, you must move away from each other immediately.

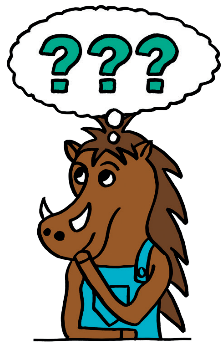
4. If we wanted these particles to move more slowly and come closer to each other, what should we take away from them?
5. If we wanted these particles to move into fixed positions and not move around, what must we take away from them?

6.3 Behaviour of particles

How do we decide whether a material is a solid, a liquid or a gas? The next activity will help us answer that question. We are going to think about some everyday materials. We will use our skills of observation to decide whether they are liquids, solids or gases.

QUESTIONS

Can you remember what your skills of observation are?



Once we have decided whether a material is a solid, a liquid or a gas, we can make some predictions about the behaviour of the particles in each material. For this we will need our imagination, as particles are much too small to see with the naked eye.

I can definitely use my imagination to think about this!

ACTIVITY 6.2: The three states of matter in everyday life

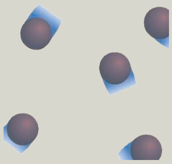
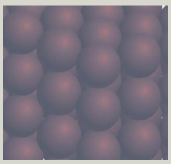
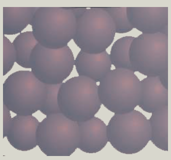
INSTRUCTIONS:

1. The table below has a list of containers. Copy and complete the table in your books.
   a. Say what material is usually kept in each container. Write your answers in the middle column.
   b. Say whether the material is a solid, a liquid or a gas. Write your answers in the column on the right.

Container	What material is inside?	Is this material a solid, liquid or gas?
1. 		
2. 		
3. 		
4. 		
5. 		

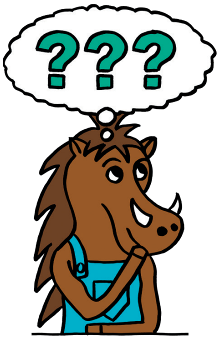
Container	What material is inside?	Is this material a solid, liquid or gas?
6. 		

2. In the next table there are three pictures. Copy and complete the table by following the instructions below.
    a. Look at how the particles are arranged in each picture and say whether it represents a solid, a liquid or a gas. Write your answer in the middle column.
    b. For each picture, choose two examples from the previous table and write them in the column on the right.

Pictures of particles	Solid, liquid or gas?	Examples of materials
		
		
		

3. Draw a picture of the particles inside each of the following examples:
    a. Bar of soap
    b. Cup of tea
    c. Balloon

In the previous activities we learnt about the behaviour of the particles inside materials. In the next activity we will learn about the particles in different states of the same material.



QUESTIONS

1. In Activity 6.1 the learners in your class acted out the behaviour of particles in a solid, liquid and gas. When the 'liquid' learners changed to 'solid' learners, did the learners themselves change as they changed from solid to liquid?
2. Did they behave differently? In what ways did their behaviour change?
3. We know that materials can change from one state to another and back again. Can you think of an example of this?

What happens to the particles inside a material when it changes from one state to another? The next activity will help us to answer that question.

Visit
States of water (video)
goo.gl/ya8f3

ACTIVITY 6.3: States of water

INSTRUCTIONS:

1. In this activity we will watch a video about water in three different states: solid, liquid and gas.
2. Watch the video, then answer the questions that follow.
3. If you cannot watch the video, do not worry! Study the picture on the next page instead.

QUESTIONS:

1. What do we call the solid state of water?
2. What do we call the liquid state of water?
3. What do we call the gas state of water?
4. What do we call the process of ice changing to liquid water?
5. What do we call the process of liquid water changing to ice?

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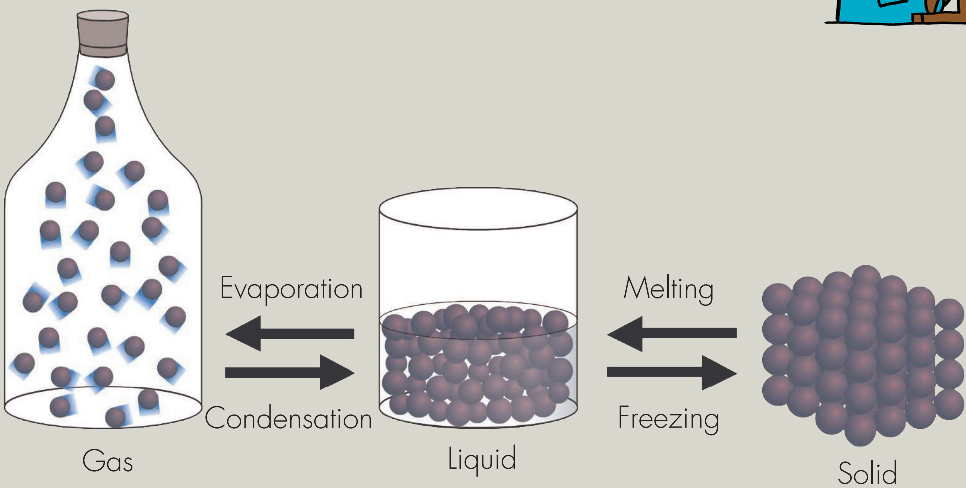
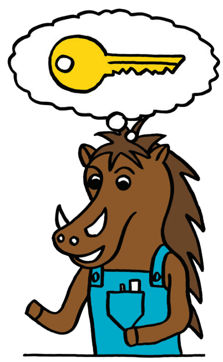
6. What do we call the process of liquid water changing to water vapour (steam)?
7. What do we call the process when water vapour changes to water?
8. Do the particles in the ice change when the ice melts?
9. If ice and liquid water have the same particles, why do ice and liquid water have different properties? (Ice is solid and water is liquid.)
10. How can the water particles in ice be made to move freely? (Think of the 'solid' learners. What did we give them to make them move?)



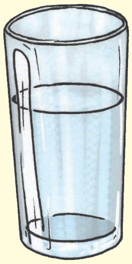
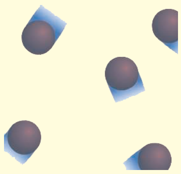
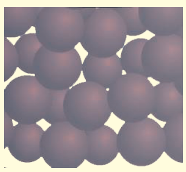
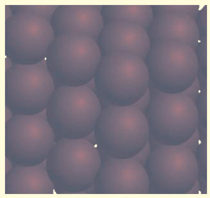
KEY CONCEPTS

- Matter can exist as three states, namely solids, liquids and gases.
- The particles in solids are closely packed and have fixed positions.
- The particles in liquids are also closely packed but they can move around each other.
- The particles in gases have large empty spaces between them.



REVISION

1. How can we change water to steam?
2. How can we change water to ice?
3. How are the particles arranged in a solid?
4. How do the particles in a gas behave?
5. Below are three images of water in the different states of matter, and three images of the arrangement of the particles. Match the image of the water state with the correct arrangement of particles.

a. 	b. 	c. 
1. 	2. 	3. 

We have learnt that materials exist as solids, liquids or gases.

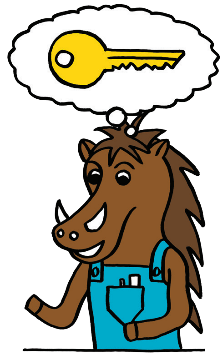
Now I want to know what happens when we mix different materials together?

Let's find out!

7 Mixtures

KEY QUESTIONS

- What is a mixture?
- When is a mixture also a solution?
- How can mixtures be separated into different materials?



7.1 Mixtures of materials

What is a mixture? A mixture is two or more different materials that have been mixed together.

In some mixtures, the different materials are still clearly visible after mixing. A mixture of peanuts and raisins would be an example of such a mixture. How would we separate the peanuts and the raisins? Well, we could simply pick the raisins out of the peanuts!

New words

- mixture
- separate
- solution
- variety
- sieve
- filter
- decant

A mixture of peanuts and raisins

Can you think of other mixtures in which the different materials are still clearly visible after mixing? Look at the pictures on page 90 for some ideas.

A mixture of different coloured jelly beans

A mixture of different fruits in a fruit salad

A mixture of swans and ducks on a lake

A mixture of red, green, yellow and orange peppers

A mixture of pink, yellow and white flowers

A mixture of different shells from the beach

In other mixtures, the materials are mixed so thoroughly that it seems one material has 'disappeared' into the other. Such mixtures are called solutions. We will learn more about solutions shortly.

Making mixtures

First, we will have some fun making mixtures.

ACTIVITY 7.1: Mixing solids

MATERIALS:

- Bag of barley (beans or lentils will also do)
- Bag of rice
- Small packet of sugar
- Clean sand (from the beach or from a building site)
- Plastic spoons for scooping and mixing
- Small yoghurt tubs or paper cups for mixing
- Flour sieve

INSTRUCTIONS (Part 1):

1. Place a scoop of barley in the mixing tub.
2. Place a scoop of rice in the mixing tub.
3. Stir the barley and rice until they are mixed.
4. Answer the questions below in your exercise book.

QUESTIONS:

1. Can you still see the individual rice and barley grains?
2. Draw a picture of the mixture.
3. Separate the mixture into a pile of rice grains and a pile of barley grains. Write a sentence to explain how you separated the mixture.
4. Did the barley and rice grains change in any way, or do they still look the same as before they were mixed?

INSTRUCTIONS (Part 2):

1. Place a scoop of rice in the mixing tub.
2. Place a scoop of sugar in the mixing tub.
3. Stir the sugar and rice until they are mixed.
4. Answer the questions below.

QUESTIONS:

1. Can you still see the individual rice and sugar grains?
2. Draw a picture of the mixture.

3. Separate the mixture into a pile of rice grains and a pile of sugar grains. Write a sentence to explain how you separated the mixture.
4. Can you think of a quick way to separate the mixture, using a sieve? Describe what you would do to separate the mixture. Describe what would happen to the mixture.
5. Did the sugar and rice grains change in any way, or do they still look the same as before they were mixed?

INSTRUCTIONS (Part 3):

1. Place a scoop of sand in the mixing tub.
2. Place a scoop of sugar in the mixing tub.
3. Stir the sugar and sand until they are mixed.
4. Answer the questions below.

QUESTIONS:

1. Can you still see the individual sand and sugar grains?
2. Draw a picture of the mixture.
3. Can you separate the mixture into a pile of sand grains and a pile of sugar grains? How long would it take if you picked the sand grains out of the sugar one by one?
4. Do you think that it would be possible to separate the mixture using a sieve? Why do you think so?

In the previous activity we mixed solid materials with different sized grains and learnt that:

- when the grains are large enough, we can separate them by hand; and
- when the two materials have grains of different sizes they can be separated by sieving.

In the next activity we will explore mixtures of solids and liquids.

ACTIVITY 7.2: Mixing a solid and a liquid

MATERIALS:

- Clean sand (from the beach or from a building site)
- Plastic spoons for scooping and mixing
- Yoghurt tub for mixing in
- Flour sieve
- Kitchen towel or paper towel

INSTRUCTIONS:

1. Place five scoops of sand in the mixing tub.
2. Pour water into the mixing tub until it is half-full.
3. Stir the sand and water until they are mixed.
4. Answer the questions below in your exercise book.

QUESTIONS:

1. Can you still see the individual sand grains?
2. Draw a picture of the mixture.
3. Can you separate the mixture into a pile of sand grains and water? How long would it take if you picked the sand grains out of the water one by one?
4. Would it be possible to separate the sand from the water using the sieve? Say why or why not.
5. Would it be possible to separate the sand from the water using the paper towel? If you think it would be possible, explain what you would do.
6. Do you think it would be possible to separate sugar and water in the same way (by filtering the mixture through a towel)? Say why or why not.

In the previous activity we mixed a solid material (sand) with a liquid (water) and learnt that sometimes a mixture of liquid and solid can be separated by filtering. In the activity the towel was used as a filter.

Is it possible to mix liquids? Can you think of examples of mixtures of liquids?

Juice is a mixture of liquids.[1]

So when I pour juice concentrate into water to make my favourite drink, I am making a mixture of liquids.

That is right Walt. Let's look at some liquids which are not so easy to mix together.

ACTIVITY 7.3: Mixing liquids

MATERIALS:

- Water
- Cooking oil
- Plastic spoons for scooping and mixing
- Small glass or transparent plastic cup for mixing

INSTRUCTIONS:

1. Place ten scoops of water in the mixing cup.
2. Place ten scoops of cooking oil in the mixing cup.
3. Stir the oil and water until they are mixed.
4. Let the mixture stand for a few minutes, then answer the following questions.

QUESTIONS:

1. Did the liquids mix? Describe what the mixture looks like.
2. Draw a picture of the mixture.
3. Do you think it would be possible to scoop all the oil out of the water? How long do you think it would take?
4. Would it be possible to separate the liquids using a sieve or a filter? Say why or why not.
5. Can you think of another way to separate the mixture into oil and water? If you think it would be possible, explain what you would do.
6. Do you think it would be possible to separate a mixture of juice and water using any of the methods that we have used so far (hand-separating, sieving, filtering or decanting)? Say why or why not.

In the previous activity we mixed two liquids (water and oil) and learned that sometimes a mixture of two liquids can be separated by decanting.

Separating mixtures

In the next section we will summarise all the different ways of separating mixtures. We have made different mixtures and tried to separate them using a variety of methods. In this section we will revise all these separation methods.

ACTIVITY 7.4: Separating mixtures

INSTRUCTIONS (Part 1):

The following table has photos of mixtures.

1. For each of the mixtures in the table, write which materials it is made up of in the middle column in exercise your books.
2. Write how you would separate the mixture in the column on the right.

Photo of a mixture	Materials in the mixture	How the mixture could be separated
a. 		
b. 		
c. 		
d. 		

INSTRUCTIONS (Part 2):

The table below has descriptions of mixtures.

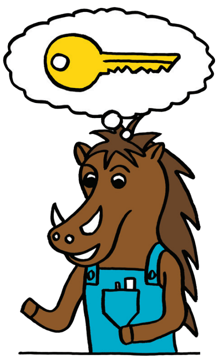
1. For each of the mixtures, write which states it is made of in the middle column (solid, liquid or gas).
2. Write how you would separate the mixture in the column on the right.

Description of mixture	States in the mixture	How the mixture could be separated
Water and oil		
Water and sand		
Sugar and rice		

It is possible to mix materials in many different combinations. In a mixture, the materials that have been mixed do not change. They keep their individual properties. Sometimes it is possible to separate a mixture into the individual materials again.

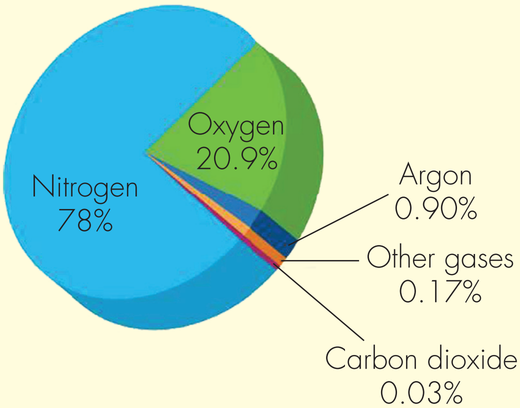
KEY CONCEPTS

- A mixture consists of two or more different materials mixed together.
- Sometimes mixtures can be separated into the individual materials again.
- Some of the ways in which mixtures can be separated are: sieving, filtering, hand sorting, and settling followed by decanting.
- When a material changes from a solid to a liquid, the process is called melting.
- When a material forms a solution in another material, the process is called dissolving.
- Melting and dissolving are two different processes.



REVISION

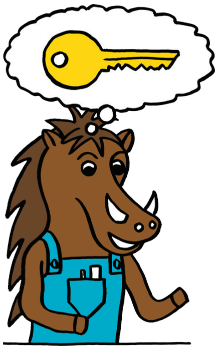
1. What is a mixture?
2. List six different ways in which solids, liquids and gases can be combined to form mixtures.
3. Did you know that the air we breathe is actually a mixture of many gases? The pie chart below shows all the different gases in clean air.



   a. Use the information in the pie chart and make a list of all the gases that are found in clean air.
   b. Which gas is the most abundant in air? (Which gas is found in the largest amount?) What percentage of this gas is present in clean air?
   c. What percentage of oxygen is present in air?
   d. If you had 5 000 air particles, how many of these particles would be oxygen particles?

Now that we know more about mixtures of materials, let's find out more about special types of mixtures!

8 Solutions as special mixtures



KEY QUESTIONS

- When is a mixture also a solution?
- Do all substances dissolve in water?
- Is there a limit to how much of a substance can be dissolved in a given amount of water?
- How can the components of a solution be separated?

8.1 Solutions

In the last chapter we looked at mixtures. We are now going to look at a special type of mixture, which are called solutions.

When is a mixture also a solution?

New words

- solution
- copper sulfate
- solvent
- solute
- evidence

When two substances are mixed it will be possible to still see each substance in the mixture. Is sugar and sand a mixture? Yes!

A solution is a special type of mixture. What makes a solution so special? When is a mixture also a solution?

Often, the best way to answer a question is to ask it in a different way: When is a mixture *not* a solution?

In the next activity we are going to make a few mixtures and then decide which of them are solutions, and which of them are not. That should help us find the answer to the question: When is a mixture also a solution?

ACTIVITY 8.1: When is a mixture also a solution?

In this activity we are going to mix substances with water to see which ones make solutions.

How do you think will we know when a substance has made a solution with the water?

MATERIALS:

- Small quantities of the following substances:
  - sugar
  - salt
  - sand
  - oil
  - vinegar
  - flour
  - copper sulfate
- Tap water
- Clean yoghurt tubs (small)
- Plastic spoons for scooping and stirring

INSTRUCTIONS:

1. Half-fill a yoghurt cup with tap water.
2. Place one small scoop of sugar in the water and stir it well.
3. Look at the mixture and discuss what it looks like.
4. At the top of the table on page 102 there are a few possible observations. Choose the one that is the best description for what you observed, by making a ✗ in the column. (You may also choose more than one column.) The first substance (sugar) has been filled in to show you what you should do.
5. Copy the table in your exercise books and record your observations like this.
6. Once you have recorded your observations, you can empty the yoghurt tub.
7. Repeat the steps until you have tested all the substances on the list.

Substance	Observations	
	It looks as though *none* of the substance has disappeared	It looks as if *all or most* of the substance has disappeared
sugar		✗
salt		
sand		
oil		
vinegar		
copper sulfate		

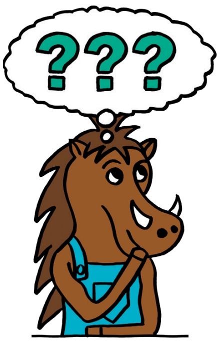
QUESTIONS:

1. Which of the substances seemed to disappear when they were mixed with the water?
2. Which of the substances in this activity did *not* form solutions with water? (Hint: Which ones did not look as if they disappeared into the water?)

What is a solution?

When two substances make a solution, it will look as if the one substance has disappeared into the other.

- The substance that looks as if it has disappeared is called the solute.
- The substance that we can still see is called the solvent.
- The solvent and solute together are called the solution.



QUESTIONS

Is sugar and sand a solution? You may want to page back to Part 3 of Activity 7.1 on mixing solids (page 92) to remind yourself.

ACTIVITY 8.2: Which mixtures are solutions?

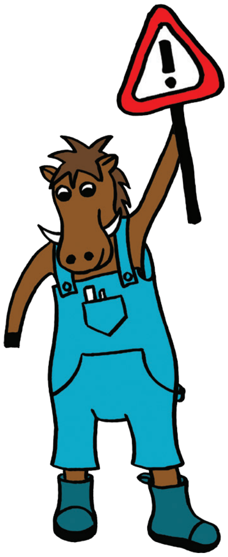
In this activity we will use our observations from Activity 8.1 (When is a mixture also a solution?) to decide which of the mixtures we made were solutions.

QUESTIONS:

1. In Activity 8.1 we mixed different substances with water. We saw that some of the substances looked as if they had disappeared in the water.
   a. What name do we give to the substance that looks as if it has disappeared?
   b. What name do we give to the substance that we can still see?
   c. What name do we give to this type of mixture?
2. In your exercise books copy and complete the table using the information about the sugar-water mixture as an example.

Mixture	Is the mixture a solution after stirring? (Yes or No)
Sugar and water	Yes
Salt and water	
Sand and water	
Oil and water	
Vinegar and water	
Copper sulfate and water	

3. In Activity 8.1, we mixed different substances with water.
   a. Which substance is the solvent in all the mixtures?
   b. From the mixtures above, choose an example of a solution that consists of a solid solute and a liquid solvent.
   c. From the mixtures above, choose an example of a solution that consists of a liquid solute and a liquid solvent.
   d. From the mixtures above, choose an example of a mixture of two liquids that is *not* a solution.



Wait! How is it possible for one substance to disappear into another?

Good question, Walt. We know that Science is not magic, and that it is not possible for something to disappear!

How do we explain the observation that one substance (the solute) disappears into the other (the solvent)?

In the next activity we will look more closely at a solution, in order to understand how it is possible for the solute to look as if it disappears into the solvent.

ACTIVITY 8.3: What is a solution?

MATERIALS:

- Copper sulfate crystals
- Tap water
- Clear container (glass beaker, test tube or water glass)
- Plastic spoon for scooping and stirring

INSTRUCTIONS:

1. Look at the copper sulfate crystals and the water. Copy the table on page 105 in your exercise books and write one sentence to describe each substance.

Substance or mixture	Description (what it looks like)
Water	
Copper sulfate crystals	
Copper sulfate solution	

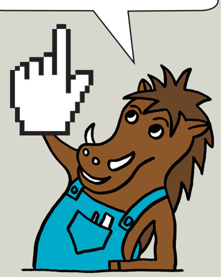
2. Mix one small scoop of the copper sulfate with enough water to dissolve it completely (half a cup of water should be enough). Let it stand for a few minutes until it clears.
3. Look at the copper sulfate solution and write a sentence to describe it in the table you have copied. Save it for answering the questions that follow.

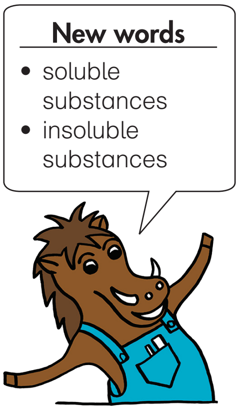
QUESTIONS:

1. Look at the solution. How can you tell that there is copper sulfate in the water? Another way to ask this question would be: What *evidence* do you have that there is copper sulfate in the water?
2. Can you see any copper sulfate crystals moving about in the water?
3. Why can't we see copper sulfate crystals moving about in the water?
4. What do you think happened to the copper sulfate particles? Where are they now?
5. Draw a picture of the particles in the copper sulfate solution in your exercise books. You can use symbols to represent each substance:
   - Shaded circles to represent water particles
   - Shaded hexagons to represent copper sulfate particles

Visit

How water mixes with a solute to make a solution. (video)
goo.gl/zH7FY





8.2 Soluble substances

We have a word for substances that form solutions when they are mixed with water. These substances are called soluble substances.

Substances that do *not* form solutions when they are mixed with water are called insoluble substances.

In the next activity we are going to use some findings from Activity 8.2 (page 103) to link this new idea to what we know about solutions.

ACTIVITY 8.4: Soluble or insoluble?

INSTRUCTIONS:

1. The table from Activity 8.2 is below with an extra column added.
2. Copy and complete the table in your exercise books. Use the extra column to say whether the substance that was mixed with water in the activity is soluble or insoluble.

Table: Soluble and insoluble substances

Mixture	Is the mixture a solution? (Yes or No)	Is the substance that was mixed with water soluble or insoluble?
Sugar and water	Yes	
Salt and water	Yes	
Sand and water	No	
Oil and water	No	
Vinegar and water	Yes	
Copper sulfate and water	Yes	

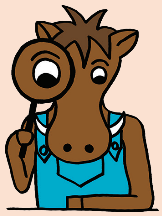
QUESTIONS:

Complete the following sentences by writing soluble or insoluble:

1. Substances that do not form solutions when they are mixed with water are called __________ substances.
2. Substances that form solutions when they are mixed with water are called __________ substances.

In the previous chapter, we saw how to separate mixtures. For example, we could hand sort the objects, sieve the larger grains out of the mixture, and decant the oil from the top of the water. But what about a solution? Do you think you can separate the sugar from the solution once it has been dissolved? Let's try to find out the answer to this question!

INVESTIGATION 8.1: How can we recover a solute (sugar) from the solution?



AIM:

What do you want to find out?

MATERIALS AND APPARATUS:

- Sugar solution
- Two beakers
- Funnel
- Filter paper
- Evaporating dish
- Stand
- Bunsen burner
- Matches

METHOD:

1. Pour a small amount of the sugar solution into an evaporating dish.
2. Place the dish outside, or on a windowsill, in a sunny spot.
3. Leave the dish outside and check regularly to observe what is happening to the sugar solution.

4. Your teacher will demonstrate whether you can also recover the sugar by boiling the solution.
5. Copy the table below in your exercise books and record all your observations.

RESULTS AND OBSERVATIONS:

Method	Result – Could you recover the sugar from the solution?
Sieving or filtering	
Settling overnight	
Evaporation	
Boiling	

1. Which methods worked to recover the sugar from the solution?
2. What was left at the bottom after completing these methods?
3. Why do you think this happens?
4. Which method do you think works best and why?

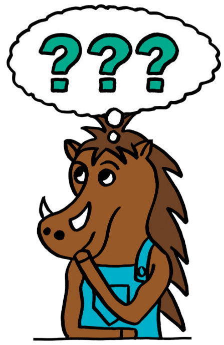
CONCLUSION:

What can you conclude from this investigation?

Now that we have looked at how to separate a solute from a solution, have you ever wondered just how much sugar you could dissolve in water? Do you drink tea for example, and put sugar in? How many teaspoons of sugar do you think you can dissolve in a cup of tea? In the next section we will explore this idea.

8.3 Saturated solutions

Suppose we were to make a cup of tea and we put in three teaspoons of sugar. Mmmm... lovely sweet, warm tea!



QUESTIONS

Now imagine you add three more teaspoons of sugar to the tea. How many teaspoons of sugar did we add?

New words
- saturated solution
- unsaturated solution
- insoluble substance

When the particles of a solute spread throughout the particles of a solvent, we say the solute dissolves in the solvent to make a solution.

Do you think six spoons of sugar will dissolve in the tea? Who has tried this at home? What did you find?

Now let us imagine three more teaspoons of sugar is added to the tea. Very sweet tea! Do you think all the sugar will dissolve?

How much sugar do you think we will be able to dissolve in the tea? An infinite amount? A cupful or less? Let's try find out.

ACTIVITY 8.5: How much solute will dissolve?

MATERIALS:

- Clear container (a glass beaker or water glass would be best)
- Tap water
- Small packet of sugar
- Plastic spoon for scooping and stirring

INSTRUCTIONS:

1. Measure half a cup of water into the container.
2. Add a teaspoon of sugar to the water. Stir until all the sugar has dissolved.

3. Add another teaspoon and stir again.
4. Keep adding teaspoons of sugar until no more sugar can dissolve.

QUESTIONS:

1. How many spoons did you add until no more sugar dissolved?
2. How did you know that no more sugar could dissolve?
3. Complete the following sentences by writing saturated or unsaturated in the open spaces.
   a. When no more solute can dissolve in a solution, we say it is a ___________ solution.
   b. When more solute can be dissolved in a solution, we say the solution is ___________.

Now let's have some fun with saturated solutions!

ACTIVITY 8.6: Making sugar crystals

MATERIALS:

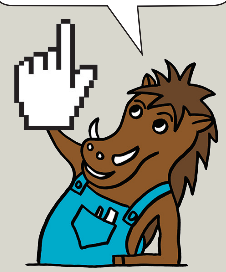
- Half a cup water
- One cup table sugar
- Clean glass jar
- Food colouring
- Pencil
- Rough string (cooking twine)
- Beaker or pan for boiling water and making solution
- Spoon
- Stove or bunsen burner and stand

INSTRUCTIONS:

1. Tie a length of string onto a pencil. The string should be long enough to reach almost to the bottom of your glass jar.
2. Make a saturated sugar solution by boiling the water in the pan, slowly adding sugar a teaspoon at a time. If you have a bunsen burner and stand, you can do this in a beaker over the flame.

3. Stir after each spoonful and keep adding sugar until the sugar won't dissolve any more in the water. If you do not add enough sugar, your crystals will not grow quickly. If you use too much sugar, your crystals will grow on the undissolved crystals and not on the string.
4. Pour some food colouring into your saturated solution to give the crystals a colour.
5. Pour your solution into the clear glass jar. If you have undissolved sugar at the bottom of your container, avoid getting it in the jar.
6. Place your string inside the glass jar.
7. Place your jar where it will not be disturbed and check on your string each day and observe the crystal growth.
8. Allow the crystals to grow until they have reached a size that you desire, or until they have stopped growing. You can pull the string out and allow the crystals to dry. You can eat them or keep them!

Visit
Copper sulfate crystal time lapse.
goo.gl/7lL35



QUESTIONS:

1. How long did it take for crystals to start forming on the string?
2. What are the crystals made of?
3. Why do you think we boiled the water when dissolving the sugar in the solution?

An example of crystals in nature

Have you ever visited a cave? Inside, you may have seen crystal formations called stalactites and stalagmites. Stalactites and stalagmites form inside limestone caves. Stalactites hang down like icicles and stalagmites grow from the floor of the cave upwards. Stalactites and stalagmites always occur in pairs. Caves form when water slowly dissolves the limestone underground. The dissolved limestone can crystallise again when the water evaporates. This is also a slow process and it happens when water drips down from the ceiling of the cave over a long period of time. The water drops that land on the floor of the cave also evaporate over time and when they land on the same spot, a stalagmite will grow on that spot.

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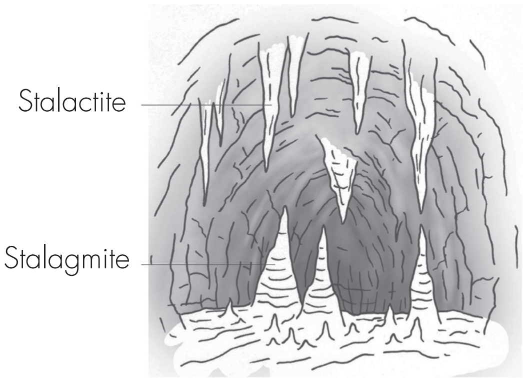
Over many thousands of years, the stalactite and stalagmite may connect up to become a column.

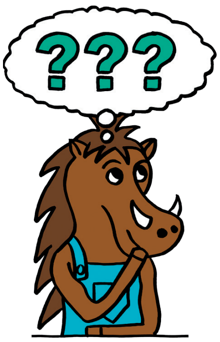


Stalactites and stalagmites forming in a cave.

Cango Caves in Oudtshoorn in South Africa[1]

Insoluble substances

We have a word for substances that do *not* form solutions when they are mixed with water. These substances are called insoluble substances.



QUESTIONS

Can you remember what substances are called that do form solutions when they are mixed with water? Write the term in your exercise book.

Some substances that are insoluble in water may be soluble in other solvents. Think about this for a moment: Is nail polish soluble in water? No, of course not, or it would be possible to wash it off! What would be a good solvent for nail polish?

What have we learnt about solutions as special mixtures?

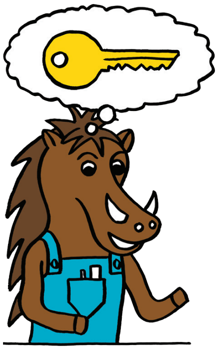
Soluble substances dissolve in water and insoluble substances do not dissolve in water.

Water is not the only solvent. Some substances which are not soluble in water, are soluble in other solvents.

When no more solute can dissolve in a solution, we say it is a saturated solution. An unsaturated solution is one where it is possible to dissolve more solute in the solvent.

Solutions are special kinds of mixtures. When we want to decide whether a mixture is also a solution, we can use the following questions to decide:

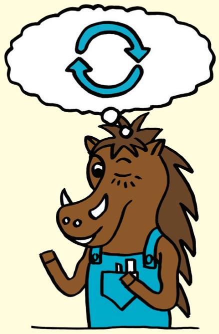
Question about the mixture	The mixture is a solution	The mixture is not a solution
Can you see the solute in the solvent?	No	Yes
Does the solute settle out?	No	Yes
Can the mixture be separated using filtration?	No	Yes
Can the mixture be separated by evaporation?	Yes	No



KEY CONCEPTS

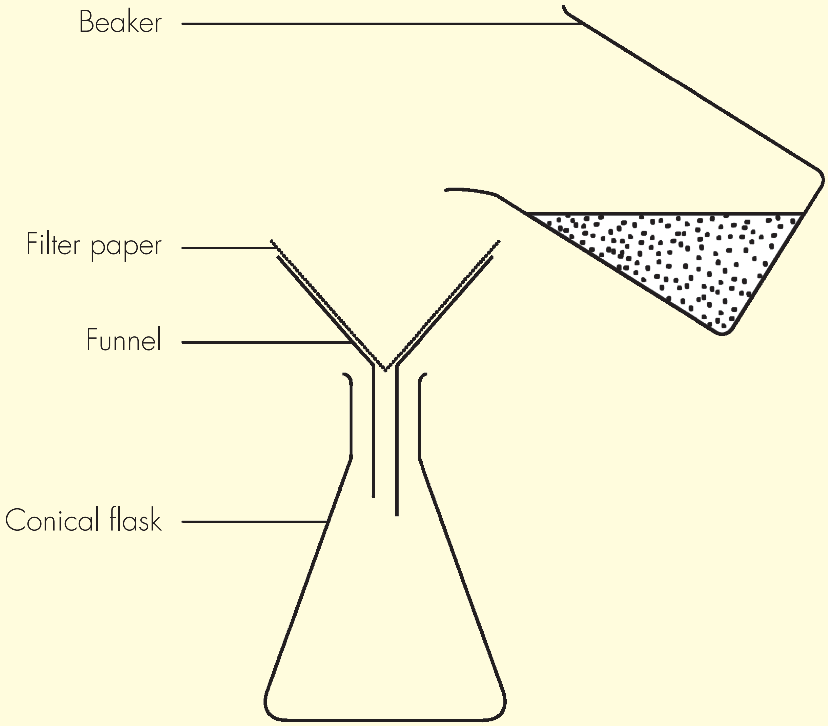
- A solution is a special kind of mixture. Like all mixtures it consists of two (or more) substances mixed together.
- A solution is made up of a solvent (such as water) in which one or more solutes have been dissolved.
- In a solution, the solute looks as if it disappears into the solvent. This is because the particles of the solute and the solvent become closely mixed.
- There are many kinds of solutions, but the most well-known ones are mixtures of a solid and a liquid, such as sugar and water.
- Not all substances dissolve in water. Those that dissolve are called soluble substances; those that do not dissolve are called insoluble substances.
- Solutions cannot be separated by sieving, filtering, hand sorting, or settling and decanting. This is because solute particles are dispersed between the solvent particles.
- Solutions can be separated by heating so that the solvent evaporates. The dry solute will be left behind.
- When we have dissolved so much solute in the solvent that no more solute can possibly dissolve, we say that the solution is saturated.

REVISION



In an activity we explored some substances, and found that sand is insoluble in water. In the same activity we found that sugar is soluble in water.

1. Can you remember how to separate sand and water? Write it down in your exercise books.
2. In the picture below a mixture of sand and water is poured through a filter. What is this process called?



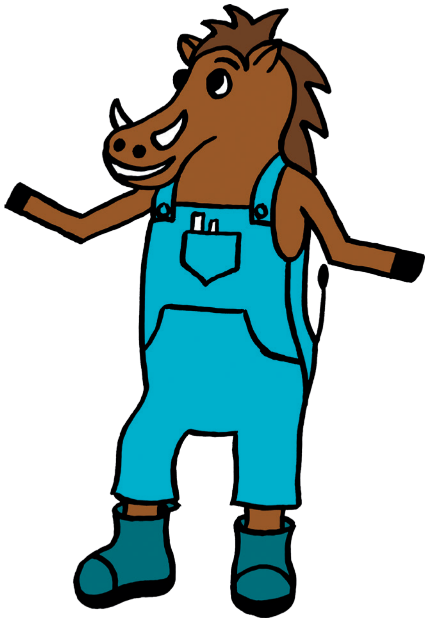
3. Why do the sand grains stay behind on the filter paper, but the water passes through it?
4. What was the mixture of sugar and water called? (Hint: It was a special kind of mixture called a __________?)

5. What would happen if the mixture of sugar and water is poured through a filter? Would it be possible to separate the water and the sugar?
6. What happens to the sugar when it dissolves in the water?
7. Why is it not possible to separate a solution through a filter?
8. Describe how you can get the solid sugar back from the sugar solution.
9. Draw a flow diagram to show how a mixture of salt and sand can be separated. Each step must be clear. Your first step will be to mix the salt and sand with water.

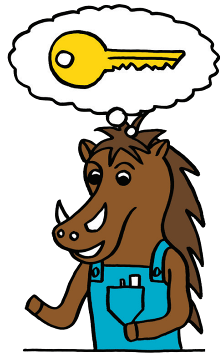
It was quite difficult in the beginning to imagine what was happing in the solution when we cannot see it.

But I love battling with a problem and thinking about it. If I do this myself it helps me to understand something better, as I do now about the particles in solutions!

I hope you do too!



9 Dissolving



KEY QUESTIONS

- What does rate of dissolving mean?
- How does temperature affect the rate of dissolving of a substance?
- How does stirring affect the rate of dissolving of a substance?
- How does the size of the solute grains affect the rate of dissolving of a substance?

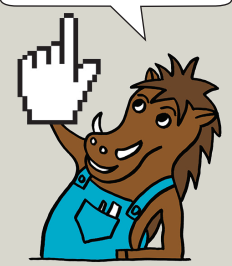
9.1 What is dissolving?

In this chapter we are going to make more solutions. We will perform some experiments to see if we can make our solutes dissolve faster. Before we do that, we have to answer an important question: Is melting and dissolving the same? What do you think?

ACTIVITY 9.1: Is melting and dissolving the same?

In this activity we are going to explore the differences between melting and dissolving. We have learnt that matter can exist as three different states: solid, liquid and gas.

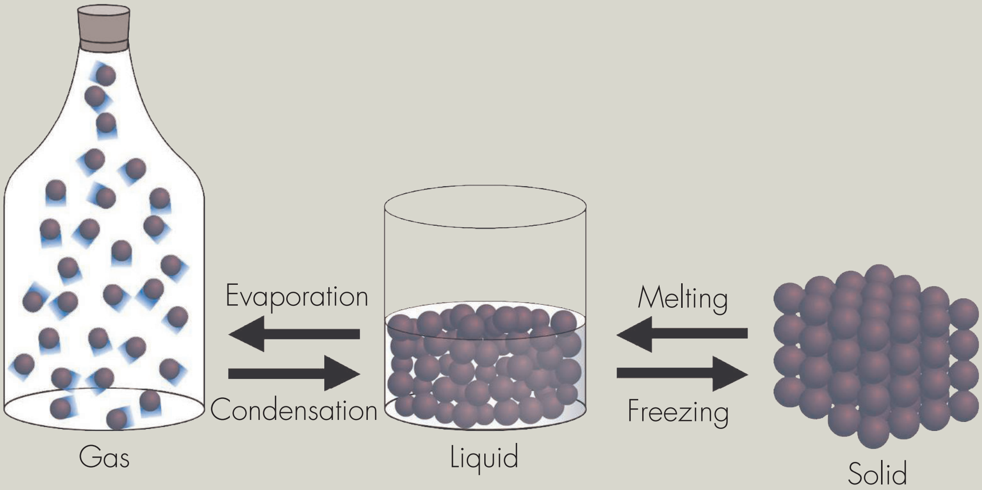
Visit
States of matter
goo.gl/gf7Ck



INSTRUCTIONS (Part 1):

1. Watch the short video clip to remind yourself how a solid, liquid and gas are different from each other.
2. Look out for the part where the states change. The solid changes to a liquid and then the liquid changes into a gas. Remember that a state change is when a substance changes from one state (like a solid) to another state (like a liquid).

3. The following diagram shows how the different states of matter are related to each other. It also shows what the different state changes or processes are called:



States of matter and processes

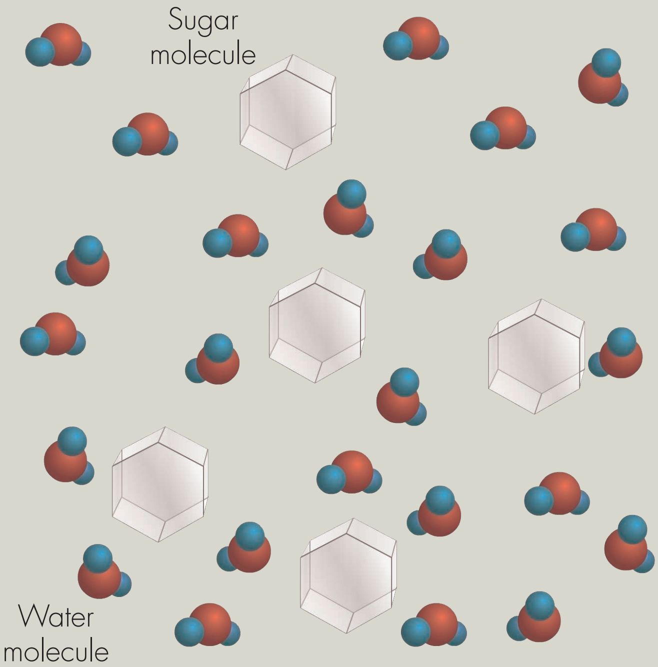
QUESTIONS:

1. What is needed to change a solid into a liquid?
2. What is the process called when a solid changes into a liquid?
3. Fill in the missing words:
   The particles in a __________ have fixed positions. When the solid melts, the particles are free to move from their positions. The state in which particles are close to each other but free to move around is called the __________ state.

INSTRUCTIONS (Part 2):

1. Do you remember dissolving sugar in water in the previous chapter? (Investigation 8.1 on page 107)
2. The picture on page 118 shows what we would see if we could shrink ourselves down to the size of water and sugar particles (molecules).

3. Look carefully at the picture and then answer the following questions.



Solution of water and sugar molecules (particles)

QUESTIONS:

1. Why is the sugar no longer visible? Give a reason.
2. How can we be sure the sugar has not disappeared and that it is still there?
3. How is the picture of the sugar and water mixture different from the liquid shown in the diagram on page 118?
4. What do we call it when two or more substances are combined?
5. Can we say that the sugar melts? Give a reason.

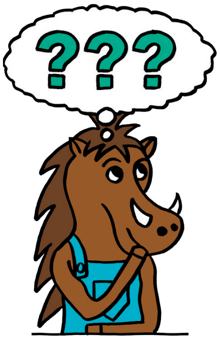
9.2 Rate of dissolving

New words
- rate of dissolving
- variables
- grain size
- components
- factors
- dissolution

The rate of dissolving refers to how quickly a solute dissolves in a solvent. The word ‘rate’ has many meanings. In Science, when we use the word ‘rate’ we usually mean how fast or how slow.

Walt likes his coffee sweet, with three teaspoons of sugar. For the coffee to taste sweet, the sugar must be dissolved. Here is a photo of a cup of coffee. Answer the questions that follow.

Cup of coffee [1]



QUESTIONS

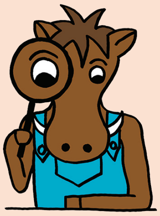
1. Is the cup of coffee a mixture? Give a reason.
2. Is the cup of coffee a solution? Give a reason.
3. Make a list of the components in the coffee mixture.
4. Which component is the solvent?
5. Is the sugar a solute or a solvent?
6. What could Walt do to make sure that the sugar dissolves quickly?

Stirring a solution is just one of the things we can do to make a solute dissolve faster.

We are going to perform three investigations to explore the factors that affect the rate of dissolving for salt (solute) in water (solvent).

In the first investigation, we will explore whether salt dissolves faster in hot or cold water. What do you expect?

INVESTIGATION 9.1: Temparature and the rate of dissolving



AIM:

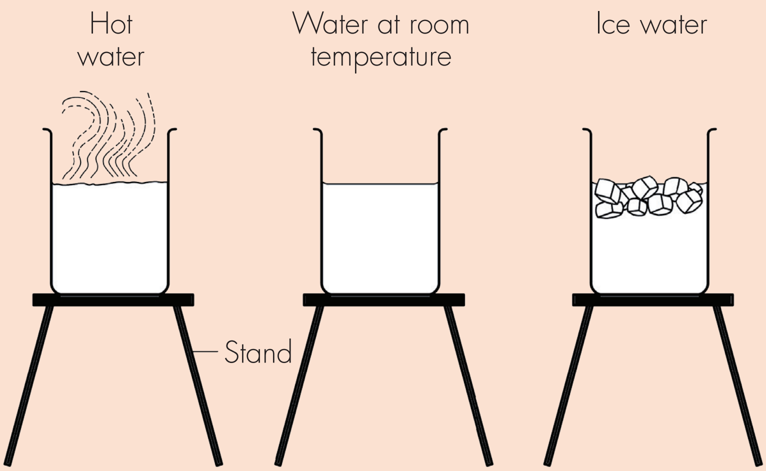
Does salt dissolve faster in hot or cold water?

MATERIALS AND APPARATUS:

- Three clear containers (Glass beakers are ideal, but small yoghurt tubs will also be suitable.)
- Table salt
- Very hot water (not boiling)
- Tap water (at room temperature)
- Ice water
- Teaspoon
- Stopwatch (or clock with a seconds hand)

METHOD:

1. Measure the same quantity (100 ml) of tap water, hot water and ice water into the three containers. Look at the diagram of the setup on page 122.
2. Place one teaspoon (5 ml) of salt into the container with the hot water.
3. Stir the solution by moving the teaspoon once back and forth through the water.
4. Measure the time it takes for the salt to dissolve completely. Copy the table on page 122 in your exercise book and record the time.
5. Repeat the steps with the tap water and record the time it takes for the salt to dissolve.
6. Repeat the steps with the ice water and record the time it takes for the salt to dissolve.



Setup for the investigation into temperature and the rate of dissolving.

RESULTS:

The effect of temperature on the rate of dissolving:

Situation	Time to dissolve (in seconds)
1. Salt in hot water	
2. Salt in tap water	
3. Salt in ice water	

QUESTIONS:

1. What did we compare in this investigation?
2. Name three things that were the same about the three situations.
3. What did we change in this investigation?
4. We measured the temperature of the water. What else did we measure?
5. In which situation did the salt dissolve the fastest?
6. Complete the following conclusion by filling in the missing words in your exercise books.

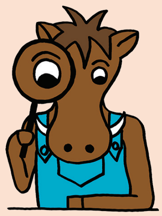
CONCLUSION:

The salt crystal dissolved ____________ in the hot water than the cold water. Temperature affects the rate of dissolving. When we increase the temperature of the solvent, the rate at which the solute dissolves ____________.

EXTENSION QUESTION:
Why do you think the salt dissolves faster in the hot water?

In the second investigation we will explore whether coarse salt dissolves faster than fine salt. What do you expect?

INVESTIGATION 9.2: Grain size and the rate of dissolving



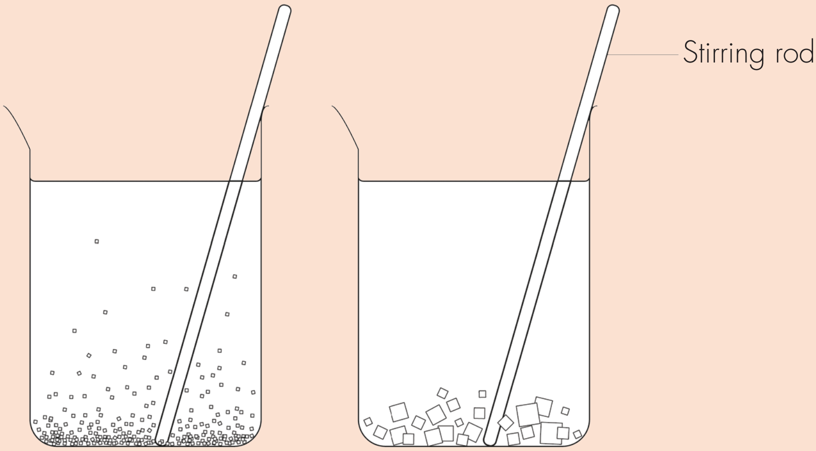
AIM:
Does fine salt dissolve faster than rock salt?

MATERIALS AND APPARATUS:

- Two clear containers (Glass beakers are ideal, but small yoghurt tubs will also be suitable.)
- Fine table salt
- Coarse rock salt
- Teaspoon
- Tap water
- Stopwatch

METHOD:

1. Measure the same quantity (100 ml) of tap water into both containers. Look at the diagram of the setup on page 124.
2. Place one teaspoon (5 ml) of fine table salt into the first container.
3. Stir the solution and measure the time it takes for the salt to dissolve completely.
4. Record the time in the table on page 124 in your exercise books.
5. Repeat the steps with the coarse rock salt and record the time it takes for the salt to dissolve.



Setup for the investigation into grain size and the rate of dissolving.

RESULTS:

The effect of grain size on dissolving:

Situation	Time to dissolve (in seconds)
1. Fine salt in water	
2. Coarse salt in water	

QUESTIONS:

1. What did we compare in this investigation?
2. Name three things that were the same about both situations.
3. What did we change in this investigation?
4. What did we measure?
5. Which type of salt dissolved faster?
6. Complete the conclusion on page 125 by filling in the missing words in your exercise books.

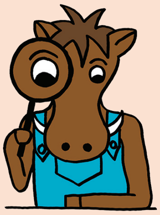
CONCLUSION:

The fine salt dissolved __________ than the coarse salt. Grain size affects the rate of dissolving. When we increase the grain size of the solute, the rate at which the solute dissolves __________.

EXTENSION QUESTION:
Why do you think the fine salt dissolves faster than the coarse salt?

In the third investigation we will explore whether salt dissolves faster in water when it is stirred. What do you expect?

INVESTIGATION 9.3: Does stirring increase the rate of dissolving?



In this investigation, you must use your knowledge of the past two investigations you did to come up with an experiment design to answer the question. Look at the materials and apparatus that have been provided, as well as the diagram on page 126, to design your investigation and then write it out in your exercise books.

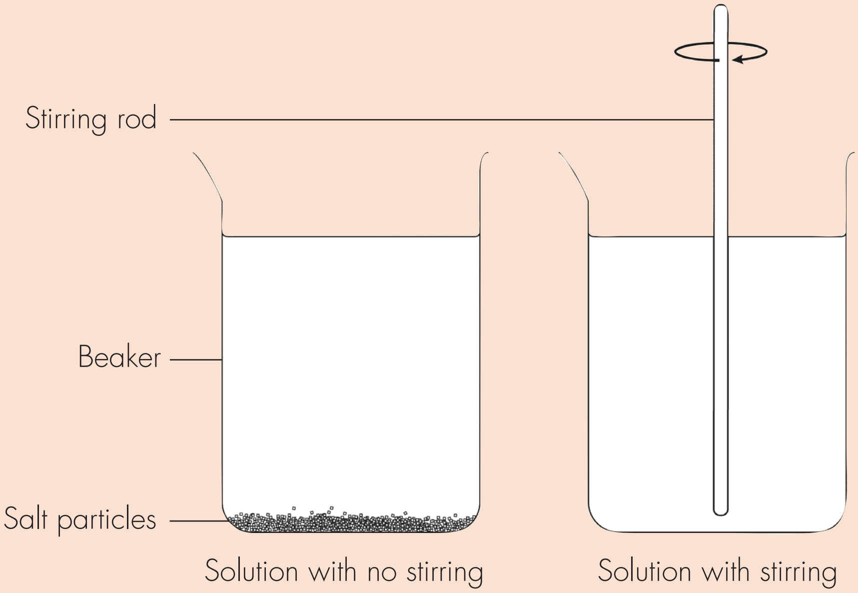
AIM:
What is the aim of the investigation?

MATERIALS AND APPARATUS:

Make a list of what you will need to complete this investigation.

METHOD:

Write out the steps that you completed to do the investigation. Remember to include measurements.



Setup for the investigation into stirring and the rate of dissolving.

RESULTS:

The effect of stirring on the rate of dissolving:

Situation	Time to dissolve (in seconds)
1. Salt in water (with stirring)	
2. Salt in water (without stirring)	

QUESTIONS:

1. What did we compare in this investigation?
2. Name three things that were the same about the two situations.
3. What did we change in this investigation?
4. What made the salt dissolve faster: stirring or not stirring?
5. Complete the conclusion on page 127 by filling in the missing word in your exercise books.

CONCLUSION:

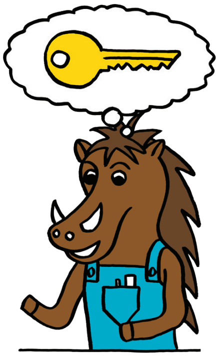
The mixture that was stirred dissolved __________ than the mixture that was not stirred. Stirring affects the rate of dissolving.

EXTENSION QUESTION:

Why do you think stirring makes the salt dissolve faster?

KEY CONCEPTS

- The time it takes for a substance to dissolve is called the rate of dissolving or the rate of dissolution.
- The rate at which a substance dissolves can be affected by three factors:
  - Temperature of the solution
  - Whether or not the solution is stirred (or shaken)
  - Grain size of the solute
- A solute will generally dissolve faster if the solvent in which it dissolves is warm.
- A solute will dissolve faster when the solution is stirred or shaken.
- A solute will dissolve faster if the size of its grains is small.



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REVISION

1. What are the three factors that affect solubility? Write a sentence describing how they affect solubility.
2. Write three examples where we use the factors that affect dissolving in our daily lives.
3. Complete the following crossword puzzle on page 129:

   Use the words in the box, and the clues that are given underneath.

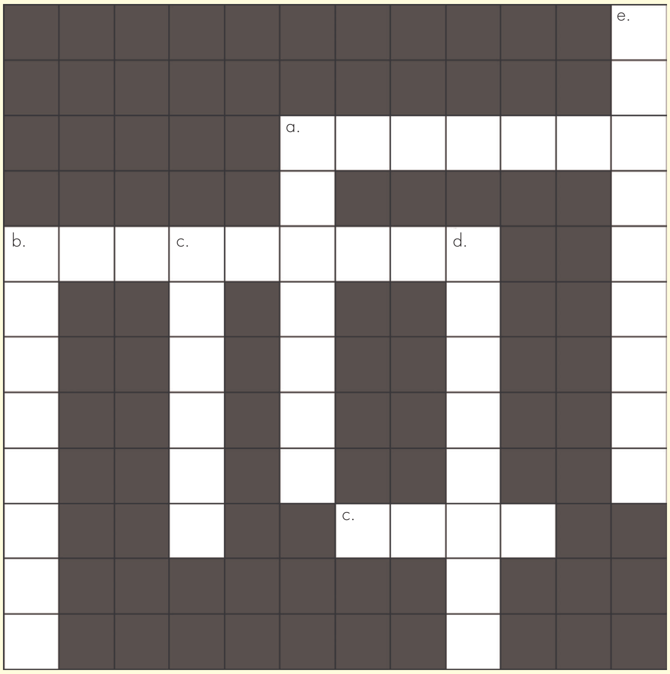
- soluble
- solute
- solvent
- dissolves
- stir
- decrease
- solution
- saturated

ACROSS:

a. The substance that dissolves the solute is called the ______ . (7 letters)
b. The solute ______ in the solvent. (9 letters)
c. When we want the solute to dissolve more quickly we should ______ the solution. (4 letters)

DOWN:

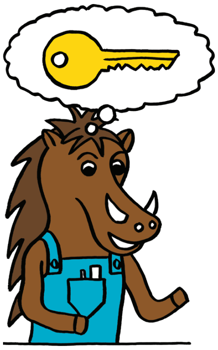
a. When a solute can dissolve in a solvent we say it is ______ . (7 letters)
b. When we lower the temperature of the solvent, the rate of dissolving of the solute will ______ (8 letters)
c. The substance that dissolves in the solvent is called the ______ . (6 letters)
d. The mixture of solute and solvent is called the ______ . (8 letters)
e. When we cannot dissolve any more solute in a solution, we say the solution is ______ . (9 letters)



We have learnt a lot about solutions and dissolving, especially in water.

But what about the water we drink? I now really want to know more about this precious resource, and its importance to all living things!

10 Mixtures and water resources



KEY QUESTIONS

- Why is it important for humans, plants and animals to have access to clean water?
- What is the difference between clean water and polluted water?
- What are the different things that pollute water?
- Why should wetlands be protected?

We have learnt that water can dissolve many substances – water is a good solvent. When water has unhealthy substances in it, we say the water is polluted. Polluted water is not clean.

New words
- pollution
- effluent
- sewage

10.1 Water pollution

When is water clean? We could say that clean water is water that is free of pollutants.

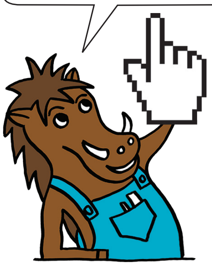
What are pollutants? Pollutants are substances (or objects) that do not naturally belong in the water and are harmful to us and to the environment.

Pollutants may be any of the following:

- Insoluble pollutants are things that do not dissolve in the water but make it dirty, such as oil, garbage and toilet waste (sewage).
- Soluble pollutants are chemicals, such as soaps and fertilisers, and poisons like insecticides and acids.
- Living germs (bacteria) can cause people or animals to get sick.

In the next activity we will discuss pollution and where it comes from.

Visit
Water pollution (video)
goo.gl/07xDe



ACTIVITY 10.1: Thinking about pollution

INSTRUCTIONS:

1. We are going to discuss pollution.
2. The following photos of different polluted water sources, and the questions that follow, are meant to guide the discussion.

Pollution in a pond

Polluted river

Pollution on the coast

People have been using this stream to dump rubbish.

Oil spill

QUESTIONS:

1. Look at the photos on page 131 and make a list of all the objects that do not belong in the water.
2. What are the three main categories of pollutants found in water?
3. Which category of pollutants would you be able to see with the naked eye?
4. Which categories of pollutants would you not be able to see with the naked eye?
5. How do you think insoluble pollutants end up in water?
6. How do you think soluble pollutants end up in water?
7. How do you think bacteria that cause illnesses like diarrhoea and cholera end up in water?
8. How do you think oil ends up in the water, especially in oceans?
9. What do all three categories of pollutants have in common?

Have you noticed that humans and their activities are often the reason why water becomes polluted?

As humans, we often forget that we are sharing this natural resource with many other organisms. Many of our activities can change the quality of the water in a way that affects the health and behaviour of other organisms.

So, as humans, we have a very important responsibility to look after our water resources.

10.2 Importance of wetlands

Nature has special methods of cleaning polluted water. In nature water is purified in natural environments called wetlands. Wetlands are very efficient natural 'water treatment' facilities, and in this section we will learn how they work.

What are wetlands?

An area is a wetland if it has the following:

- Waterlogged soil
- Water-loving plants
- High water table

If soil is waterlogged, it means that it is full of water. The water table refers to the level in the ground where all the soil below this level is waterlogged (full of water). If an area has a high water table, then this level is close to the surface. This means water will not filter down into the ground but remain on the surface forming a wetland.

Examples of wetlands:

- Marshes
- Floodplains
- Swamps
- Lakes and pans
- Seeps and springs
- Estuaries
- River banks

Look at the photos of different wetlands:

New words

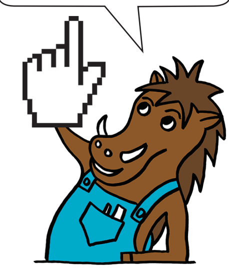
- water table
- waterlogged
- marshes
- waterways
- drainage

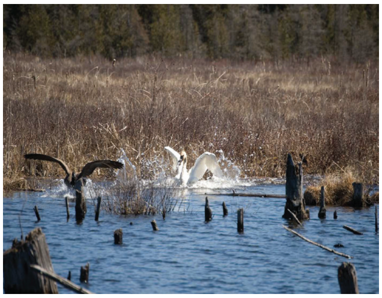
Visit

Wetlands in South Africa.
goo.gl/PQvKw

Visit

Isimangaliso Wetland Park (website).
goo.gl/2RT6H






Wetlands are not necessarily wet throughout the year:

- A temporary wetland is wet between one and four months of the year.
- A seasonal wetland is wet during the rainy season. This means it will be wet between five and eleven months of the year, depending on the length of the rainy season.
- A permanent wetland is wet throughout the year.

Did you know?

In South Africa, the most well-known wetlands are the St Lucia wetlands in KwaZulu-Natal.

Why are wetlands so important?

Wetlands are very special places that should be protected. But why are they so important?

Three unique abilities of wetlands make them very important.

1. **Wetlands are like giant sponges:**
   Wetlands soak up water and store it. During a drought, when there is not much rain, this stored water can help to keep rivers and streams flowing so that animals and plants can stay alive.

2. **Wetlands slow down flood waters:**
   Water that is 'in flood' flows so strongly and quickly that it becomes dangerous. It can drown people and animals, and it can cause damage to property and also to the environment, through soil erosion. Floodwater slows down when it flows into a wetland, because the wetland is a large area that can hold a large amount of water.
3. **Wetlands are natural filtration systems for purifying water:**
   As water flows through the wetland, it is filtered. Plants in the wetland trap soil particles and sediments, nutrients, as well as pollutants and disease-causing organisms, which make the water unsafe.

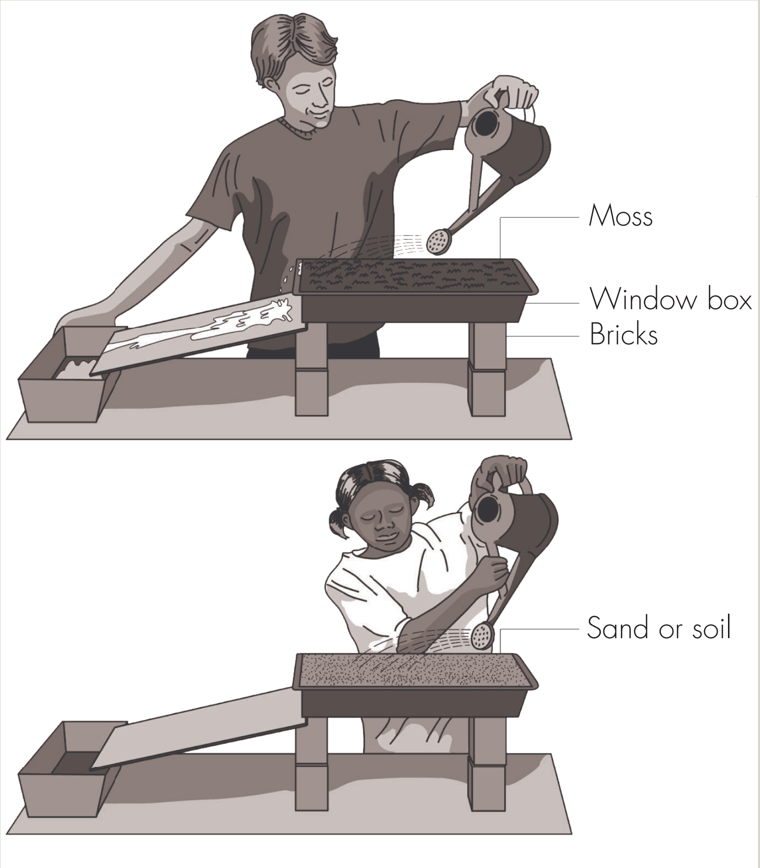
ACTIVITY 10.2: Making a model of a wetland

MATERIALS:

- Grass moss or other garden moss
- Bricks
- Sand and soil
- Shallow plastic trays (about 7–10 cm deep)
- Hardboard
- Watering can
- Measuring tool to measure two litres of water
- Watch or stopwatch
- Plastic window box
- Hand or electric drill
  IMPORTANT! To be used only under strict adult supervision.

INSTRUCTIONS:

1. Drill a hole in the middle and at the bottom of one side of the plastic box.
2. Pack two layers of bricks, the window box, and the hardboard as shown in the illustration on page 136.
3. Position the hole you drilled in the tray over the centre of the hardboard so you do not accidentally lose water over the sides that should run into the window box.
4. Fill your watering can with two litres of water.



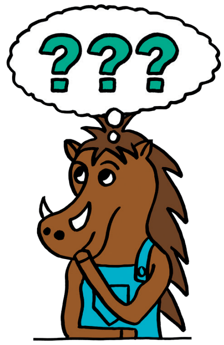
Setup for the drainage experiment

5. Moss is found in many wetland areas like marshes, bogs and waterways. Place the moss inside the tray over moist soil. Pour the water slowly and evenly over the moss. Time how long it takes for the water to filter through the moss and run into the window box.
   a. How long did it take the water to run into the window box?
   b. Why do you think it took the water this long to drain off?
6. Repeat this experiment with sand – this is what happens to rainwater in the Namib or Sahara deserts.
   a. How long did it take the water to run into the window box?

QUESTION:

What did you learn from doing this experiment about the relationship between plants and water drainage in a wetland?

Wetlands are also important as they provide a habitat to many different plant and animal species. Wetlands are important because of their biodiversity.



QUESTIONS

1. Do you remember studying habitats in Grade 4 and Grade 5? What does a habitat provide to an organism?
2. Discuss with your partner what you understand by the term 'biodiversity' and write it down in your exercise books.

Let's now do some research about the wetlands in South Africa and their importance.

ACTIVITY 10.3: Research the different wetlands in South Africa

MATERIALS:

- Pamphlets, posters and any other reading material on wetlands
- Books or other reading material from home, or printed pages from the internet
- Poster material: cardboard, glue, colour pencils, scissors, pictures, etc.

INSTRUCTIONS:

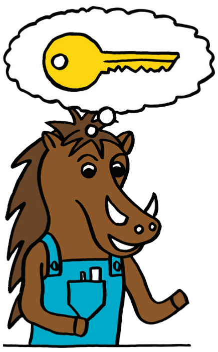
1. You might get to visit a wetland near your school or hear a talk by a conservationist.
2. If you do not get this opportunity, you must still complete the project by doing research in books, pamphlets and on the internet. Answer the questions that follow.
3. Present your report as a poster.

QUESTIONS TO ANSWER IN YOUR REPORT:

1. What is a wetland?
2. What does a wetland do for the environment?
3. What does a wetland do for plants and animals?
4. What does a wetland provide for humans?
5. What are the environmental dangers that wetlands face?
6. Choose a specific wetland and assess the habitats, biodiversity and water quality of this wetland.
7. What would the impact be to biodiversity and water quality if this wetland was lost?

Wetlands should be protected for several reasons:

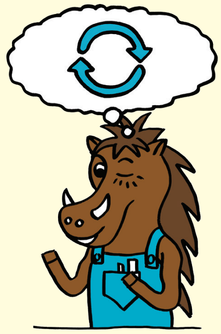
- They are natural water-purification systems.
- They act like sponges to store water in the wet season and supply water in the dry season.
- They slow down flood water to prevent damage to property and the environment.



KEY CONCEPTS

- Clean water is vitally important to ensure the health of humans, animals and plants.
- Water can be polluted by insoluble substances, soluble substances and disease-causing organisms.
- Wetlands act as natural water purifiers because they can absorb soluble and insoluble impurities from water, and they regulate water flow across the landscape.

REVISION



1. Look at the photo below of the bird covered in oil and answer the questions.

Bird covered in oil[1]

   a. How do you think the oil got into the water that this bird lives in?
   b. Is oil a soluble or insoluble water pollutant?
   c. How will the oil damage this bird and other sea animals?
   d. List some of the dangers that wetlands face.
   e. Search the wordsearch puzzle for the types of animals found in wetlands.

See if you can find:

- clam
- crayfish
- mosquito
- heron
- frog
- egret
- dragonfly
- turtle
- fish
- shrimp
- crab
- salamander
- duck

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

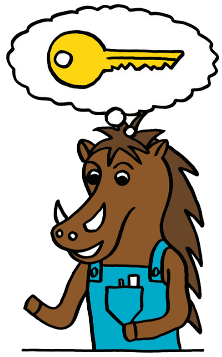
Water is very important for us and all living things. But what happens if the water is not clean?

I really want to try build something to make water clean again. Let's find out how we can do this!

11 Processes to purify water

KEY QUESTIONS

- Why is a clean water supply so important?
- How can water be cleaned?
- How is water cleaned by municipalities to ensure that we have clean water in our homes?



11.1 Clean water

Have you ever seen a sign like the one in the photo? This sign is a warning that the water is not clean and humans should not drink it, as it could be dangerous to your health. If it is unsafe for consumption, it is also unsafe for swimming.

A warning against drinking polluted water.

New words

- water supply
- water treatment
- dehydration
- ecological balance
- contaminate
- distillation
- raw water

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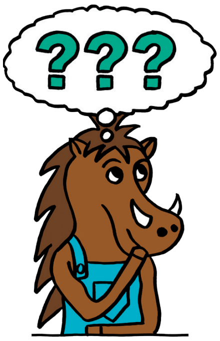


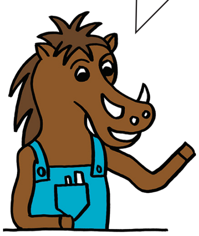
QUESTIONS

What does 'clean water' mean to you? Can you remember what pollutants are? Write it down in your exercise books.

We have also learned that nature has special methods of cleaning polluted water. Water purification happens in special natural environments called wetlands. Wetlands are very efficient natural water treatment facilities, but they work slowly. Humans, animals and plants need fresh water every day, and for this reason we have to clean our dirty water so that it can be reused. Cleaning dirty water is what this chapter is all about.

Did you know?

Water is needed for humans to avoid dehydration. The amount you need each day depends on the temperature, how much activity you are involved in, and other factors.



Why do we need clean water?

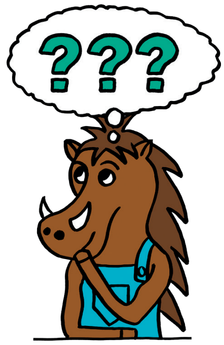
Why is it so important for humans, plants and animals to have clean water?

- Our bodies contain a lot of water. In fact you are mostly water! We need water every day because we lose water constantly with the waste our bodies produce and excrete. The water we drink must be clean to prevent us from becoming sick or being poisoned.
- Plants and animals need clean water too, so that they can grow and be healthy. We need healthy plants and animals in our environment because they provide an ecological balance and food.
- Water is also used for fun. Water sports are a very popular recreational activity and include things like swimming, surfing and water-skiing. We want clean water in our seas and lakes so we can enjoy being in the water without becoming ill.

How can water be purified?

Imagine you are in a place without clean water. The only water around is a muddy stream. How can the dirty water be made clean enough to drink? When thinking about how to purify water, we need to consider what it is that we need to do to separate the contaminating particles from the water.

The muddy water is actually a mixture of sand and water, and possibly other contaminants.



QUESTIONS

1. Do you remember in the beginning of the term we looked at different ways to separate out mixtures? What are some of these ways?
2. Which methods do you think would be useful to separate the large impurities from the dirty water?
3. Which methods would be useful to remove the soluble impurities from the dirty water?

Let's investigate some different ways to purify water at home or at school.

ACTIVITY 11.1: Purifying water by distillation

MATERIALS:

- Clean, dry small pot or container
- Muddy water
- Big, deep cooking pot
- Ruler
- One marble or clean stone
- Plastic cling wrap

INSTRUCTIONS:

1. Pour the muddy water into the big pot until it is about 5 cm deep. (You can use the ruler to measure the depth of the water.)
2. Place the smaller pot or container inside the bigger pot.
3. Cover the bigger pot with cling wrap.
4. Place a marble or stone in the middle of the cling wrap so that it is above the small pot inside the big pot. You have now made a still for purifying water.
5. Leave the still out in the sun for a day.
6. Look carefully at the still and answer the questions that follow.
7. If you have a phone with a camera, you could take pictures of the still and show them to your class.

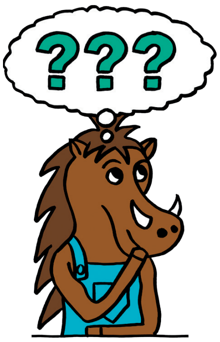
NatSci&Tech_Gr6_Book.indb 143 2018/05/02 3:58:46 PM

QUESTIONS:

1. What do you notice about the inside of the smaller container? Is it wet or dry?
2. What do you notice about the cling wrap? Is it wet or dry?
3. Write a paragraph to explain how the water got inside the small container. You can use words from the wordbox, but you can also add your own words:

energy, sun, evaporate, water, water vapour, condense, drip, clean

4. Why is there no dirt inside the small pot?
5. Where was the dirt at the end of the experiment?
6. Make a poster of the process. You can draw pictures or use the photos you took of the experiment.



QUESTIONS

Can you remember what methods we used to remove sand from water in Activity 7.2 (page 93) in Chapter 7 about mixtures?

Filtering is a good way of removing insoluble substances from water. Large pieces of insoluble substances can also be sieved out of the water.

The Quantum Club are planning a camping trip and they have invited you and your classmates to come with them. They have all the equipment such as tents, sleeping bags and mats. The only problem is that there is no clean drinking water at the campsite. For such a large group, they cannot take enough bottles of clean water. So, Walt has decided that the group should build a filter to purify the muddy water from the nearby stream. But they do not know how! We need to help them design and build a filter to purify the water on the camping trip.

ACTIVITY 11.2: Design, make and evaluate a filter

DESIGN BRIEF:

Write a short statement where you state what you are going to be designing and why.

Your filter has the following specifications:

- The filter must be able to filter a cup of muddy water and the water which comes out must be cleaner than the water that went in.
- The filter must be able to hang up, for example from the branch of a tree.
- You must be able to use it outside.

Your filter has the following constraints:

- You cannot make the filter at home, you must make it in class.
- You are confined to using as many recyclable materials as possible, such as two-litre plastic bottles, plastic bags, etc.

INVESTIGATE:

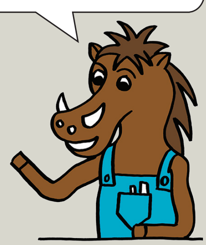
We now need to do some more investigating about how to purify water. We saw how to purify water using a still and evaporation. But what are the ways to purify water using a filter? Do some research on the internet and in books to answer the following questions:

1. What types of filters can you make?
2. What materials do these filters make use of?
3. What is the purpose of each of the materials used to filter?

For example, are some materials there for filtering large particles and some for filtering small particles? If so, which one is which?

Did you know?

Water purification tablets can be used in emergencies, such as a flood or earthquake, when you do not have access to clean water. The tablets remove microscopic impurities and chemicals that could harm you.



DESIGN:

Let's now get on to designing your filter! Answer these questions before you start drawing your design.

1. What kind of filter are you going to design?
2. What size and shape will your filter be?
3. What recyclable materials could you use?
4. How are you going to hang it up, for example from the branch of a tree?
5. How will you collect the water that has been filtered?

In your exercise books, draw a design for your filter. Remember to label the different parts and show which materials you are going to use. Leave some space to do a second drawing as you might come up with a better design while you are making your filter and see ways to improve it.

MAKE:

Now that you have a design, it is time to make your filter according to the specifications and constraints. Once you have all made your filters, you need to test them out to see if they work.

Do the testing outside. Show the class how your filter works and pour a cup of muddy water through the filter, and collect the water that comes out.

IMPORTANT! Do not drink the water! You do not know if you have completely purified the water. To further purify the water from the filters, you can also do a solar distillation using the still you made in the last activity to remove solids. Finally, you must boil the water!

EVALUATE:

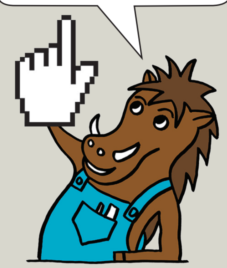
After you have made your filter, you have to ask: Does it work and could you do a better one?

1. Compare the water before and after filtering. Was the water cleaner after filtering?
2. Which impurities did your filter remove – big or small or both?
3. How much filtered water were you able to collect from your filter? Was it the same amount that you poured in?

4. Did your filter leak anywhere? If so, how could you prevent it from leaking?
5. Do you think you could further purify the water you filtered by passing it through your filter again? Try it out and see if this makes a difference.
6. How could you improve your design?
7. What further steps could you take to purify the water that comes out of your filter?

Visit

Purifying water while hiking (video).
goo.gl/LEB5J



COMMUNICATE:

1. The last part in the design process is to communicate what you designed and made to others, so that they can also learn about what you did and learn from you.
2. Write a paragraph in your exercise books where you tell Walt about the filter that you designed and made to take on the camping trip to purify the muddy water in the stream.
3. Tell Walt what you found that worked and what did not work, and anything that you would change.

11.2 How is water purified by municipalities?

Do you have running water in your home? If you have, you are very fortunate, because many South Africans do not.

Clean water coming out of the tap.[1]

New words

- water treatment plant
- settling tank
- sludge
- aeration
- disinfection

South African municipal water is generally clean and fresh, and safe to drink. How does it get that way? This section tells the story of how water is treated at the large municipal facilities.

The water from a tap does not start out clean and fresh. It may come from a river or a dam, or it may even be waste water that was used by a community or in a factory.

The process of purifying the water is called water treatment, and the place where it happens is called a water treatment plant.

So what exactly happens at a typical water treatment plant?

There are five steps (or processes) in the treatment of water. The five processes commonly used to treat water are screening, settling, sedimentation, aeration and disinfection.

Visit

Fun activity to get you thinking about water, and where it goes once we have used it.
goo.gl/eh8ke

Let us take a closer look at each process.

Step 1: Screening

The raw water that arrives at the plant may contain dirt, fish, rubbish, plants and even sewage.

These things are screened out as the water flows into the plant. This means that the water passes through a screen (which is very much like a large sieve), and the solid matter stays behind on the screen.

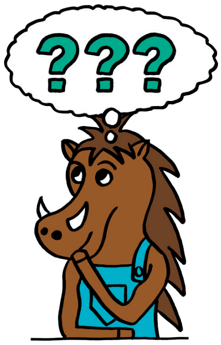
After the screening step the water is still dirty, but the large pieces of rubbish have been removed.

Step 2: Settling

During this step the raw water is allowed to stand in a large tank called a settling tank.

QUESTIONS

What happens to the dirt when muddy water stands for a long time?



When the raw water stands in the settling tank, the medium-sized pieces of solid matter (called sludge) sink to the bottom of the tank.

The raw water at the top is still dirty but now it only contains small pieces of solid matter. The bits of solid matter left are small enough for small organisms (such as bacteria) to eat. This is what happens in the next step of the treatment process.

Step 3: Aeration

The raw water now flows into a special tank that contains bacteria. These are useful bacteria, because they help to break down the last little bits of solid matter, as well as break down any natural soluble pollutants.

Since bacteria need oxygen to stay alive and healthy, air is bubbled through the water. This process is called aeration, because the name comes from the word 'air'.

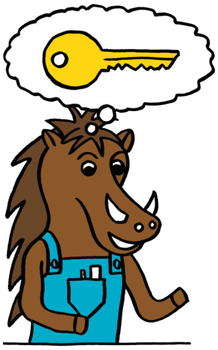
Step 4: Filtering

Next, the water flows through a special filter made of layers of sand and gravel. It is just like the one you designed, only much bigger. The gravel layer of the filter is about 30 cm deep and the sand layer is about a metre deep! The filtering step removes any remaining particles and most of the bacteria left in the water.

After this step the water is clear, but some germs and bacteria from Step 3 may still be in the water. Remember that germs and bacteria are small enough to pass between the gaps between sand and gravel.

Step 5: Disinfection

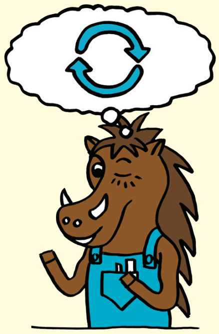
During disinfection, chemicals are added to the water to kill any surviving germs.



KEY CONCEPTS

- Clean water is important for people, plants and animals.
- Water can be purified by processes such as sieving, filtering, settling, decanting, boiling and adding chemicals to kill germs.
- The water we use in our homes is purified before and after we use it.

REVISION

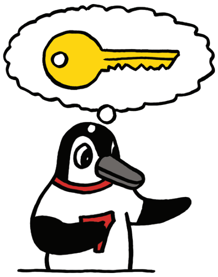


1. What does it mean to purify water?
2. What is clean water?
3. Why do humans, animals and plants need clean water? Write a paragraph where you describe some of these needs.
4. If you were not sure about the water that came out of the tap and you had a kettle, what would you do to the water to purify it? Why do you think this method of purifying works?
5. The woman in the picture is drinking water from the edge of a dam. What possible threats could she face from drinking this water without doing anything to purify it?

6. Name the five steps in the water treatment process.
7. Do you think it is important to conserve water? Why do you think so? Write a paragraph to justify your answer.

Energy and change
and systems and control

12 Electric circuits



KEY QUESTIONS

- What is electricity?
- How do we construct a simple electric circuit?
- What are electric circuit components?
- What is the function of each circuit component?
- What is the difference between a closed and open electric circuit?

12.1 Simple circuits

If we think of the world that we are currently living in, one of the things that we encounter every day and almost everywhere is electricity.

New words

- electricity
- electric circuit
- appliance
- battery
- electric current
- pathway
- conducting material
- switch

ACTIVITY 12.1: What do you know about electricity?

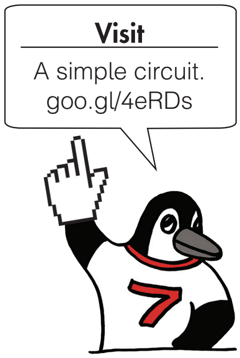
Think about electricity and write your answers to the questions in your exercise books.

QUESTIONS:

1. Name and draw five appliances in your home that need electricity to work.
2. Name five applications (uses) of electricity in your neighbourhood.
3. Name five applications of electricity in your school.
4. Why is electricity important to you?
5. Why is electricity important for your city or town?
6. Why is electricity important for our country?
7. You are building a brand new house. You want an electric stove in your kitchen. Name all the things that must be done by the electrician for your stove to work.

8. Cell phones work with electricity. How does your cell phone get its electricity?
9. What is the difference between the way we can get an electric stove and a cell phone to work?
10. What would you say electricity is?

Connecting simple circuits



We are using electricity all the time. We need to understand what it is, and how to use it safely and correctly.

Have you ever used a flashlight (torch)? What is it used for? How do you get the flashlight to work? Let us try to get the bulb of a torch to work. We want to do this without using the torch itself.

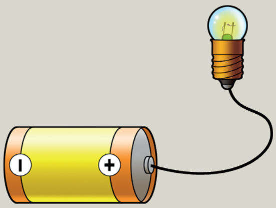
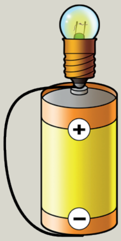
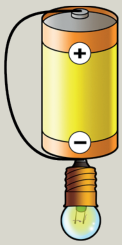
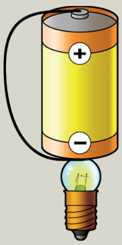
ACTIVITY 12.2: How to get a light bulb to work

MATERIALS:

- D-size battery (1.5 V)
- Torchlight bulb
- Three pieces of electric wire (15–20 cm long with the ends about 1 cm stripped of the plastic insulating material)
- Adhesive tape or Prestik
- Piece of cardboard
- Two thumbnails with metal (brass) tops (remove plastic if tops are covered)
- Metal paperclip (remove the plastic if covered)

INSTRUCTIONS:

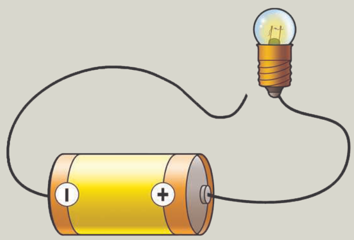
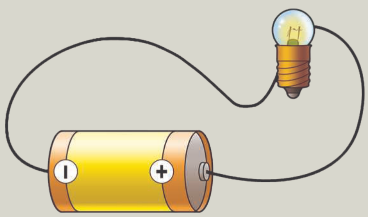
1. Work in pairs. Copy the table on page 156 in your exercise books to record your results.
2. The pictures show four ways of connecting the battery and the bulb using only *one* wire.
3. First predict if the bulb will light in each connection.
4. Then do the connection and test if your prediction was correct.

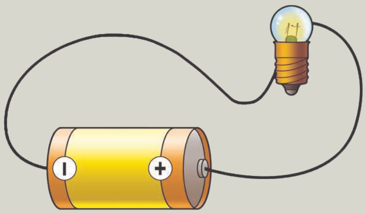
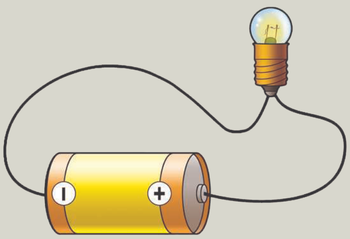
Circuit connection	Prediction – Will the bulb light up? (Yes or No)	Observation	Explanation
a. 			
b. 			
c. 			
d. 			

5. How many other ways can you light the bulb? Try different connections. Copy the following table in your exercise books and draw the connections that work, and those that do not work.

Connections that work	Connections that do not work

6. Describe in words what you did to get the bulb to light.
7. You have just constructed a simple electric circuit! Let us now see if you can also find a way to light the bulb using two wires.
8. The pictures in the next table show four ways of connecting the battery and the bulb with *two* wires.
9. Use adhesive tape or Prestik to keep the wires attached to the battery. Do this same as before.
10. First predict if the bulb will light for each connection.
11. Then make the connections and test if your prediction was correct. Draw the connections in a table in your exercise books.

Circuit connection	Prediction – Will the bulb light up? (Yes or No)	Experiment – Did the bulb light up? (Yes or No)
a. 		
b. 		

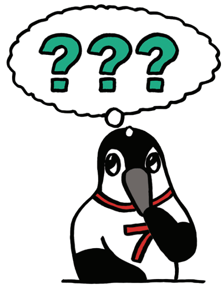
Circuit connection	Prediction – Will the bulb light up? (Yes or No)	Experiment – Did the bulb light up? (Yes or No)
c. 		
d. 		

12. Try some more ways to connect the battery and the bulb with two wires. Draw one example of a setup that worked and one that did not work.

Setup that works	Setup that does not work

13. You have constructed another example of an electric circuit! Describe in words what you have done to get the bulb to light up using two wires.

Now that we have investigated different ways of making a simple circuit, let's explain it in more detail.



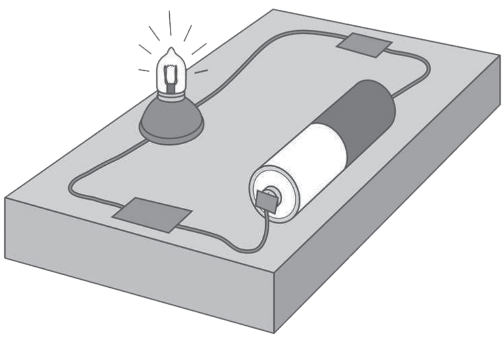
QUESTIONS

Electric circuits have different components. What does 'component' mean? Look up the definition for component in your dictionary and write it in your exercise books.

You should have found that components are basic devices used to manage the flow of electricity. Basic components for a circuit, includes components such as cells, light bulbs, conducting wires, buzzers, and switches.

A simple electric circuit has at least three components:

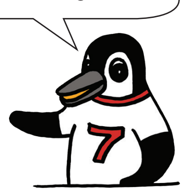
- A source of electrical energy, such as battery cells.
- Conducting material, such as the electric wires.
- A device that transfers the energy for a useful purpose, such as the bulb that provides light.



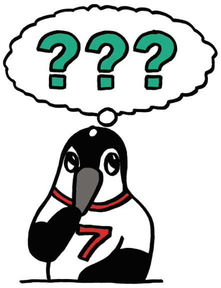
Simple circuit

Did you know?

'Cell' is the scientific term for what most people call a battery in everyday life. What a car has is a real battery. It has six cells that are connected end to end inside the battery case.



Do you think there is something flowing through the bulb when it lights up? When we connect the bulb so that it lights up there is something flowing through the whole circuit. When it does not light up, we have not made a proper or complete pathway for electricity. This flowing thing is called electric current. If the bulb lights up, we say there is an electric current in the circuit. The electric circuit is a system for transferring energy. Think again about the circuits that you have constructed so far.



QUESTIONS

What are the conditions for the bulb to light up?

Let us look at the torch once more:

1. Is the bulb providing light all the time?
2. When does it provide light and when not?
3. What do we call the component of the flashlight that allows us to turn the light on and off?

Visit

Simulations to build simple circuits:
goo.gl/Vimj2
goo.gl/jrGJ3

A switch is used to turn an electrical device on or off. But how does it work?

A typical torch – the big red button is the switch.

ACTIVITY 12.3: Investigating how a switch works

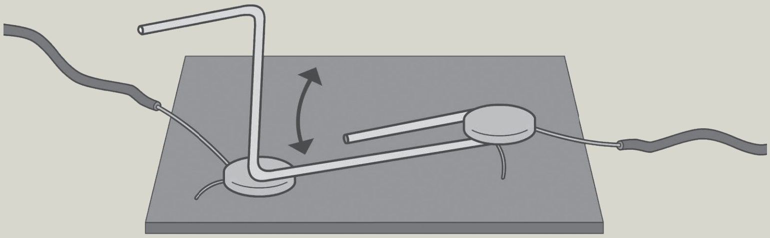
MATERIALS:

- Paperclip
- Two thumbnails (drawing pins)
- Piece of cardboard
- Light bulb
- Three pieces of wire
- Cells

INSTRUCTIONS:

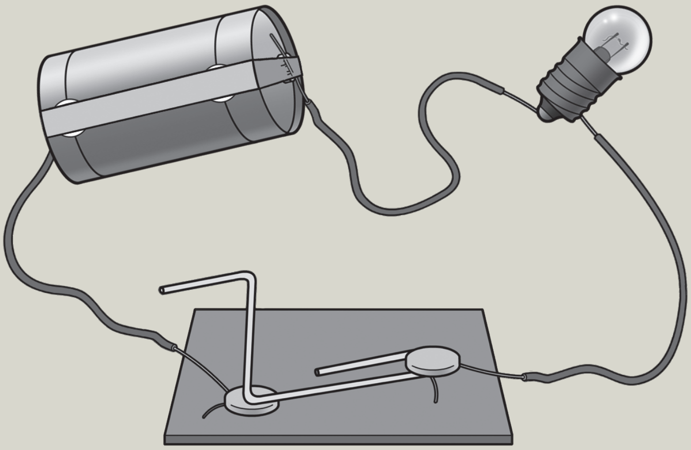
1. To make the switch, bend the paper clip as shown in the following diagram.

2. Pin the ends of the two wires down on the cardboard with the thumb nails. One of the thumbnails should also pin down the paper clip.
3. The other end of the paper clip can be moved to make contact with the second thumb nail or not.
4. Move the paper clip away so that it does not make contact with this thumb nail.



The switch

5. We now want to use the switch. Use the same setup for a simple electric circuit with a bulb, cell and two wires as you did in Activity 12.2.
6. Connect the paperclip switch to the battery by using a third electric wire. Remember to keep the wire ends in position with cellotape or Prestik.



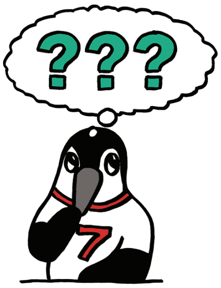
The setup of a switch and simple circuit.

QUESTIONS:

1. Move the paper clip onto the second thumbnail. What happens?
2. Move the paper clip away from the second thumbnail? What happens now?
3. Explain why you think the paper clip and cardboard device can be called a switch.

We already said that a switch is used to turn an electrical device on or off. We can also say that a switch is used to close or open an electric circuit. When the switch is on, the circuit is closed or completed. An electric current then exists in the circuit. We could also say there is an unbroken electric pathway in the circuit.

When the switch is off the circuit is open. In this case there is no electric current in the circuit. The electric pathway is now broken or incomplete.



QUESTIONS

Name four other electrical appliances in your home that have a switch.

Circuit components

We need to have a closer look at the components in the electric circuit. This will help us to understand how a circuit works.

ACTIVITY 12.4: Batteries and cells come in all shapes and sizes

MATERIALS:

A selection of different batteries, such as:

- Flashlight battery
- Watch battery
- Cellphone battery
- Hearing aid battery
- Car battery (or photo)

INSTRUCTIONS:

1. Look at a typical flashlight cell.
2. Describe in words what the cell looks like. Refer specifically to the ends of the cell.
3. Look carefully to see if you can identify a positive (+) and a negative (–) sign on the cell. Which side of the cell is marked with a positive sign and which side with a negative sign?
4. Below is a photo of a cell. Indicate on a sketch which is the positive and which the negative pole of the cell. Use a (+) and (–) sign as you have seen it on the cell.

A typical torch cell

5. Batteries come in all shapes and sizes. Look at the photo below of different batteries. A cell is a single unit of a power supply which uses chemical energy to produce electricity. A battery is a group of cells joined in series (one after the other).

Different sized and shaped batteries

6. You may be lucky enough to have different types of batteries in your class, such as from a watch, a cellphone or a car. If not, ask an adult in your family to show you a car battery, a cellphone battery and a battery used in a watch after school.
7. Copy the table below and draw sketches of such batteries. Indicate on each sketch the positive and the negative pole of each kind of battery. Below are some photos to help you if you cannot find these batteries.

Car battery	Cellphone battery	Watch battery

Car battery

These watch batteries are quite small!

For some appliances it is very important that the batteries are put correctly into a specific position. Why do you think this is the case? This is because the battery is used to get an electric current in the appliance and in some appliances the electric current can only go in a specific direction through the appliance. To prevent the appliance from being damaged, the battery must be inserted in the correct direction.

Light bulbs

Light bulb

Did you know?

In 1879 Thomas Edison invented the first light bulb. Think of all the changes it has brought to our world today!

The battery is the source of energy. Some of the energy is transported through the electric wires to the thin wire inside the bulb. The thin wire becomes hot and emits (gives off) light. The energy is transferred in the thin wire to produce heat and light. So, chemical energy in the battery is changed into electrical energy, and then into light and heat energy in the bulb.

ACTIVITY 12.5: Looking at electric wires

MATERIALS:

- Pieces of electrical wire
- Scissors to strip some plastic at the end

INSTRUCTIONS:

Carefully examine the inside and outside of your wire. Or else look at the photo.

The end of this wire has been stripped of the plastic.

QUESTIONS:

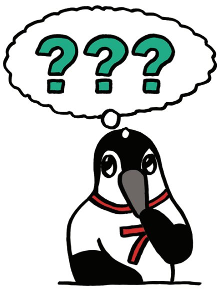
1. What is on the inside and outside of the wire?
2. Why does the wire have different materials on the inside and the outside? What are the functions of the inside and outside materials?

We have already discussed and constructed a switch, but a light switch in a building looks different.

Light switch

QUESTIONS

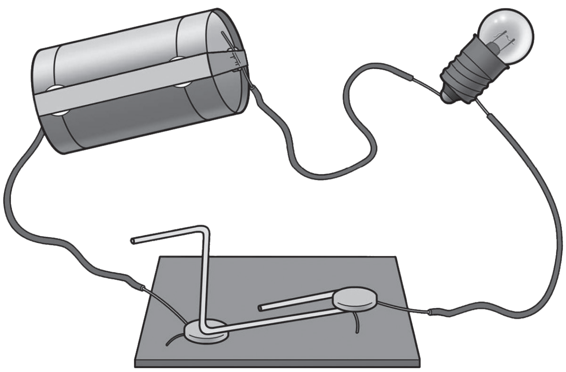
Describe in words how you think a light switch in a house works. Hint: Look again at how we made a switch with a paper clip in Activity 12.3 on page 160.



12.2 Circuit diagrams

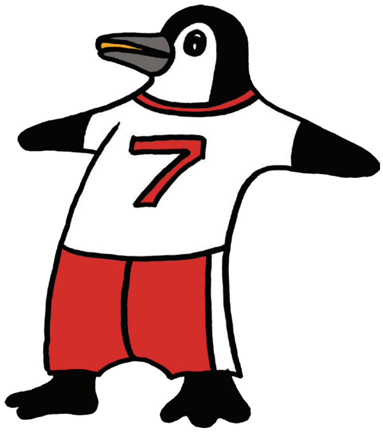
If we want to keep a record of how we constructed a specific electric circuit, we could take a photo of it. Or we could remember the circuit by drawing a sketch.

Look at the sketch that Mothusi drew of the circuit you made in Activity 12.3 with the paperclip switch.



Simple circuit with a paperclip switch, cell and bulb

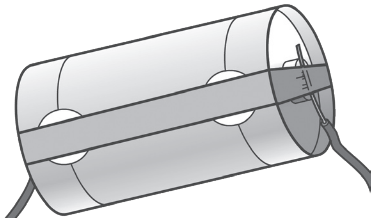
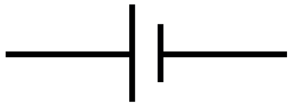
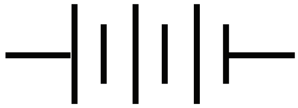
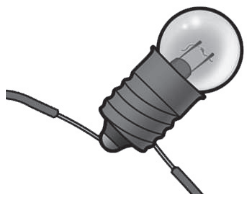
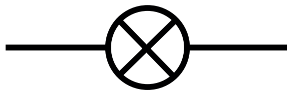
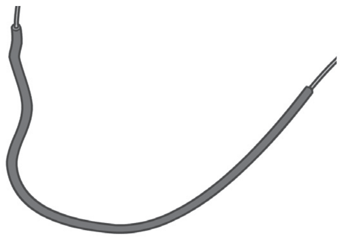
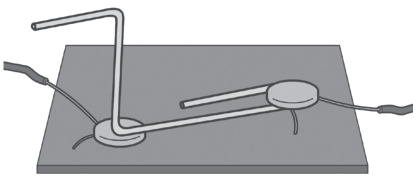
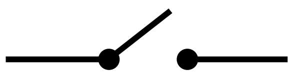
Hey, but I can't draw as well as Mothusi! It would take me forever to draw a sketch of the circuit we made in class!



That's right Phumlani, it takes time to draw a sketch like the one that Mothusi drew. It will take even longer if we add more components to a circuit. We could have more than one bulb like in the case of all the lights in your home. There could be also more than one switch. Each light in your home has its own switch.

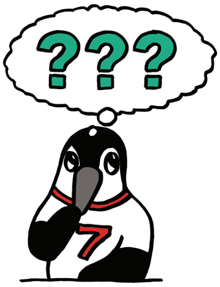
As Phumlani pointed out, all of us do not draw equally well! To save time and to avoid bad sketches, scientists came up with a way of representing the components of a circuit with special symbols. These standard symbols are used all over the world. They help scientists, engineers and technicians draw or record circuits quickly. It also helps everybody to understand the circuit in the same way.

The table shows the sketch Mothusi drew and the symbol for each of the components of our circuit.

Component	Sketch	Symbol
Cell		
Battery		
Bulb		
Electrical wire		
Switch		Open switch:  Closed switch: 

When we put these symbols together to represent an electric circuit, we call it a circuit diagram.

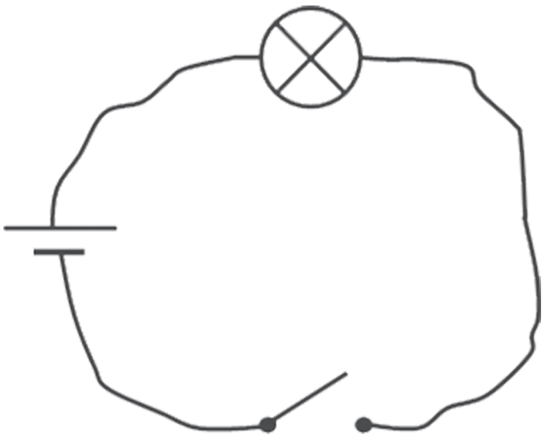
That's much better! I can definitely draw these easy symbols for circuit diagrams!



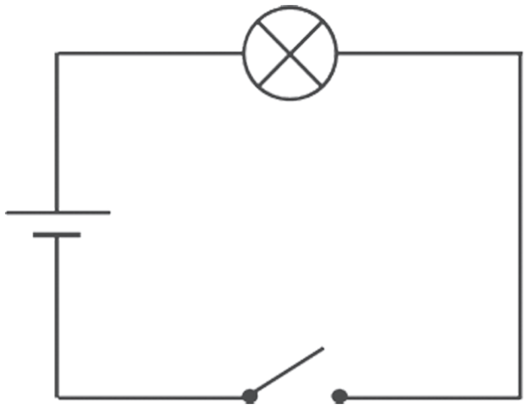
QUESTIONS

Draw a circuit diagram for the sketch on page 167. Use the symbols in the table above for the components.

Compare your diagram with the one below. You might have drawn a diagram like this:



For electric circuit diagrams we represent the wires with straight lines:



This is a simple and quick way to represent an electric circuit. It should be clear to everyone that this circuit has a cell, a bulb and a switch, all connected with electric wires. Although we draw the wires as straight lines in a circuit diagram, in real life the wires are not straight. Just think of the electric wires that are attached to the appliances in your home, like to the kettle, lamp, vacuum cleaner or the computer.

ACTIVITY 12.6: Swop the components

Teacher note: In step 4 of the Learning Cycle, the teacher provides opportunities for learners to extend their understanding by providing new and/or related experiences for them to apply what they have learned.

MATERIALS:

Circuit components (cell, wire, bulb, switch)

INSTRUCTIONS:

1. Think again about our electric circuit and the diagram above. We have the battery on the left, the bulb at the top and the switch at the bottom.

2. Assume we swop the bulb with the battery. The bulb is now on the left and the battery at the top.
3. First draw the circuit diagram for such a setup.
4. Predict what will happen if you close the switch.
5. Set up the circuit like this with the components you used before. Put the switch on and check if your prediction was correct. What do you conclude? Does it matter where in the circuit we position the components?

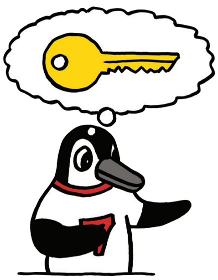
Let's now practice drawing circuit diagrams.

ACTIVITY 12.7: Drawing circuit diagrams

INSTRUCTIONS

Draw circuit diagrams in your exercise books using all the components that are listed for each below.

1. A circuit with one cell and two bulbs.
2. A circuit with two cells and two bulbs.
3. A circuit with three cells and three bulbs.
4. A circuit with three cells, a bulb and an open switch.
5. A circuit with one cell and two bulbs and a closed switch. The switch must be in between the bulbs.



KEY CONCEPTS

- An electric circuit is a system for transferring energy.
- A circuit is a complete and unbroken pathway for electricity.
- A simple circuit is made up of different components (a source of energy, conductors and a device).
- A circuit can have a switch to turn it on or off.
- Electric circuits can be drawn as circuit diagrams using symbols.

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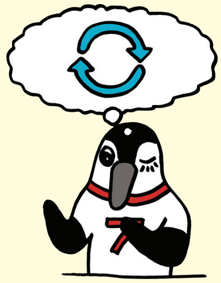
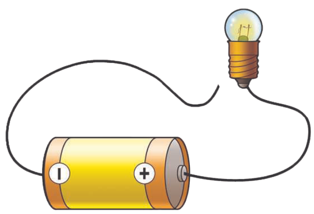
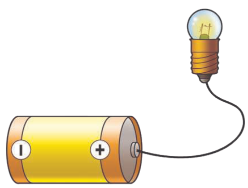
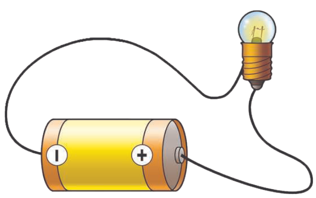
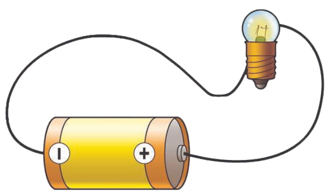
REVISION



1. Explain in your own words what an electric circuit is.
2. What is the function of each electrical component in the table below? Copy and complete the table in your exercise books.

Component	Function
Electrical wire	
Battery	
Switch	
Bulb	

3. In which of the following electric circuits will the bulb glow? Write yes or no for each diagram in your exercise books. Write down a reason for your answer.

a. 	b. 
Yes or no:	**Yes or no:**
Reason:	**Reason:**
c. 	d. 
Yes or no:	**Yes or no:**
Reason:	**Reason:**

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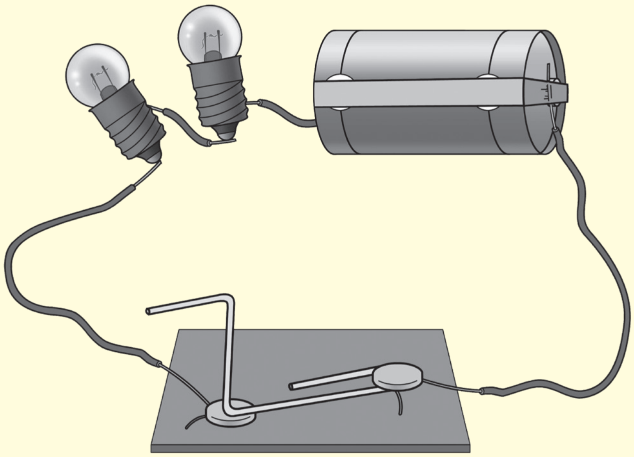
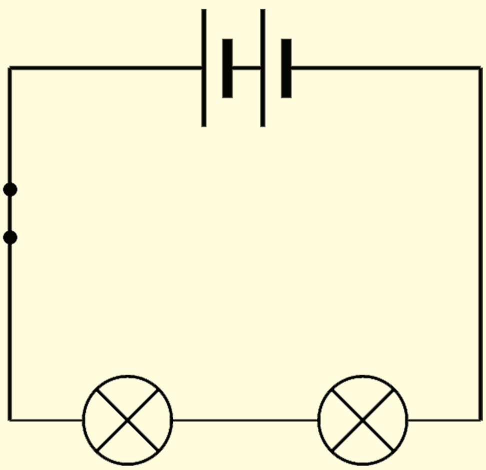
4. Draw a circuit diagram of the circuit shown below in your exercise books.

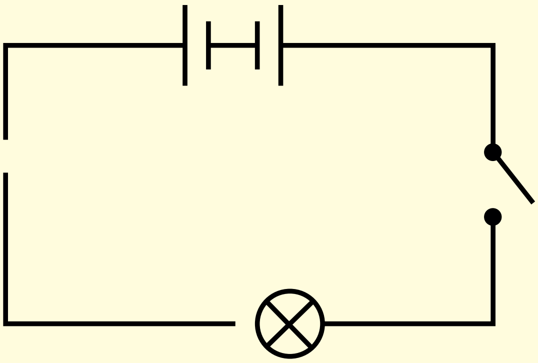


5. Look at the following circuit diagram. Write down all the components that make up this circuit. Include the number of each component as well.



6. The circuit diagram in question 5 represents a real circuit. In the real circuit, are the bulbs lit up? Why do you say so?

7. Copy the following circuit diagram. The bulb does not light up for four reasons. Draw a circle around the parts of the circuit that prevent the bulb from lighting up. Give a reason why the bulb doesn't light up for each.



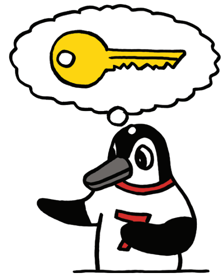
8. The circuit diagram in question 7 represents a real circuit. Use your exercise books to draw what the real circuit might look like, which the symbols represent.

I hope you enjoyed drawing circuit diagrams too! Let's find out more about electrical components.

13 Electrical conductors and insulators

KEY QUESTIONS

- What does it mean if something conducts electricity?
- What is the difference between an electrical conductor and insulator?
- Why are insulators important?

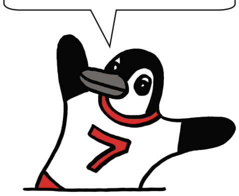


We use electric wires in electric circuits. Did you have a close look at the wire? Did you notice what materials are used on the inside and outside of the wire? We should also know why two different materials make up an electrical wire.

13.1 What are conductors and insulators?

New words

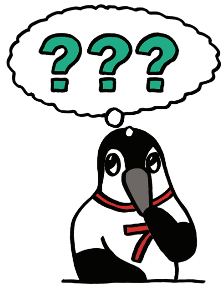
- conductor
- insulator



We can say that a material or object conducts electricity or it does not. But what does this mean? Let's do an investigation to find out. To do this we are going to use a simple circuit. We will connect pieces of different materials into a closed circuit with a light bulb in it. We can easily see if the material is a conductor.

QUESTIONS

How will you know if the material in the simple circuit conducts electricity?



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INVESTIGATION 13.1: Which of the following given materials conducts electricity?

AIM:

Write down an aim for this investigation.

MATERIALS AND APPARATUS:

- D-size battery (1.5 V)
- Bulb for a flashlight
- Three pieces of electrical wire (15–20 cm long with 1 cm of the ends stripped of plastic insulating material)
- Adhesive tape or Prestik
- Various objects made of different materials like:
  - metal paper clip (remove the plastic if covered)
  - paper clip covered with plastic
  - rubber band
  - nail
  - glass object (rod, tube or just a piece of glass)
  - pen
  - coins (brass and silver)
  - cardboard
  - paper (fold the paper to form at least four layers to make it easier to connect in a circuit)
  - steel wool
  - piece of wood
  - pencil (contact points on the wood)
  - pencil with both sides sharpened to expose the lead (test the lead part of the pencil)
  - rubber
  - chalk
  - piece of ceramic
  - aluminium foil
  - metal spoon
  - plastic spoon
  - piece of leather
  - drinking straw
  - styrofoam

METHOD:

1. Use three electric wires to set up the electric circuit as shown on page 179. Note that the ends of two of the wires are not touching. What do we call such a circuit?

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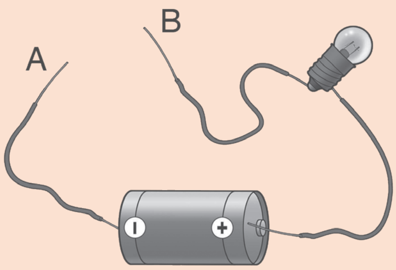
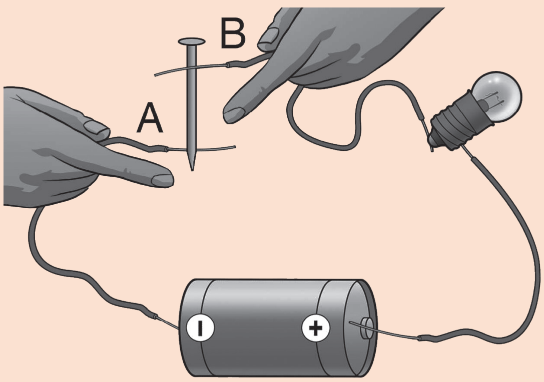
2. Draw the circuit diagram for the circuit shown in the sketch below.

Sketch	Circuit diagram
	

3. Test that the circuit is connected properly by touching ends A and B to each other and making sure that the bulb lights up.
4. Take the first one of the objects in the list on page 178. Put the object between the two wire ends at A and B.
5. The sketch below shows how to do it. Make sure there is good contact between the object and the wire ends.



Test each object as shown here with the nail.

6. Does the bulb light up or not? Copy the table on page 180 in your exercise books. Write the name of the object in the left or right column, depending if the bulb lights up or not.
7. Repeat the test for all the other objects in the list.

RESULTS AND OBSERVATIONS:

Record your results in the table.

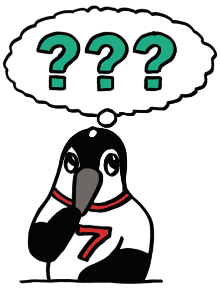
Observation		Prediction	Interpretation
Bulb lights up	**Bulb does not light up**		

1. What do the objects that lit up the bulb have in common?
2. What do all the objects that did not light up the bulb have in common?

CONCLUSION:

Write a conclusion for this investigation in your exercise books.

If the circuit is closed, the bulb lights up. We have learnt before that in such a case there is an electric current in the circuit. A material that allows a pathway for an electric current is called an electrical conductor. The material conducts electricity.



QUESTIONS

What type of materials did not light up the bulb? Although the circuit seemed closed, the bulb did not light up. What does that mean?

In this case the path for the electric current is broken. We call a material that does not allow a pathway for an electric current an insulator.

13.2 Good electrical conductors and insulators

We have seen in Activity 13.1 that the most familiar conductors are metals. Copper is the most common material used for electrical wiring. Silver is the best conductor, which means it is the material that makes it the easiest for electric current to flow through it. But silver is expensive. Gold does not rust and is used when high-quality contacts are needed. Although aluminium is a metal, it is not a very good conductor. However, it is sometimes used where weight is a consideration. Aluminium is not as heavy as copper.

Our bodies are also good conductors of electricity. This is why an electric current can easily flow through you and into the Earth, giving you a shock. This is because our bodies are made up mostly of water with salts in it. Water with other substances in it, such as salt, is a good conductor of electricity.

All conductors can allow current to flow through them if there is enough electrical energy. Normally the energy is too low. The plastic insulation on an electric cord is like this. Rubber gloves and shoes will protect you from mains electric current but not from lightning where the energy is very high.

Conductors and insulators are opposites!

- A good conductor is a bad insulator.
- A good insulator is a bad conductor.

The importance of electrical insulators

Think of the electric wires that you use in class for the activities. Why do you think they are covered in plastic? The plastic is an insulator and therefore prevents you from getting a shock. The plastic acts as a barrier so that you can still touch the wire, but you will not get a shock from the electricity when the circuit is closed, as the plastic coating prevents this.

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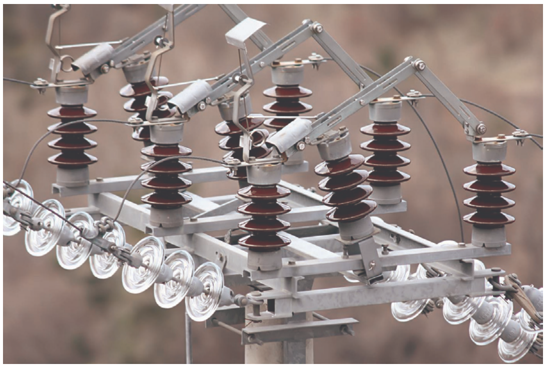
Electrical insulators are also used in other places. Have you ever looked up at power lines or telephone lines? You will see that the poles that carry the lines are sometimes made of wood. Wood does not conduct electricity so the electricity can therefore not flow from the wires into the pole.

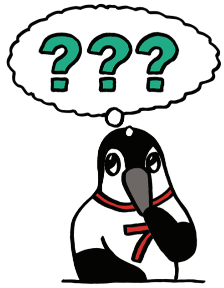
You may also see little white or coloured caps holding the wires as in the photo below. These caps are ceramic, which also does not conduct electricity.

In this photo, the wooden poles and white ceramic caps are electrical insulators.

It may be especially important to have ceramic electrical insulators between two different metal conductors. This is to prevent electricity from flowing between the different parts, such as in the photo below.

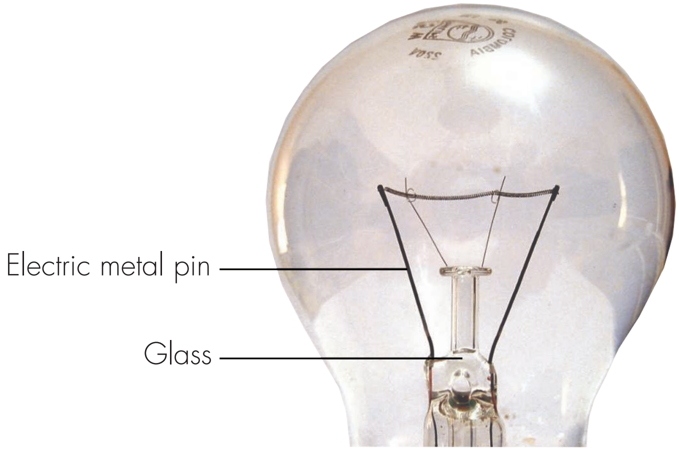


Can you see the dark red-brown ceramic electrical insulators?

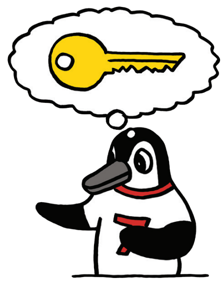


QUESTIONS

Look at the picture of a bulb below. Explain why you think the piece separating the electric metal pins (conductors) is made of glass.

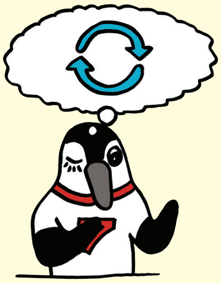


Electricians are people whose job it is to work with electricity and fix the wiring in houses and other buildings. Electricians often wear rubber gloves to protect themselves from getting a shock. Rubber is an electrical insulator.



KEY CONCEPTS

- Some materials allow electric current to flow through them. They are called conductors.
- Some materials do not allow electric current to flow through them. They are called insulators.
- Metals are usually conductors and non-metals are usually insulators.
- Electrical insulators have important functions like insulating wires or protection from electrical shock, an electrician's rubber gloves for example.



REVISION

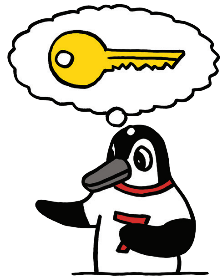
1. Suppose you have found a piece of material. You are not sure what the material is. You want to find out if it is a good conductor or a good insulator. Describe what you would do to determine if the material is an electrical conductor or insulator.
2. What is the difference between an electrical conductor and insulator?
3. What kinds of materials are used to make electric wires? What are the functions of the materials?
4. Why are insulators important?
5. List five insulating materials.
6. Look at the owl sitting on the pole below. Why does it not get an electric shock from the powerlines?

An owl perched on a pole.[1]

7. The man in the photo below is setting up an electric generator. Why is the man wearing gloves while he does this? Why is he also wearing boots with thick rubber soles?

This man is wearing gloves.[2]

14 Systems to solve problems



KEY QUESTIONS

- How can we use electric circuits to make useful devices and appliances?
- What happens to energy when we use electrical devices and appliances?

14.1 Using electric circuits

Electric circuits are used all around us, for example in lights in our homes, streets and shops. Let us imagine our world of today without electricity!

ACTIVITY 14.1: A world without electricity

INSTRUCTIONS:

1. Write a short paragraph of how our world would be without electricity.
2. Describe the three things that will be the biggest disaster for you if there was no electricity.
3. Would there be any advantages of not having electricity? Discuss this with your classmates and write your answer in your exercise books.
4. Your group should now compare the advantages and disadvantages of electricity. What is the group's conclusion, a yes or no for electricity? Write down your group's reasons for saying yes or no.

Electric circuits are often used to solve a problem where we need energy. A battery or mains supply is a source of energy. The energy is transported to a device or an appliance using electric wires. The device or appliance changes the electrical energy to another form, such as

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light energy, sound energy, heat energy or movement energy. We call this an energy transformation. One form of energy is changed into another form. Appliances can do this job for us.

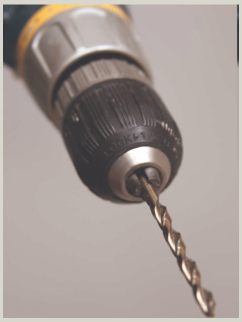
A system is something that consists of different parts working together to form a whole. In an electric system, there is an input (electrical energy) and an output (such as light, heat, movement or sound energy.) Let's look at some examples of electric systems where we use the output energy to do something useful.

ACTIVITY 14.2: Electric circuits influence our lives

INSTRUCTIONS:

1. Look at the photos in the table below.
2. Name the appliance or device.
3. Say what it is used for and what the energy is transformed to (light, sound, heat or movement)? In some cases it might be more than one thing!

a.  1	Name: Use: Energy transformed from __________ energy to __________ energy
b. 	Name: Use: Energy transformed from __________ energy to __________ energy

c. 	Name: Use: Energy transformed from ____________ energy to ____________ energy
d. 	Name: Use: Energy transformed from ____________ energy to ____________ energy
e.  2	Name: Use: Energy transformed from ____________ energy to ____________ energy
f. 	Name: Use: Energy transformed from ____________ energy to ____________ energy

g. 	Name: Use: Energy transformed from ____________ energy to ____________ energy
h. 	Name: Use: Energy transformed from ____________ energy to ____________ energy
i. 	Name: Use: Energy transformed from ____________ energy to ____________ energy
j.  3	Name: Use: Energy transformed from ____________ energy to ____________ energy

k. 	Name: Use: Energy transformed from ___________ energy to ___________ energy

Each of the examples in Activity 14.2 uses an electric circuit to provide us with energy where we need it, whether it is light on the street, sound for our radio, or heat in a building. Or even in some toys and models such as a car racing game, or model electric train set! We can say that electrical appliances can solve problems for us. They are able to transform electrical energy into another useful form of energy.

14.2 Be an electrical engineer or electrician

Let's say you want to become an electrical engineer or electrician. One of the things that you will be doing is to design systems that use circuits to solve problems for people, whether it is the wiring in a house, an alarm bell, a lighthouse on the coast, or constructing toys which use electrical energy to work.

Wow, I would love to be an electrical engineer!

ACTIVITY 14.3: Design, make and present a system using a circuit

DESIGN BRIEF:

You are an electrical engineer and you need to come up with a design for an electrical system to solve a problem. You need to design and make a system that uses a circuit to produce movement, light, sound or heat. Write a design brief where you identify what you are going to make and why it needs an electric circuit.

INVESTIGATE:

The next step in the design process is to do some research about the device that you are going to make. You can use books and the internet to do your research.

Answer these questions when doing research about your electrical system:
1. How is this system normally made?
2. What components does it need?
3. What type of energy will be produced from electrical energy?
4. Why do people need this system? What problem does it solve?

DESIGN:

Now that you know a bit more about the system you want to make you need to design how you are going to make it.

Your system has the following specifications:
- The system must make use of an electric circuit.
- The system must produce either movement, sound, light or heat.
- The circuit must make use of some of the components that you have learned about, such as cells, light bulbs, switches, wires, etc.
- Your system must make use of a switch to turn it on and off.

Your system has the following constraints:
- You must make it in class.
- You cannot get an adult electrician to design your project for you! You must come up with your own design.
- Your system is not life-sized, but must be a model.

Answer these questions:

1. What materials will you need to make it? For example, which electrical components will you need? Which other materials will you need, such as a cardboard box to put the system in, adhesive tape or Prestik, drawing pins or paint to paint the box?
2. What tools will you need to make it? Such as pliers to cut the wire and scissors to cut cardboard. Make a list and collect some of these items from home, or else ask your teacher if he/she has any.
3. How many cells (batteries) will you need for your circuit?
4. Where will you place the switch? What type of switch are you going to make?

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

When you are making your system you might get better ideas to improve the design as you test it out to see if it produces the required output. So come back afterwards and draw what you really decided to make.

MAKE:

Now make your system! After you have all finished making your systems, perhaps go around and look at what others have done. Ask questions to see what you can learn from each other. You will also have to present your project to the class so use this time to get ideas about how to present your idea and product that you made.

EVALUATE:

Before we get on to presenting the projects, you need to evaluate your own project. You can then use this evaluation in your presentation to show others what worked and did not work.

1. Does your system look like your initial design?
2. Does your system produce a movement, sound, light or heat?

3. Where would people use the system you designed to solve a problem in their daily lives?
4. Is there anything you might do differently to improve your design?

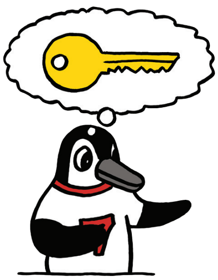
COMMUNICATE:

Engineers need to be able to present their designs to show others what they have come up and communicate their ideas. Engineers can present a written report and hand in their design drawings. But, often an engineer will need to present the design and project by giving a verbal report.

Your last task in this design project is to present your system to your class.

These are your instructions:

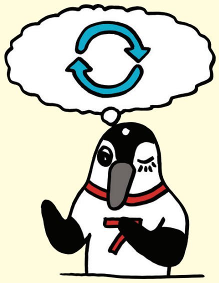
1. Present an oral report to the rest of the class to tell them about the system that you built.
2. You must have your system with you in the front of the class and show how it works.
3. You must explain the electric circuit that is used and what type of energy is produced.
4. Tell the class how your system could be used by people and why they might value your design. For example, how it could be used in a house by people or how it could form a new toy on the market.
5. Lastly, tell the class what you learned by doing this project and anything that you found tricky or difficult, or that you might change if you had to do it again.



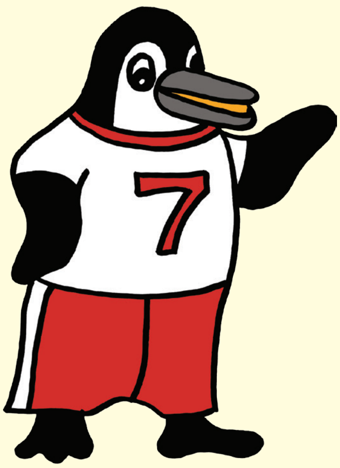
KEY CONCEPTS

- Electric circuits solve problems like getting electric lighting for example.
- There are many instances in the world around us where electric circuits are used, such as street lighting, alarms, electric gates, traffic lights, fans and heaters, and some models and toys.

REVISION



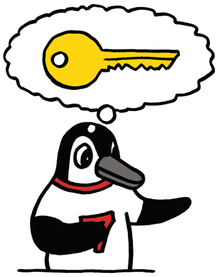
1. Name five things that we would not be able to do without using electricity. Explain why you think each of these things is important to us.
2. Phumlani builds an electric circuit that includes a bulb and battery for his bedside table so that he can read at night, but the bulb does not light up. List three things that could be wrong.
3. Phumlani does not want the battery in his bedside light to run out of energy. What could he do?
4. List three electrical devices that use energy from a battery.
5. List three electrical devices that use energy from a mains supply.
6. Draw an electric circuit diagram for the system that you designed and made in the design project.



We have now seen how to make simple circuits and use a circuit to do something for us.

But how do we get electricity in our homes, school and shops? Let's find out!

15 Mains electricity



KEY QUESTIONS

- Where does mains electricity come from?
- What are fossil fuels and how did they form underground?
- Why should we save energy and how can we do it?
- Why are illegal electrical connections so dangerous?
- What is the difference between renewable and non-renewable energy resources?

We are so used to switching on electrical appliances that we hardly think what makes it possible to have these things. Our focus turns to appliances that need a mains electrical supply. You have listed examples like a television, a computer, a kettle and many others before.

The big question here is: "Where does mains electricity come from?"

15.1 Fossil fuels and electricity

New words

- mains electricity
- power supply
- power station
- turbine
- generator
- renewable
- non-renewable

Do you remember learning about fossil fuels and power stations in Grade 5? A battery has stored energy which can be changed into electrical energy. However, our homes, schools, shops and factories cannot run on batteries because they cannot store or provide large amounts of energy.

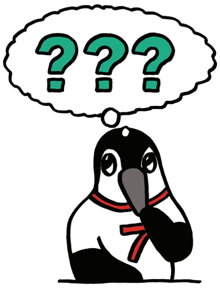
Electricity does a lot of work for us and is used every day. The main supplier of electrical energy is from power stations. We call this mains electricity. But power stations also need a source of energy to make electricity. In South Africa, this is mostly sourced by burning fossil fuels, especially coal.

What are fossil fuels?

Coal, oil and natural gas are fossil fuels. Some people think that fossil fuels are the remains of dead dinosaurs, but this is not true! Actually, most of the fossil fuels we find today were formed millions of years before even the first dinosaurs. Fossil fuels were once alive!

QUESTIONS

Do you remember learning about fossils in Grade 5 in Earth and Beyond? Write down what you think a fossil is.

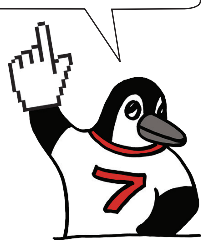


So fossil fuels are actually the remains of prehistoric organisms that lived millions of years ago!

Wow, that's amazing! So the coal we burn was actually once a real tree millions of years ago?

Visit

How fossil fuels are made.
goo.gl/5XGW5



Yes, that is right Phumlani. But different fossil fuels come come from different organisms and are formed in slightly different ways.

ACTIVITY 15.1: Let's take a trip back in time, millions of years ago!

INSTRUCTIONS:

1. Read the text below about how fossil fuels were formed and study the pictures.
2. Then answer the questions that follow.

300 million years ago ...

Think about what the Earth must have looked like back then! There were swamps and marshes everywhere and it was warmer than it is today. Ancient trees, ferns and plants grew everywhere. Very weird looking animals roamed the earth, and even stranger looking fish lived in the rivers, and deep in the oceans and seas.

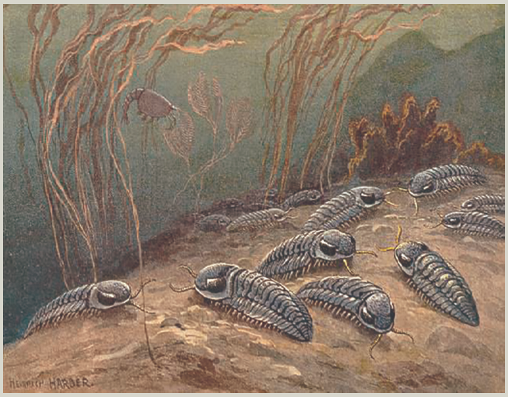
An ancient, prehistoric world

When these prehistoric plants and animals died their bodies decomposed just in the same way as organisms decompose today. The dead organisms became buried under layers and layers of mud, rock, sand and water. Over time, these layers built up and became very deep, and they pushed down with a great pressure on the layers below.

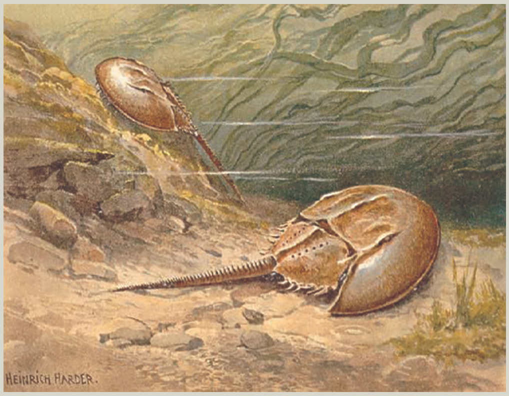
Millions of years passed, and the dead plants and animals slowly decomposed and formed fossil fuels. Different types of fossil fuels were formed, depending on different factors. For example, whether it was the remains of plants or animals, or a combination, and how long the remains of the organisms had been buried for. The type of fossil fuels that formed also depended on the temperature and pressure conditions during the decay of the organisms.

Oil and natural gas

Oil is a dark, thick liquid that can be used to make petrol to burn in vehicles, such as cars, buses and trucks. Natural gas is a colourless gas, and it is used mostly in homes for heating and cooking food.



Trilobites



Limulus

Ceratodus

Ammonoids

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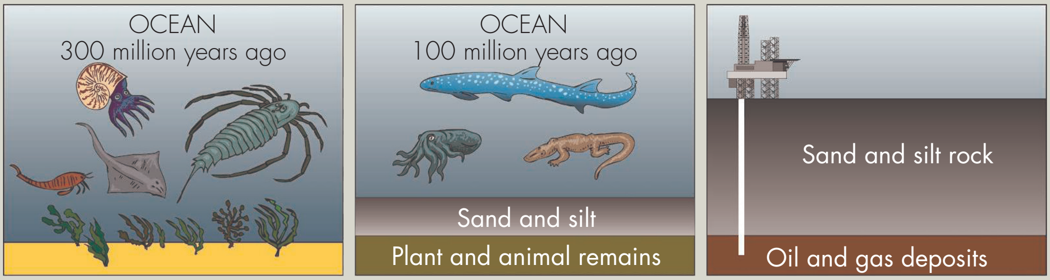
Oil and natural gas formed from organisms (plants and animals) that lived in the oceans before there were dinosaurs. When these organisms died, they settled on the bottom of the riverbed or ocean floor, and the layers built up under mud and sand (silt). The mud and sand slowly changed into rock, and the rock and water pressure pushed down on the remains of the dead plants and animals.

Over millions of years of being under heat and pressure, the dead plants and animals changed into a thick liquid, called crude oil. In deeper, hotter places tiny bubbles of natural gas formed. These were trapped under the rocks.

Over time, some of the oil and natural gas began to work its way up through the rock and to the Earth's crust, and into rock formations called caprocks. Today, most of the oil and natural gas is collected from these caprocks by drilling down through the layers of rock.



Coal

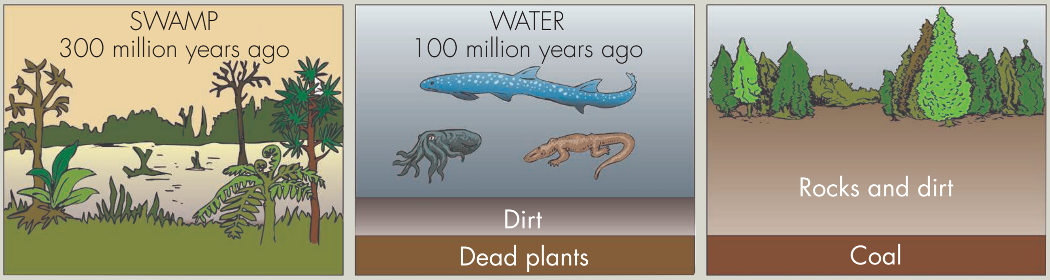
Coal is a black rock that can be burnt to produce energy in power stations all over the world.

Coal was formed from the dead remains of trees, ferns and some other plants that lived 300 to 400 million years ago. This was when the Earth was mostly covered in swampy forests. These kinds of plants were very different to the plants that we get today. Over time, the layers of dead plants at the bottom of swamps was covered with layers of water and mud. The top layers compressed down on the dead plants. Over millions of years the heat and pressure turned the plants into coal, which we mine today.

Ferns were very common in the prehistoric world of plants.[1]

Much of the Earth was covered in swamps millions of years ago.

The energy in coal originally comes from energy from the sun. Plants on Earth used the energy of the sun for photosynthesis and to grow. This energy was stored in the leaves, flowers and stems of the plants. As the plants died the energy was trapped.



QUESTIONS:

1. What are the three fossil fuels discussed in the text?
2. The organisms that fossil fuels were formed from lived many years ago, and are different to the organisms that we get today. How many millions of years ago was this?
3. The dead organisms were covered with sediments over time. Do you remember learning about sediments in Grade 5 Earth and Beyond, and how sedimentary rock forms? Write a description of what deposition is.

Visit

Fossil fuel formation (video).
goo.gl/R7Z6L

4. What are the two main factors, which turned the remains of organisms into fossil fuels deep under the layers of rock and mud?
5. Explain why we say that all our energy originally comes from the sun, even in fossil fuels.
6. Do you remember learning about the states of matter in Matter and Materials? Each of the three fossil fuels discussed here is in a different state of matter. Say what they are.
7. The process of coal formation, and natural gas and oil formation, have similarities but also differences. Draw a table where you compare these two processes. Give your table a heading.

The way we obtain the different fossil fuels is also different. Coal is usually obtained by digging mines into the rock and sand to reach the coal deposits deep under the surface. This creates a huge hole in the surface of the Earth as you can see in the photograph of a coal mine below.

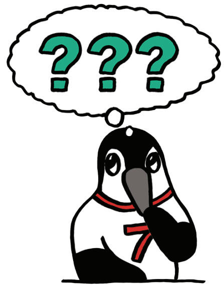
Oil and natural gas is obtained by drilling down through the rock. A hole is sunk with a huge drill so that the oil and natural gas can be reached, and then brought up to the surface. This normally takes place in the ocean, as you can see in the photo of an oil rig below.

Coal mine[2]

An oil rig in the ocean, which sinks a drill into the ocean floor to reach the oil deposits.

QUESTIONS

Search the internet to find out which countries in the world have large quantities of coal, oil and natural gas. Find out which three countries use the most fossil fuels.



So we have spoken about fossil fuels and energy, but how do we then get electrical energy from fossil fuels?

That is a great question, Phumlani! A good scientist always asks questions!

Fossil fuels and electricity

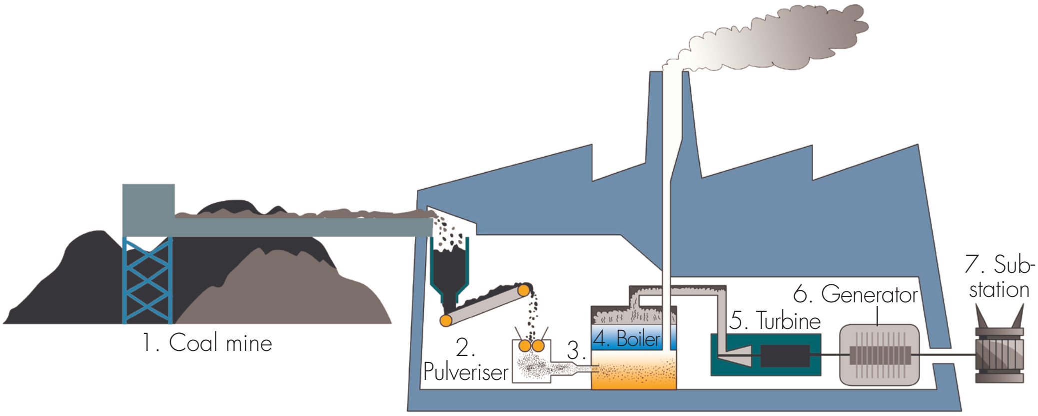
The main supplier of electricity in South Africa is Eskom. Eskom uses mainly coal to produce energy for industrial and household use.

Let's look at a power station to find out how coal is used to produce electricity.

Look at the following diagram and the steps that outline the process to make electricity from coal:

1. Coal is transported from a coal mine to a power station.
2. At the power station, the coal is ground into a fine powder (pulverised)

3. The ground coal then goes into a container where it is burned.
4. The heat generated from the burning coal is used to boil water in a huge boiler.
5. The boiling water produces steam that turns a turbine (a turbine is a big wheel which turns).
6. The turbine is linked to a generator, which uses a coil to produce energy.
7. From the generator the electric current is transported (carried) by a system of electrical transmission lines (also called power lines) to substations near our homes.



The process of making electricity from coal in a power station.

ACTIVITY 15.2: Make a poster to trace the source of our electricity

MATERIALS:

- Poster-size paper or cardboard
- Colour pens or pencils

INSTRUCTIONS

1. Design and make a poster for your classroom on which you illustrate the chain of objects and processes that allow us to use an appliance in our homes (such as a television set, stove or refrigerator).

2. Start with a picture or drawing of the sun in the top left corner and end with the appliance in the bottom right corner of the poster.
3. Use arrows to show the sequence of objects and processes.
4. Label each object or process on your poster.
5. Decide on a heading for your poster and write it in big letters at the top.

Fossil fuels are non-renewable resources of energy. This is because they take millions of years to form. Once these fuels are burnt, they cannot be recovered or re-used. They are non-renewable.

People on Earth are using up these deposits of fossil fuels much, much faster than they are being made as they take millions of years to be made!

Look at the diagram of a power station on page 202 again. Do you see the smoke that is given off when the coal is burnt? This causes huge environmental concerns as it is polluting our atmosphere. A bit later in this chapter we will look at other ways of producing energy which, unlike fossil fuels, are renewable.

Did you know?

The burning of coal produces billions of tonnes of carbon dioxide each year. Carbon dioxide is one of the greenhouse gases that contributes to global warming.

15.2 Cost of electricity

Do you hear your parents and other adults talk about the cost of living? Do they remind you to switch off lights and other appliances that are not in use? Electricity is an expensive resource!

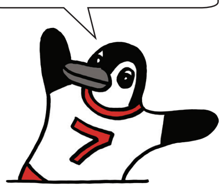
Why is electricity expensive?

Electricity is costly for various reasons:

- The production and delivery of electricity requires infrastructure (the structures and facilities), like coal mines, trucks and trains to transport coal, power stations, substations and wiring.
- All of these buildings, structures, materials and processes are very expensive to build and maintain.

New words

- infrastructure
- kilowatt



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- Some electrical appliances require a lot of energy, much more than others. For example, a geyser uses a lot of electricity to heat the water, and so it becomes expensive.

When electrical energy enters your home, it must pass through a meter. Have you ever seen a white box outside your house? This is the electricity meter.

A worker from the city council reads the meter so that they will know how much electricity you used. They then bill you for the cost. The more electricity we use, the more we pay, and the more we use up fossil fuels. Some houses now have prepaid electricity meters where you pay for your electricity before you use it.

Can you see the number recording the electricity usage in kilowatt hours (kWh) on this electricity meter?[3]

Running electrical appliances

We already mentioned that some electrical appliances use more electricity to run than others. Appliances that heat use the most energy, such as a geyser or heater. How do we know which electrical appliances use more electricity? Let's find out!

ACTIVITY 15.3: Finding out how much energy appliances and devices use

INSTRUCTIONS:

1. Find the appliances or devices listed in the table below. If you do not have them in your home or school, ask family, friends or neighbours if you could look at theirs.
2. Have a look at each appliance and check for a label with information like the one below. This information is usually at the back or the bottom of the appliance.

230 V – 240 V; 50 Hz; 2 kW

3. Copy the following table in your exercise books. Record the number that is followed by a W or kW on the label in column 2 of the table. This number indicates how much energy is required by the device in a certain time. It is called the power required by the device. We measure power in watt (W) or kilowatt (kW). The higher the value the more energy the device uses in a specific time.
4. Add any other three appliances or devices to the list.
5. Record all the power values in column 3 in watt. If the power is given in kW, multiply this number by 1 000 to get the value in watt (W). If the device does not show a value in W or kW, look for two quantities given in volt (V) and milliampere (mA). Multiply these two numbers and then divide the answer by 1 000 to get the power in watt.

Appliance or device	Power in W or kW	Power in watt (W)
Cell phone charger		
Electric kettle		
Television set		
Light bulb		

Appliance or device	Power in W or kW	Power in watt (W)
Energy-saving light bulb		
Computer		
Electric iron		

6. Now arrange the appliances in the next table in terms of the power required. The list should be from small to large values of the power.

Appliance or device	Power in watt (W)

QUESTIONS:

1. What do you see in this table? Which two appliances have the lowest power requirements? What do these appliances have in common?
2. Which two appliances have the highest power requirements? What do these appliances have in common?

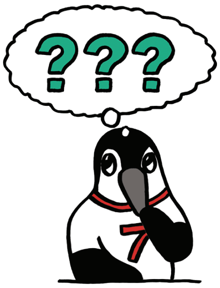
Saving electricity

Just when I am ready to run outside, my mom often makes me come back to turn my bedroom light off.

Good for her, Phumlani! Electricity is expensive so we should try and save electricity.

QUESTIONS

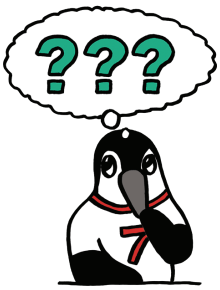
This is not the only reason to try save electricity. Remember when we spoke about the pollution given off by coal power stations? Why else do you think it is important to try save energy and reduce your power usage?



There are many different ways to save electricity, from small actions, to larger actions, such as using renewable energy resources. We will discuss this a bit later in the chapter.

QUESTIONS

How can you prevent wastage of electricity in your home? Name four possible ways.



15.3 Illegal connections

We discussed a world without electricity and we all realised how dependent we are on this resource. It is illegal for anyone to use electricity that was generated by Eskom without their permission. Some people make illegal connections because they don't want to pay for the electricity. They cut through the insulation in a power line and attach other cables to this line. They can then direct some electricity to their house or workplace. These connections are dangerous to people as they are often unsafe.

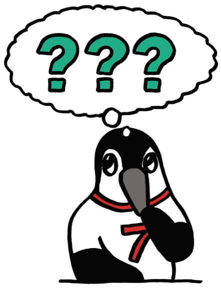
People who make illegal connections try to get electricity for free but the dangers are not worth it. It is not worth your life!

Look at this mess of illegal electrical connections.[4]

Accidents caused by electricity happen all the time. People often get hurt or even killed by electricity because they do not use it safely. Not only is it important to know how to use electricity safely, but also what to do if someone is hurt or shocked by electricity.

QUESTIONS

1. What types of emergencies can happen at home or at school with electricity?
2. Find out about the emergency services in your area, and write down their names and telephone numbers. Also write this information on a piece of paper and stick it to the wall next to your phone or in a central place in your home.



Accidents with electricity can be avoided. We just need to be smart about working with electricity. Let's formulate some safety rules for working with electricity.

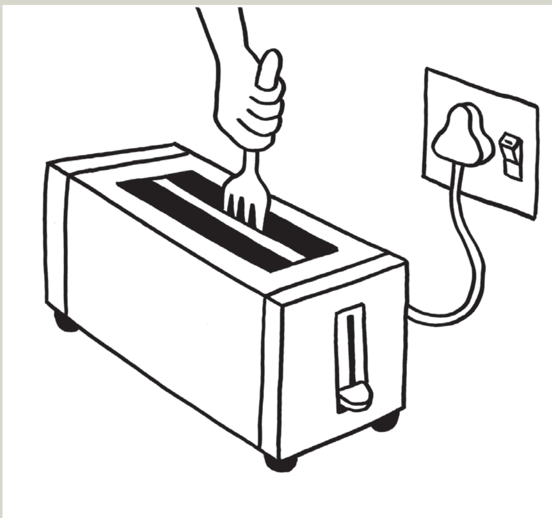
ACTIVITY 15.4: Safety rules when working with electricity!

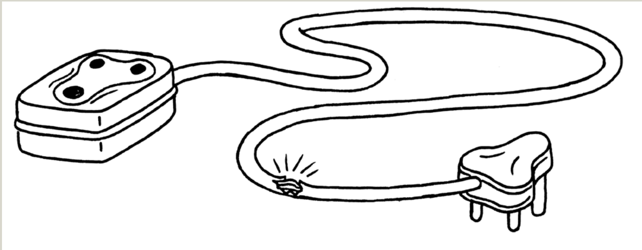
INSTRUCTIONS:

1. Look at each of the pictures that follow.
2. Each one shows someone doing something with electricity, and often the person is doing something dangerous!
3. Answer the questions about each of the pictures.

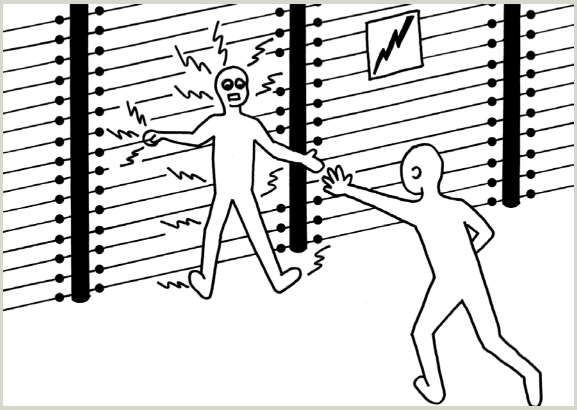
QUESTIONS:

1. The person in this illustration is using a fork to remove a coin that has fallen in the toaster, before switching off the appliance. What are the dangers related to this act?
2. What safety rule can you formulate regarding this?

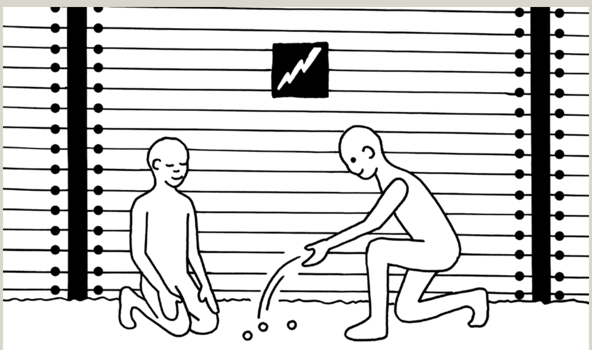




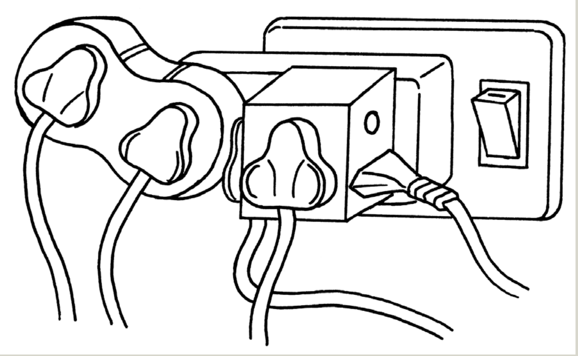
3. Why is this an unsafe cable to use? Note the area that makes it unsafe.
4. What could be done to the cable to make it safe to use?
5. What safety rule can you formulate regarding this?



6. Why is it dangerous to pull the boy from the electric wires?
7. What can the helper do to save the boy without being shocked by the electricity?
8. What safety rule can you formulate regarding this?



9. Why is this not a safe place to play?
10. What safety rule can you formulate regarding this?

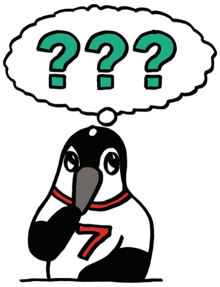


11. Why is this connection dangerous?
12. What safety rule can you formulate regarding this?

13. Explain why it is not a good idea to be playing outside when there is lightning in the sky?
14. Why should no one play under a tree when it is storming?
15. Why is it dangerous for the children to swim during a lightning storm?
16. What safety rules can you formulate regarding lightning?

17. Why is the gardener unsafe when mowing the lawn in the rain? Give at least two reasons.
18. What safety rules can you formulate regarding using electrical appliances outside in the garden?

15.4 Renewable ways to generate electricity



We have learnt that fossil fuels are non-renewable resources of energy.

QUESTIONS

What do you understand by the word 'non-renewable'?

So, if we are using an energy resource that is non-renewable, then this will be a problem in the future when these resources run out. Are there other sources of energy?

Scientists and engineers are looking for ways to harness energy from renewable resources. A renewable resource is the opposite to a non-renewable resource. It will not run out and can be used over and over.

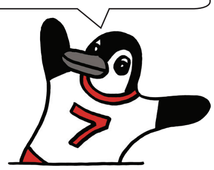
Renewable energy sources include natural phenomena, such as sunlight, wind, tides and plant growth. The energy comes from natural processes that happen over and over.

Examples of renewable energy resources:

- Solar (energy from the sun)
- Wind
- Ocean (tides and waves)
- Hydropower (waterfalls or freshwater dams)
- Biomass (energy from plants and other organic material)
- Geothermal (energy from steam underneath the surface of the Earth)

New words

- hydropower
- biomass
- geothermal



QUESTIONS

Why do you think natural phenomena, such as sunlight and wind, can be considered as renewable?

Sun, wind and water can be used as sources of energy. Solar panels can be fitted to houses but this source of renewable energy is only available on sunny days. Wind energy can be collected with a windmill or wind-turbine, which can be big and noisy. Hydroelectric power stations harness the energy in water stored in dams. It is only possible in areas where there are high mountains and rivers.

Did you know?

The first windmills were developed in Persia in about 600 BC. But the first windmill to produce electricity was in Denmark in 1890.

Wind turbines use wind to generate electricity.

Visit

Wind energy (video).
goo.gl/XthW5

Did you know?

Solar panels which convert the sunlight energy to produce electrical energy are also called photovoltaics. There are also solar water heaters, but this is a different system to solar panels. Solar heaters directly heat water.

Visit

How hydro-electricity works (video).
goo.gl/j6Oz1

A water wheel uses the flow of water to push the wheel around, which can then do work.

A large hydroelectric power station. As the water flows from the higher dam, through the station to the lower dam, electricity is made.[5]

Solar panels[6]

What are the advantages and disadvantages of renewable and non-renewable sources? There is a lot of debate around the use of renewable and non-renewable sources for energy. Let's join this debate!

ACTIVITY 15.5: Renewable versus non-renewable energy

INSTRUCTIONS:

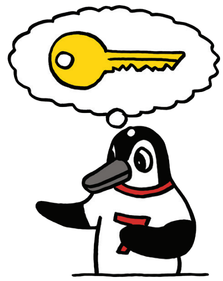
1. Work in groups of four and discuss whether your house uses renewable or non-renewable sources of energy.
2. Does anyone in the group have solar panels at home?
3. Think about the advantages and disadvantages of renewable and non-renewable sources. You can use the internet or other information sources to check for more ideas.
4. Copy the table below in your exercise books and write some of your answers.
5. Report back to the class and see what others think about this debate.

	Advantage	**Disadvantage**
Renewable		
Non-renewable		

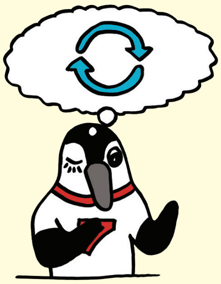
Did you know?

South Africa also has large reserves of uranium, which are used in the Koeberg nuclear power station.

KEY CONCEPTS

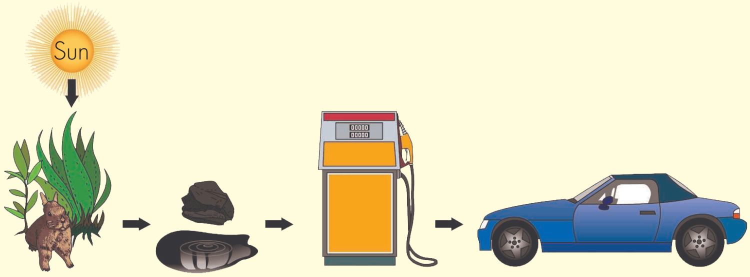


- Most of our electricity comes from fossil fuels such as coal, oil and natural gas.
- Fossil fuels are the remains of dead plants and animals from millions of years ago.
- The energy in fossil fuels originally comes from the sun, which was captured by the plants that lived millions of years ago.
- Electricity is expensive due to the infrastructure required to produce and deliver it.
- Fossil fuels are non-renewable, meaning they will run out
- We should ty to be energy-efficient and not waste electrical energy.
- Illegal connections pose a huge threat to people as they can be unsafe.
- There are other resources which are renewable and can be used to generate electricity, such as wind power, solar power and hydropower.



REVISION

1. Look at the flow diagram below. Describe what it is showing using what you have learnt in this chapter.



2. Why are fossil fuels considered non-renewable resources?
3. Write a paragraph in which you explain why you think humans should investigate alternative energy sources, such as renewable energy sources. How might this help the Earth?
4. What type of electrical appliances in our homes use the most energy in a specific time?
5. Imagine that you are writing an article for your local newspaper on how to save electricity in your homes. Use your imagination to write your article telling people how to save electricity. Give your article a catchy heading.
6. How do you think saving electricity will reduce the demand on Eskom's power stations?
7. What is an illegal electrical connection? How do you think the local government could stop or reduce the number of illegal connections?

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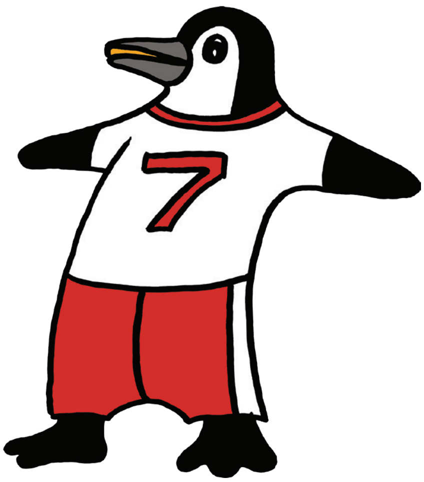
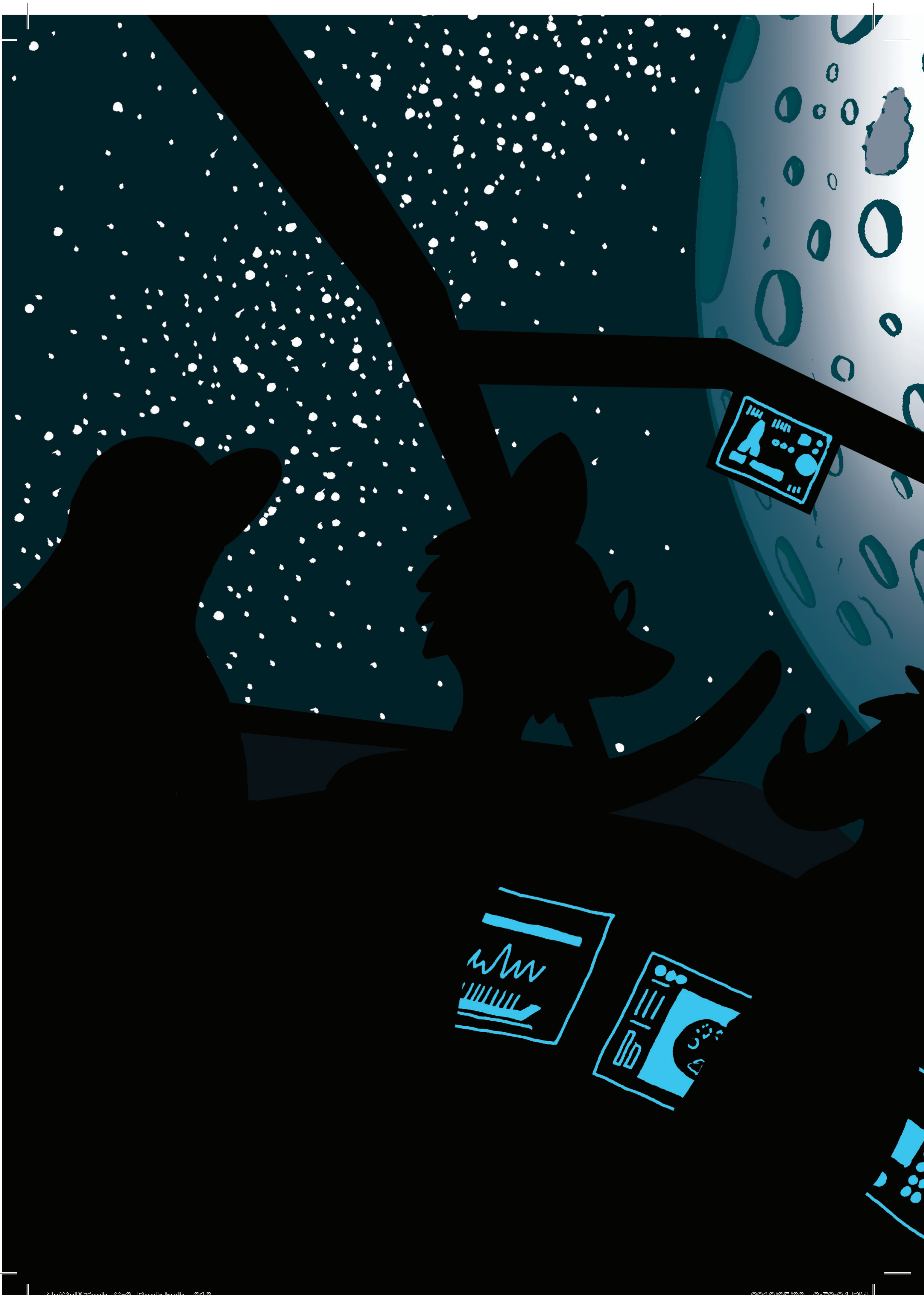
That is all from me for Energy and Change!

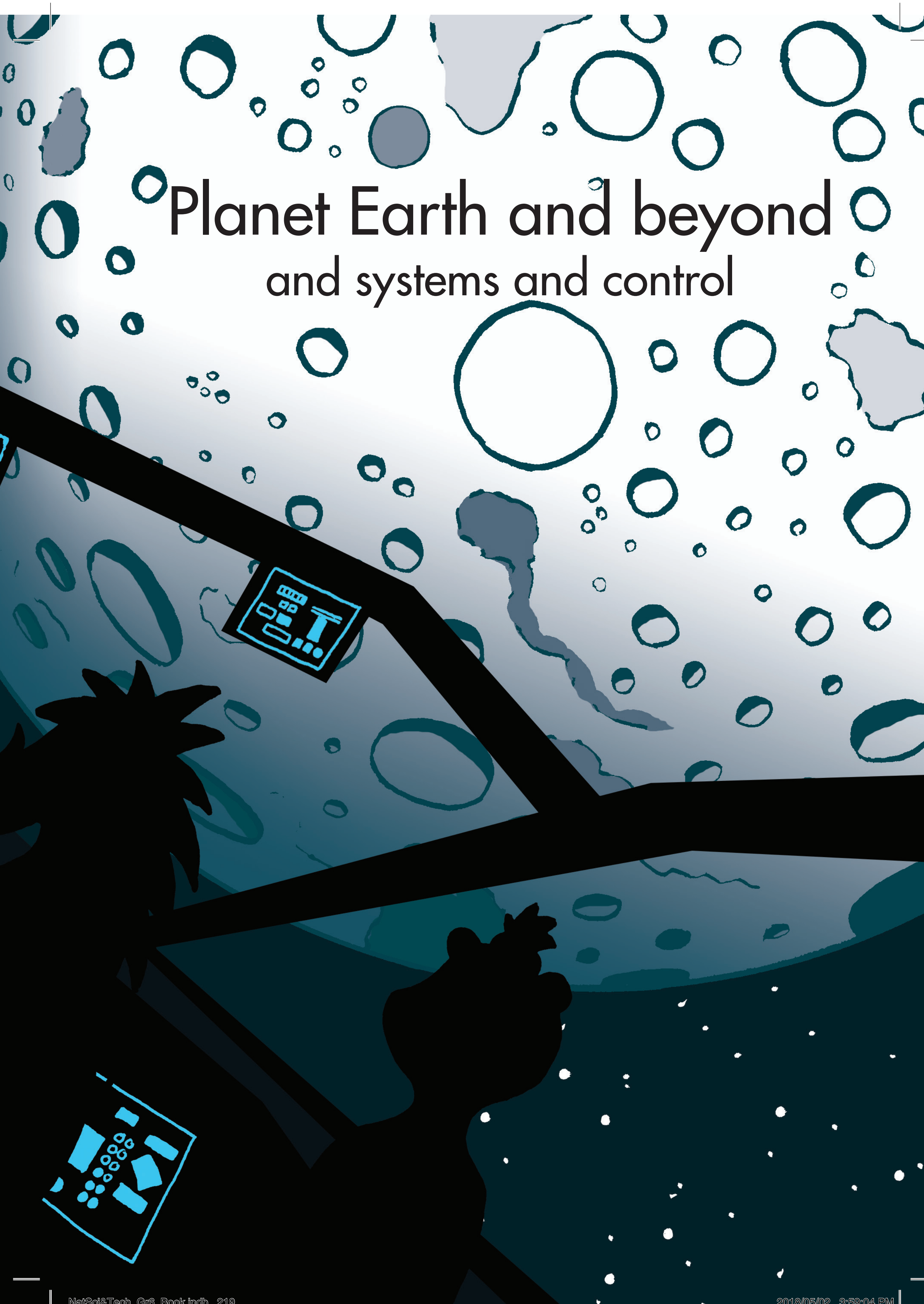
Join Felicity next to learn more about our planet Earth and outer space.



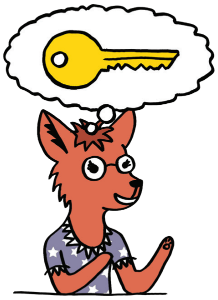


Planet Earth and beyond

and systems and control



16 The solar system



KEY QUESTIONS

- How can we tell the difference between a star and a planet?
- What are asteroids?
- What is a moon? Does the moon produce its own light?
- Can we see the moon during the day?

Do you remember that in Grade 4 we looked at space and the objects found in space? Last year, in Grade 5 we mostly looked at Earth and the features of Earth. Now we are going to explore space a bit more! Before carrying on, let's refresh our memories on some of the things about space from Grade 4.

ACTIVITY 16.1: Wordsearch about space

INSTRUCTIONS:

1. Find the following words in the wordsearch.
2. When you find the word, discuss with your partner what you remember about this word from Grade 4.

- space
- gravity
- astronomy
- orbit
- rotate
- moon
- axis
- galaxy
- sunrise
- sunset
- star

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

Visit
The birth of our solar system.
goo.gl/yDya6

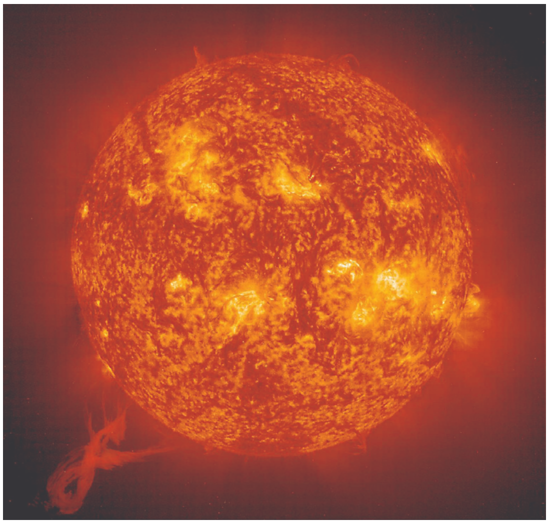
16.1 The sun, planets and asteroids

Do you remember what a solar system is? Our solar system is made up of the sun and the planets. Let's take a look!

What is the sun?

The sun glows so fiercely that it is not safe to look straight at it, even though it is so far away. The sun is a ball of gases.

The sun is extremely hot: The temperature is about 15 000 000 degrees Celsius (°C) in the centre! The surface is about 5 500 °C. Can you see the explosion from the surface of the sun in the photo?



Can you see the big burst of gas from the sun on the bottom left?

The sun is a star, because it produces its own energy. The sun appears bigger and brighter because it is much nearer to earth than the other stars.

The sun is about 420 times bigger than the Earth and about 1 700 times bigger than the moon! The sun is much further away than the moon from the Earth. The sun produces light and heat, which warms the surface of the Earth.

New words

- photosphere
- convection zone
- radiation zone
- sunspots
- hydrogen
- helium
- constellation
- astronomer
- observatory

Visit

Comparing the sizes of planets and the sun.
goo.gl/3XlOi

Did you know?

The sun is about 150 million kilometres from Earth, and the next nearest star to us after the sun, is over 40 million million kilometres away.

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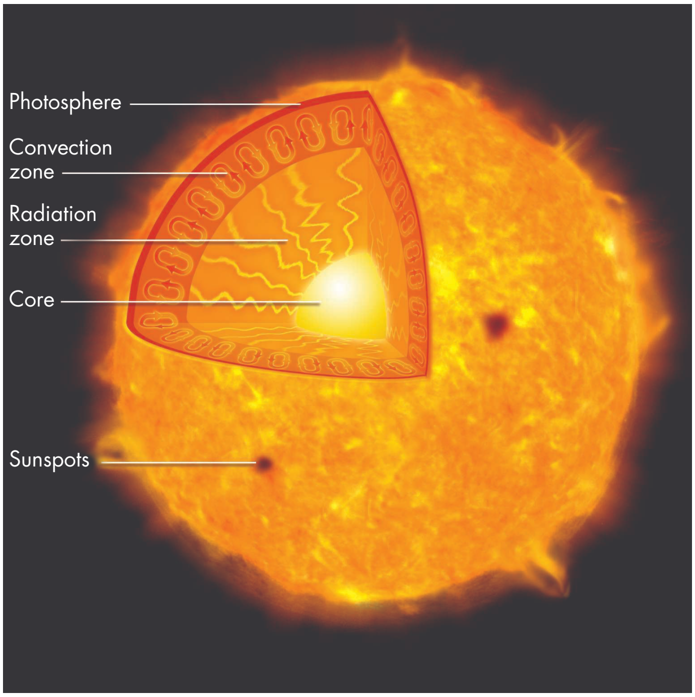
Study the image of the sun, and then answer the questions that follow in the activity below.

Did you know?

When the sun has changed all its hydrogen into helium and other substances, it will begin to die. But we need not worry, because that will happen 10 000 million years from now.



This image shows the different layers of the sun.

ACTIVITY 16.2: Looking at the structure of the sun

INSTRUCTIONS:

1. Look at the picture of the sun showing the different layers inside.
2. Answer the questions.

QUESTIONS:

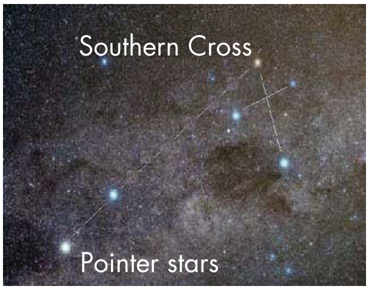
1. Which is the hottest part of the sun?
2. The sun's energy comes from burning gases being squeezed together (compressed) until hydrogen turns into helium. Where do you think the gases are compressed the hardest?
3. What are the dark spots on the surface of the sun called?

Come with me!
We are going to hear a story about the planets. It's a bit of Science, Maths and History all mixed up!

Constellations and planets

Long, long ago people watched the stars at night. Shepherds looking after their sheep and cattle would lie down and look up at the night sky. People in hot countries slept on the roofs of their houses. So they had plenty of time to look at the stars. They knew the patterns of stars in the sky and how the stars moved across the sky during the night. The patterns were fixed (they did not change). For example, you can find a pattern like the Southern Cross if you look up towards the south. You can see it in the first photo below. The second photo with white lines helps you to see the cross pattern. It always looks the same because the stars are always the same distance apart.

This pattern of stars is the Southern Cross. The pattern does not change.



The white lines are not really in the sky, they just show you how to view the Southern Cross.

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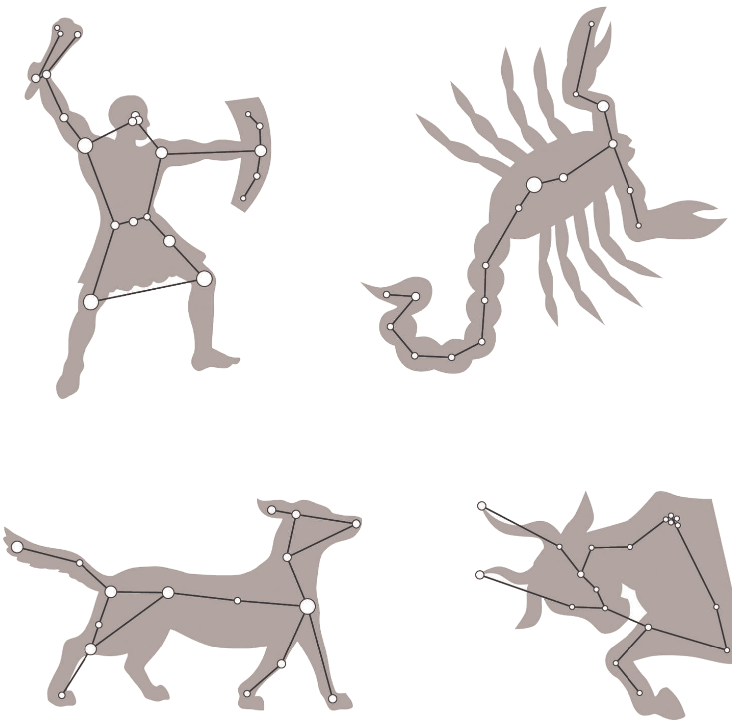
Patterns of grouped stars are called constellations. The next pictures show some other famous constellations of stars, which you can see in the night sky.



Some well-known constellations of stars in the night sky

Long ago people noticed that some bright objects did not behave like the others. These objects came close to a star one night and then the next night, at the same time, the object had moved away from the star. Night after night, these objects appeared in new positions among the stars.

The Greeks of those ancient times called these objects 'the wanderers' because they were in a slightly different position each night. The Greek word for wanderer is *planetes* and so we get the English word 'planet'. A person who wanders is someone who walks around wherever they feel like going.

The planets were a science puzzle

People who study the stars are called astronomers. The planets were a puzzle for ancient astronomers. Why did they move differently to the stars? Were they just as far away as the stars? Why were they brighter at some times of the year than at other times?

You can see the planet Venus just after the sun has set. Venus is usually very bright. At some times of the year, you have to look for Venus in the dark sky where the sun will rise.

The ancient peoples gave names to the planets. For example, Mars was named after the god of war. One planet was so beautiful that they called it Venus after the goddess of love and beauty.

You can see Mars at some times of the year. Mars is orange-red, and at most times it looks smaller than Venus. It is not as easy to find as Venus is. Sometimes you have to look late at night to see Mars rising in the east.

Did you know?

A system is a set of parts that work together. Any change or movement in one part causes changes in the other parts.

How astronomers solved the puzzle

Over hundreds of years, astronomers set up observatories in places like India, Egypt, Iraq, England and countries in Europe. An observatory is a building that has permanent measuring marks. These marks are always in the same position. The astronomers make notes of where stars and planets are compared to these fixed positions, and they note the dates and times.

Hypatia was an astronomer and mathematician at the University of Alexandria in Egypt. She lived about 1 700 years ago. Can you see the globe next to her?

Over many years of careful observing, the astronomers kept records of where the planets moved. They used Maths to predict where a planet would be on a future date. Then on that date they went to check if their prediction was correct. They became very good at measuring, doing Maths and doing calculations with big numbers.

Ancient astronomers made observations.

So they worked out that the planets are closer to us than the stars, and that the planets are moving around the sun. Then they realised that Earth is a planet too, and it is moving around the sun!

This idea upset some people who believed that the Earth was the centre of the universe and that everything moved around the Earth. Nowadays we know exactly where each planet is at any time, and we can actually send spacecraft to the planets.

The sun together with the planets moving around it is called the solar system. You will learn about that next.

Visit

The birth of the planets.
goo.gl/Nr0eL

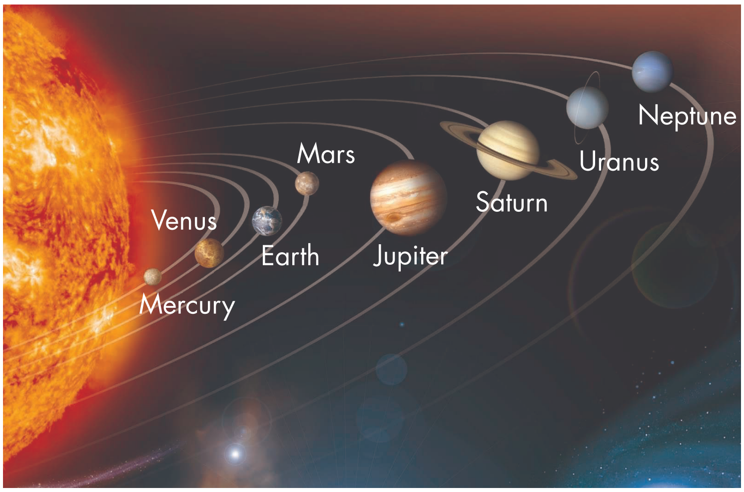
The solar system

The solar system consists of the sun and all the planets that orbit around it. It also includes asteroids and the planets' moons.

Below you can see a diagram of the solar system. In Activity 16.3 on page 228 you can see another diagram of the solar system. Both these diagrams try to show you what the solar system is like.

Did you know?

Pluto used to be classified as a planet but not anymore.



The solar system consisting of the sun and eight planets.

Visit

Why isn't Pluto a planet anymore?
goo.gl/tx8G

In the solar system, each object's force of gravity pulls on all the other objects. Gravity is a force of attraction between objects. The sun is the biggest and heaviest object in our solar system and so it exerts the greatest force of gravity on all the planets. This force of gravity makes all the planets move in circles around the sun.

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The names of the planets in our solar system are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Mercury is the planet closest to the sun and Neptune is the planet furthest from the sun.

QUESTIONS

1. Earth is the third-closest planet to the sun. Find Earth in the picture.
2. Could the planets really be as close to the sun as the picture below shows? Give some reasons for your answer.

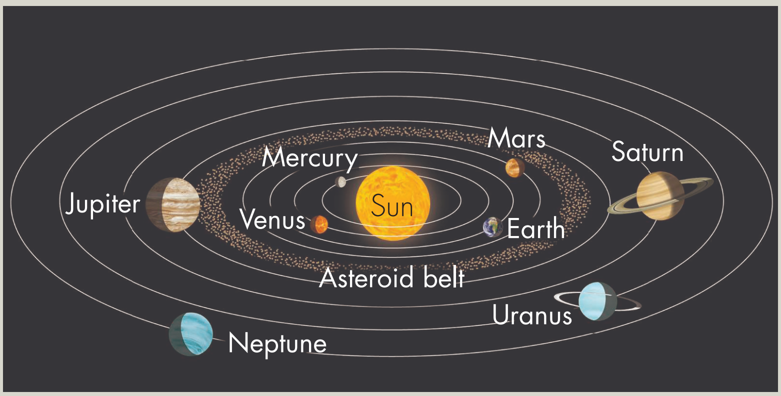
ACTIVITY 16.3: Looking at the solar system

INSTRUCTIONS:

1. Imagine you are in a spacecraft very far from the Earth. You can see the planets all moving around the sun in orbits, like in the picture. The white lines in the picture show the path that each planet follows when orbiting the sun. These orbits (white lines) are not actually visible.
2. Look at the picture and answer the questions.

Did you know?

The word 'solar' comes from the Latin word *sol*, which means sun.



The solar system showing the orbits of the planets.

QUESTIONS:

1. Which planet is the closest to the sun?
2. Is Venus or Earth closer to the sun?
3. Write the names of the planets in order, beginning from the one that is closest to the sun.
4. Which planet do you think is the coldest, and why?
5. Why do the planets all keep on moving in orbits around the sun?

Let's now use our bodies to create a model of how the planets move around the sun!

ACTIVITY 16.4: Make a model of two planets orbiting the sun

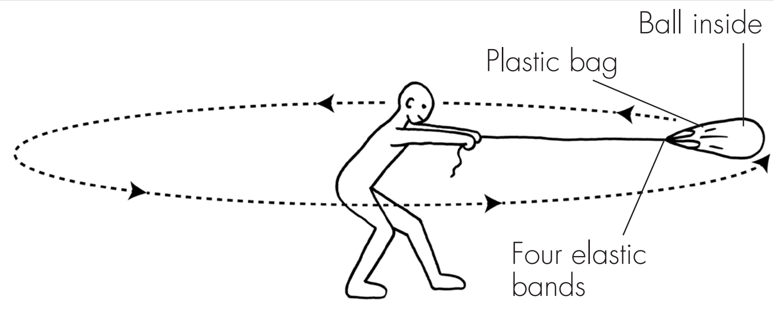
MATERIALS:

- Strong rope (about 5 m long)
- Another strong rope (about 3 m long)
- Two balls in plastic bags
- Eight thick rubber bands
- Small chair or box (plastic milk crate)

INSTRUCTIONS (Part 1):

1. Tie four elastic bands onto the handles of the plastic bag. Then tie the 5 m rope onto the four elastic bands. Put one ball inside.
2. You are going to do as you see in the picture on page 230.
3. Someone must run with the ball in the bag to help you get it going.
4. Then swing the ball around as fast as you can, on the end of the rope.
5. The rest of the class must watch the plastic bag carefully to see whether the rubber bands stretch.
6. See the learner in the picture swinging the ball around himself. The learner represents the sun and the ball represents the Earth.
7. Take turns to swing the ball. Feel how hard you need to pull on the ball to keep it going around.

8. The people who are watching will see the rubber bands stretch. This means that the ball is pulling on the rope, and the rope is pulling on the ball.

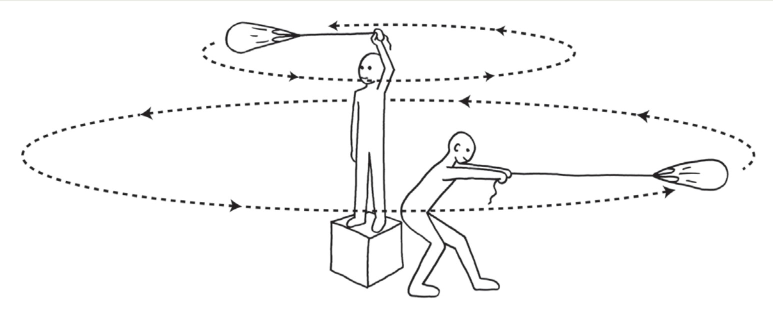


QUESTIONS:

1. What does the learner who is swinging the ball represent? What does the ball represent?
2. What do you feel is happening to the elastic as you swing the ball?
3. If the ball in its bag could feel, what would it feel?
4. If the string breaks, in what direction will the ball carry on travelling?
5. The ball represents the Earth. The learner swings it quite fast, but how long does the Earth really need to go once around the sun?

INSTRUCTIONS (Part 2):

1. This part is more difficult and it needs some practice. You are still making a model of planets moving around the sun.
2. Use the 3 m rope and tie it onto a bag and ball as you did before.
3. In the next picture you see one learner standing on a stool and swinging another ball in a bag.
4. The first learner now has to walk around the stool to keep his ball moving.
5. This might take some time to get it right!



Two learners must now swing balls at the same time.
This is quite tricky!

QUESTIONS:

1. Which part of this model represents the sun?
2. Which part of the model represents planet Earth?
3. Which part represents planet Venus?
4. In this model, when Earth revolves around once, how long a period of time does that represent?

The planet Earth orbits around the sun in 365.25 days and we call that one year. As Earth moves to new positions around the sun, we have four seasons: summer, autumn, winter and spring, and then summer comes again.

Now in space, the Earth keeps on going around the sun at more than 100 000 kilometres in every hour. But there is no rope pulling on the Earth, so what keeps it moving?

The force of gravity pulls the sun and the Earth towards each other. There is no rope in space between Earth and the sun! The Earth would move away, but the sun 'traps' the Earth with its much greater force of gravity. The sun pulls on the Earth and the Earth pulls on the sun with the force of gravity. The pull is so strong that it works at a distance of 150 million kilometres! Like the rope, the force of gravity keeps the Earth moving in its orbit around the sun, year after year.

It does the same for the other planets too. The force of gravity pulls the planet Neptune into its orbit even though Neptune is 30 times further away from the sun than Earth is.

Did you know?

The planet Venus orbits around the sun in 224.7 days. Those are 224.7 Earth days.

QUESTIONS

In the model in the previous activity, what does the rope represent?

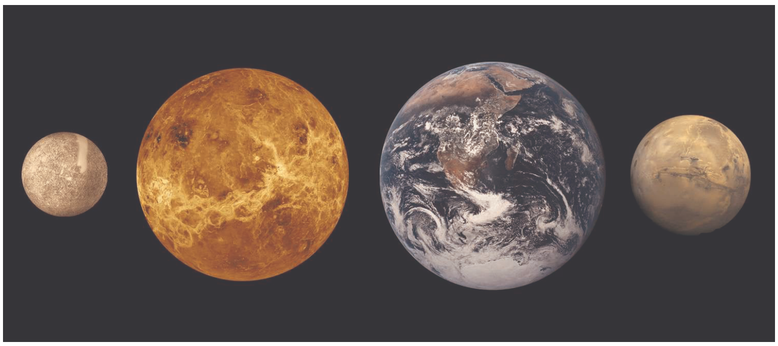
New words

- gas giants
- molecular hydrogen
- methane gas or ice
- ammonia
- rocky planets
- sulphuric acid
- NASA
- zinc
- iron oxide
- to scale

We visit the eight planets

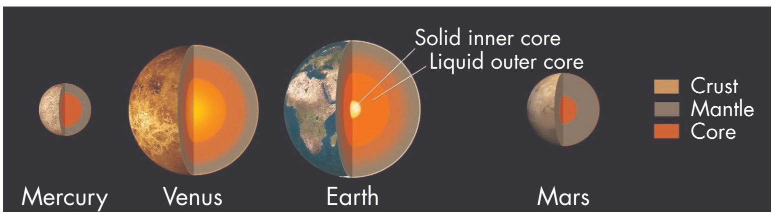
The four inner planets are rocky.

Look at the picture on page 228 of the solar system again. The four planets closest to the sun are called the inner planets of the solar system. They all are made of rock. Some of them have a thin layer of gas on the outside. Earth has a very thin layer of water and soil too.



These are the four inner rocky planets. This picture shows their sizes compared to each other. Can you name them?

The next image shows us what the core of each of the rocky planets looks like. The core is the inner part of the planet and it is made up of different layers.



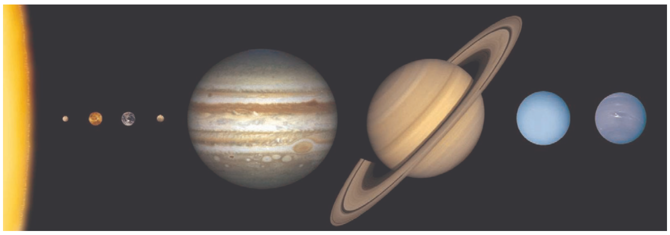
The core of each of the four inner rocky planets of our solar system.

QUESTIONS

1. Give the names of the four inner, rocky planets by looking at the picture on page 232.
2. Name the three layers of the rocky planets. Hint: They are each given a different colour in the picture.

The four outer planets are gas giants.

These planets are very far from the sun. They don't have a hard surface that a spacecraft can land on. Instead, they are giant balls of very cold gases. Astronomers think that these planets have hot, solid cores, deep down inside them.

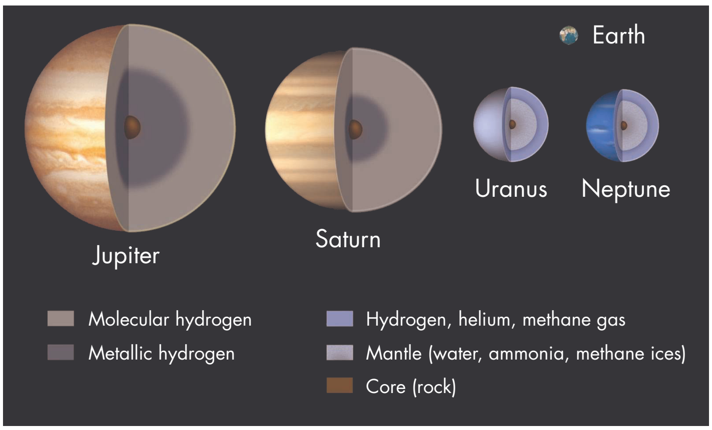


This diagram shows the different sizes of the planets. Can you see how much bigger the four outer gas giants are?

Visit

Introduction to the planets (video).
goo.gl/gcQ7w

This next image also shows us what the inside of the gas giants is like. There are also different layers of gases.



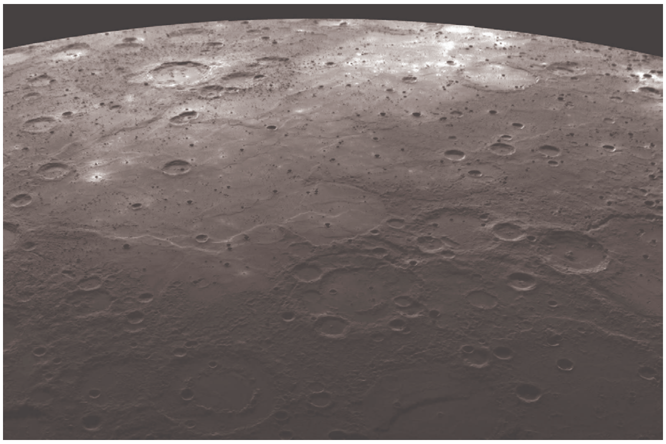
The four gas giants, showing the gases which make up these planets.

QUESTIONS

1. Give the names of the four outer, gas planets by looking at the picture on page 233.
2. Give the name of one of the gases that make up the gas planets.

Let's now take a closer look at each of the planets.

Mercury is closest to the sun, and the smallest planet. It has no atmosphere and its grey surface is marked with thousands of craters. A crater is the mark that we see where a rock has crashed onto a planet or a moon.



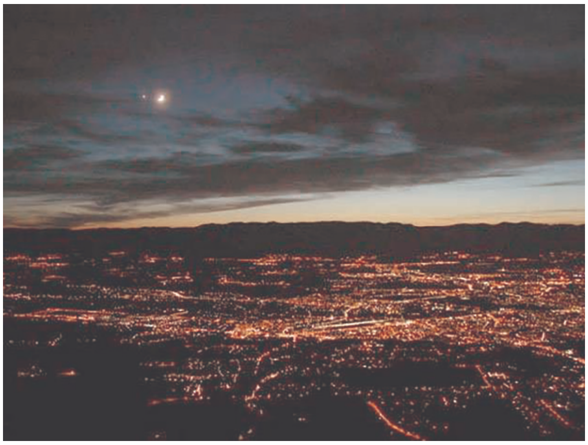
The surface of Mercury. Can you see all the craters?

Did you know?
Venus alternates every 584 days between being an 'evening star' and a 'morning star'. In other words, shining brightest just after sunset, or just before sunrise.

Venus is second closest to the sun. It is almost the same size as Earth. To us, it looks white and it shines brightly in the evening or morning.

Venus shines brightly like that because it is covered in a thick cloud of gas. It would be horrible to breathe the atmosphere on Venus, because the gas is mostly carbon dioxide and sulphuric acid!

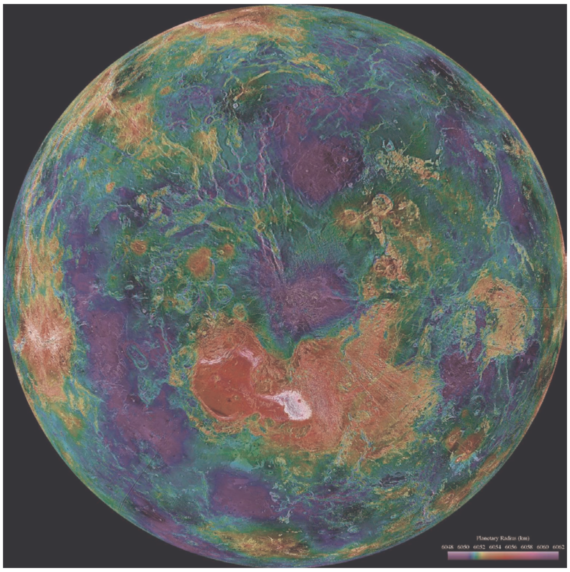
The atmosphere absorbs lots of heat from the sun and does not cool down at night. Venus is the hottest planet in our solar system.



Venus rising next to the moon.

Visit

Video on Venus.
goo.gl/1V0m7



This beautiful image of Venus was created from a whole lot of photographs taken by NASA over ten years, put together to make a single image.

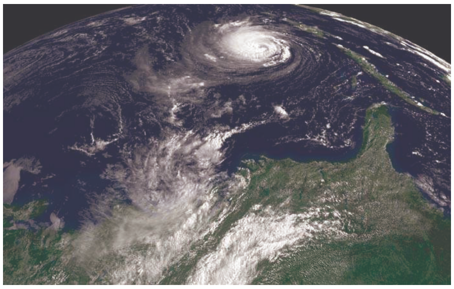
Did you know?

The temperature is about 450 °C on the surface of Venus!

QUESTIONS

1. At what temperature does water boil?
2. Zinc melts at about 420 °C, so what would zinc look like on the surface of Venus?

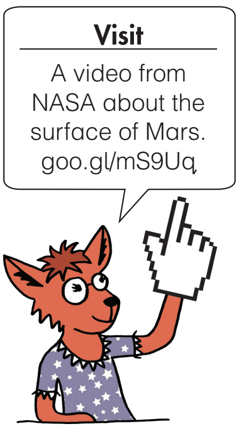
Then we reach **Earth** – the blue planet, and our home in space. You know a lot about Earth already. Earth has its moon that we know well. The moon moves in its orbit around the Earth.

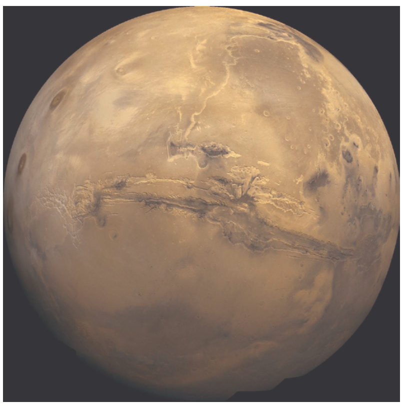


A satellite tracking a hurricane moving over Earth's surface. Can you see the hurricane? It appears as the white swirl of cloud on the photo.

Next furthest out is **Mars**, the red planet. Many spacecraft have been sent to Mars to take photographs and some spacecraft landed to take samples of the soil. So we know quite a lot about Mars.

Mars needs almost two Earth years to complete one orbit around the sun, so if you lived on Mars you would have to wait a very long time for your birthday. Mars spins like the Earth, and a day on Mars is almost the same length as a day on Earth. A day on Mars is called a sol.



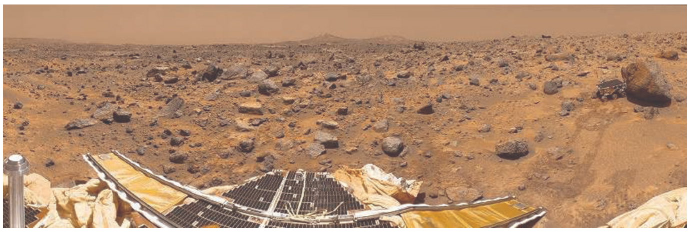


Can you see the long, darker mark across the surface of Mars? This is a deep valley.

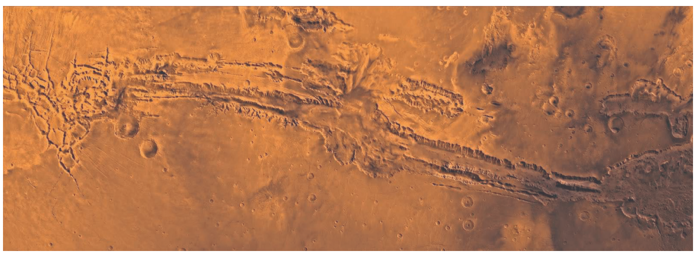
This planet is further from the sun than Earth, and for this reason it is very cold. It has a thin atmosphere but this atmosphere is mostly carbon dioxide gas. Humans cannot breathe that atmosphere.

The surface is mostly sand and rocks. The sand is full of iron oxide, which is the same substance as red-orange rust. From Earth we see Mars as a small red-orange dot in the sky, because of the colour of the soil.

There are some very big valleys on Mars. Valleys are caused by erosion when water flows downhill, so we can guess that there was a lot of water on the planet long ago. If there was water, perhaps there were living things on Mars too. But we cannot be sure. Scientists have sent another spacecraft to look carefully at the rocks and sand. The spacecraft is called Curiosity and it will try to find signs of living things in the ground.



This is a very recent photograph of the surface of Mars, taken in 2012 by the rover called Curiosity. Can you see all the rocks?



This is a closer view of the valley you saw on the surface of Mars. On Earth, valleys like this are caused by water. Did Mars have water long ago?

QUESTIONS

Mars is smaller than Earth and if you went there, your weight would be only a third of your weight on Earth.

1. If your mass is 40 kg on Earth, you weigh 400 Newtons (N). If you went to Mars, what would you weigh?
2. Would you feel heavier or lighter on Mars?

Did you know?

But before we can get to Jupiter, we have to pass safely through the asteroid belt. You can read about the asteroid belt further on.

Now we have to go very far from the sun, five times further than Earth from the sun. We begin to see the gas giants, which are the four outer planets. These gas giants have no solid surface we could land on. They are huge balls of gas and if we came close we would fly through clouds of cold gases.

Jupiter is the first gas giant we come to, and it is the biggest of all the planets. From Earth we see it shining white but close up, its colour is light pink-brown. It is bigger than all the other planets put together.

Jupiter is a huge ball of gases, such as hydrogen, with clouds of ammonia. Winds blow from east to west on Jupiter's surface, and they blow at the speed of jet planes. The surface is very cold, and some of the gases are so cold that they have become liquid or solid.

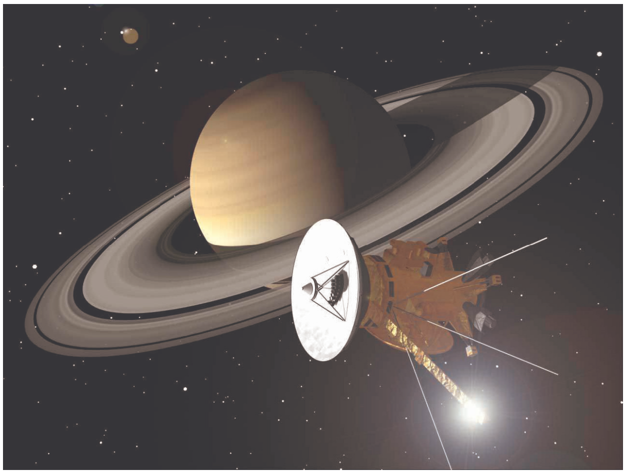
Deep inside, Jupiter may have a very hot core of rock. Jupiter has four big moons, and sixty smaller ones.

Jupiter, showing the swirling light pink and brown colours on the surface.

Visit

A video on Jupiter.
goo.gl/T0rhi

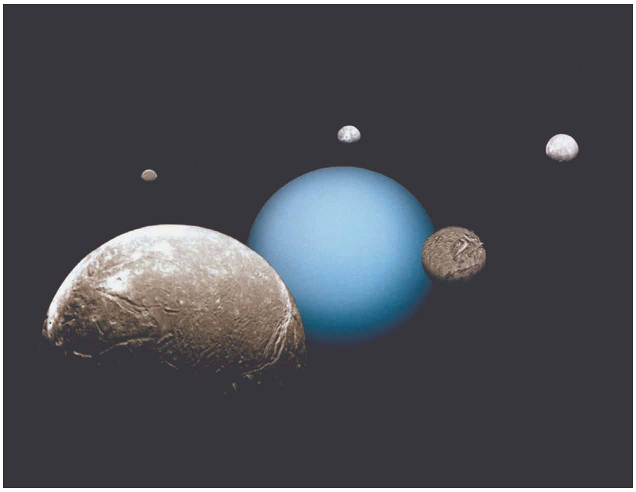
If we now go even further into space, to double the distance we went to reach Jupiter, we reach the planet **Saturn**. Saturn is almost as big as Jupiter but it has a light yellow colour. It is mostly gas and it has rings of rock spread out and spinning around it. Saturn has about 62 moons.



This image is an artist's drawing of the Cassini spacecraft approaching the planet Saturn and its magnetic rings.

Did you know?
You will read about Galileo in Chapter 20. He was the first person to see the moons of Jupiter.

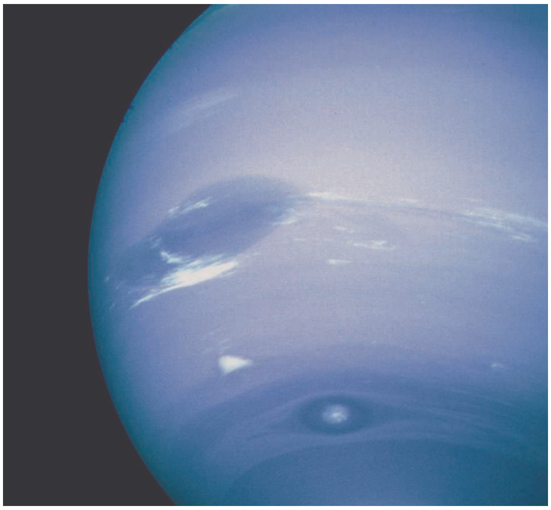
Then we get **Uranus**, a smooth blue-green ball of gas, with almost no marks and shapes on it that we can see. It has more than 25 moons.



The blue globe of Uranus shown here with five of its major moons.

Did you know?
Saturn isn't the only planet with rings. The other gas giants, Jupiter, Uranus and Neptune also have rings – they are just less obvious.

Now we are more than 30 times further from the sun than Earth is, and we see the last planet, **Neptune**. Neptune is also a ball of gas and looks like Uranus. It has about 12 moons, and possibly more. Neptune has a very 'stormy' surface. Images of the planet often show huge storms and winds.



A close-up of the surface of Neptune. Can you see the stormy surface? These are the darker blue and white spots.

ACTIVITY 16.5: Comprehension on the eight planets of our solar system

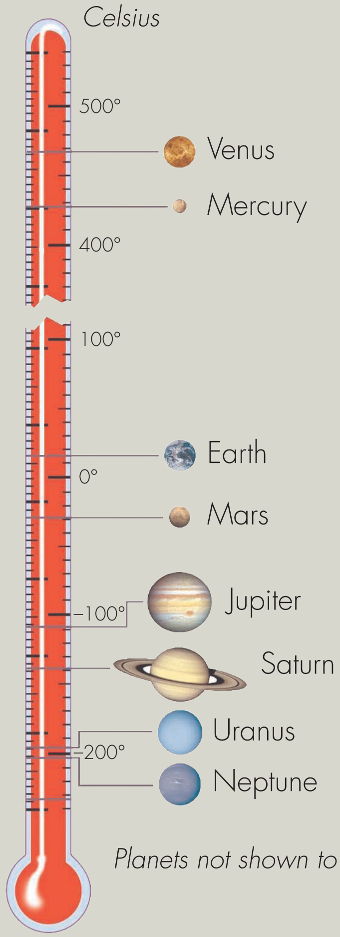
INSTRUCTIONS:

1. We have read a lot about the planets in our solar system.
2. Use all the information and images in the previous pages to answer the following quesons.

QUESTIONS:

1. Name all the planets in order starting from the one closest to the sun.
2. What are the four inner planets known as?
3. What are the four outer planets known as?
4. Which planet is the hottest?
5. On which planet do scientists think there might have been water long ago? Why?
6. Which planet has a 'stormy' surface?
7. Venus also has an atmosphere like Earth, but we would not be able to breathe there. What gases make up the atmosphere on Venus?

8. Below is a picture of a thermometer showing the temperatures of the planets. Mercury is the closest to the sun, but Venus is actually hotter than Mercury. This is because of the dense atmosphere of Venus, which acts like a greenhouse and traps the sun's energy in the atmosphere. Use the picture to give the temperatures of Earth, Jupiter and Neptune.



9. Which is the biggest planet in our solar system? What colour is it?
10. Which planet is blue-green in colour?
11. Saturn has rings around it. What are these rings made of?
12. Draw a picture of Saturn in your exercise books.

Asteroids

What a strange word – asteroid! Have you heard this word before? Maybe when we mentioned the asteroid belt?

Let's find out what they are!

The asteroids are lumps of rock from planets that broke up long ago. Some of the lumps are bigger than a school building and some are only as big as small stones. They orbit around the sun and so they are travelling very fast. Some of them are travelling as fast as 25 kilometres every second. That is much faster than a bullet!

Did you know?

Many scientists believe that an asteroid hit Earth and caused the extinction of the dinosaurs around 65 million years ago.

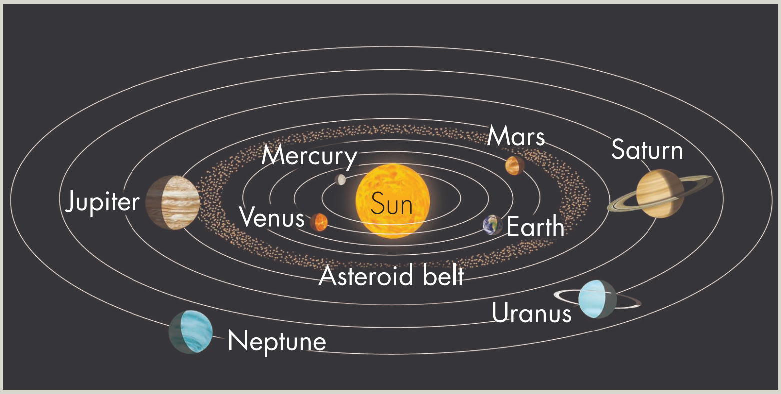
This is a photo of the asteroids Ida and Gaspra. Ida is the bigger one and is 30 km long.

The asteroids have gathered together in a ring in the solar system. This ring is called the **asteroid belt**.

ACTIVITY 16.6: Where is the asteroid belt?

INSTRUCTIONS:

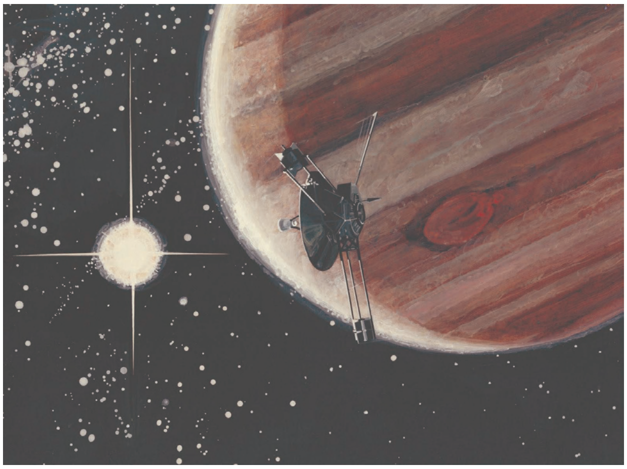
1. Find the asteroid belt in the picture below.
2. In your exercise books write out the whole sentence below and complete it.
3. Use some of the words from the wordbox.



• Mars	• pieces of rock
• Jupiter	• in orbit
• Venus	• the sun

Asteroids are __________ that move __________ around the sun. The asteroid belt is in space between the orbit of __________ and the orbit of __________.

In 1973, Pioneer 10 was the first spacecraft to travel to Jupiter. To get there, Pioneer 10 had to go through the asteroid belt. Do you remember how fast asteroids are moving? If an asteroid had hit Pioneer 10, the spacecraft would have been destroyed and smashed to pieces. However, space is a very big place and the asteroids are usually far apart. Pioneer 10 got through safely and went on to take the first close-up photos of Jupiter.



An artist's painting of the Pioneer 10 spacecraft near Jupiter, after it was the first to cross the asteroid belt.

16.2 Moons

You know from the section on planets that other planets have moons.

Earth's moon

Let's begin with Earth's moon. You learned about Earth's moon in Grade 4. So what do we already know about Earth's moon?

ACTIVITY 16.7: Revising what we know about the moon

QUESTIONS:

1. Does the moon make its own light? Explain how the moon gives us light at night.
2. Can we see the moon during the day?
3. Does the full moon look bigger when it rises at supper-time, and then smaller when it is high in the sky?
4. Why does the moon sometimes look like the letter D or the letter C?
5. Is it easier to see the stars when the moon is full or when it is not full?

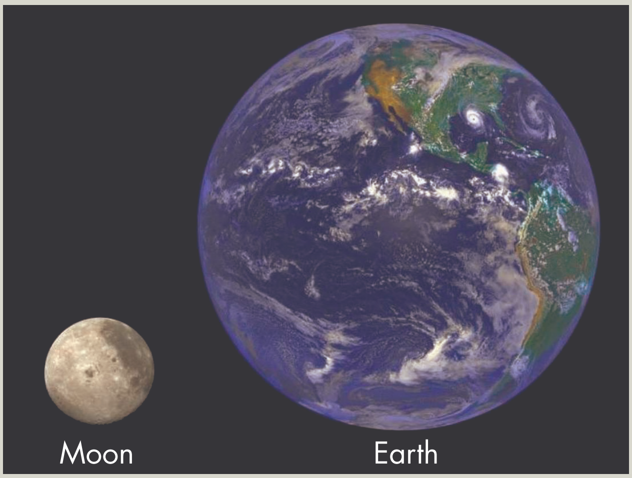
6. Why do we sometimes see the new moon looking like this, in the next photo? The sun is almost behind the moon, so where is the light coming from?

Only one side of the moon in this photo has light on it. Where is this light coming from?

ACTIVITY 16.8: Comparing the moon with the Earth

INSTRUCTIONS:

1. Work with a partner or in a small group.
2. Look carefully at the picture and answer the questions.



The moon and the Earth showing the difference in size.

QUESTIONS:

1. List all the differences you can see between the Earth and moon.
2. List some differences that you know about, even though you can't see them in the picture.

Many people say that the full moon looks bigger when it rises just after sunset, and then looks smaller late at night. Is this true? Let's do an investigation to find out.

INVESTIGATION 16.1: Does the moon look bigger when it rises than when it is high in the sky?

AIM: What do you want to find out?

HYPOTHESIS: What do you think will happen?

APPARATUS:

- Date when the moon will be full
- Piece of wire shaped like a V (You can make this from a paper clip.)
- Ruler

METHOD:

1. Just after sunset on the right date, look for the rising moon.
2. When you see it coming up behind some trees or buildings, hold out your width-measure as you see in the picture below.

Hold your width-measure at arm's length.

3. Bend the wires until the points (the tips) of the wire touch the sides of the moon. *You must keep your arm straight while you measure the moon.* Can you think of the reason why?
4. Go inside and use a ruler to measure how far apart the tips of the width-measure are.
5. Record your measurement in millimetres.
6. Go outside again about two hours later and measure the width of the moon a second time. Remember to keep your arm straight while you measure.
7. Come inside and use the ruler again. Measure the distance between the tips on your ruler again.
8. Record your measurement in millimetres.

RESULTS AND OBSERVATIONS:

Width of the moon when it was touching the trees: ___ mm.
Width of the moon when it was high in the sky: ___ mm.

How could you have done this investigation better?

CONCLUSION:

Write down a conclusion about what you learnt from this investigation.

The moon has a pale grey surface with dark grey marks on it. Nobody knew what the surface was like until a spacecraft landed on the moon. The first astronauts to walk on the moon stepped into fine, powdery dust. They collected rock samples (small pieces) to bring back to Earth.

The footprint of the first person to ever stand on the moon.

The surface of the moon. Can you see all the craters?

Did you know?
The footprints from the astronauts who first walked on the moon are still there! There is no wind on the moon to blow them away.

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Did you know?

A spacecraft a few years ago found signs of water frozen under the south pole of the moon. Scientists are not sure how the water got there.

The surface of the moon is covered with holes called craters. These craters are made by space rocks that hit the moon. These rocks may be as small as grains of sand or as big as a house. They travel so fast that they explode when they hit the moon, and they make a round hole.

The light-coloured areas on the moon are mountains, and the darker areas are plains. Some of these plains were made by huge space rocks that made craters 300 km wide. Other plains were made by volcanoes on the moon a long time ago. Lava flowed out from those volcanoes. Nowadays the moon has no volcanoes.

The moon has no air so there is no wind to blow the dust. The moon has no water, so there is no rain to wash away sand and cause erosion. That is the reason why we see the craters on the moon so clearly.

Moons of other planets

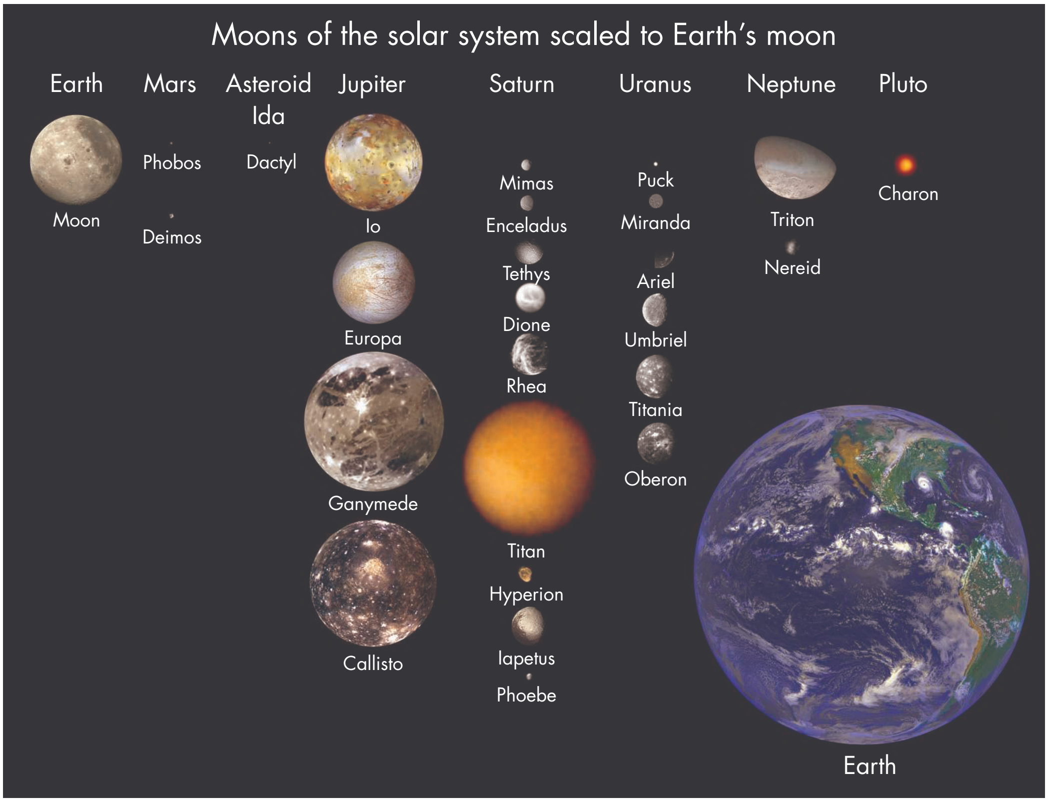
Other planets have moons, too. On the following page is an image showing some of the moons in our solar system. Not all of them are shown here. They have been scaled to be the correct size compared to Earth and our moon.

Visit

Quick tour of planets and their moons.
goo.gl/nSwf8

Mars has two moons, and astronomers called them Deimos and Phobos. Phobos has deep craters showing that it has also been hit by fast-moving rocks. Can you see how small these moons are compared to our moon?

On the other hand, Jupiter has 66 moons, which we have identified. Each time humans send another space probe to Jupiter, more moons are being discovered! Only Jupiter's four biggest moons are shown in the image on the next page. This image is only for enrichment.



Some of the moons in our solar system.

ACTIVITY 16.9: Moons in our solar system

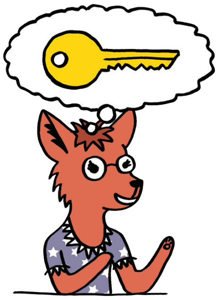
INSTRUCTIONS:

1. Look at the picture above of the moons in our solar system.
2. Answer the questions below.

QUESTIONS:

1. How many moons does Earth have?
2. What are the names of Mars' two moons.
3. Give the name of one of Jupiter's moons.
4. Pluto is not actually a planet anymore, but it has been classified as a dwarf planet. Pluto also has three moons. How many of Pluto's moons are shown in the picture?

5. There are two planets that are not listed here, as they do not have any moons. Which two planets are these?
6. What is the name of Saturn's biggest moon?



KEY CONCEPTS

- The sun is at the centre of our solar system.
- Planets move in orbits around the sun.
- Planets cannot produce their own light; they reflect light from the sun.
- Asteroids are rocks that move in orbit around the sun. They are very much smaller than planets.
- Most of the planets have moons. A moon is a body that orbits around a planet.

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REVISION

1. Copy and complete the table below in your exercise books according to the instructions below. The table is a comparison of planets and stars. Choose sentences from the list below and write them under the heading 'Planets'. Match your sentences about planets to the sentences about stars.

Stars	Planets
Stars are very hot balls of gas that give out light and heat.	
We can see thousands of millions of stars with a telescope.	
Stars are very, very far away from us.	
Stars do not orbit around our sun.	
The stars seem to stay the same distance apart always.	

Sentences to select from:

- Planets do not make their own light, they reflect the light from the sun.
- We can see only seven other planets in our solar system.
- Planets change their positions each night, compared to the positions of the stars.
- Planets are not as far away as stars.
- Planets orbit around our sun.

2. If you wanted to find Venus, where would you look? At what time would you look?
3. People call Venus the evening or morning star. Explain why Venus is not a star.

4. Here are two sentences about the solar system. The two sentences have been broken and the parts are mixed up. Work with a partner to sort out the parts. Then write out both sentences in your exercise books:
   - The solar system is
   - the sun.
   - The sun and all the planets
   - a set of parts that
   - pull on each other.
   - the planets move around
   - pull on each other as

5. What made the craters on the surface of the moon?
6. The surface of the moon has many craters but the surface of the Earth has very few craters. Explain why that is so.
7. Neil Armstrong was the first man to put his foot on the moon. His footprint is still there after 40 years. On Earth, a footprint does not last so long. Explain why it lasts so long on the moon.
8. The Earth is travelling through space at 100 000 km per hour. How can we work that out? Here is information for you to use: The length of the Earth's path around the sun is 942 million km and it takes 365.25 days to go all the way around. Now you can work it out for yourself.

   Hint to help you: How many hours are there in one day?

It is amazing to think that our planet is just one of eight in our solar system, and our solar system is one of millions in our galaxy!

Let's now find out about the movements of our planet in our solar system.

17 Movement of the Earth and planets

KEY QUESTIONS

- If it is nighttime in South Africa, is it also nighttime in Brazil?
- Do the other planets also take a year to revolve once around the sun? Is their year the same length as our year on Earth?
- Why do we get daytime and nighttime?
- What is the difference between revolution and rotation?

17.1 Rotation of the Earth

For a long time people believed that the Earth stood still and the sun moved around the Earth. In this chapter we will find out what really happens. We'll start by thinking about day and night.

New words
- direction
- rotate
- rotation
- axis of rotation

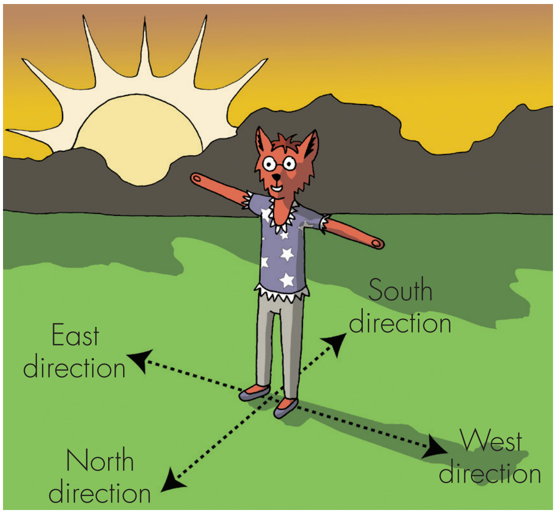
Day and night

During the day, it appears as though the sun moves across the sky as it rises (comes up) in the morning and sets (goes down) in the evening.

East and west are two directions you must know. If you point at the sun when it appears to rise in the morning, you are pointing in the direction of east. If you point at the place where the sun sets, you are pointing in the direction of west. Have a look at the picture of Felicity on page 254. It is sunrise in the morning and she is standing with her arms out pointing in the direction of east and west.

Visit

Short video showing the sun, Earth and moon system.
goo.gl/hb4nS



You can tell direction from the rising and setting of the sun.

ACTIVITY 17.1: Finding east and west

MATERIALS:

A place where you can stand in the early morning.

INSTRUCTIONS:

Look at Felicity in the picture and answer the questions.

QUESTIONS:

1. Which is Felicity's right hand? Show her right hand with your finger.
2. Why do we see a shadow of Felicity on the ground?
3. In which direction is her shadow pointing?
4. If Felicity looks straight in front of her, in which direction is she looking?
5. Now find the direction of east in your classroom. You must point to the place where you see the sun come up in the morning. In the classroom, stretch out your arms and point in the direction of east and west. Clear the floor and stick some insulating tape on the floor so that everyone can remember which direction is east and which direction is west.

What does the word 'direction' mean? You can walk in a direction towards a place. If the wind blows, you see leaves moving in the same direction as the wind. Remember, a direction is not a place that you can reach!

QUESTIONS

Let's have a discussion. To discuss something is to talk about it and your ideas with someone else or a group of people. Turn to your classmate next to you and discuss the following question. Write your answer down, then write your partner's answer down.

Where does the sun go at night? Why do we get day and night?

Your answer is:

My partner's answer is:

In this next section we will find out these answers!

Does the sun really move, or does the Earth move?

When you ride in a bus, you may see houses outside the bus. It looks as if the houses move past your window.

To Felicity, who is riding in a bus, it looks like the houses are moving past.

QUESTIONS

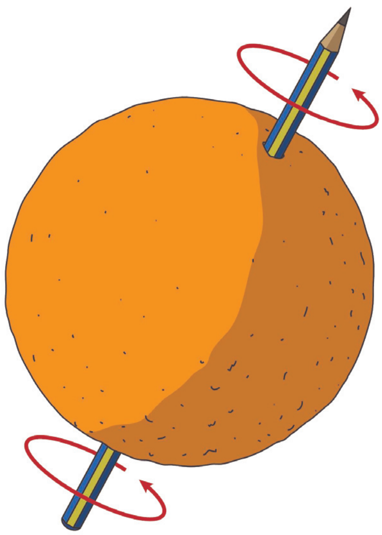
Why do the houses seem to move past your window?
Are the houses really moving? Discuss these questions.

So it is really the person in the bus who is moving. It looks to the person as though the houses are moving but they are not moving.

You saw how big the sun is when we compare the Earth and the sun. Go back to the beginning of this term's work to find the picture of the sun and the Earth (page 227). That great big sun does not move around the Earth.

The Earth is spinning around and that is why we see the sun move past us. We are like Felicity in the bus. She is in the bus and she is moving past the houses. The sun is like the houses; they are not moving. It looks to us as though the sun is moving, but it's really the Earth that is spinning around.

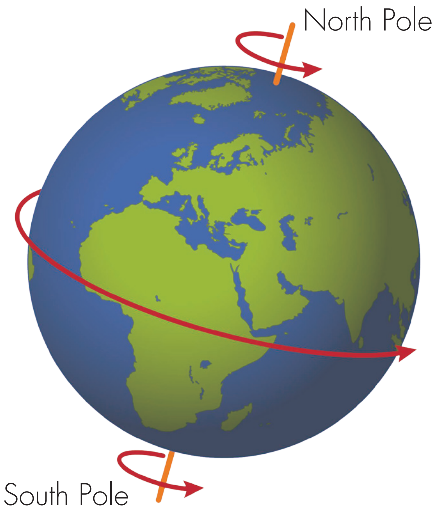
You can think of the Earth as an orange with a pencil through it.



The Earth spins like an orange on a pencil.

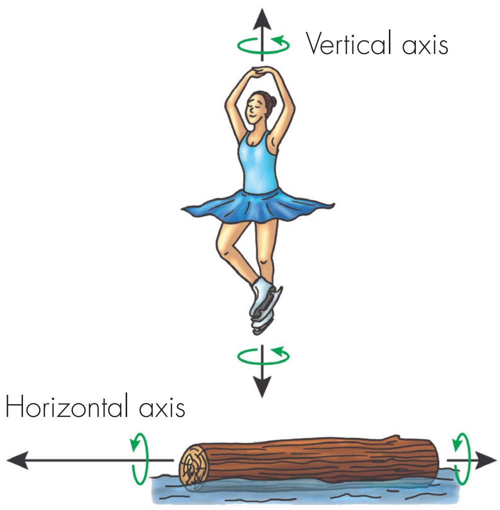
If you twist the pencil, the whole orange spins around. This is like the Earth spinning around. The pencil is called the axis of the orange. In the same way, we can think of an axis that goes through the Earth. The axis is a line that we can imagine, it is not a real thing. Earth spins around that axis. We say the Earth rotates (spins).

We say that the Earth has an axis that it rotates on. This axis runs from the North Pole to the South Pole as you can see in the picture below.



Other objects also have axes of rotation. For example, an ice skater has a vertical axis that she rotates on when spinning on a spot during her performance.

A log which is floating in water can also roll around. It will have a horizontal axis of rotation.



Different axes of rotation

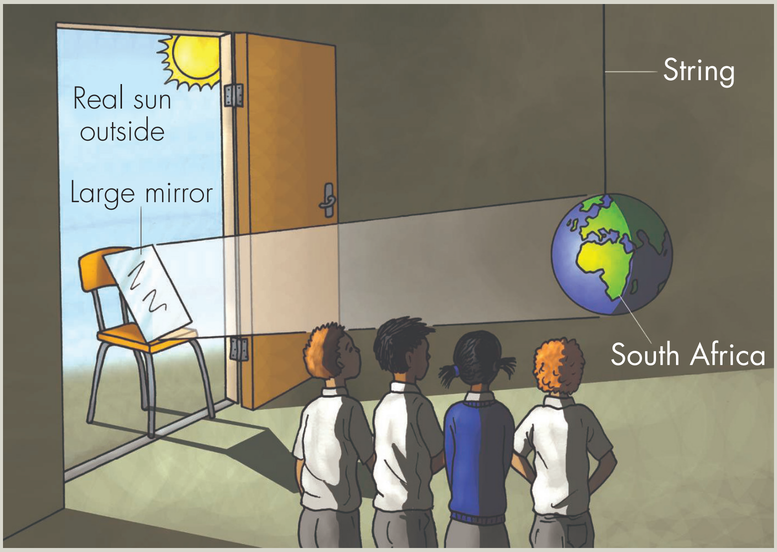
ACTIVITY 17.2: Making a model of the Earth in daytime and night time

MATERIALS:

- Globe of the Earth (or a balloon with the shapes of the continents drawn on it)
- String to hang a globe or balloon
- Large mirror

INSTRUCTIONS:

1. This picture shows you how to set up the equipment.
2. Set up a mirror outside the room so that it reflects bright sunlight onto the Earth globe. Your globe must be able to spin around.

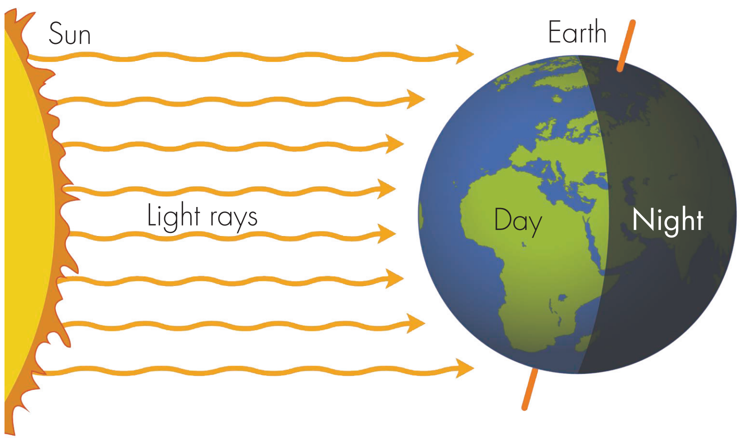


Everyone must look at the globe from the same side. A globe is a model of the Earth.

3. Everyone must look at the globe from the same side.
4. Find Africa on the globe. Turn the globe so that the sun's light falls on South Africa.
5. One side of the globe is in shadow. Find the shadow in the picture.
6. Find where Durban and Cape Town are on the globe.
7. Look at the globe in the picture. If you were in Durban, would it be daytime or night time?

8. If you were in Cape Town, would it be daytime or night time?
9. Now turn the globe so that Africa moves to the right. That is, you turn the globe towards the east. You will see Durban becoming dark and moving into the shadow. When Durban is in night time, Cape Town will still be in sunlight.
10. Keep on turning the globe towards the east. Now Cape Town will go into the shadow. That is night time for the people in Cape Town
11. Which city will come back into daytime first, Cape Town or Durban?
12. Keep on turning the globe to the east, and Durban will come back into daytime. You have to move to the other side of the model to see Durban move into sunlight.
13. How many hours pass for the Earth to turn around once?

We see the sun appears to rise and move across the sky every day. But the sun does not really move; it only seems to move! Earth is spinning round and round, and we are moving around with the Earth. The Earth takes 24 hours to complete one full rotation.



Can you see how the light from the sun only reaches one half of the Earth as it rotates?

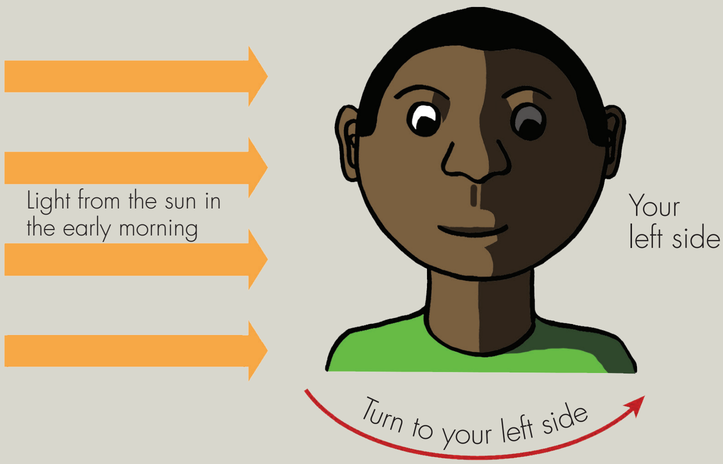
ACTIVITY 17.3: Your head can be a model of the Earth

MATERIALS:

- Yourself
- Sunlight coming from one side

INSTRUCTIONS:

1. This model will help you to understand why we see the sun move across the sky. Do this in the early morning when the sun is still low.
2. We will say that your nose is Africa. You are on Africa. Look at the picture below.



Using your head as a model of the Earth.

3. Now stand so that bright light from the sun shines across your right cheek.
4. Turn slowly to your left. Turn your eyes towards the bright place where the sun is. You will see the sun move to your right while you move to the left.
5. Move your feet and turn further; you will see the sun 'go down' over your right cheek.
6. When you have turned your back to the sun, you cannot see the bright light any more. That is like night time in Africa.
7. Turn further to your left and you will see the sun 'rise' over your left cheek. That is like sunrise in Africa.

17.2 Revolution of the Earth

New words
- revolve
- revolution

By now you know that all the planets revolve (travel) around the sun. Each planet has its own pathway. This is called its orbit. We can also say planets orbit the sun. Earth also moves in its own orbit around the sun. This movement is called the revolution of the Earth around the sun. We can also say that the Earth orbits around the sun.

We have now come across two new words: rotation and revolution. Remember, these are not the same thing! Let's do an activity using our own bodies to understand the difference between revolution and rotation.

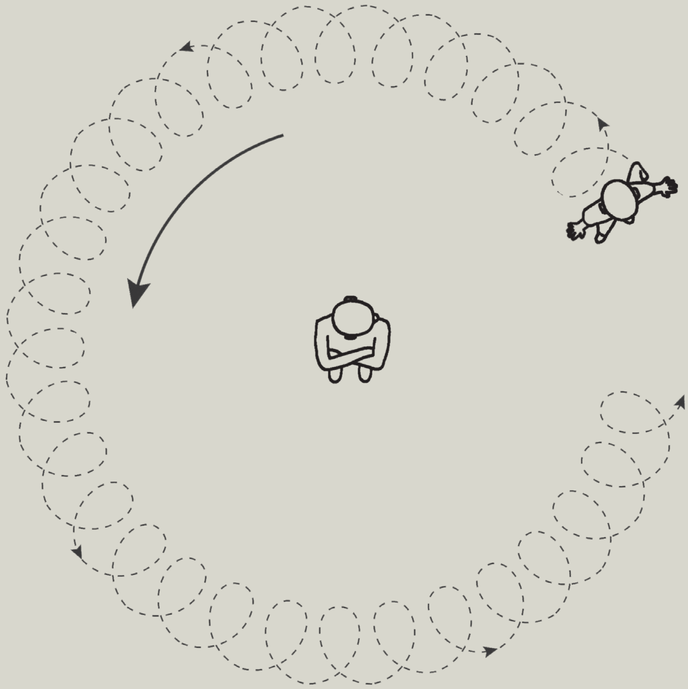
ACTIVITY 17.4: Making a model of the Earth revolving around the sun

MATERIALS:

Room to move around

INSTRUCTIONS:

1. We are going to use our bodies to understand the difference between revolving and rotating.
2. First, the whole class must spread out and stand on a spot. Now spin around with your arms out, staying on one spot. This is called rotation! The Earth rotates like this on its axis.
3. Now get into pairs. One learner must stand in one spot and the other learner must walk in a circle around the other person. This is revolution. The second learner is revolving around the learner standing still in the middle. The Earth revolves like this around the sun.
4. Now, let's put both movements together! As the Earth rotates on its axis, it also revolves around the sun. This might be tricky! Spin around (rotate) while also moving in a big circle around your partner (revolve). Look at the picture on page 262.



The learner is rotating (spinning) and revolving around his partner.

Did you know?

Every four years we have a leap year, which is when there is one extra day in the year. This is because the Earth actually takes 365.25 days to revolve around the sun, and not just 365 days. So every four years, we have an extra day to account for these quarter days.

QUESTIONS:

1. In this model, who represents the sun and who represents the Earth?
2. When you are spinning and walking in a circle around your partner, sometimes you face your partner and sometimes your back is to your partner. Which of these represents day for you and which represents night for you?
3. You could spin around very quickly. How many hours pass in reality for the Earth to rotate once?
4. You could move around your partner quite quickly. On the real Earth, how long does it take to go once around the sun?

KEY CONCEPTS

- Wherever we are, we can find the east – west direction by where the Sun rises and sets.
- The Earth spins on its axis once in 24 hours. This spinning is called rotation.
- The part of the Earth that faces the sun experiences daylight, and the part that is turned away from the sun experiences night.
- The Earth travels in its orbit right around the sun. This travel in orbit is called revolution.
- A complete travelling of the earth around the sun makes a year.

NatSci&Tech_Gr6_Book.indb 263 2018/05/02 3:59:17 PM

REVISION

1. How can you find east?
2. How can you find north?
3. Why does it look as though the sun moves across the sky when we know that the sun does not move?
4. Where is the sun, when it is night time where we are?
5. When we are having night, is everybody in the world also having night?
6. The Earth spins on its own axis. What term refers to this?
7. The Earth and the other planets travel in an orbit around the sun. What term refers to this?
8. How many hours does it take the Earth to rotate once?
9. How many days does it take the Earth to revolve once around the sun?
10. Do you think Mars would take more Earth days to revolve around the sun than Earth does? Why?
11. **Bonus question:** Why do you think we have a leap year every four years and not every three or five years?

We have now seen how our planet Earth moves, but what about our moon? Does it also rotate and revolve? Let's find out!

18 The movement of the moon

KEY QUESTIONS

- Does the moon move around the Earth?
- Has anyone ever seen the far side of the moon?
- What is a solar eclipse?

18.1 Rotation of the moon

On Earth we see only one side of the moon. Nobody knew what the far side of the moon looked like until the Soviet Luna spacecraft went into orbit around the moon in 1959 and photographed the far side. The force of gravity between the Earth and moon holds the moon's near side facing us.

The far side of the moon that we never see. This photo was taken by a spacecraft orbiting the moon.

Visit

Video showing the movement of the moon.
goo.gl/B9Jq8

ACTIVITY 18.1: So does the moon rotate?

MATERIALS:

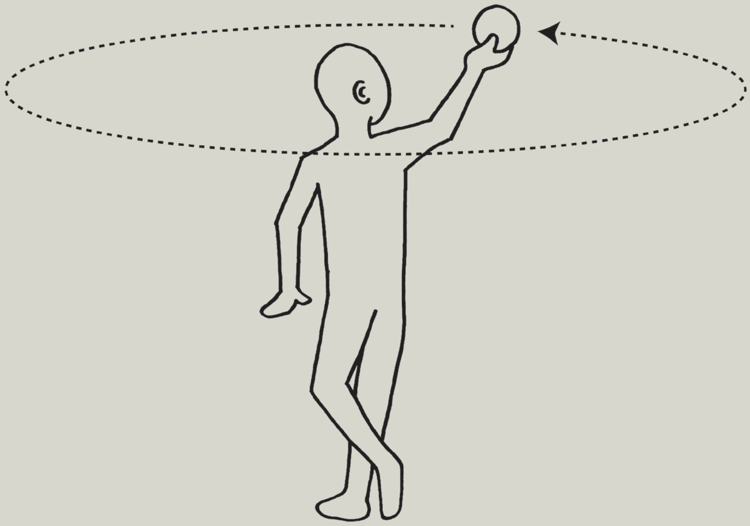
- A white ball with a red mark on it
- Learner to swing the ball around (see the picture)
- Learner to observe the ball as it swings around

INSTRUCTIONS:

1. Do as the learner in the picture is doing. Stretch out your arm and make the white ball revolve around your body by holding out your arm and moving around on a spot.

NatSci&Tech_Gr6_Book.indb 265 2018/05/02 3:59:17 PM

2. As you are moving the ball around yourself, you only ever see one side of the ball. Do you agree?
3. Your partner must stand on one side of you as you swing the ball around. What does this person see? They will see different sides of the ball.
4. Take it in turns to be the one moving the ball around as you rotate and the one observing.



The learner represents the Earth and the white ball represents the moon.

Visit

Do we always see the same side of the moon? (video)
goo.gl/cdoJJ

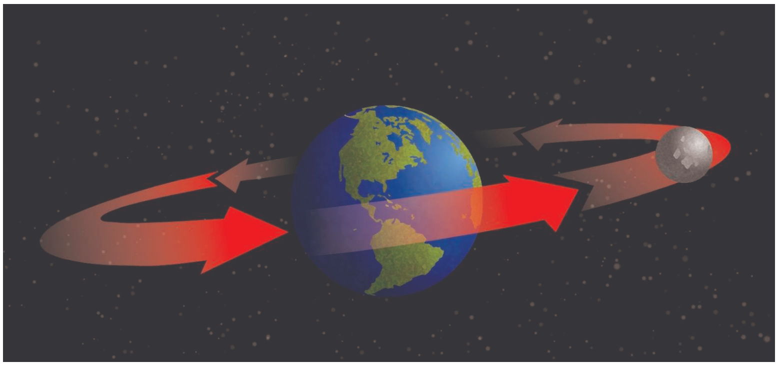
The learner swinging the ball always sees the same side of the ball, but a person standing watching the ball will say that it rotates. The red mark on the ball will point to the *side* of the room, then to the *back* of the room, then to the *other side*, and then to the *front* of the room.

So the person watching will say that the ball has rotated, and also revolved.

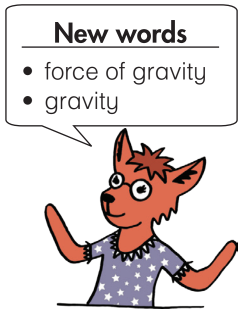
Our moon takes about 28 days to rotate once.

18.2 Revolution of the moon

The moon also revolves in orbit around the Earth, as you saw in the last activity. The moon takes about 28 days to complete one orbit. The force of gravity between the Earth and the moon holds the moon so that it always faces us on Earth.



The moon revolves around the Earth.



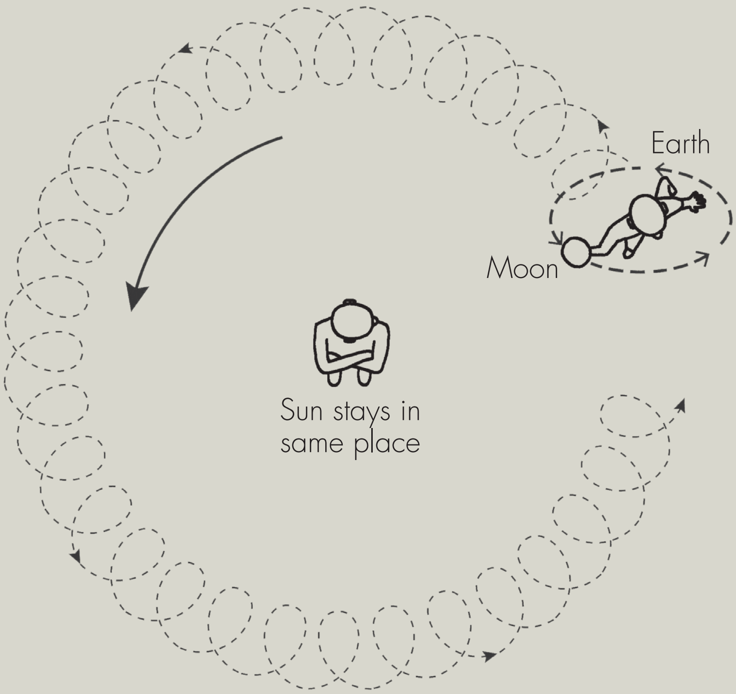
ACTIVITY 18.2: Make a model of the Earth and moon revolving around the sun

MATERIALS:

- White ball
- Two people who have practised the model in the previous activity

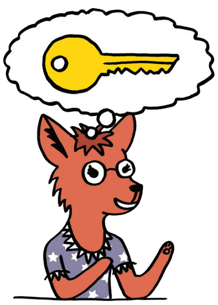
INSTRUCTIONS:

1. Work with the same partner. You must use your bodies and the white ball to act out this model of the Earth and moon revolving around the sun.
2. You must put together the movement of the moon around the Earth from the last activity and the movement of the Earth with its moon, around the sun.
3. Then perform the movements for the class.
4. So the model you must perform will be like the following picture shows.



Acting out the moon and Earth moving around the sun.

So in reality the moon will be rotating on its own axis at the same time that it revolves around the earth. The moon orbits the Earth once every 27.322 days. It also takes 27.322 days for the moon to rotate on its own axis. As a result the moon does not seem to be spinning but looks like its keeping almost perfectly still from Earth.



KEY CONCEPTS

- The moon revolves in an orbit around the Earth in 27.322 days.
- The moon rotates on an axis which also takes about 28 days. It rotates on its axis at the same speed as its revolution around the Earth.
- We always see only one side of the moon.
- Together, the Earth and moon revolve around the sun.

REVISION

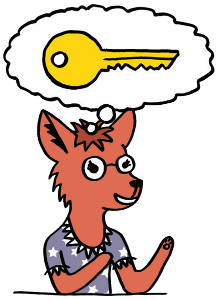
1. Copy and complete the sentences using all the words from the wordbox. Write the sentences below out in full.
   a. The sun stays in ___________
   b. The Earth rotates on its own ___________
   c. The moon revolves ___________
   d. The ___________ revolve together in a big circle around the sun.
   e. We only ever see ___________ of the moon.

- moon and the Earth
- around the Earth
- one side
- axis
- the same place

2. Copy and complete the table comparing the sun, Earth and moon. Some answers having been filled in for you.

Question	Sun	Earth	Moon
What is the object classified as?			A moon
What is the shape?			
What is the size relative to the other objects being discussed here?	The Sun is the biggest		
What is the movement in relation to other objects?		The Earth revolves around the sun	
What is the object made of?			Rock
Can this object produce light?			No, the moon reflects the sun's rays.
Is there water present?			

19 Systems for looking into space



KEY QUESTIONS

- The stars we see at night – are those all the stars there are?
- How do scientists find out what stars are like?
- How come you can't see other planets when looking up at the sky, but we have some beautiful close-up photographs?

19.1 Telescopes

The telescope was first discovered by the Dutch. In Holland, a lot of the people were sailors and sea-explorers so they used their telescopes at sea to see if ships far away on the horizon were friends or maybe pirates.

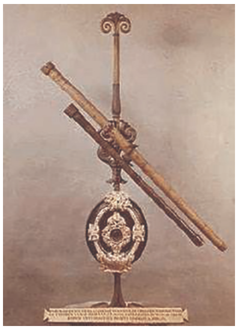
New words

- horizon
- Milky Way
- bright
- magnify
- lenses
- distant
- dishes
- faint
- galaxy
- electromagnetic waves
- square kilometre array
- radio waves

A telescope makes faraway things look bigger and closer.

So a telescope is like a really big magnifying glass!

Galileo Galilei was a professor of Mathematics at the University of Padua, Italy. In 1609 he heard that somebody in Holland had invented a telescope, and he worked out how to make one himself.



Galileo Galilei's telescope looked like this. It could only see a small part of the sky at a time.[1]

Galileo Galilei showing his telescope to a group of scientists.

Did you know?

Galileo got into trouble with the authorities because they did not like what he wrote. They taught that the Earth was the centre of the universe and the sun, moon, stars and planets all revolved around the Earth. Galileo told people that was not true, and so he was put in jail.

Galileo used his telescope to look at the planets in the night sky, and he made careful notes of what he saw there. He was the first person to see that Jupiter had moons. He saw that Saturn has rings and he saw that Venus has phases like the moon has. He also used his telescope to show people that the Milky Way was really made of billions of stars. He wrote books that taught people about telescopes and what they could show us in the night sky.

People can now buy telescopes like this to watch the stars from their own backyards.[2]

Visit

The Hubble Space Telescope story.
goo.gl/vHZAV

Nowadays there are big telescopes in many parts of the world, and these telescopes have cameras to photograph the sky.

Did you know?

The biggest space telescope in the world is the Hubble Telescope, named after Edwin Hubble who first showed there were other galaxies besides our own, the Milky Way.

This photo of the sky was taken through a telescope. Each point of light is a star.

Telescopes have shown us that there are thousands of millions of stars that we could not see with our naked eyes. Some of those stars are so distant that their light has been travelling for millions of years to reach us.

Visit

Real-time views from webcams at SALT. goo.gl/9mYji

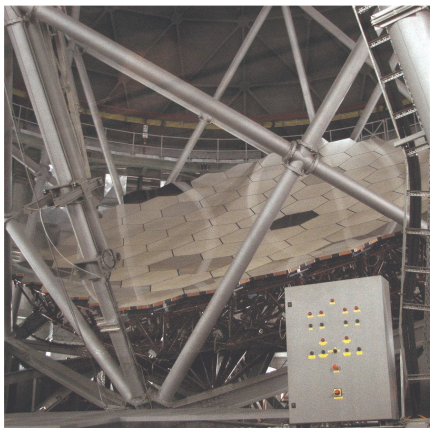
The Southern African Large Telescope

One of the biggest telescopes in the world is here in South Africa, near the town of Sutherland. The telescope is called the Southern African Large Telescope or SALT. The telescope uses lenses and a very big mirror to see the stars and take photographs of them.

Visit

The South African Large Telescope (video). goo.gl/0JgbE

This is SALT. Here the roof is closed, but at night it opens so that the telescope can see the sky.



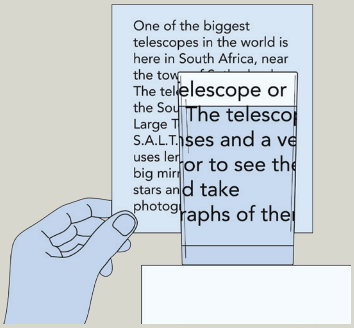
This photo is taken from inside the dome of SALT and shows the large mirror.

ACTIVITY 19.1: How lenses and mirrors make telescopes work

MATERIALS:

- Lens for each group (You can use hand-lenses, or round empty bottles with water in them. Or you can use the glass part of a light bulb, full of water. Your teacher will show you how to remove the inside parts of an old light bulb.)
- Mirror for each group (It can be a small mirror, or you can make a mirror. You can glue the shiny foil from a potato-chip packet onto cardboard.)
- Jar with lid
- Candle
- Chocolate

A lens can make things look bigger.



If you look through a bottle or glass of water, you will see how it makes things look bigger.

INSTRUCTIONS (Part 1):

1. Hold up the lens and look at something on the wall. You can look at a poster, for example.
2. If you are far away from the wall, the poster will seem to be upside down.
3. When you come closer to the wall, the poster will be right way up and bigger. The lens is *magnifying* the poster (to magnify means to make bigger).

QUESTIONS:

1. What do you notice about the shapes of lenses?
2. Why do you think this shape is necessary for the lens?

INSTRUCTIONS (Part 2):

1. Now the class must go outside into the sunshine. Take the lens and your mirror with you. This will work best on a hot, clear day.
2. Your teacher can point out a place on the wall that is in the shade.
3. Use your mirrors to reflect sunlight onto that spot.
4. The class can spread out; it does not matter where you stand. Just make sure you move your mirror so that it helps to light up the spot your teacher showed you.
5. If everyone reflects sunlight onto that one spot, it will become very bright there.

Light from all the mirrors goes to one shady spot on the wall.

QUESTIONS:

1. How could you make the spot brighter?
2. Will the spot feel hot? Make a prediction. (To predict means you say what you think is going to happen.)
3. How will you find out whether your prediction was correct?

4. The sun does not only give us light. It also gives us heat. You know that if you stand facing the sun with your eyes closed, you can still feel heat from the sun on your face. How could the class make the spot hotter?
5. Can you make it even hotter by passing all the sunlight through a lens, onto the wall?

INSTRUCTIONS (Part 3):

1. Put a candle inside a glass jar and put on the lid.
2. Can you melt the candle by using your mirrors?
3. Can you melt chocolate by using your mirrors?

All the mirrors work together like one big mirror, even though they are far apart. They all collect a little bit of energy from the sun and send it to the bright spot.

The mirror of a telescope works like that. The light from some stars is very faint because the stars are very far away. But the big mirror collects all the faint light and focuses it to one lens. Then the telescope can gather (put together) enough light from the star to get a photograph of the star.

Did you know?

Sound waves must have a medium like air or water to travel through, but electromagnetic waves can travel through empty space.

The Square Kilometre Array (SKA)

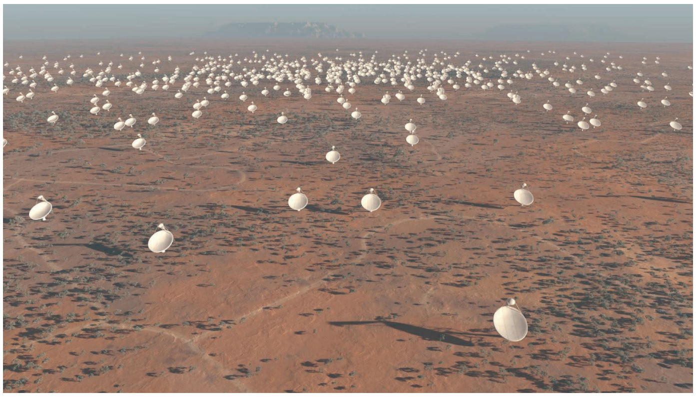
The SKA is a different kind of telescope for looking at the stars. Stars send out energy in light but also in radio waves. The SKA will receive radio waves that our eyes cannot see.

An array means a large number of the same items. For example, when the desks in your classroom are all lined up neatly, we can call that an array of desks.

Visit

SKA video
goo.gl/ERYT4

The SKA will have an array of several thousand dishes like those in the picture on page 276. When you add together the area of all the dishes, the total area will be the same as one square kilometre. A square kilometre is an area in the shape of a square and the sides are each 1 km long. The area of the square will be 1 km^2. That is why the telescope is called the Square Kilometre Array.



This is how the SKA will look once it has been built. (Credit: SKA Organisation)

There was actually a contest between South Africa and Australia to see who would host the SKA. Both countries really wanted it and the bid and voting went on for nine years. Then in 2012, it was announced that it would rather be hosted in both countries, but the larger portion of the dishes are to be in South Africa and Africa.

But why does SKA need so many dishes? Isn't one enough?

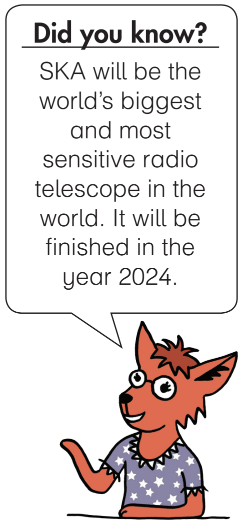
Good question Felicity! Let's find out.

The dishes in the picture above look like the satellite TV dishes that you see on some people's houses. Those dishes collect the weak TV signal that comes from a satellite high up in space.

In the SKA, each dish collects a little of the radio signals that come from the stars, and sends it to a computer. The computer puts together all the signals to make a new picture of that star.

Scientists from many countries are working together to build the SKA in the Northern Cape. Most of the telescopes will be near the town of Carnarvon.

Some of the dishes will be very far away from Carnarvon. Some dishes will be in Ghana, Zambia, Mozambique and Madagascar. They will also collect signals from stars and send them to the computer in Carnarvon.



Some of the dishes will be far away from Carnavon, in other countries across Africa, as well as Australia and New Zealand. (Credit: SKA Project South Africa)

ACTIVITY 19.2: Answering questions about the SKA

INSTRUCTIONS:

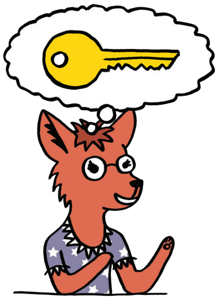
1. Look at the pictures of SKA in the previous text about the SKA.
2. Answer these questions.

QUESTIONS:

1. How is the picture of the SKA dishes like the picture of the class using mirrors to make a bright spot on the wall?

2. Why does the SKA need so many collecting dishes?
3. Why does it help the SKA to have dishes far away in Ghana, Kenya and Mozambique?
4. Where in South Africa will the SKA dishes be built?

The SKA will be able to pick up signals that stars sent out thousands of millions of years ago. The signals have been travelling through space for all that time. When the SKA picks up those signals, we will learn something about that time when the universe began, thousands of millions of years ago!



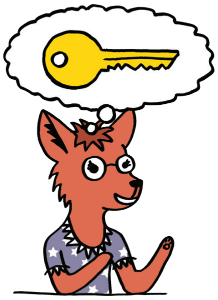
KEY CONCEPTS

- The objects we see in the sky are very far away.
- We can use telescopes to see them more clearly, and to measure how far away they are.
- Lenses can focus light to make a clear image.
- Mirrors help to collect more light when stars are very faint (not bright).

REVISION

1. What does a telescope do?
2. Before Galileo, nobody knew that the planet Jupiter had moons. What was the reason?
3. What does SKA stand for?
4. Why are the words 'square kilometre' in the name?
5. With a telescope we can see very, very many stars. Why did we not know about all those stars before there were telescopes?
6. Astronomers build their telescopes far away from cities. Think of a reason why they do this and write it down.

20 Systems to explore the moon and Mars



KEY QUESTIONS

- How do we make a vehicle move on the moon or Mars?
- How do we collect information about the rocks on the surface?
- What do scientists want to know about the moon and Mars?

New words
- rover
- photovoltaic
- radio signal
- micro-organisms

20.1 Vehicles used on Mars

No humans have ever been to Mars but scientists know a lot about the surface of Mars. You learned about this planet in Chapter 16. They have found out what Mars is like by using vehicles called rovers that send back information to Earth. Let's have a look at some of these different rovers and how they operate.

Did you know?

Photo means 'light' and voltaic means 'electricity'. So photovoltaic means producing electricity using light.

The Pathfinder rover

In 1997 the Pathfinder spacecraft landed on Mars. It had a small rover inside; the Pathfinder opened up and the rover came out and began taking photographs of Mars. Look at the photo on page 281. The photo is not very clear but remember that it was taken with a robot camera, which sent the picture by radio signals, back to Earth. The driver of the rover was millions of kilometres away on Earth and used radio signals to steer the rover.

The Pathfinder rover used electric motors to move. The electricity for the motors came from photovoltaic (solar) panels on its rooftop. Solar panels transfer energy from sunlight to the electric motors. Find the solar panels in the photo. The solar panels that you learned about in Chapter 15 last term are also photovoltaic panels.

This is the rover that was carried by the Pathfinder spacecraft. It has instruments to find out what the rock is made of.

The rovers called Spirit and Opportunity

These two rovers landed on Mars in 2004. Like Pathfinder, they also used solar panels that generate electricity from sunlight. In 2010, after six years, the rover called Spirit got stuck in sand. Soon after this it stopped sending back messages.

The rover called Opportunity is still working, after 13 years on Mars! It has travelled over 44 km and sent back thousands of pictures.

The Opportunity rover is going to scrape some grains off that rock and analyse it.

Visit

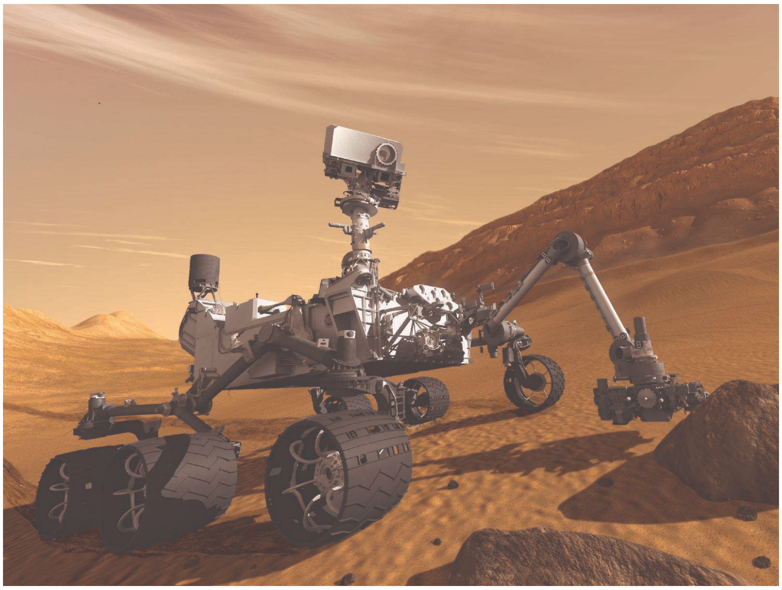
The making of Curiosity (video). goo.gl/BwDaz

Visit

Teaching Curiosity to use a robotic arm on Mars (video) goo.gl/nwj68

The rover called Curiosity

This rover is the size of a small car and will be able to travel further and collect much more information about the surface of Mars. Scientists want to know whether there are any living things on other planets. So the rover will look for signs that micro-organisms lived on Mars a long time ago. Micro-organisms are very tiny organisms that cannot be seen by the eye. They are so small that millions would fit onto the tip of a needle.



The Mars rover called Curiosity

The rover has video cameras to show the driver back on Earth what is in front of the rover, and it has a long arm with a scoop to pick up soil samples. It also has a laser that can heat rock until it turns into vapour. Then special cameras look at the vapour and find out what substances are in the vapour. Can you see the cameras in the photo?

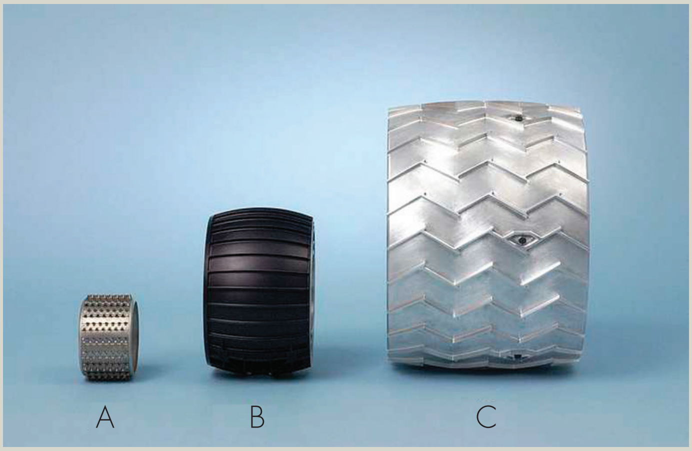
QUESTIONS

Do you think that there could be living things on Mars? What do living things need, to go on living?

ACTIVITY 20.1: The wheels of Mars rovers

INSTRUCTIONS:

1. Look at the wheels of three Mars rovers below.
2. Answer the questions.



The wheels of three Mars rovers

QUESTIONS:

1. We know that wheels are round. Why do these wheels look like rectangles?
2. The diameters of the three wheels are 13 cm, 30 cm and 45 cm. Draw three circles to show these diameters.
3. The wheels shown belong to the rovers, Pathfinder, Opportunity and Curiosity. Match the wheels to the rovers. Write down the letters A, B and C with the name of the rover next to it.
4. Why are the wheels different diameters?
5. Why did the designers choose such wide wheels?
6. Use your ruler and work with the photo of the three wheels. Measure the diameter of each wheel in the picture and the width of each wheel. Write your measurements in the following table. Include the diameters from question 2.

Visit

Landing Curiosity on Mars (video). goo.gl/BwDaz and goo.gl/LBda0

	Diameter of wheel	Width of wheel
Pathfinder		
Opportunity		
Curiosity		

What is the pattern that you find? Write out the whole sentence: The bigger the diameter, the ...

20.2 Vehicles used on the moon

Apollo 11 mission astronauts walked around on the moon. This was the first time, but for Apollo 15, 16 and 17 each mission had a lunar rover called a moon buggy. Lunar means 'relating to the moon'.

Look at the first photo of the lunar rover. This vehicle went to the moon in 1972 and it is still there. Another spacecraft photographed it in 2011. You will find out more about this rover when you investigate rovers for your Technology project.

Visit

Footage from the first landing on the moon (video)
goo.gl/Yp2o7

The Apollo 17 astronauts drove this lunar rover on the Moon.

Astronauts testing out a lunar rover on Earth.

The second photo above is of astronauts testing out a lunar rover on Earth before they used it on the surface of the moon.

20.3 Design and make a vehicle to collect moon rocks

In the last term of Grade 4, you learnt about the way to the moon with the Quantum Club? You are now part of a crew in the Apollo scientific mission.

New words
- potential energy
- kinetic energy
- hinge

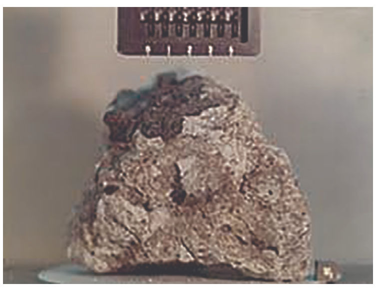
We are approaching the moon!

Investigate the need for a moon rover

Your mission is to collect rocks from the moon. Scientists back on Earth want to study those rocks and find out whether they are the same as rocks on Earth. You have to collect from different places on the moon, so you need to be able to move around on the surface.

In 1972, scientists really did go to the moon to collect rocks. In the picture you see a photo of one of the rocks that came back to Earth with the Apollo 16 Mission.

Visit
Apollo 17 lunar rover (video).
goo.gl/e3Cgj

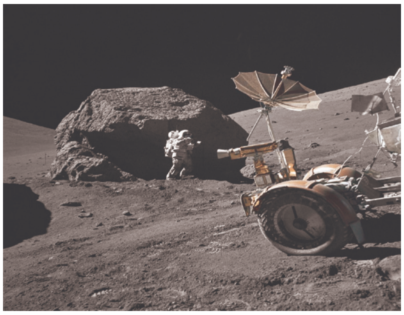


A rock from the moon

The sun heats the moon surface to the temperature of boiling water, so you will have to wear a special suit to protect you and cool you. The suit will make it difficult to work and walk.

The moon has no air, so you will have to carry air for yourself in tanks (bottles). To do all this work, you will need a vehicle to move around on the moon.

Astronaut Ceman and Schmitt practising to pick up rock samples before going on the Apollo 17 lunar mission.



Astronaut Schmitt collecting samples on the moon.

Your design brief

A design brief is a short statement about what you are going to make and intend to make.

QUESTIONS

Write your design brief in your exercise books, using the following phrases:

- I am going to design and make a ____________
- that will help scientists to ____________
- ____________ the moon.

Now that you have specified your design brief for your project, we need to do some more investigating to answer some questions before we can start designing.

Investigate the surface of the moon

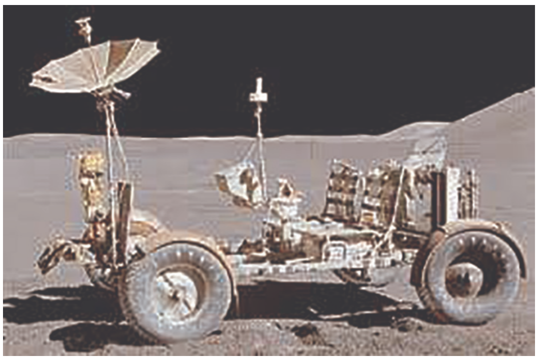
In Chapter 16, you learned about the moon. The rover needs to be able to drive over the moon's surface, so we must investigate what the surface of the moon is like.

QUESTIONS

Write one fact about the moon that you must think about when you design your rover. Write a sentence to explain why that fact is important.

Investigate ways to move people and equipment

The rover on the moon had four electric motors – one motor in each wheel. It did not need a steering wheel, because the driver could switch the motors on and off in each wheel. This steered the vehicle. It had two seats with seat-belts.



Astronauts used this rover on the moon during the Apollo 17 mission.

The part that looks like an umbrella is an aerial that picked up radio messages from Earth. Can you see this in the photo? It looks a bit like a satellite dish you see on some houses for television.

QUESTIONS

1. How do you think the rover got energy to work the motors in the wheels?
2. The rover was made of very light materials. Why did the rover have to be light?
3. Why did the wheels have shields over them? The shields are the orange things over the wheels.
4. The wheels of the rover were quite wide. What would happen if the wheels were narrow like a bicycle wheel?
5. Why must cars on Earth have headlights?
6. Do you think the rover needed headlights?

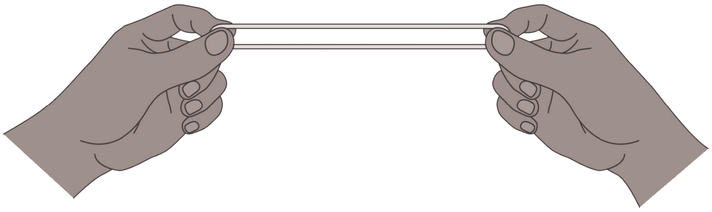
Investigate ways to give energy to the rover

Your moon rover needs energy to make it move. Do you remember that in Grade 5 we looked at energy and movement in Energy and Change?

Hey, that was over a year ago when we did energy and movement! I don't remember much so can we please refresh our memories?

Of course Felicity! This is also quite a difficult topic and you will learn more about it in later grades, so let's refresh some of these terms.

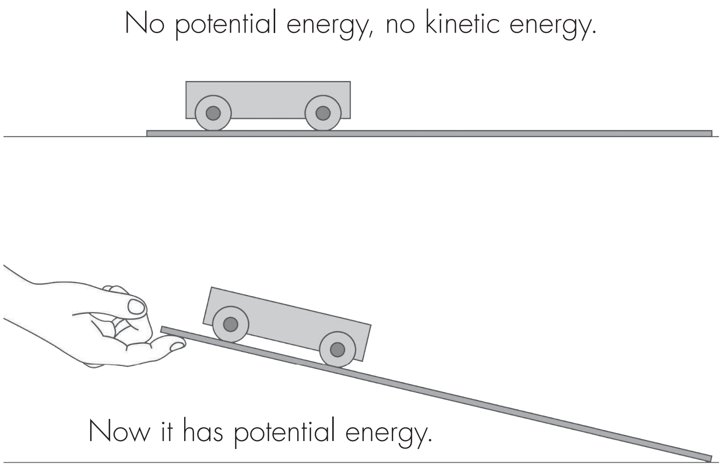
When you stretch an elastic you give it energy, called stored energy. Another way of saying this is that you give the elastic potential energy. This means it has the potential to do work. Or in other words, in the future the stretched elastic band can do something.



This stretched elastic band has potential (stored) energy.

When you let the stretched elastic band go, it now moves as it springs back. This is movement energy, which is also called kinetic energy. Kinetic means movement. The potential energy stored in the stretched elastic band changed into kinetic energy as the elastic band was released and moved.

Now let's apply these terms to the rover. You can also give something potential energy by lifting it up off the ground, as it then has the potential to fall or move back to the ground. You can give energy to your moon rover if you lift it up on a plank, as you see in this picture.



One way to give your rover energy to move.

When you lift up the plank and rover, your hand gives some of your energy to the rover. It now has potential energy to move.

QUESTIONS

When you let the rover go, what will happen? Use the words 'kinetic energy' in your answer.

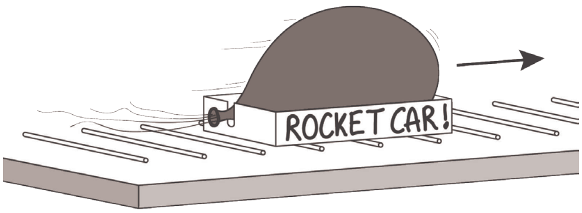
The plank is useful for testing the wheels of your model. But the rover must be able to go up hills, not only down them.

The second way to give your rover energy to move is to use an electric motor and battery. Do you remember last term when we looked at electric circuits? The source of energy for a circuit is a cell or battery. You can fit an electric motor and a battery to your rover. The potential energy in that system is in the battery.

A battery is a source of potential energy for an electric motor.[1]

Another way to make your rover move on the moon is to use a rocket. Rockets will work on the moon. Inside the rocket, gas pushes against all the sides. Some gas pushes against the walls of the balloon, and some gas pushes out through the opening of the balloon.

Look at the rocket car in the picture. The gas pushing through the opening of the balloon pushes the whole car forward.



The balloon works like a rocket. You have to give it potential energy first.

This rocket is on rollers. Could you fit wheels to this car?

The real moon rovers had batteries and electric motors in each wheel. Many electric cars have a motor. This motor can give energy to your moon rover.

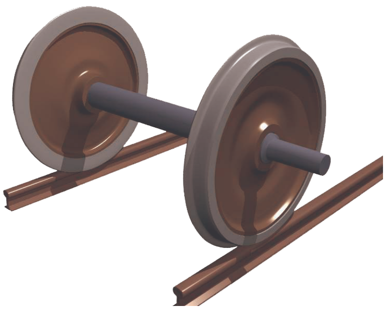
Investigate ways to make a body with wheels

Your moon rover needs a body for the scientists to sit on and to put the rocks into. The body of a vehicle must have good ways to hold the wheels.

We looked at wheels and axles in Grade 5 in Energy and Change. A wheel fits onto an axle, which is a solid rod or bar that allows the wheels to turn.

QUESTIONS

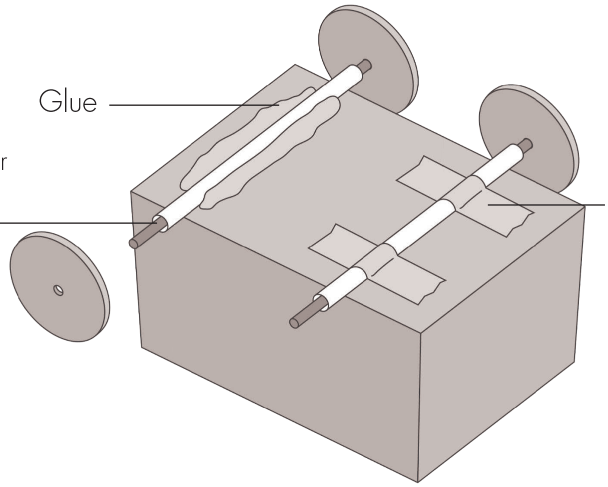
Draw and label the two wheels and the axle on the diagram:



You know there are different ways to let wheels turn on an axle. One way is to have the axle fixed to the body, and the wheels are free to turn on the axle. What is the other way to let wheels turn?

Wheels fixed to the axle

You can use plastic straws or the barrel of a ballpoint pen to make a bearing for an axle. The following picture shows two ways to fix the bearings onto the body. The bearing is the hollow tube that the axle goes through. The bearing must be bigger than the axle so that the axle can turn easily.

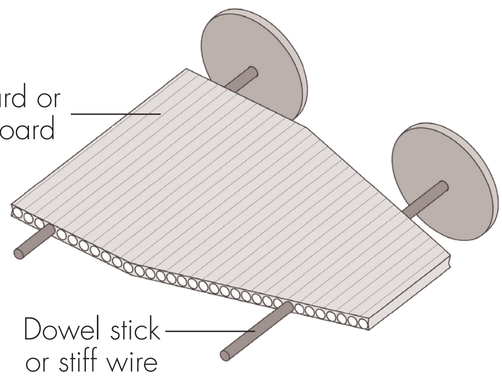


Two ways to fix the bearings onto the body

QUESTIONS

What are the two ways used in the picture above to fix the bearings onto the body? What are some materials that you could use to make the axle in the above picture?

You can also use plastic signboard or strong corrugated cardboard to make a body with wheels. Can you see how the axle goes through the holes in the cardboard?



The board makes bearings for the axles, which are fixed to the wheels. The axles turn in the holes.

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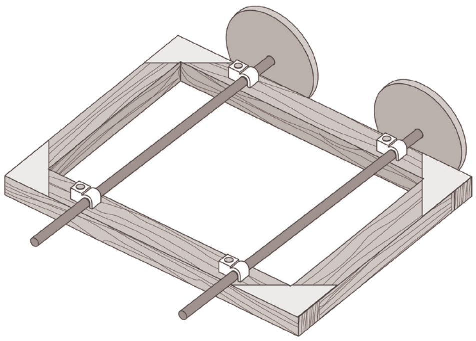
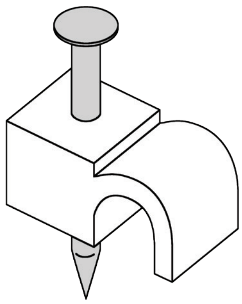
Wheels turn on the axle

The next picture shows you another way to let the wheels turn. This time the axle remains still and the wheels turn on the axle. The axle is fastened to the wooden body with cable clips. Cable clips fasten telephone cables to walls. Can you see the blown up version of a cable clip? The clips must hold the axle tightly, so that the wheels are free to rotate.



How the cable clips can hold an axle.



A clip to hold telephone cables to the wall.

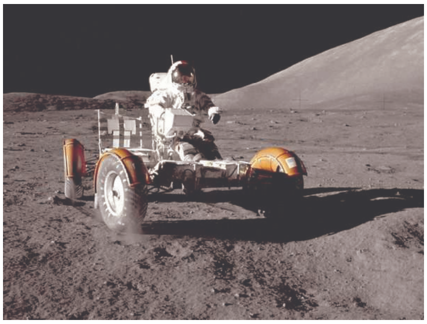
Now that we are finished investigating, let's start designing!

Did you know?

An engineer is someone who designs and builds machines and structures for a living. If you enjoy the Technology projects then maybe one day you could be an engineer!

Designing and making

Your moon rover can look different to the Apollo rovers.



One of the astronauts driving a moon rover.

The Apollo engineers designed other rovers, but in the end they chose this design. Your design will look different to their designs.

ACTIVITY 20.2: Designing and making your rover

SPECIFICATIONS:

1. Your rover must be balloon powered.
2. Your rover's wheels should be able to roll easily and it should go at least 2 m on the floor.
3. Your rover must have two seats and it must have a model of you as a moon explorer.
4. It must be able to carry two small stones for at least 2 m. The stones represent rock samples from the moon, to take back to Earth.

CONSTRAINTS:

You must build your rover in class.

DESIGN:

1. Draw a picture of a rover you could make in your exercise books.
2. Show the seats, with an astronaut in one seat. Show the place where the moon rocks will go.

3. Add other parts that your rover should have. Write labels to tell everyone what the different parts of the rover are.
4. Leave some space for a second design. When you begin making the rover, you will get better ideas. Then you can draw another picture of your final design. The two pictures will show how your ideas changed.

MATERIALS:

Things to collect for wheels: You can collect snuffboxes, shoe-polish tins or the lids of bottles. You can also cut out cardboard circles.

Things to collect for axles: You can find sosatie sticks, stiff plastic straws, wooden dowel sticks, aluminium rods. The school may have plastic rods from a supplier. You can also use nails or wire to make axles.

Things you can use for wheels and axles

Tools and materials you need as a class:
- Long-nose pliers to cut and bend wire
- Hole-makers (small and big nails) and big scissors for cutting cardboard

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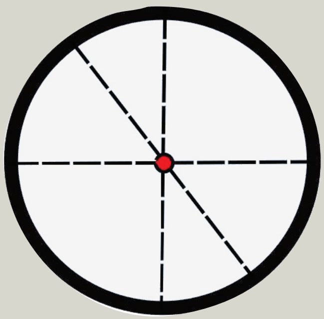
- Small hammer to drive the nails
- Glue (make flour glue in class)
- Balloons to power the rover
- Crayons or paint (to decorate your rover car)

Remember to also colour the scientist who drives the rover.

MAKE:

Now let's make the rover. Below are some tips that will help you when making your rover. Remember that you may not have the perfect design from the start! So when making your rover, you need to go back and modify your design as you find things which work and do not work.

1. How to find the centre of a wheel – a wheel is a circle:
    - Some plastic lids have a small dimple or lump that shows you where the centre is.
    - If your lids or discs do not have a dimple, you can use a ruler to draw diameter lines across the middle.
    - A diameter line is the longest line you can draw across a circle. Where diameters cross, that is the centre.

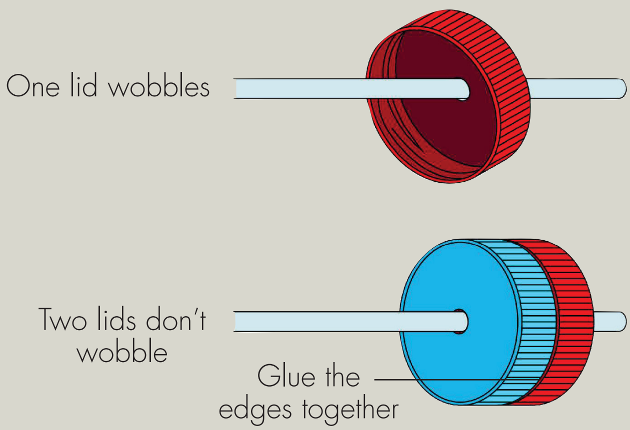


Draw three diameters and mark the centre. In this example the centre is the red dot.

2. How to make the right size hole in the centre:
    - If you want the wheel to *rotate* on the axle, then you must make a hole that is a little bit bigger than the diameter of the axle.

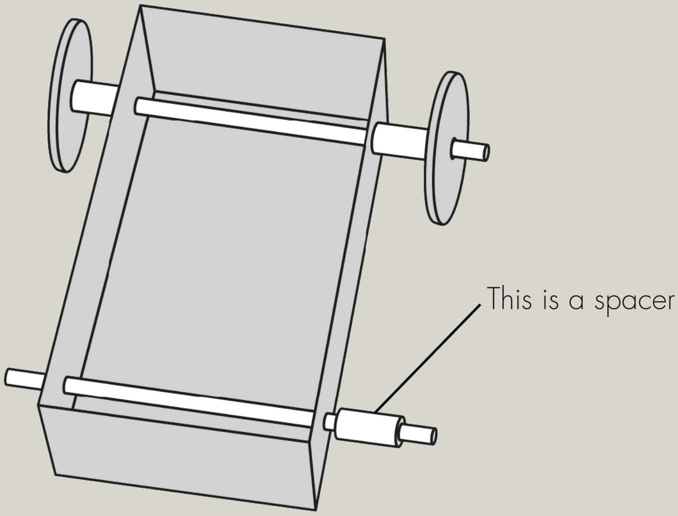
- If you want the wheel to be *tight* on the axle, then you must make a hole that is smaller than the diameter of the axle. When you push the wheel onto the axle, it will grip the axle.

3. How to stop wheels wobbling on their axles:
   - If the axle goes through just one surface of the lid, this is what can happen: the wheel will wobble. You need to give the lid another surface. Glue two lids together.
   - Or else, trace the shape of the lid on cardboard, mark a hole in the centre of the circle, and cut out the cardboard. Cut the cardboard so that the disc will be a tight fit in the lid. Then glue the cardboard into the lid.



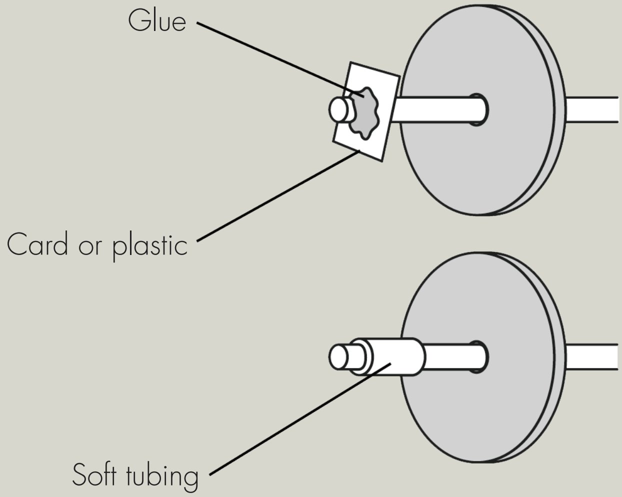
You can stop the wobbling by glueing two lids together.

4. Does the wheel rub against the body of the rover?
   - You need a spacer on the axle, to keep some space between the wheel and the body.
   - You can use a bead with a large hole, or you can make plastic washers from slippery plastic. Milk bottles are good for making slippery washers.
   - Use an office punch for making neat holes in a piece of milk-bottle plastic. Then cut around the holes to make washers.



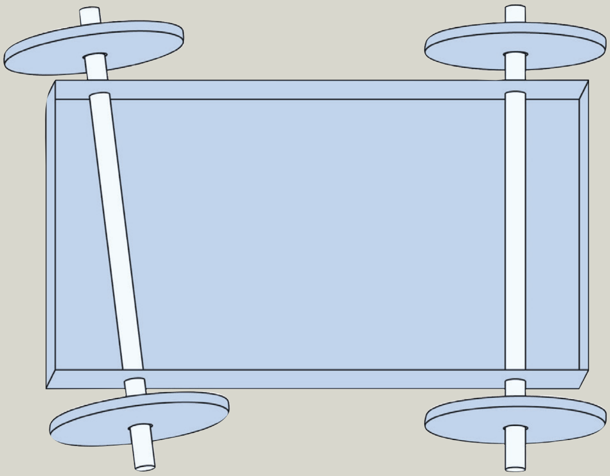
Where to use a spacer or washer.

5. Does the wheel come off the axle?
   - Push a piece of soft tubing onto the end of the axle as you see in the picture below.
   - Or push on a flat piece of cardboard and hold it on the axle with glue.



Soft plastic tubing or glue will stop the wheel coming off the axle.

6. Does the rover not run in a straight line?
   - The axles must be parallel in your rover.
   - These axles in the picture below are not parallel. If your axles go through the body, then the axle holes must be the same distance apart on the left and the right side.
   - If you need to make a hole in a new place, then you can glue a small piece of card with a hole in it over the old hole.



These axles are not parallel so the rover will not go straight.

Test your rover and make it run as well as you can. Go back and draw your improved design. Draw the rover you have made and write labels to explain what all the parts do. For example, you can write: "This piece of straw stops the wheel rubbing against the body."

EVALUATE:

At this point in a Technology project, you stop and ask yourself, did we do a good project? Did we make something that solves the problem?

Clear an area in the classroom to show the moon rovers. Show your moon rover and how it moves by itself, or how it rolls down a sloping plank.

Discuss these questions in the class for each moon rover:

1. What were the specifications for the moon rover?
2. Does the rover have a model of the astronaut sitting on it?
3. Can your rover carry small moon rocks back to your moon lander?
4. Does your rover have a hinge anywhere in it?
5. Do the wheels roll easily?
6. Can your moon rover go at least 2 m?
7. Whose rover rolls the furthest?
8. Does it roll in a straight line, or does it roll in a curve?
9. Did you need to make the body of the rover stronger? What did you do to make it stronger?
10. If you really had to go to the moon, what would you need on a real rover car?
11. Write down how far each moon rover can go after it rolls down the plank. You now need to draw a bar graph to present this data (information) in your exercise books. Your teacher will help you to get started and then you can finish drawing it yourself.

After you have tested and evaluated everyone's rovers as a class, write an evaluation of your own rover. Remember to answer the questions above when evaluating how successful your rover is.

Below is a summary of some of the things that we learned from doing this project:

- Axles must be parallel for the vehicle to run straight.
- Axles can be fixed and wheels free to turn, or the axle can turn with the wheels fixed to it.
- Axles turn in bearings. Bearings let axles turn freely.
- A car must have energy from some source. The source can be a hand that lifts the car up to the top of a ramp, or the source can be a falling weight, or the source can be rubber bands or a blown-up balloon.

KEY CONCEPTS

- Scientists send vehicles to explore the surfaces of moons and other planets.
- These vehicles have radios that send back information to scientists on Earth.
- The vehicles need special wheels to move across the sand and stones.
- People have been to the moon, but no people have yet been to Mars.
- Only vehicles (robots) operated by people back on Earth have been sent to explore the surface of Mars.

REVISION

1. Give three names of vehicles used on Mars to explore the surface of the planet.
2. Which of these vehicles is the most recent one to go to Mars?
3. Why do people need moon rovers when they are exploring the surface?
4. What is the main difference between vehicles used on the moon and vehicles used on Mars to explore the surfaces?

   Hint: This is to do with whether people have visited the moon or Mars.
5. What is the name given to the solid bar that connects two wheels?
6. Describe how you made sure that your moon rover went straight and that the wheels did not fall off.
7. Why do you think the human race is so interested in exploring other planets and objects in our solar system?

Congratulations!
You are finished with Grade 6!

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Notes

Chapter 1 Photosynthesis

1. http://www.fiicr.ico/phctco/cewl/6471030841/
2. http://www.fiicr.ico/phctco/aligraney/661789978/

Chapter 3 Nutrition

1. http://www.fiicr.ico/phctco/jcanet/5772686658/
2. http://www.fiicr.ico/phctco/oeeoeeiardo/7209691478/in/oet-72157629756301182/
3. http://www.fiicr.ico/phctco/78428166@N00/4296824658/

Chapter 4 Food processing

1. http://www.fiicr.ico/phctco/oaloabcy/2449275663/
2. http://www.fiicr.ico/phctco/55530505@N08/5148999033/
3. http://www.fiicr.ico/phctco/37743612@N05/4685092625/

Chapter 5 Ecosystems and food webs

1. http://www.fiicr.ico/phctco/wrathdelivery/393079740/
2. http://www.fiicr.ico/phctco/graeoe/4183321986/
3. http://www.fiicr.ico/phctco/ociloiienie/5097054849/

Chapter 7 Mixtures

1. http://www.fiicr.ico/phctco/hcriavarlan/4268285083/

Chapter 8 Solutions as special mixtures

1. http://www.fiicr.ico/phctco/exfcrdy/384963651/

Chapter 9 Dissolving

1. http://www.fiicr.ico/phctco/preppybyday/6703560771/

Chapter 10 Mixtures and water resources

1. http://www.fiicr.ico/phctco/19378856@N04/2037098785/

Chapter 11 Processes to purify water

1. http://www.fiicr.ico/phctco/wwarby/4916577404/

Chapter 13 Electrical conductors and insulators

1. http://www.fiick.ito/phttto/vhhaooek/6S67396763/
2. http://www.fiick.ito/phttto/edittk/72SS0973/oizeo/l/

Chapter 14 Systems to solve problems

1. http://www.fiick.ito/phttto/andnbutcaj/149S901113/
2. http://www.fiick.ito/phttto/39747297@N0S/S229733311/
3. http://www.fiick.ito/phttto/oagiicevin/7161372SS7/

Chapter 15 Mains electricity

1. http://itootno.wicioedia.tkg/wici/File:Tkee_Fekno_%28pod%29.jpg
2. http://www.fiick.ito/phttto/hekkn/3S14827S/
3. http://www.fiick.ito/phttto/hendkn/397S10397/
4. http://itootno.wicioedia.tkg/wici/File:Aliiia_Nijdao-ktiinha.jpg
5. http://www.fiick.ito/phttto/tntakitptwekgenekatitn/413709S98/in/
6. http://www.fiick.ito/phttto/oaghakebia/S2636170S0/

Chapter 19 Systems to explore the moon and Mars

1. http://www.fiick.ito/phttto/kaztkS12/2109796S82/

Chapter 20 Systems for looking into space

1. http://itootno.wicioedia.tkg/wici/File:Tel_galilet.jpg
2. http://www.fiick.ito/phttto/knanwiic/34618S0112/

Glossary

Absorb	To take in or soak up a liquid, energy or other substance by chemical or physical action.
Absorbent	A material that is able to soak up liquid easily.
Adapt	To become adjusted to new conditions.
Additives	Different chemical preservatives, flavourings and colourings, as well as salt and sugar, added to preserve the food or enhance its taste or appearance.
Aeration	During the aeration stage of water treatment the raw water flows into a tank that has bacteria to break down the last solid matter and soluble pollutants. Bacteria need oxygen so air is bubbled through the water.
Aim	The purpose or reason for doing a Science investigation.
Ammonia	A colourless gas with a strong smell, which dissolves in water to produce an alkaline solution.
Apparatus	The equipment you will need to carry out a Science investigation or experiment.
Aquatic	To do with water, from the Latin word *aqua*.
Argon	The most common noble gas (gaseous element), making up nearly 1% of the earth's atmosphere.
Artificial sweetners	Chemical sugar substitutes or food additives that try to duplicate the taste of sugar but with fewer calories.
Asteroid belt	Asteroids, which are solid, rocky irregular bodies, orbit our sun between the orbits of Mars and Jupiter.
Asteroids	Chunks of rock of various sizes that orbit the sun. Large numbers are found in a belt between the orbits of Mars and Jupiter.
Astronomers	Scientists who study areas outside the Earth – the celestial bodies, such as stars, planets, moons, comets and galaxies.
Atmosphere	The envelope of gases surrounding the earth or another planet.
Axis of rotation	A three-dimensional object always rotates around an imaginary line called a rotation axis. If the axis passes through the body's centre of mass, the body is said to rotate upon itself, or spin.
Axle	Rod or spindle (either fixed or rotating) passing through the centre of a wheel or group of wheels.
Balanced diet	A diet consisting of a variety of different types of food and providing adequate amounts of the nutrients necessary for good health.
Battery	A container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.
Bearing	Machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts
Binder	A substance used in construction that sets, hardens and adheres to other materials, binding them together.
Biodiversity	The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.

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Biomass	Organic matter used as a fuel, especially in a power station for the generation of electricity.
Biome	A large naturally occurring community of flora and fauna occupying a major habitat, for example a forest or tundra.
Breeding ground	An area where birds, fish, or other animals habitually breed.
Brittle	When a material is not bendy or flexible, the opposite of malleable. This means that they will break when we try to bend them with enough force.
Calcium	An important mineral needed by the body to strength bones and teeth. Calcium can be found in fish, green vegetables, milk and cheese.
Calories and joules	The energy of food is measured either in calories or kilojoules.
Carbohydrates	One of the macronutrients found in most foods as sugar and starch, including fruits, vegetables and grains. They provide most of our energy and are converted into blood glucose or blood sugar by the body to be used for energy.
Carbon dioxide gas	Carbon dioxide gas is a natural element released by people and animals into the air when they breathe out. Plants use the carbon dioxide gas to make food and then release oxygen gas.
Carnivores	An animal that only feeds on other animals.
Cell	A device that generates electricity from chemical reactions.
Cell	The smallest microscopic structural and functional unit of a living organism, which consists of cytoplasm and a nucleus enclosed in a membrane.
Cement	Powdery substance made by calcining (burning) limestone and clay.
Change of state	When temperature changes, matter can undergo a change of state, shifting from one form to another, such as melting, solidifying, freezing, evaporating or condensing.
Chlorophyll	A green pigment, present in all green plants, which is responsible for the absorption of light to provide energy for photosynthesis.
Chronic illness	When the course of the disease lasts for more than three months. Examples include arthritis, asthma, cancer, diabetes and viral diseases such as hepatitis C and HIV/Aids.
Classify	To group or arrange things in classes or categories according to shared qualities or characteristics.
Coal	A combustible black or dark brown rock consisting chiefly of carbonised plant matter, found mainly in underground seams and used as fuel.
Combine	To join or merge to form a single unit or substance. In Science a compound is a pure chemical substance made of two or more different chemical elements combined.
Commercial	Making or intended to make a profit.
Common properties	General properties or physical properties that can be observed or measured without chemically changing the material or substance.
Components	A part or element of a larger whole, especially the parts that make up a mixture or an electric circuit.
Compression	An external force (stress) that tends to crush a material, or push down on the material and squeeze its particles closer.
Conclusion	Summary of what was learnt from the results of a Science investigation.

Concrete	Building material made from a mixture of broken stone or gravel, sand, cement, and water, which can be spread or poured into moulds and forms a stone-like mass on hardening.
Condensing	The change of the physical state of matter from a gaseous state into liquid phase, and is the reverse of evaporation.
Conditions	Set prior requirements on (something) before it can occur or be done.
Conducting material	Component of an electric circuit that allows the transfer of electrical energy, electric wires for example.
Conduction	Process by which heat or electricity is directly transmitted through the material of a substance when there is a difference of temperature or of electrical potential between adjoining regions, without movement of the material.
Conductivity	The degree to which a specified material conducts electricity or heat.
Conductor	Materials like copper and silver that allow a path for an electric current.
Constellation	A group of stars that form a recognisable pattern, which is named after its apparent form or identified with a mythological figure.
Constraints	A description of the limitations or restrictions for the design of a product. They describe the things that the product or structure you are making cannot do.
Consumers	Organisms that need to eat (consume) something else as food to get their energy.
Contaminate	To make something impure by exposing it to or adding a poisonous or polluting substance.
Control group	Group in an experiment where what is being tested is not applied. It is then used as a benchmark to measure how the other groups do.
Convection zone	A region of turbulent plasma between a star's core and its surface, through which energy is transferred by convection. The hot plasma rises, cools as it nears the surface, and falls to be heated and rise again.
Copper sulphate	An inorganic blue crystal compound that combines sulfur with copper. It can kill bacteria, algae, roots, plants, snails and fungi.
Core	The inner part of the Earth, which may consist of a liquid outer core of iron and nickel, and a solid inner core. No one knows exactly what the core is made of but scientists keep doing experiments. The outer core has a magnetic field. The inner core may rotate slightly faster than the rest of the planet.
Corrosion	The deterioration of a metal as a result of chemical reactions between it and the surrounding environment.
Corrugated	Material shaped into a series of parallel ridges and grooves so as to give added rigidity and strength.
Crater	A large bowl-shaped cavity in the ground or on the moon caused by the impact of a meteorite.
Cross-section	A surface or shape exposed by making a straight cut through something, especially at right angles to an axis.
Crust	The thin outermost solid rocky shell of the Earth, which includes the thicker continental crust and the thinner oceanic crust. Its thickness varies between 5 km and 30 km.
Curdle	To separate, or cause to separate into curds or lumps.

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Cure (curing)	To preserve (meat, fish, tobacco, or an animal skin) by salting, drying, or smoking.
Cycle	A series of events that are regularly repeated in the same order.
Data	Facts and information collected during a Science experiment.
Decomposers	Organisms that break down dead or decaying organisms, and in doing so, they carry out the natural process of decomposition.
Desert	Barren area of landscape where little rain occurs and living conditions are hostile for plant and animal life.
Design brief	Description of what you plan to do to meet the specifications and constraints for designing the product.
Diabetes	A disease in which the body's ability to produce or respond to the hormone insulin is impaired, resulting in abnormal metabolism of carbohydrates and elevated levels of glucose in the blood.
Diameter	A straight line passing from side to side through the centre of a body or figure, especially a circle or sphere.
Diffuse	To spread over a wide area. When gas moves through the air without something pushing it.
Direction	The course along which someone or something moves.
Disinfection	During the final stage of water treatment chemicals are added to the water to kill any surviving germs.
Dissolve	When solid material becomes combined with a liquid so as to form a solution.
Distillation	When referring to water it is evaporating and collecting of a liquid by condensation as a means of purification.
Dormant	Alive but not actively growing.
Ductile	When a material like metal is pliant and can be drawn out into a thin wire. When a material can be reformed without losing toughness or becoming brittle.
Dull	The opposite of the quality of being shiny or lustrous.
Dwarf planet	A celestial body that resembles a small planet but lacks certain technical criteria that are required for it to be classified as such.
Ecological balance	The equilibrium between and harmonious coexistence of organisms and their environment.
Ecosystem	A system, or a group of interconnected and interdependent elements, formed by the interaction of a community of living organisms with their natural environment.
Effluent water or sewage	Wastes that pour into our water, such as liquid factory waste, raw sewage and grey water from washing facilities. It is carried away from homes and other buildings in a system of pipes.
Electric current	The electrical energy that flows through an electric circuit, which is a complete pathway for the transfer of electrical energy or electricity.
Electric circuit	A path in which electrons from a voltage or current source flow.
Electricity	A form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.

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Electromagnetic waves	The waves of the electromagnetic field radiating through space carrying electromagnetic radiant energy. It includes radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma radiation.
Energy transfer	The act of moving energy from one place to another place.
Energy value	The energy value of a food indicates its value to the body as a fuel. It uses a single factor for each of the energy-yielding foods (protein, fat, carbohydrate).
Environmental disaster	Natural events, such as floods, earthquakes or hurricanes, which cause great damage to ecosystems.
Estuary	The tidal mouth of a large river, where the tide meets the stream.
Evaluate	To decide how successful the product design and construction was in solving the problem identified or meeting its specifications.
Evaporating	The process of a substance in a liquid state changing to a gaseous state due to an increase in temperature and/or pressure.
Evidence	Scientific evidence is evidence that serves to either support or counter a scientific theory or hypothesis.
Excreting waste products	Animals rid themselves of waste materials through organs such as the lungs, kidneys and skin. Plants excrete oxygen gas and water.
Expand and contract	Heat causes most substances to expand and become less dense. When cold, most substances contract and become denser.
Experiment	Scientific procedure done to test a prediction, answer a question or prove a known fact.
Extinct	When a certain species of animal or plant no longer has any living members.
Factors	The circumstances, facts or influences that contribute to a result.
Fertilise	To cause an egg, female animal or plant to develop a new individual by introducing male reproductive material.
Fieldwork	Field research or fieldwork is the collection of information outside a laboratory, library or workplace setting.
Flexible	The property of a material where it is capable of bending easily without breaking.
Flexible	The property of a material where it is capable of bending easily without breaking.
Folding	One of the ways to strengthen materials is by folding. Corrugated cardboard and bubble wrap plastic are examples of strengthened folded materials.
Food chain	A series of organisms each dependent on the next as a source of food and energy.
Food web	A single food chain is a series of organisms each dependent on the next as a source of food and energy. Many food chains that are interdependent and linked are called a food web.
Force of gravity	The force of attraction between all masses in the universe, especially the attraction of the earth's mass for bodies near its surface. The gravitational force is a force that attracts any objects with mass. You, right now, are pulling on every other object in the entire universe!
Force	A push or pull on an object caused by the object's interaction with another object.

Force	A push or pull on an object caused by the object's interaction with another object.
Forest	Large area covered chiefly with trees and undergrowth.
Fossil fuels	Sources of energy that have developed within the earth over millions of years, such as oil, natural gas and coal. Because they take so long to form, they are considered non-renewable.
Fossil	The remains or impression of a prehistoric plant or animal embedded in rock and preserved in petrified rock form.
Fragile	The property of a material where it can be easily broken or damaged.
Fynbos	A distinctive type of South African vegetation that includes a wide range of plant species, particularly small heather-like trees and shrubs.
Galaxy	A system of millions or billions of stars, together with gas and dust, held together by gravitational force.
Gas planets	The four outer planets made up mostly of gases, such as hydrogen and helium, with small rocky cores.
Gas	Substances that take up all the available space to fill the container they are in or diffuse through the air. So they can flow, have no definite shape and can be pressed to fill a smaller space.
Generator	Machine that converts one form of energy into another, especially mechanical energy into electrical energy.
Geothermal	Relating to or produced by the internal heat of the Earth.
Germinate	When a plant seed begins to grow under the right conditions.
Grassland	Large open area of countryside covered with veld grass.
Gravity	The force that attracts a body towards the centre of the earth, or towards any other physical body having mass.
Habitat	The natural home or environment of an animal, plant or other organism.
Hardness	The property a material has of being hard.
Helium gas	After hydrogen, helium (He) is the second lightest and second most abundant element in the universe. It makes up 24% of the burning gas in the sun.
Herbivores	An animal that only feeds on plants.
Horizon	The line at which the earth's surface and the sky appear to meet.
Human-made	Made by, built by or caused by human beings (opposite of occurring or being made naturally).
Hydrogen gas	Hydrogen (H) is a chemical element and hydrogen gas is colourless, odourless, tasteless and non-toxic. While hydrogen fills stars and gas planets, here on Earth it's bonded to other elements. For example, when combined with oxygen, it forms water (H_20).
Hydropower	Hydroelectric power produced from machines that are run by moving water. An example of hydropower is the electricity produced by a water channel turbine.
Hypothesis	A prediction or proposed explanation made on the basis of limited evidence as a starting point for further investigation.
Immune system	The organs and processes of the body that provide resistance to infection and toxins. Organs include the thymus, bone marrow and lymph nodes.
Indigenous	Coming from or originally occurring naturally in a particular place.

Infrared rays	Invisible radiation from the sun found in sunlight. Infrared rays are thermal so people can feel it as heat or warmth from sunlight.
Infrastructure	Basic physical and organisational structures and facilities (buildings, roads, power supplies) needed for the operation of a society or enterprise.
Inorganic	Not consisting of or coming from living matter.
Input and output energy	Energy is transferred from one component into another. People, machines and appliances need an energy input to work. They also have an energy output that may be useful.
Insectivore	An animal that feeds on insects, worms, and other invertebrates
Insoluble substances	Substances that do not form solutions when they are mixed with water.
Insulate	To protect something by depositing materials that protect, prevent the loss of heat or prevent the intrusion of other things.
Insulator	Materials like plastic and ceramic that do not allow a path for an electric current.
Iodine	A non-metallic chemical element, which turns starch blue when combined with it.
Iron oxide	Chemical compound of iron and oxygen that is formed on iron or steel by oxidation, especially in the presence of moisture.
Kilowatt	Measure of one thousand watts of electrical power.
Kinetic energy	The energy that an object has due to its motion. Or the work needed to accelerate an object of a given mass from rest to its stated velocity. Having gained this energy during acceleration, the body maintains this kinetic energy unless its speed changes.
Leap year	A calendar year that has one additional day added to keep the calendar year aligned with the Earth's revolutions around the sun (seasonal year).
Liquid	Substances that have no fixed shape, that can flow and will take the shape of the container they are in.
Lustre/lustrous	Metals are usually shiny. The shine that we see when light reflects off the surface of a metal is called the lustre of the metal.
Magnetic	Exhibiting or relating to magnetism, a fundamental property of some materials.
Magnetism	Fundamental property of some materials. A physical phenomenon produced by the motion of electric charge, which results in attractive and repulsive forces between objects.
Magnify	To make something appear larger than it is, especially with a lens or microscope.
Mains electricity	Term used to refer to the electricity supply from power stations to households.
Malleable	When a material can be hammered or pressed into shape without breaking or cracking.
Mantle	The Earth's thickest layer between the crust and the core. Earth's mantle is a solid rocky shell with an average thickness of 2 886 km. Temperature and pressure increases between the outer mantle and the inner mantle.
Manufactured material	The result when raw materials have been processed, meaning humans have changed it.

Matter	Any physical substance that has mass and takes up space, including atoms and anything made up of these. It does not include other energy forms or waves like light or sound.
Melting	A physical process that occurs when a material is heated and changes form from a solid to a liquid.
Metal	Solid material which is typically hard, shiny, malleable, fusible and ductile, with good electrical and thermal conductivity (e.g. iron, gold, silver, and aluminium, and alloys such as steel).
Metallic hydrogen	Hydrogen can become liquid atvery low temperatures and a solid under high pressures, which is metallic hydrogen.
Methane gas	The chemical compound of carbon and hydrogen, which forms the main component of natural gas used as fuel. Natural methane is found below ground and under the sea floor. It is also found in the atmosphere.
Methane ice	Large amounts of methane trapped in the crystal structure of water, forming a solid similar to ice. Scientists thought it could only be found on the gas giants but deposits have been found under sediments on the ocean floors.
Method	Systematic procedure or steps for doing something, like carrying out a Science investigation.
Microbes	A microorganism, especially a bacterium causing disease or fermentation.
Microorganism	A living organism too small to be seen with the naked eye. A microscopic organism, especially a bacterium, virus, or fungus.
Milky Way	The galaxy that contains our solar system, which seems milky because of the way it looks from Earth – a band of light seen in the night sky formed from stars that cannot be individually distinguished by the naked eye.
Mixture	A substance made by mixing other substances together.
Molecular hydrogen	The hydrogen we find in the atmosphere on earth is a molecular gas.
Molecule	Group of atoms bonded together, representing the smallest fundamental unit of a chemical compound that can take part in a chemical reaction.
Molecules	Molecules are the smallest bits of compounds. Hydrogen is an element of which a hydrogen atom is the smallest piece of hydrogen. But two hydrogen atoms and one oxygen atom combine to form a molecule of water, which is a compound.
Mould	A hollow container used to give shape to molten or hot liquid material when it cools and hardens.
NASA	The National Aeronautics and Space Administration of the United States federal government that is responsible for the space program, and aeronautics and aerospace research.
Natural gas	Mixture of natural hydrocarbon gases found beneath the Earth's surface, often with or near petroleum deposits. Natural gas contains mostly methane but also has varying amounts of propane, butane and nitrogen. It is used as a fuel and in making organic compounds.
Natural resources	Materials or substances occurring in nature which can be exploited for economic gain.
Nectar	A sugary fluid secreted within flowers to encourage pollination by insects and other animals, collected by bees to make into honey.
Nitrogen	The chemical element that occurs as a colourless, odourless unreactive gas, which forms about 78% of the earth's atmosphere.

Non-metal	An element or substance that does not have the properties of metal. Materials that tend to have properties such as being dull and brittle. They make good insulators because they do not conduct electricity or heat well.
Non-renewable	Natural resource or source of energy that exists in finite quantities and cannot be replenished.
Nutrients	Soil substances that provide nourishment essential for the plants to live and grow. The three main nutrients are nitrogen, phosphorus and potassium.
Obesity	Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health.
Observations	What you observe or see during or after the investigations. Observations are usually recorded or written down.
Observatory	Room or building that houses an astronomical telescope or other scientific equipment for the study of celestial objects.
Oil	Naturally occurring product made of hydrocarbon deposits and other organic materials, which is used to make petrol and diesel.
Omnivores	An animal that feeds on both plants and animals. Omni is a combining word from the Latin for 'all'
Orbit	The regularly repeated elliptical course of a moon around a planet or planet around a star.
Organic	Relating to or coming from living matter.
Organism	An animal, plant or single-celled life form.
Oxygen gas	Oxygen gas is a natural element found in the atmosphere and water. It makes up 21% of the air animals and humans breathe and is essential for life. Plants make and release oxygen gas when they make food.
Paraffin	Also known as kerosene, it is a colourless, flammable, oily liquid similarly obtained and used as fuel.
Particles and atoms	Atoms are the smallest pieces of matter; they are made of particles (protons and electrons). Particles aren't matter, but the building blocks of it.
Permafrost	A thick subsurface layer of soil that remains below freezing point throughout the year, occurring chiefly in polar regions.
Phase	Distinct period or stage in a process of change or forming part of something's development.
Phosphorus	A mineral nutrient found in food that essential to cell function, bone strength and energy production. After calcium it is the second most abundant mineral nutrient in the body.
Photosphere	The luminous envelope of a star from which its light and heat radiate.
Photosynthesis	Process by which green plants use sunlight to synthesise nutrients from carbon dioxide and water. In plants the process involves the green pigment chlorophyll and generates oxygen as a by-product.
Photovoltaic	To generate direct current electricity from sunlight using solar cells, which can be used to power equipment or to recharge a battery.
Pigment	The natural colouring matter of animal or plant tissue.
Plaster of paris	A hard white substance made by the adding water to powdered and partly dehydrated gypsum, used for holding broken bones in place and making sculptures and casts.

Pollination	The transfer of pollen to a stigma, ovule, flower, or plant to allow fertilisation.
Pollution	The presence in or introduction into the environment of a substance which has harmful or poisonous effects.
Potential energy	The energy possessed by a body because of its position relative to others, stresses within itself, electric charge, and other factors.
Prediction	When you make a good guess what the result of an investigation or experiment will be.
Preservatives	Substances or chemicals that are added to food products to prevent chemical changes and decay by microbial growth.
Preserve	The process that keeps organic things from decomposing.
Process	A series of actions or steps taken in order to achieve a particular end.
Processing	To perform a series of mechanical or chemical operations on (something) in order to change or preserve it.
Producers	Plants that make their own food, by taking energy from the sun, and with the help of water, converting that energy into useable energy in the form of sugar.
Products	Articles that are manufactured from raw materials or added to so that they can be sold.
Properties	The traits or attributes of a substance or material, which are used to describe it and understand how it behaves in different situations.
Property	The traits or attributes of a substance or material, which are used to describe it and understand how it behaves in different situations.
Proteins	One of the macronutrients found in foods like meat, milk, eggs, soy and quinoa, which provide the essential amino acids our cells, tissues and organs need to function properly.
Radiation zone	The layer of a star's interior where energy travels to the exterior by means of radiation in the form of electromagnetic waves.
Radio signal or waves	Radio waves are a type of electromagnetic radiation with wavelengths that are longer than infrared light. Like all other electromagnetic waves, they travel at the speed of light. It is the technology of using electromagnetic energy waves to carry information, such as sound.
Rate of dissolving	How quickly a solute dissolves in a solvent.
Raw material	Basic unprocessed material from which a product is made. This material in its natural state.
Raw water	Natural water found in the environment that has not been treated, such as rainwater, groundwater and water from lakes and rivers.
Refined carbohydrates	Grain products that have been processed so that the whole grain is no longer intact. The refining process removes dietary fibre, vitamins, and minerals.
Reinforce	To strengthen or support (an object or substance), especially with additional material.
Renewable	Natural resource or source of energy that is not depleted by use, such as water, wind or solar power.
Report	A written account of something that one has observed, heard, done, or investigated.
Reproducing	Living organisms make copies or offspring of themselves through sexual reproduction (male and female) or by splitting.

Research	Step-by-step investigation into and study of materials and sources in order to establish facts and reach new conclusions.
Results	What you found out, in other words the outcome of a Science investigation or experiment.
Revolution	An instance of revolving around something.
Revolve	To move in a circular orbit around something.
Rocky planets	The four planets closest to the sun, which are mostly made of rock and metal.
Rotate	To move or cause to move in a circle round an axis or centre.
Rotation	The circular movement of an object around a centre (or axis) of rotation.
Rust	Reddish- or yellowish-brown flaking coating of iron oxide that is formed on iron or steel by oxidation, especially in the presence of moisture. Iron oxide is a chemical compound of iron and oxygen.
Saturated solution	When no more solute can dissolve in a solution.
Savanna	Grassy plain in tropical and subtropical regions, with few trees.
Scavenger	An animal that feeds on dead organisms, especially a carnivorous animal that eats dead animals rather than or in addition to hunting live prey. Vultures, hyenas and wolves are scavengers.
Scrap metal	Discarded metal for reprocessing.
Seed dispersal	The movement or transport of seeds away from the parent plant.
Seedling	Young plant developing out of a seed after it has germinated or started to grow under the right conditions.
Settling tank	During the settling stage of water treatment the raw water is left to stand in a large tank so that the medium sized pieces of solid matter (sludge) sink to the bottom of the tank.
Shelf-life	The length of time for which a food item remains usable, fit for consumption or for sale.
Sodium	One of the important minerals found in the food we eat. It helps to keep the correct balance of water in the body and is essential for nerve transmission and muscle contraction.
Solar energy	Radiant light and heat from the sun that can be used to power equipment.
Solar system	The collection of eight planets and their moons in orbit round the sun.
Solid	Materials that keep their shape in a fixed form and take up a definite space.
Solidify	A physical process that occurs when a material is cooled and changes form from a liquid or gas to a solid.
Soluble substances	Substances that form solutions when they are mixed with water.
Solute	The substance dissolved in a solvent, the minor component in a solution.
Solution	A liquid mixture in which the minor component (the solute) is uniformly distributed within the major component (the solvent).
Solvent	The liquid in which a solute is dissolved to form a solution.
Specifications	A detailed description of the design and materials used to make something. They describe the things that the product or structure you are making needs to do.
Stainless steel	Metal mixture (alloy) of iron with a minimum of 10.5% chromium, which prevents corrosion. It also has carbon, silicon and maganese. Other elements like nickel can be added to enhance malleability and corrosion resistance.

Starch	An odourless, tasteless white substance occurring widely in plant tissue. It is made from the stored glucose stored in the storage parts of the plant.
Starting materials	Raw materials or intermediate substances that are used in producing a new substance.
States of matter	The different forms that matter takes on, with the main difference being the structures of each state or the density of the particles.
Stomata	The minute pores on the leaf of a plant, which allows movement of gases in and out of the intercellular spaces.
Substances	Matter that has a specific composition and specific properties. Salt water is not a substance but a mixture of two substances, water and sodium chloride.
Substation	Stored equipment for reducing the high voltage of electrical power transmission to that suitable for supply to consumers in their homes, offices, etc.
Succulents	Plants that have thick fleshy leaves or stems, and are adapted to storing water for living in dry conditions.
Sulphuric acid	Strong acid made by oxidising solutions of sulphur dioxide, which in its concentrated form is an oily, dense, corrosive liquid.
Survey	Research done with a list of questions aimed at extracting specific data from a particular group of people.
Sustainable	For systems to remain diverse and productive indefinitely; to be renewable and to be used without being completely used up or destroyed.
Switch	Device used to close and open the electric current in order to put an electrical appliance on and off. When the switch is off the circuit is open. In this case there is no electric current in the circuit. The electric pathway is now broken.
Tarnish	Thin layer of corrosion that forms over certain metals like copper, brass and silver, as their outermost layer undergoes a chemical reaction. It is a surface phenomenon that is self-limiting, unlike rust.
Technology process	The process followed in designing and making products and structures.
Telescope	An optical instrument that with curved mirrors and lenses makes distant objects appear nearer. Rays of light are collected and focused, which magnifies the image.
Temperature	A measure of the warmth or coldness of an object or substance.
Tension	The state of being stretched tight.
Thermal energy	Energy that comes from heat, which is generated by the movement of tiny particles within an object. The faster these particles move, the more heat is generated.
Thermal	Of, relating to, or caused by heat or temperature.
Thermometer	Instrument used to measure temperature in degrees Celsius (°C).
To scale	With a uniform reduction or enlargement in size.
Toughness	The property a material has of being strong enough to withstand adverse conditions or rough handling.
Traditional	When something is part of a particular culture and has been done the same way for a long time.
Transmission lines	Conductors designed to carry electricity over large distances with minimum losses and distortion.

Transpiration	Water is carried through the plant from the roots to small pores on the underside of leaves, where it changes to water vapour and is released to the atmosphere.
Tropical rainforest	Dense forest that is rich in biodiversity, found typically in tropical areas with consistently heavy rainfall.
Tubing	Materials for supporting weight can be strengthened by shaping them into a tube, which may be circular, square, triangular or even in a U-shape.
Tundra	The vast, flat, treeless Arctic regions of Europe, Asia, and North America where the subsoil is permanently frozen.
Turbine	Machine for producing continuous power with a wheel or rotor that revolves by a fast-moving flow of water, steam, gas or air.
Ultraviolet rays	Invisible radiation from the sun found in sunlight. UV rays are shorter than visible light but longer than X-rays and make up 10% of the total light output of the sun.
Unsaturated solution	Where it is possible to dissolve more solute in the solvent.
Vacuum	A space entirely devoid of matter so without a medium sound will not travel.
Veins	Vessels that support the leaf structure and transport water and nutrients to the leaf and plant food from the leaf to the rest of the plant.
Vitamins	Any of a group of organic compounds that are essential for normal growth and nutrition. They are required in small quantities in the diet because they cannot be synthesised by the body.
Volcanoes and lava	Mountains or hills, typically conical in shape, which have craters or vents through which lava, rock fragments, hot vapour and gas erupt from the Earth's crust. Lava is hot molten or semi-fluid rock.
Water supply	The provision of water by public utilities, commercial organisations and community endeavours, usually via a system of pumps and pipes.
Water treatment plant	Facility used to purify contaminated substances from wastewater to reduce industrial water consumption and environmental pollution.
Water treatment	Any process that makes water more acceptable for a specific end-use, such as drinking or industrial water supply. It removes contaminants so that the water becomes fit for its desired end-use.
Water vapour	Water in its gaseous invisible state-instead of liquid or solid (ice).
Waterproof	A material that keeps out water.
Wetland	Land consisting of marshes or swamps and water saturated land.
Zinc	Silvery-white metal that is a component of brass and is used for coating (galvanising) iron and steel to protect against corrosion.