Natural Sciences and Technology

Grade 6-A

CAPS

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

Distributed by the Department of Basic Education.

COPYRIGHT NOTICE

Your freedom to legally copy this book

You are allowed and encouraged to freely copy this book. You can photocopy, print and distribute it as often as you like. You can download it onto your mobile phone, iPad, PC or flashdrive. You can burn it to CD, email it around or upload it to your website.

The only restriction is that you cannot change this book, its cover or content in any way.

For more information, about the Creative Commons Attribution-NoDerivs 3.0 Unported (CC-BY-ND 3.0) license, see *http://creativecommons.org/licenses/by-nd/3.0/*

The Thunderbolt Kids characters were originally created as part of the Kusasa project (*www.kusasa.org*), a Shuttleworth Foundation initiative. The Shuttleworth Foundation granted permission for the use of these characters and related artwork.

AUTHORS LIST

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

Siyavula Core Team

Megan Beckett, Ewald Zietsman

Siyavula Extended Team

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

Contributors

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

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

THIS IS MORE THAN JUST A WORKBOOK!

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

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

You can watch these links in your lessons, at home on a PC, laptop or on mobile phones.

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


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



Hi there! My name is **Farrah.**

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. This year we will learn more about the amazing fact that plants make their own food! I am also excited to learn about nutrition and how to be healthy. We will also process foods – I think I am going to make plum jam and decorate the lids to give as presents to my family.

Sophie 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 **Tom**.

I have two places where I am most happy! The first is in the Science lab because this is where we get to be inventive and tinker away with projects and experiments! My second favourite place is the junk yard! Do you know how many interesting objects you can find there?! I use these objects in my latest inventions.

This is why I am really excited to be going through **Matter and Materials and Processing** with you. This year we are going to learn more about the states of matter, and some new topics such as mixtures and solutions. I am also really excited to design a system to purify water as I think this will be really useful to have!

I also really enjoy maths and thinking about how we can solve problems logically. Jojo is one of my best mates, although he can be very messy at times! But, Jojo 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 **Jojo.**

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 and Systems and Control** with you this year.

I am really looking forward to understanding more about electricity this year and why it is expensive. I have also heard that there are other ways to make electricity, besides burning coal, which are better for the environment. We will find out more later! The best part about Natural Sciences and Technology for me is that we get to learn actively. We have goals and questions which we want to answer and I am always the first to leap into action!

Tom 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 Tom 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 **Sophie**.

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 and 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. I am going to go through **Earth and Beyond and Systems and Control** with you. Did you know that we only ever see one side of the Moon?! I am also excited to find out more about telescopes, especially since South Africa will be playing a major role in astronomical research in the future.

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 Farrah 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.



Join the
Thunderbolt Kids
by adding your details here!

My name is:

_____

My favourite subject is:

_____

On the weekends, I love to:

_____

_____

My friends' names are:

_____

_____

One day, I want to:

_____

_____

STICK OR DRAW
A PICTURE
OF YOURSELF
HERE!



Table of Contents

Life and Living and Processing 4

1 Photosynthesis 4
1.1 Plants and food 4
1.2 Food from photosynthesis 9
1.3 Plants and air 15

2 Nutrients in food 22
2.1 Food groups 22

3 Nutrition 36
3.1 A balanced diet 36
3.2 Diseases caused by an unhealthy diet 45

4 Food processing 54
4.1 Why do we need food processing? 54
4.2 How are foods processed? 64

5 Ecosystems and food webs 78
5.1 Different ecosystems 78
5.2 Living and non-living things in ecosystems 82
5.3 Food webs 86

Matter and Materials and Processing 104

1 Solids, liquids and gases 104
1.1 Arrangement of particles 104

2 Mixtures 118
2.1 Mixtures of materials 118

3 Solutions as special mixtures 134
3.1 Solutions 134
3.2 Soluble substances 141
3.3 Saturated solutions 145

4 Dissolving 156
4.1 What is dissolving? 156
4.2 Rates of dissolving 159

5 Mixtures and water resources 174
5.1 Water pollution 174
5.2 Importance of wetlands 177

6 Processes to purify water 188
6.1 Clean water 188

7 Notes 204




Life and Living
and Processing

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 the gas carbon dioxide. They also recycle the air and make oxygen for us to breathe.



QUESTIONS

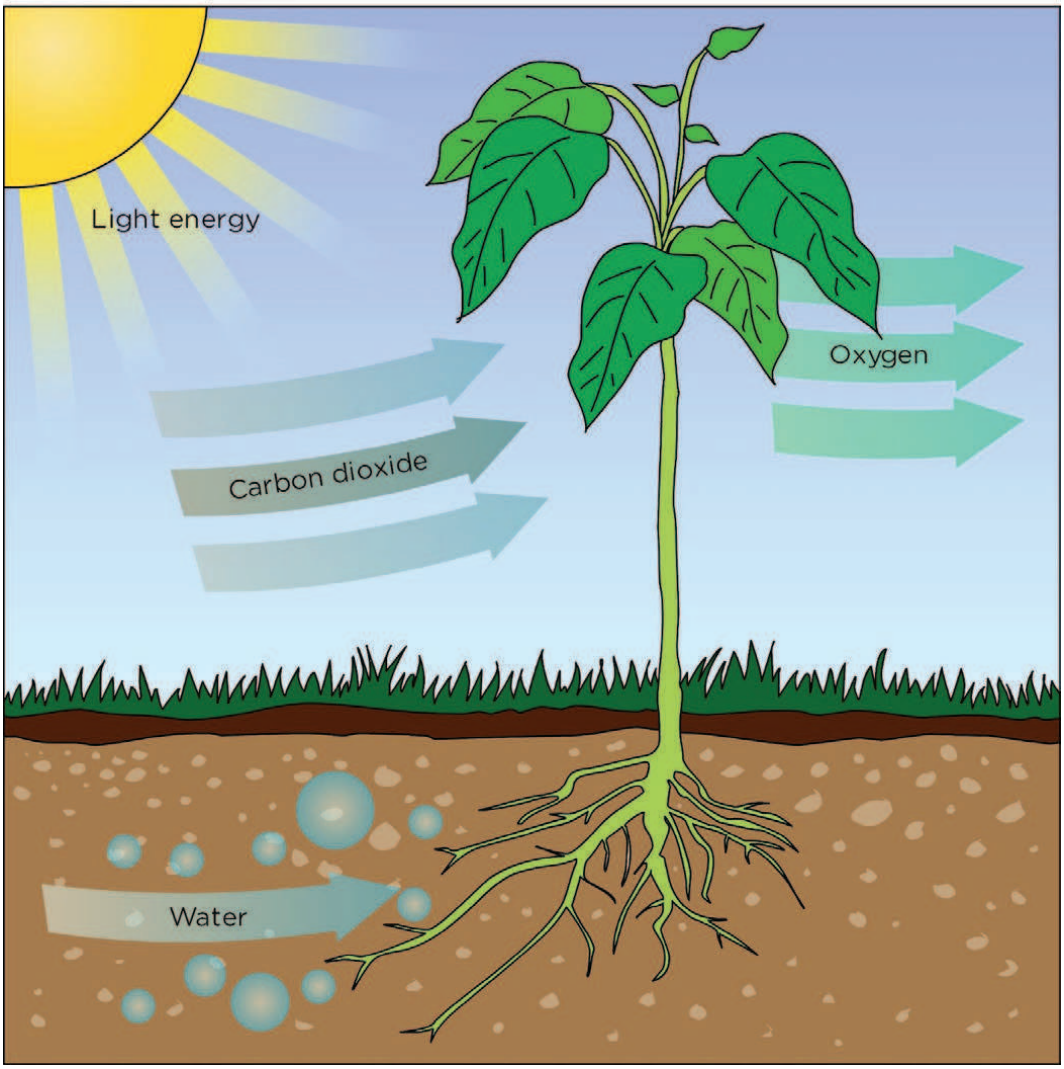
1. What happens in a factory? Why do you think we can say plants are like factories?

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 Gr 5? Plants need certain things to photosynthesise.

There are some important requirements for photosynthesis to happen. These are explained on the next page.

NEW WORDS

- photosynthesis
- chlorophyll
- carbon dioxide
- oxygen
- glucose
- molecule
- conditions
- anchorage
- microbes
- fertile



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?



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 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. These holes are found all over the plant, mostly under the leaves.

5. Soil: The soil provides mineral nutrients and water for the plant that are necessary during photosynthesis. Soil also provides anchorage to the plant, otherwise the plant cannot stand up straight.

DID YOU KNOW?

These holes 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! The same job as the pores in your skin when you sweat!



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)

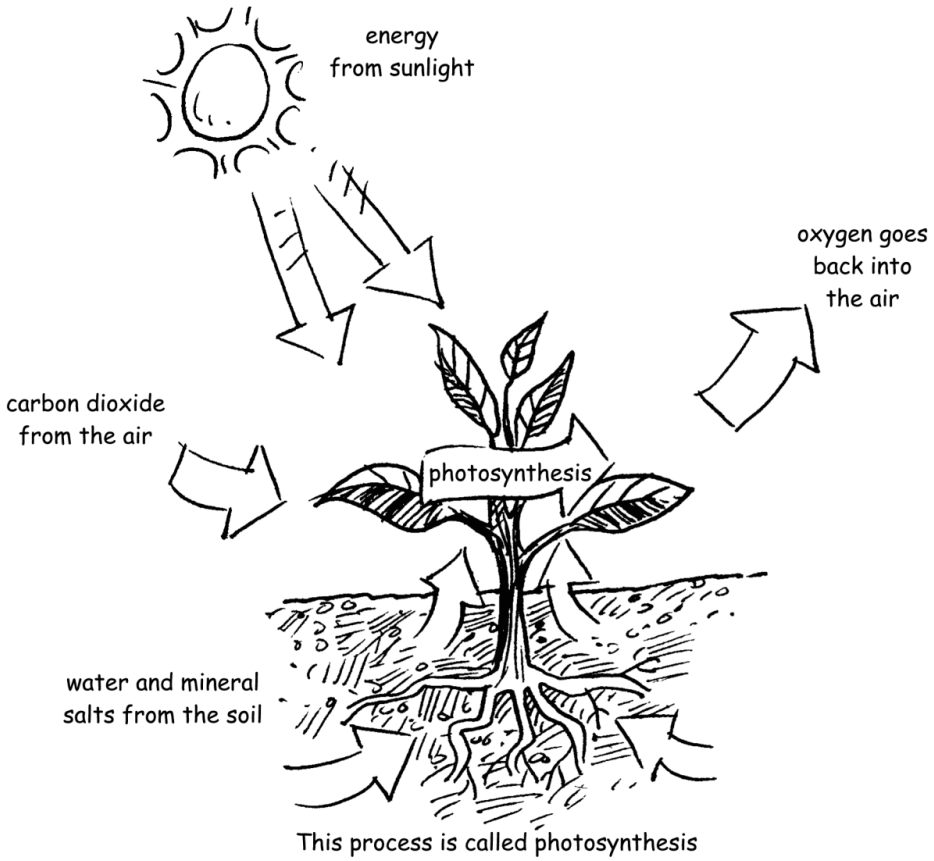
- stem (sugar cane)
- seeds (wheat or mealies)
- flowers (nasturtiums, broccoli and cauliflower)
- roots (carrots or beetroot)

VISIT

A game on growing plants!
goo.gl/RpHpV



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



The process of photosynthesis.



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



ACTIVITY: 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 above to remember in what order everything is happening.
- **Sun** - this learner can dress in yellow and perhaps get some old tin foil or shiny paper to decorate their 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 / 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 learner's chests that say 'Carbon dioxide' and dress in purple.
- **Oxygen** - attach signs to the learner's chests that say 'Oxygen' and dress in orange.
- **Glucose energy** as fruit and vegetables - dress up or make posters from scrap cardboard to show large carrots, apples, potatoes, or something similar.
- Some learners need to be **animals** who breathe out carbon dioxide and eat the plants. You can make masks out of paper plates with eyes cut out.

QUESTIONS:

1. Why do plants die when there is a drought?

2. Design a poster for your Gr 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

NEW WORDS

- iodine
- solution
- indicator
- starch
- test



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 parts of the plant that an animal will eat. They can store it in their leaves, stems or roots, flowers, fruits or seeds.



QUESTIONS

Look at the images below of different plant products. For each image, 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?) Use the space below to draw a table for your answers.



Cabbage.



Tomatoes.



Potatoes.



Broccoli.



Celery.



Carrots.



Sunflower seeds.



Lettuce.



Sugar cane.



Hazelnuts.



Mealies.



Bananas.

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



ACTIVITY: Difference between a starch and a sugar

MATERIALS:

- mealie flour
- flour
- cooked rice, potato, bread
- glucose sweets
- sugar
- sugar cane, if possible
- fresh fruit
- blindfold
- clipboard

INSTRUCTIONS:

1. Work in pairs.
2. One partner must be blindfolded.
3. On a piece of paper list the numbers 1 - 10.
4. 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.
5. After each taste your blindfolded partner must guess if it is a sugar or a starch based on the taste.
6. Record your partners answers on the piece of paper containing the numbers 1 - 10.
7. 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?

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: The iodine starch test

Note: There will be NO tasting in this activity.

MATERIALS:

- iodine
- the same foods used in the taste test (they should be marked 1 - 10)



- also include some other foods such as cheese and a boiled egg

INSTRUCTIONS:

1. Write the food or plant product that you chose in the first column below.
2. 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.
3. Use a dropper and drop iodine solution onto each food group.
4. Put a tick next to the food product that turns blue-black - this is a starch. Put a cross 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		
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?

NEW WORDS

- cell
- waste product
- cycle



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 below.



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.

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

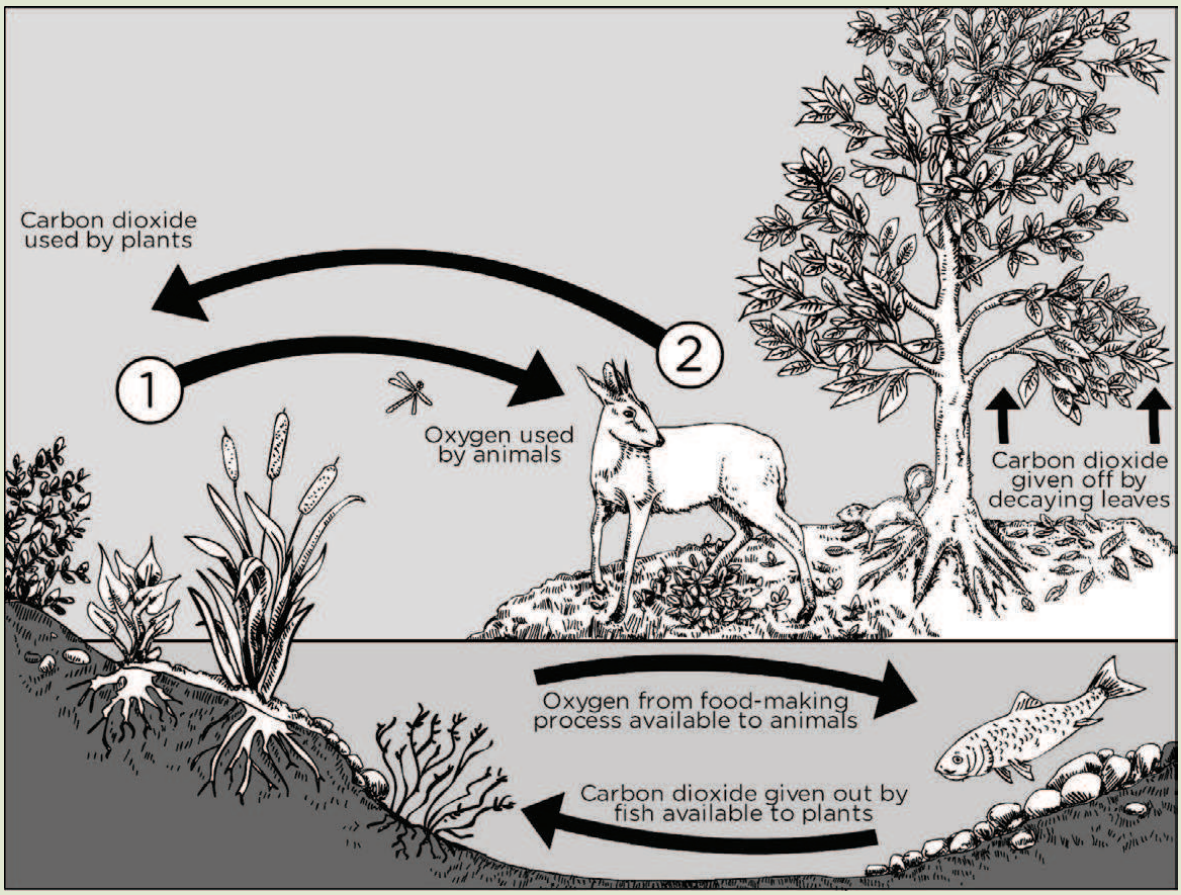
This cycle of oxygen production and use, and carbon dioxide use and production, is very important to life on Earth.



ACTIVITY: The oxygen and carbon dioxide cycle

INSTRUCTIONS:

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



The oxygen and carbon 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/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 the 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 the 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.

Word box:

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

a. The process when the green parts of plants make food is named _____.

a. Water and minerals are absorbed by the _____ of plants.

a. 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?

NEW WORDS

- classification
- carbohydrates
- proteins
- vitamins
- nutrition
- pyramid
- immune system
- insulate



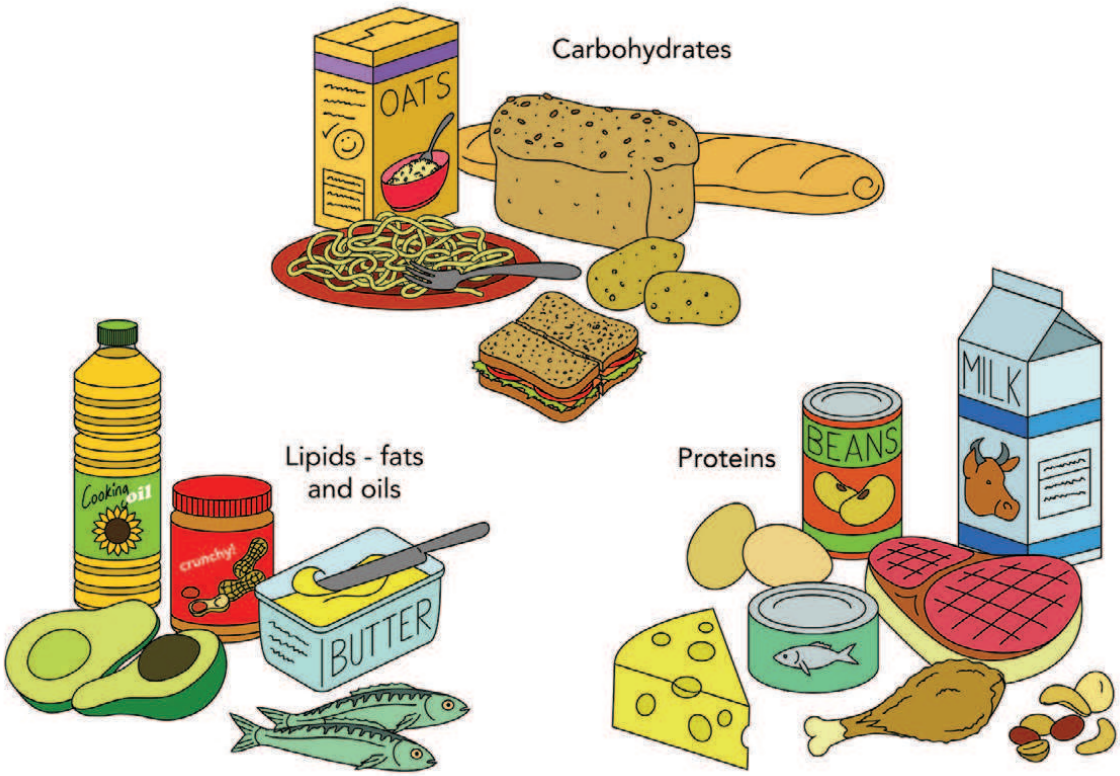
2.1 Food groups

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.

Classification offood groups

The food we eat can be grouped or classified into different types or groups. We call these *food groups*. There are a 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. **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 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** that helps to keep the correct balance of water in the body and is found in most food except fruit.
     - **Calcium** that is important for strengthening of 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 food that contains them and some of their functions in the human body:

Name of vitamin	Sources	Function
Vitamin A	Egg yolk, liver, deep-yellow and deep-green fruits and vegetables, fish liver oils	Enables the eye to produce a pigment that helps us to see in dim light.
Vitamin B	Brown rice, whole-wheat 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 ultra-violet 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.



Milk is a source of calcium.



Fruit and vegetables are sources of vitamins.





ACTIVITY: Classifying food into the different food groups

MATERIALS:

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

INSTRUCTIONS:

1. Work in groups of 2 or 3.
2. Choose the 3 foods that you think are the most healthy to eat from the different wrappers and boxes that you have in your group. Write a reason next to each of these 3 choices why you think they are really healthy.

_____

_____

_____

3. Locate the LIST OF INGREDIENTS on each food container. You should have at least 10 different containers. (If you have too few, swap with another group when they are finished with theirs.)
4. Sort the different foods into the major food groups.
5. Record your work in the table below.

Carbohydrates	Proteins	Lipids	Vitamins & Minerals

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**.

6. Read the ingredients on your 10 packaging labels again.
7. In the first column, write the name of your product.
8. Tick (✓) under each column if your product has any of these items added to it.
9. 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				

10. Make a list of the main flavourings that were used in your products.

11. What preservatives are used most often by the food manufacturers?

12. Look at the 3 foods you said were the most healthy 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 3 most healthy 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: 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 contain more than one food group.
4. In the table, write out each food in the meal, and next to it, write the food group it belongs to.

Meal	Food groups
	
	

QUESTION:

1. 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



- 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 of more than one food group.
- Most processed (manufactured) foods have added salt, sugar, preservatives, flavourings and colourings.



REVISION:

1. Write the sentence out in full below and fill in the missing words.

   Foods are classified into the following food types, ***carbohydrates***, _____, ***proteins*** and _____.

2. Name 3 reasons why lipids are important in our diet.

3. List 3 sources of proteins.

4. Why is it necessary to supplement our diets with vitamins?

5. Complete the table below which shows some important vitamins, their natural sources and functions.

Name of vitamin	Sources	Function
Vitamin A		Enables the eye to produce a pigment that helps us to see in dim light
	Brown Rice, whole-wheat 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 oils, can be made in the skin when the ultra-violet 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?

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?



QUESTIONS

Discuss the word **diet** with your class and come up with a definition for this word. Write it below.

_____

_____

NEW WORDS

- diet
- balanced



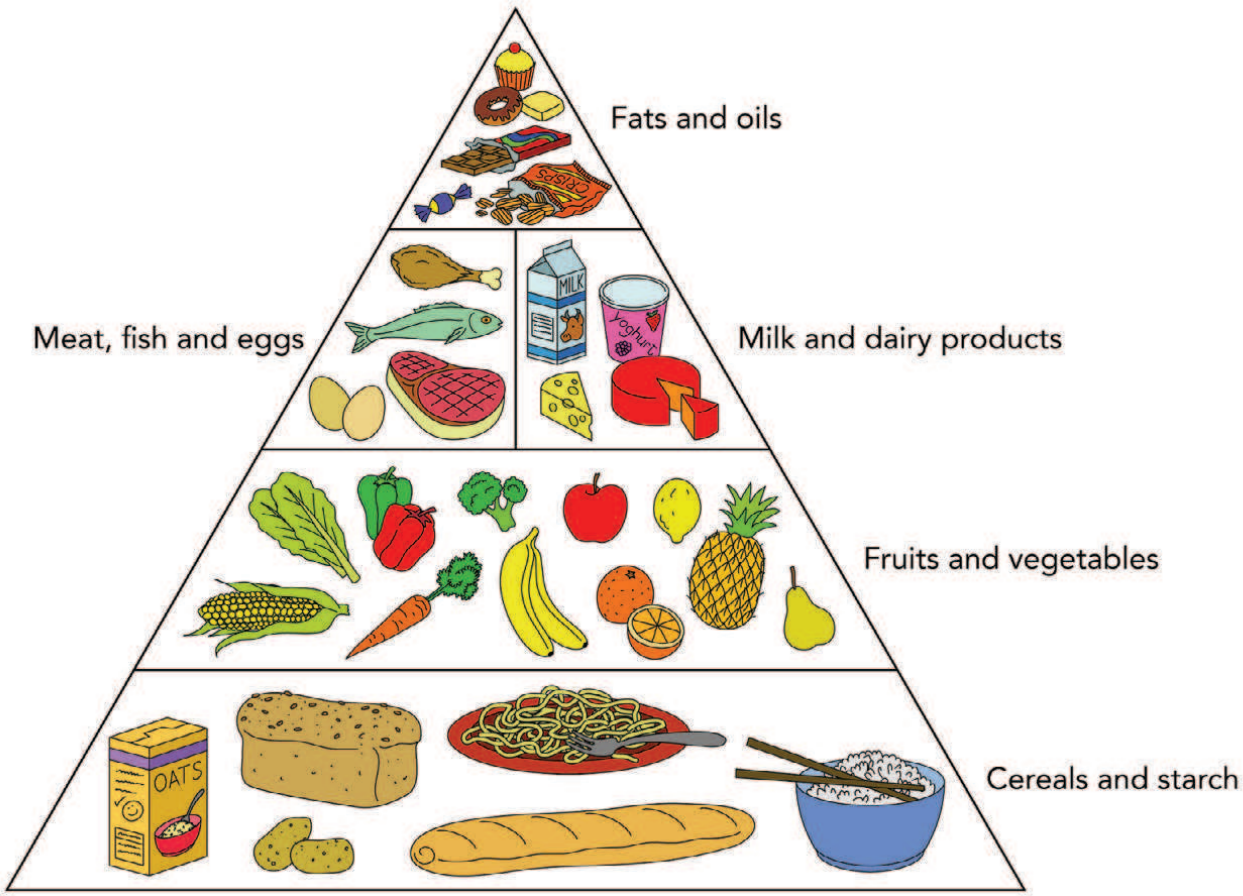
Food pyramids

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.)

- The food in the middle of the pyramid, fruit and vegetables, must also be eaten in fair amounts.
- You should eat less meat, chicken, fish and other proteins than vegetables and fruit.
- 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: Evaluating a diet to see if it contains all the food groups.

MATERIALS:

- a record of the weekly diet of Farrah's brother, Rajesh

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 3 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 2 teaspoons of sugar

Tuesday	toast with peanut butter, coffee with milk and 3 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 3 teaspoons of sugar
Wednesday	late for school - didn't eat.	2 eggs and toast with cheese, tea with milk and 3 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 3 teaspoons of sugars	indoor hockey practice after school - pie from tuckshop and Coke, chocolate and packet of hot chips	roast chicken, butternut, baked potatoes, salad, fruit juice, coffee with milk and 1 teaspoon of sugar
Friday	toast with butter (peanut butter is finished), coffee with milk and 3 teaspoons of sugar	band practice after school - pie from tuckshop and coke, sweets	takeaway chicken in a bucket, hot chips, Coke, tea with milk and 3 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 & 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 prepare the food in deep oil. Rajesh and Farrah'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 Farrah 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: Comparing meals

INSTRUCTIONS:

1. Below are photographs of different meals for breakfast, lunch and dinner.
2. One of the meals is unhealthy and the other meal is healthy.
3. Choose which is 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
	

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.

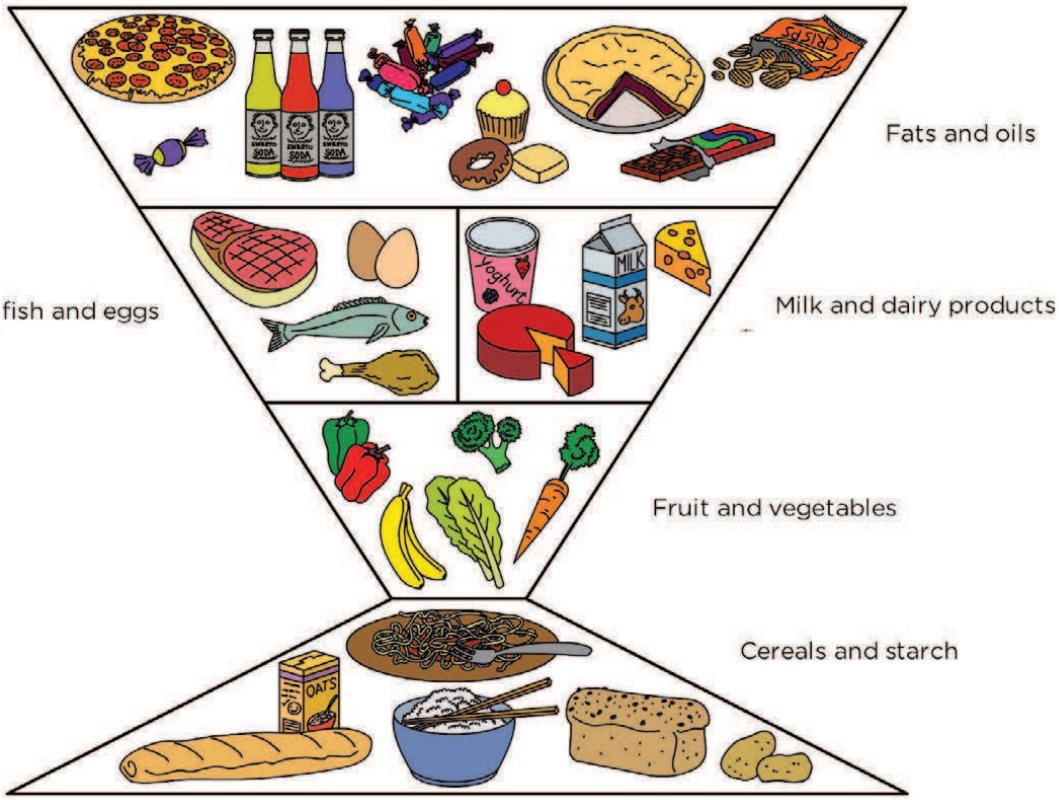
Many people live in cities and can afford to buy takeaways often, or to eat hastily prepared meals that do not always include foods from the 4 food groups.

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

NEW WORDS

- nourishment
- overeat
- obesity
- diabetes





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 and write down some of the differences below.

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 that may arise from this.

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 affordone 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.

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.



Remember to brush your teeth to help prevent tooth decay!

- **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.

VISIT

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





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



- **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 patient starves 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 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: What diseases or symptoms could Farrah'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.

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



ACTIVITY: 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 the causes of the disease, which people are most likely to suffer from it and why, the symptoms, the health risks, and 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 4 food groups, as well as water and fibre.
- Some diseases can be related to diet.





REVISION:

1. What do you understand by the term "balanced diet"? Write a description below.

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?

NEW WORDS

- processing
- preserve
- cure/curing
- artificial sweeteners
- preservatives



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.

VISIT

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





Bokkoms (cured fish).



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

ACTIVITY: A REALLY old role play



Work in groups of 4 - 5

You are time-travelers and you are joining the Thunderbolt Kids 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 Thunderbolt Kids and jump through the wormhole to 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 as much 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 and how they packaged and protected this food from scavenging animals and pesky insects.

Brainstorm this problem 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 6 month's time, and

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.



- right at the end of your stay - a week or so before you return to the present time.

Think especially offood 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 the following items that you can make and use when you land.

1. Something that you can collect and carry water in, and store it for 'the future'.
2. Something that you can collect and carry food in, and specifically something that you need to store it in to keep it away from scavenging animals and insects.
3. Something that you can use to cut with - you will need to make a shelter to sleep in and keep safe from wild animals; and also 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 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 sentences: 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?

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

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 below.

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.



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

- Today people can eat fresh fruit and vegetables all year round and 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.
- 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.



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



VISIT

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



- 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.

VISIT

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





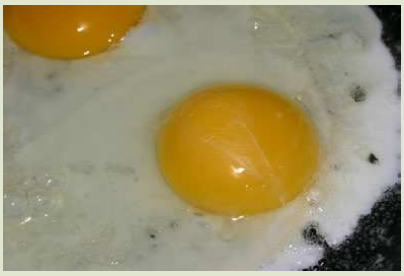
Rice or soya milk are processed foods and an alternative to cow's milk for people with allergies.



ACTIVITY: 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 why and how each food has or will be processed.

Food	Reason for being processed
 Raw meat	
 Yoghurt	
 Pickled gherkins	
 Glace cherries	
 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.



QUESTIONS

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

ACTIVITY: 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 the space below.

4.2 How are foods processed?

NEW WORDS

- shelf-life



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.

Levels of food processing

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 habitat to the point where it lands on your table.
- 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.



Milk and juice are minimally processed.



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

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.



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.

Highly processed foods:

- Highly processed foods include snack foods and desserts, biscuits, cereal bars, chips, cakes and pastries as well as soft drinks and 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?

The Swazi people make Marula beer by placing the ripe fruit in large traditional pots and letting them ferment.



DID YOU KNOW?

Mealie meal made by grinding maize forms a huge part of the diet in many indigenous cultures in southern Africa, such as the Ndebele, Zulu and Swazi.



The table below shows how a raw product is processed to make a raw ingredient which looks very different to the original raw product. Then the processed raw 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: Learning how to summarize

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

INSTRUCTIONS:

1. Use the space below to draw a table to summarize the information above about the levels of food processing.
2. Include a short description of the 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 could see in the above breakdown, the degree in which food is processed determines many of the food preserving processes involved.

Food processing methods have changed in many ways, but the basic principles are still applied. Food is still dried or heated to

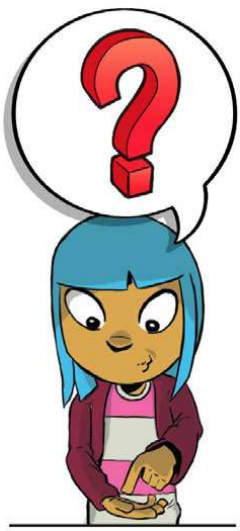
preserve it, just like people did 300 years ago, but there are many modern methods that are also used today.

- sun drying
- fermenting dairy into cheese, buttermilk (Amasi) or yogurt, or barley or grapes
- pickling vegetables (onions or gherkins for example)
- salting and spicing meet to preserve it (then drying it)
- adding sugar to berries and/or fruit to make preserves
- pasteurization: using just the right amount of heat to warm up milk or juice for example, to extend the shelflife
- cooking: roasting, smoking, baking, frying
- toasting
- freezing or refrigerating
- freeze drying
- spray drying
- making juice concentrates

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.





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 5 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 5 points are important in food processing. You might need to do some extra reading and have a class discussion.

ACTIVITY: Comparing traditional and commercial food processing methods



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.

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 in 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 (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 which 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, hand woven basket, called Iquamba, is used to store any leftover beer.

QUESTIONS:

1. What are the ingredients used to make utshwala?

2. What are the Zulu names for the three different clay 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. Use the space below to 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 outside of class, 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. In the space below, write a paragraph where you compare this modern beer-making process to the indigenous method of the Zulu people.



ACTIVITY: Food Processing Project

Now that you 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 and then process the food at the end.

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 10 different questions to ask this person during the interview. You need to 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 slide show 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 present your poster/presentation/slideshow to the class as well as 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. Below is a table. Next to each item in column A write the degree to which the raw materials were processed.

Food	**Degree of processing**
mealie bread	
fresh mealie washed and packaged	
sunflower oil	

8. Explain why many people believe that highly processed food is bad for your health.

9. Compare the food processing methods of any two food processing techniques.

10. Write a short paragraph summarising what you have learnt about food processing and why 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?

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 nonliving 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
- dependent
- interdependent



5.1 Different ecosystems

An ecosystem is an area where living and non-living things depend on each other in many different ways. An ecosystem can survive on its own without any help or products from any other sources because the living and non-living things in the ecosystem depend on each other for their survival.

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 rain forests, and forests of coniferous and/or deciduous trees in moderate climates support many kinds of herbivores and carnivores.
- deserts and semi deserts

ACTIVITY: Describing different ecosystems



INSTRUCTIONS:

1. Below is a table with photographs of different ecosystems. Study each photograph.
2. In the column next to the photo, identify the type of ecosystem.
3. Then write a description of the ecosystem where you identify:
   a. Some important physical features and structures, such as rivers, mountains, rocks, etc.
   b. The type of climate you expect where this ecosystem is found.
   c. The types of plants and animals you would expect to find in the ecosystem and why they might benefit from living in these conditions.

Ecosystem	Type and description of ecosystem
	

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.







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.



Typical Fynbos at Cape Point Nature Reserve.

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 nonliving 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: Assessing the balance between living and non-living things



INSTRUCTIONS:

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



A dried river bed.

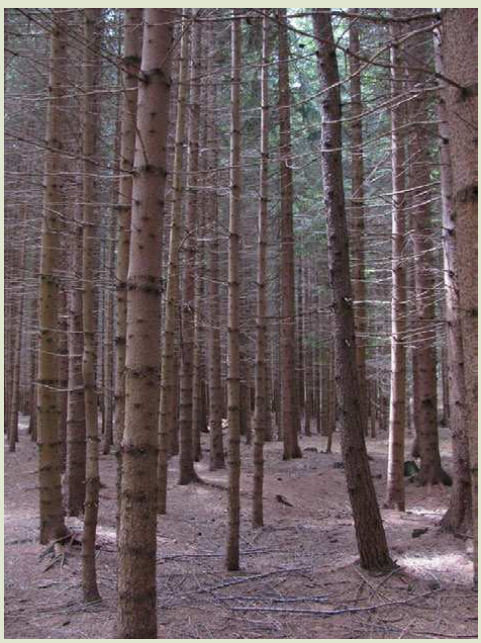
In this river ecosystem, the water has dried up due to a drought. How does this affect the biodiversity of the plants and animals in this ecosystem?

_____



The soil has started to erode.

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



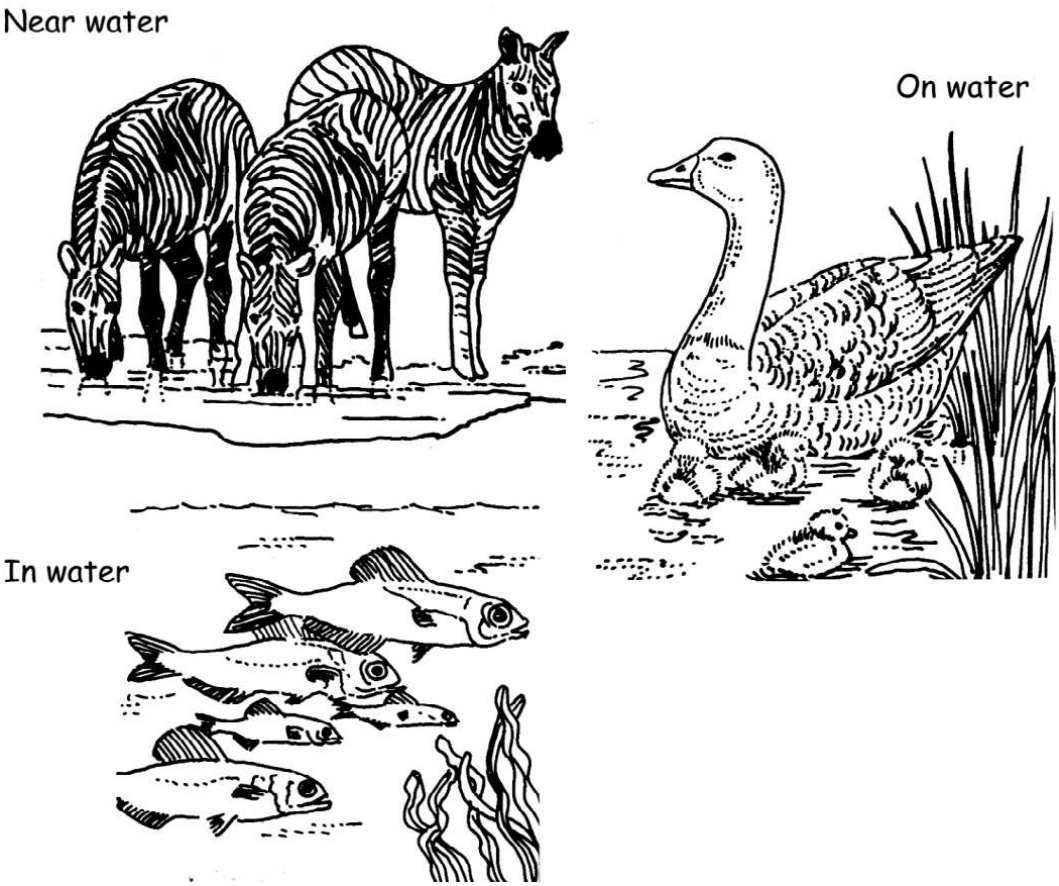
A pine tree plantation

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 nonliving 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.



Animals depend on water in their ecosystems.

- 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.)

NEW WORDS

- food web
- microorganism



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 Gr 5 work but also from the photosynthesis work you started this term with)? Write an answer below.

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.

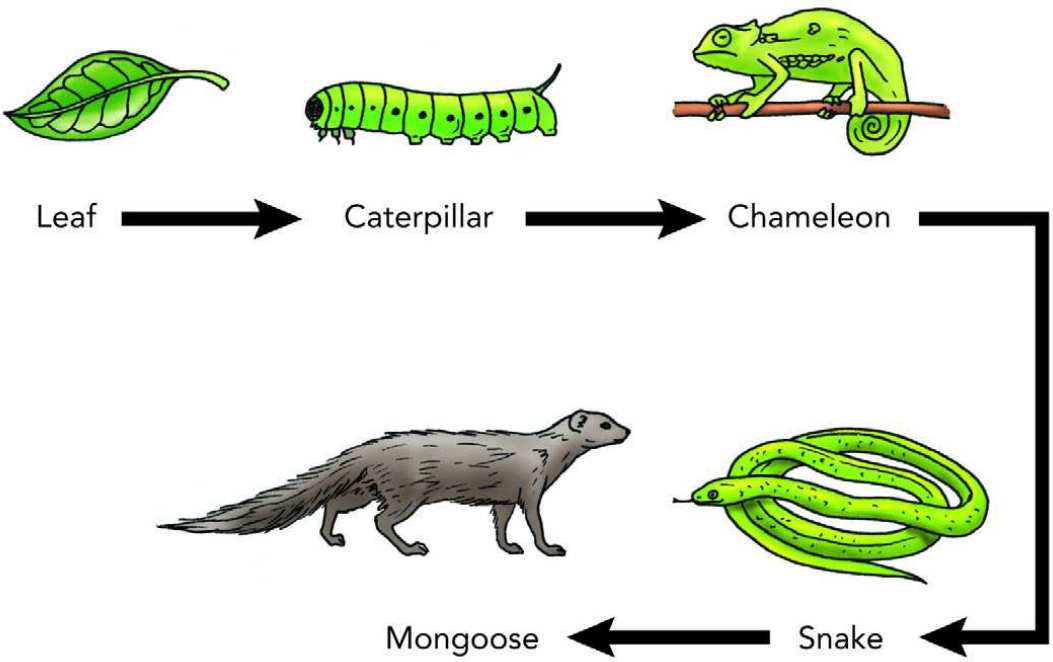
- insectivores only eat … can you guess what?
- scavengers eat dead animal matter.
- decomposers are micro-organisms like bacteria and fungi, as well as mushrooms, that break down animal and plant material into tiny particles and recycle it into the ground ready for the plant to use.

QUESTIONS

What do you call a human herbivore?



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



A simple food chain.



QUESTIONS

Turn to a friend and design your own food chain consisting of 4 organisms. Remember a food chain always starts with plants (producers).

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

For example, in the above food chain, 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.

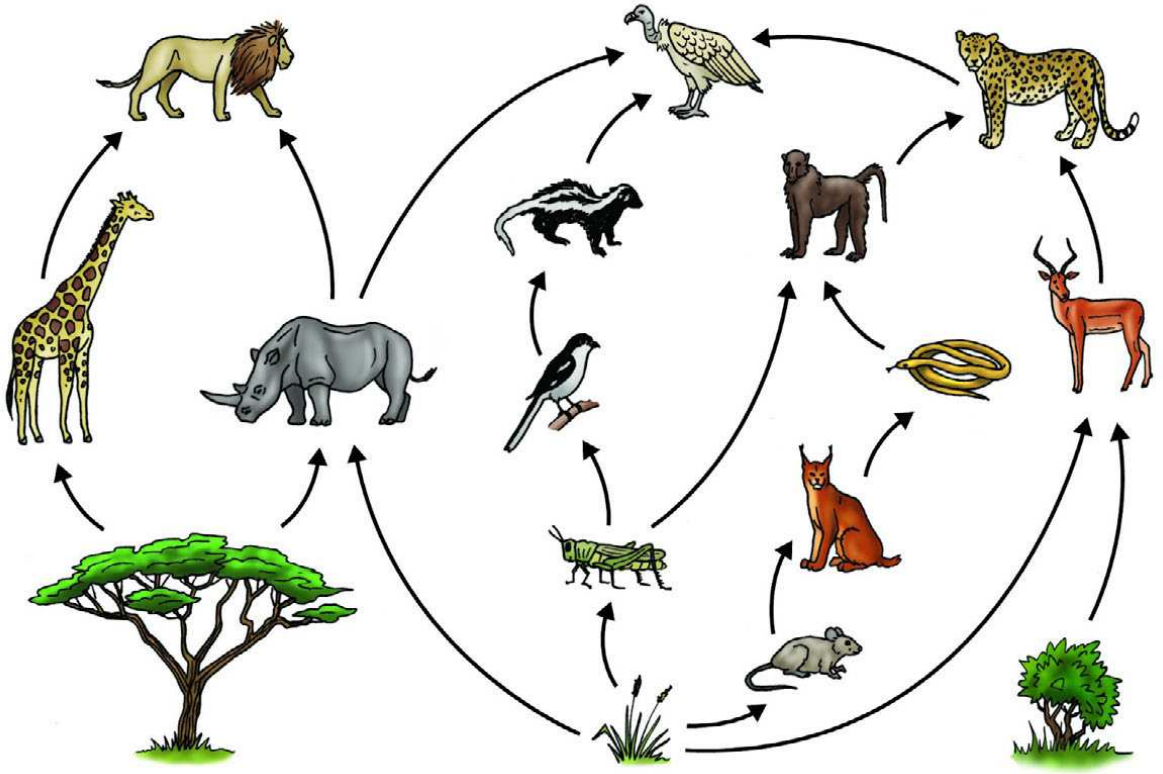


So what is a food web?

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.

On the next page is a food web in a savanna ecosystem.



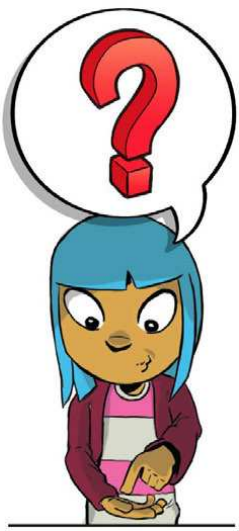
A food web in a savanna.

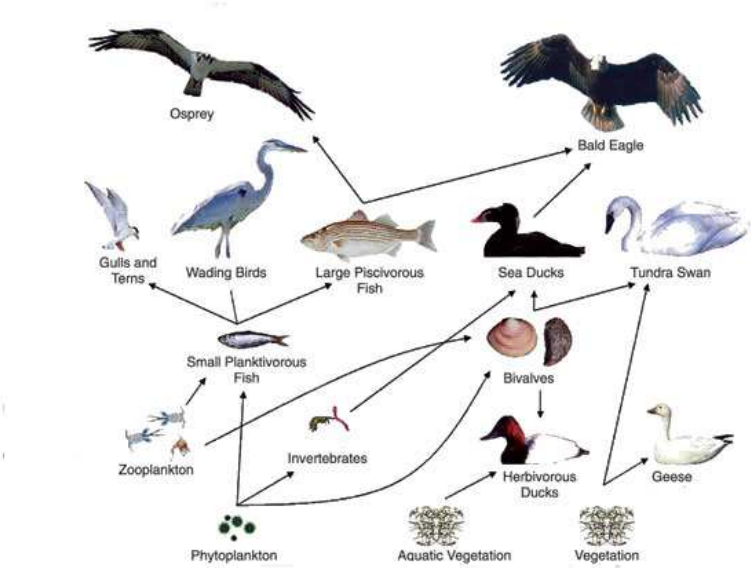
There are also different levels of consumers in an ecosystem:

- Primary consumers are the herbivores which 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 and identify the producers and the consumers. Distinguish between the primary, secondary and tertiary consumers. You can write your answers (in pencil in case you make a mistake) on the food web illustration.
2. Below is another food web consisting of plants, fish and birds. What kind of ecosystem do you think this foodweb describes?





A food web consisting of plants, fish and birds.



ACTIVITY: Drawing food webs

INSTRUCTIONS:

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

- Sea ecosystem: phytoplankton, sea weed, zooplankton, crab, lobster (scavenger), prawn, small fish, large fish, turtle, seal, dolphin, killer whale.

- Forest ecosystem: grass, small plants, seeds, beetle (herbivore), butterfly, tree frog, rabbit, mouse, seed-eating bird, insectivorous bird, snake, fox, owl.

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.



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

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".





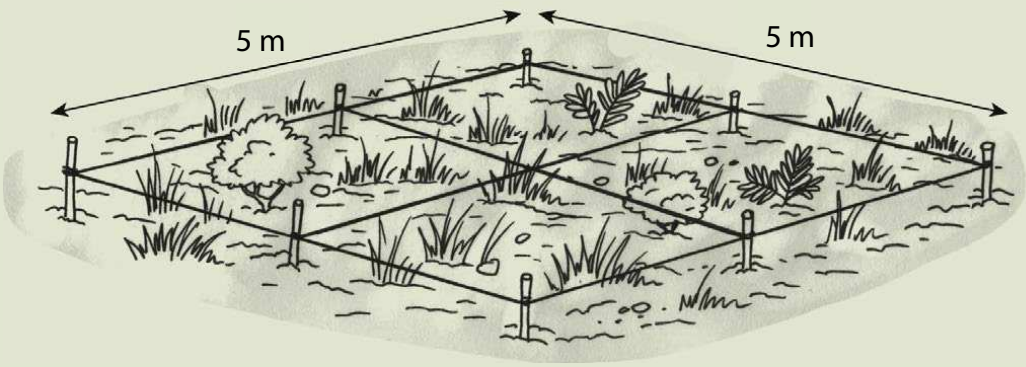
ACTIVITY: Studying an ecosystem

MATERIALS:

- 8 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.
2. Go outside with your teacher and identify an ecosystem in your school grounds, or near to the school which you can study
3. You will need to mark out the area with the sticks and string using the quadrant method.
4. Look at the picture below to get an idea of how to set up your quadrants.
5. The area must be about 5m x 5m.
6. Once you have marked out the square, divide it up into 4 smaller squares with the string so that you have a quadrant with 4 squares as shown in the picture.



A 5m x 5m quadrant.

7. 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.

8. For each of the 4 quadrants in your ecosystem, count the number of different species of plants and animals.

9. See if you can identify the names of the different plant and animal species using reference books. Fill this out in the table below when you get back to class.

10. 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. Fill out the table below for each quadrant:

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

6. 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 quadrant)

7. What is the average number of animal species?

8. What is the average number of total organisms in your ecosystem?

9. What is the number of organisms per unit of area? This is quite tricky - your teacher might need to help you!

10. Fill in the names of 3 species of plants and 3 species of animals that you identified in the table below. Do a simple drawing of each organism and write a short description of each species.

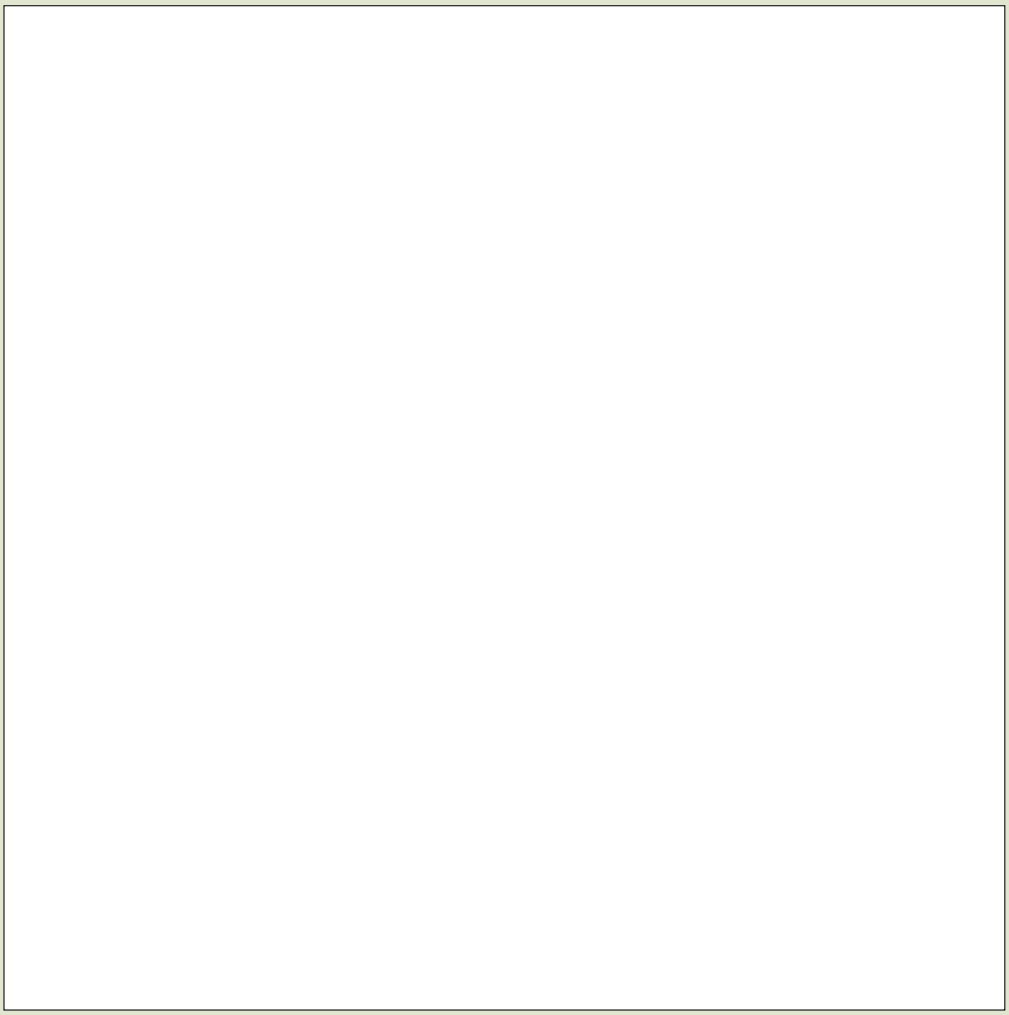
Names of species	**Drawing**	**Description**
Plant species:		
1:		

2:		
3:		
Animal species:		
1:		
2:		
3:		

11. 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.

12. Your ecosystem will contain animals and plants which are

interdependent and they are connected by their feeding relationships. Use the space below to draw a food web for your ecosystem.



13. Ecosystems are often destroyed due to the impact of humans or other environmental disasters, such as a flood or drought. Identify some possible threat to your ecosystem and write about them below and why they could destroy your ecosystem.

14. Brainstorm possible ways to prevent these threats to your ecosystem from destroying it. Record your ideas below.



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 relationship.
- 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.

REVISION:



1. Provide a definition for an ecosystem.

_____

_____

_____

2. Why do you think the feeding relationships between plants and animals in an ecosystem is called a food ***web?***

_____

_____

3. What is the term given to animals which break down dead plant and animal material?

_____

4. Read this blog entry made by a Gr 6 pupil in Limpopo province reporting on their environment.

   " I live in the Waterberg area in north Limpopo province. 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 Dutch 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."

5. Described what happened to the land when all the cattle, sheep and goats were grazing on it.

6. Explain what happened to the original, indigenous animals that lived on the land after the cattle farmers arrived?

7. Can you predict what would have happened if the people did not change the way they used the land?

8. What factors did they have to change to protect and conserve their land?

9. If the farmers instead of removing the cattle and goats, rather planted crops on the land, what do you think would have eventually happened?

10. 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?

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

Now, it is time to join Tom to learn more about Matter and Materials!




HOT
WET
CEMENT


Matter and Materials
and Processing

1 Solids, liquids and gases



KEY QUESTIONS

- How are the 3 states of matter different from each other?
- How can we draw pictures of the 3 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?

NEW WORDS

- state (of matter)
- particle
- vacuum



1.1 Arrangement of particles

We have learnt that matter can exist in 3 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 (solids, liquids and gases) has 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!

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 Tom? Most people find it very hard to think about, so do not worry, we will go through it slowly.



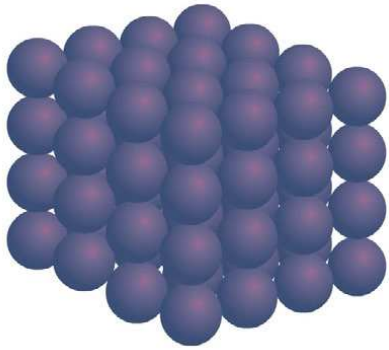
The particles that matter is made of are much too small to see with the naked eye. They are even too small to see with a strong microscope. So how do we know they exist? Scientists, with special microscopes and other special scientific instruments, have collected evidence that they exist. It is now a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



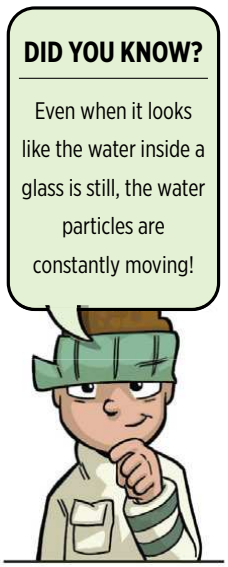
The particles in a solid.

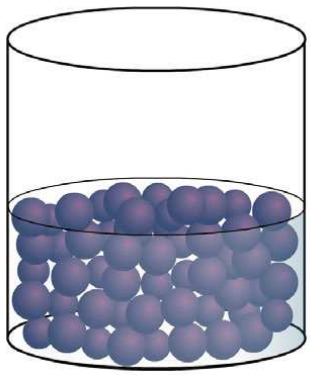
The particles in a liquid

If we could shrink ourselves down to the size of a 'matter 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.

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





The particles in a liquid.

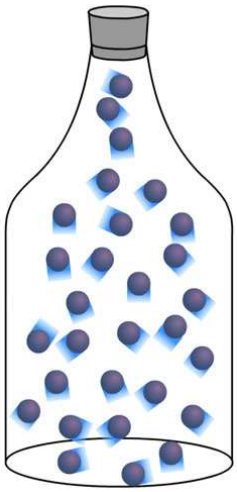
The particles in a gas

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 them closer together. We can make the spaces between them smaller.

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 (disperse means to spread out over an area or space.)





The particles in a gas.

ACTIVITY: 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 3 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?

Gas:

1. Now let's pretend to be the particles in a liquid. 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?

_____

VISIT

Solids, liquids and gas particles (video)
goo.gl/CcDTr



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: The 3 states of matter in everyday life

INSTRUCTIONS:

The table below contains a list of containers.

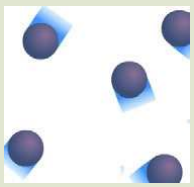
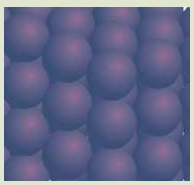
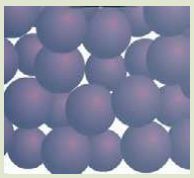
1. Say what material is usually kept in each container. Write your answers in the middle column.

2. 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?
		
		
		
		
		
		

In the next table there are 3 pictures.

1. 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.
2. For each picture, choose 2 examples from the previous table and write them in the column *on the right*.

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

Draw a picture of the particles inside each of the following examples:

1. A bar of soap.

2. A cup of tea.

3. A 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 the first activity, 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?

3. In what ways did their behaviour change?

4. We know that materials can change from one state to another and back again. Can you think of an example of this?

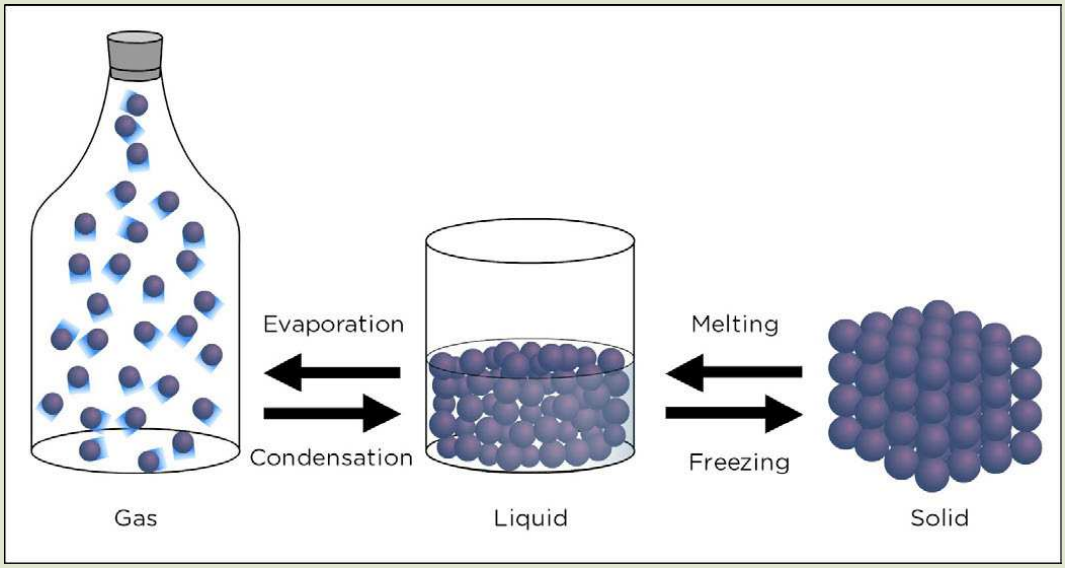
What happens to the particles inside a material when it changes from one state to another? The next activity will help us to answer that question.

ACTIVITY: The states of water



INSTRUCTIONS:

1. In this activity we will watch a video about water in 3 different states: solid, liquid and gas.
2. Follow the link below and watch the video, then answer the questions that follow. goo.gl/ya8f3
3. If you cannot watch the video, do not worry! Study the picture below 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?

6. What do we call the process of liquid water changing to water vapour (steam)?

7. What do we call the process when steam (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 3 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:

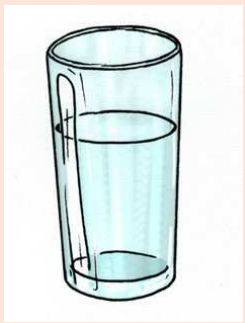
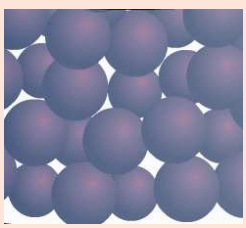
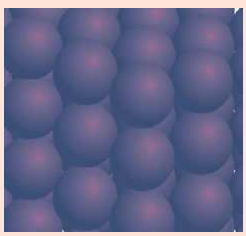
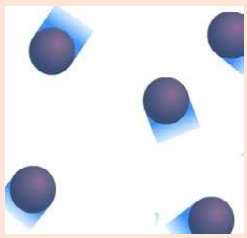
1. How can we change water to steam?

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 3 images of water in the different states of matter, and 3 images of the arrangement of the particles. Match the image of water with the arrangement of particles by drawing lines between them, to pair them up.

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!



2 Mixtures



KEY QUESTIONS

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

2.1 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
- variety





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 below 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 sweet 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: Mixing solids

MATERIALS:

- 500g bag of barley (beans or lentils will also do)
- 500g bag of rice
- Small packet of sugar
- Clean sand (from the beach or from a building site)
- Plastic spoons for scooping
- Small yoghurt tubs or paper cups for mixing
- Sieve (the type used for sieving flour)

INSTRUCTIONS (Part 1):

1. Place 10 scoops of barley in the mixing tub.
2. Place 10 scoops of rice in the mixing tub.
3. Stir the barley and rice until they are mixed.
4. Answer the questions below.

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 10 scoops of rice in the mixing tub.
2. Place 10 scoops 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 10 scoops of sand in the mixing tub.
2. Place 10 scoops 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: Mixing a solid and a liquid

MATERIALS:

- clean sand (from the beach or from a building site)
- plastic spoons for scooping
- small yoghurt tubs or paper cups for mixing
- sieve (the type used for sieving flour)
- kitchen towel or paper towel

INSTRUCTIONS:

1. Place 5 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.

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 ofliquids?



Juice is a mixture of liquids.

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



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



ACTIVITY: Mixing liquids

MATERIALS:

- water
- cooking oil
- plastic spoons for scooping
- small glass or transparent plastic cup for mixing

INSTRUCTIONS:

1. Place 10 scoops of water in the mixing tub.
2. Place 10 scoops of cooking oil in the mixing tub.
3. Stir the oil and water until they are mixed.
4. Let the mixture stand for a few minutes, then answer the questions below.

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: Separating mixtures

INSTRUCTIONS (Part 1)

The table on the next page contains pictures of mixtures.

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

Picture of mixture	Materials in the mixture	How the mixture could be separated
		
		
		
		

INSTRUCTIONS (Part 2)

The table below contains descriptions of mixtures.

1. For each of the mixtures in the table, 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.

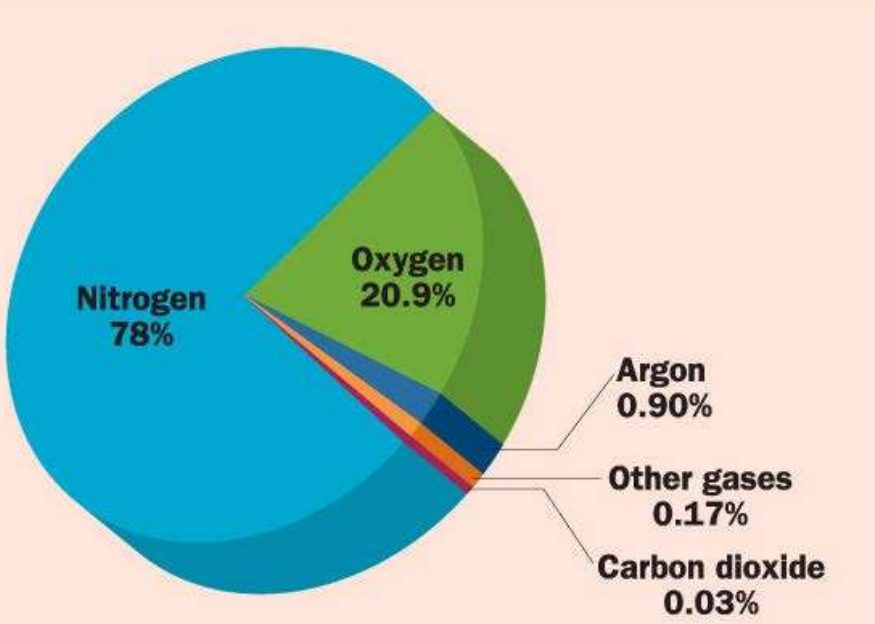
REVISION:



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 5000 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!



3 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?

NEW WORDS

- solution
- solvent
- solute



3.1 Solutions

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

When is a mixture also a solution?

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: 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 below, a few possible observations are given. Choose the one that is the best description for what you observed, by making a cross in the matching 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. Once you have recorded your observation, you can empty the yoghurt tub.
6. Repeat steps 1 - 4 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		X
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 ifit 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 the activity *Mixing solids* to remind yourself.)



ACTIVITY: Which mixtures are solutions?



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

QUESTIONS:

In the activity *When is a mixture also a solution?*, we mixed different substances with water. We saw that some of the substances looked as if they had disappeared in the water.

1. What name do we give to the substance that looks as if it has disappeared?
2. What name do we give to the substance that we can still see?
3. What name do we give to these mixtures?

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	

In the activity above, we mixed different substances with water.

1. Which substance is the **solvent** in all the mixtures?

---

2. From the mixtures above, choose an example of a solution that consists of a **solid solute** and a **liquid solvent**.

---

3. From the mixtures above, choose an example of a solution that consists of a **liquid solute** and a **liquid solvent**.

---

4. 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 Tom. 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: What is a solution?



MATERIALS:

- copper sulfate crystals
- tap water
- clear container, such as a glass beaker or test tube (a water glass will also do)
- plastic spoon for scooping and stirring

INSTRUCTIONS:

1. Look at the copper sulfate crystals and the water. Write one sentence to describe each substance in the table below.
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 below. Save it for answering the questions that follow.

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

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 the space. You can use the following symbols to represent each substance:
   - shaded circles to represent water particles
   - white hexagons to represent copper sulfate particles

VISIT

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



3.2 Soluble substances

NEW WORDS

- soluble substance
- insoluble substance



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 a previous activity (*Which mixtures are solutions?*) to link this new idea to what we know about **solutions**.



ACTIVITY: Soluble or insoluble?

INSTRUCTIONS:

1. The table from the activity *Which mixtures are solutions?* has been copied below, and an extra column has been added.
2. 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 the 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** in the open spaces.

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



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

_____

_____

MATERIALS AND APPARATUS:

- sugar solution
- 2 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. Record all your observations in the table below.

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?

NEW WORDS

- dissolve
- saturated solution



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 the 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.

3.3 Saturated solutions

Suppose we were to make a cup of tea and we put in 3 teaspoons of sugar. Mmm... lovely sweet, warm tea!

QUESTIONS

Now imagine you add 3 more teaspoons of sugar to the tea. How many teaspoons of sugar did we add?



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

Now let us imagine 3 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 it out.



ACTIVITY: How much solute will dissolve?

MATERIALS:

- clear container (a glass beaker would be best, but a large yoghurt tub would also work, but not if you heat it later)
- tap water
- small packet of sugar
- plastic spoon for scooping and stirring

INSTRUCTIONS:

1. Measure a 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: Making sugar crystals



MATERIALS:

- 1/2 cup water
- 1 cup table sugar
- clean glass jar
- food colouring
- pencil
- rough string (cooking twine works great)
- 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 sting 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!



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

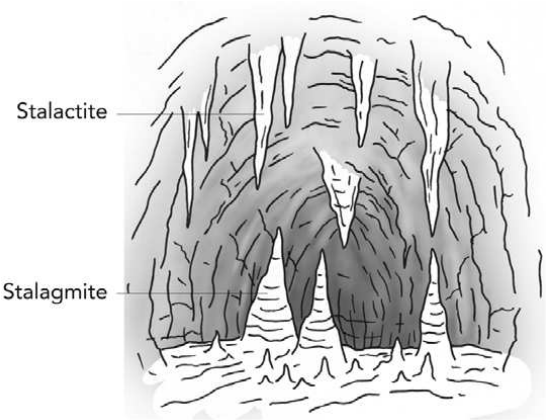
Have you ever visited a cave? Inside, you may have seen crystal formations called stalactites and stalagmites. Stalactites and stalagmites form inside limestone caves. Stalactites hang down like icicles and stalagmites grow from the floor of the cave upwards. Stalactites and stalagmites always occur 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. Over many thousands of years, the stalactite and stalagmite may connect up to become a column.

NEW WORDS

- insoluble substance





Stalactites and stalagmites forming in a cave.



Cango Caves in Oudtshoorn in South Africa.

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 below.

_____



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.



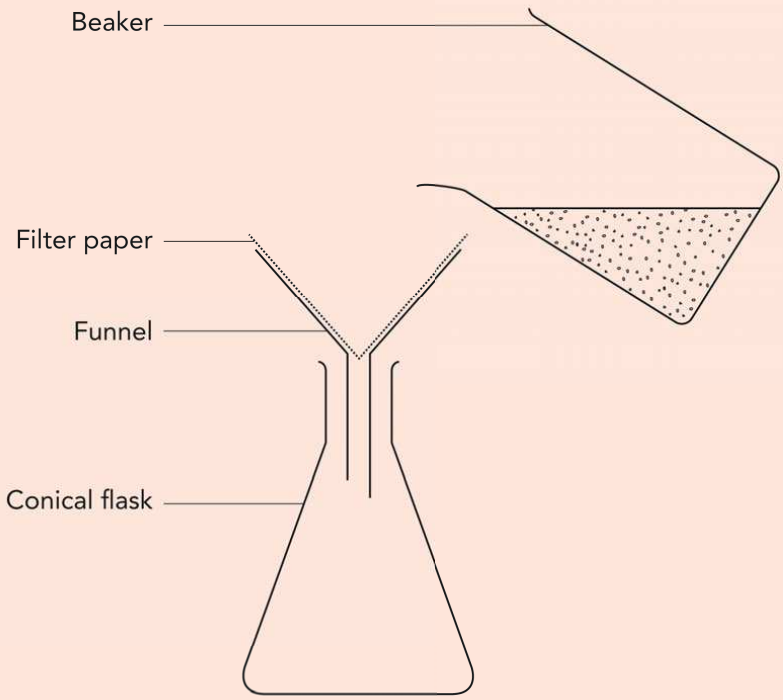
REVISION:

In the activity *Soluble or insoluble?* 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? (Hint: Look at the activity *Mixing a solid and a liquid.*) Write it down below.

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.. ?)

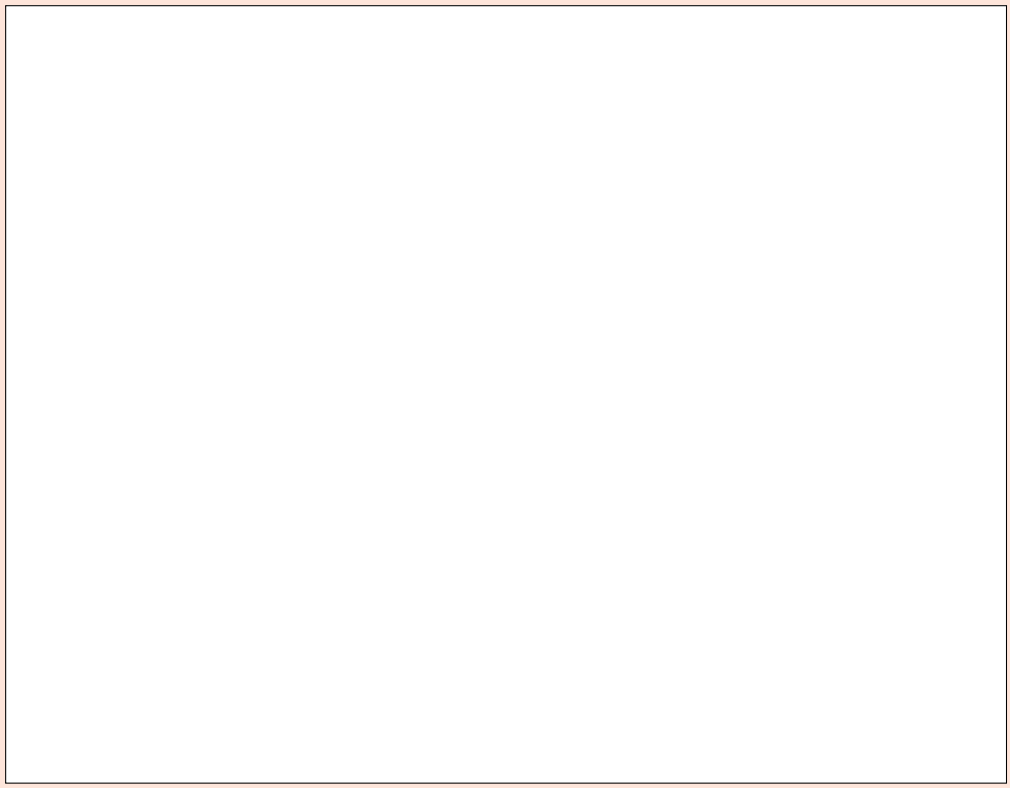
5. What would happen if the mixture of sugar and water is poured through a filter? Would it be possible to separate the water and the sugar?

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!



4 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?

4.1 What is dissolving?

In this section 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, namely: is melting and dissolving the same? What do you think?



ACTIVITY: Is melting and dissolving the same?

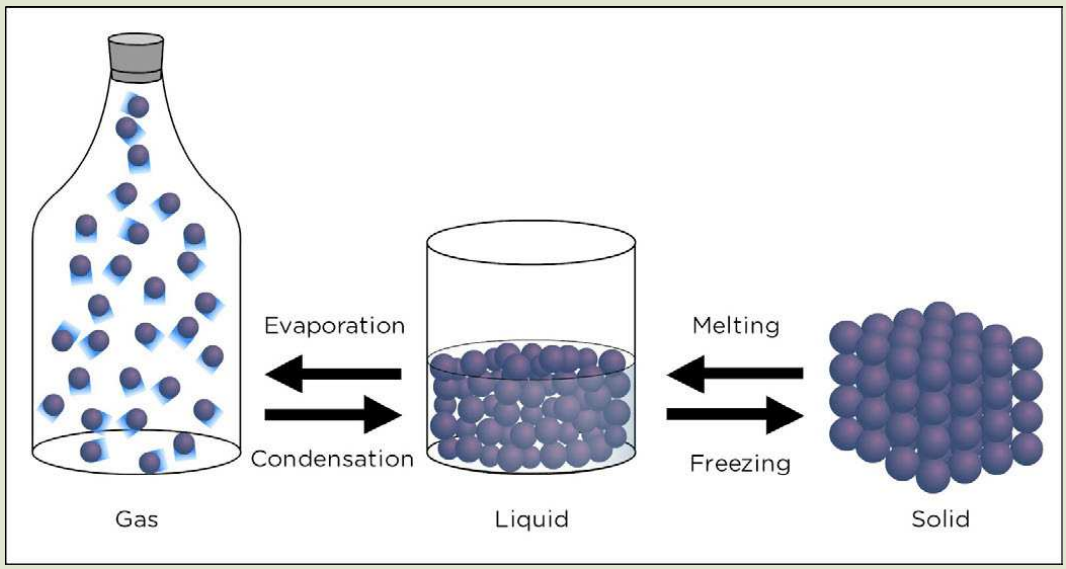
In this activity we are going to explore the differences between melting and dissolving. We have learnt that matter can exist as 3 different states, namely solid, liquid and gas.

INSTRUCTIONS (Part 1)

Watch the following short video clip to remind yourself how a solid, liquid and gas are different from each other. You should 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 (i.e. solid) to another state (i.e. liquid). goo.gl/gf7Ck

The following picture shows how the different states of matter are related to each other. It also shows what the different state

changes are called.



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?

---

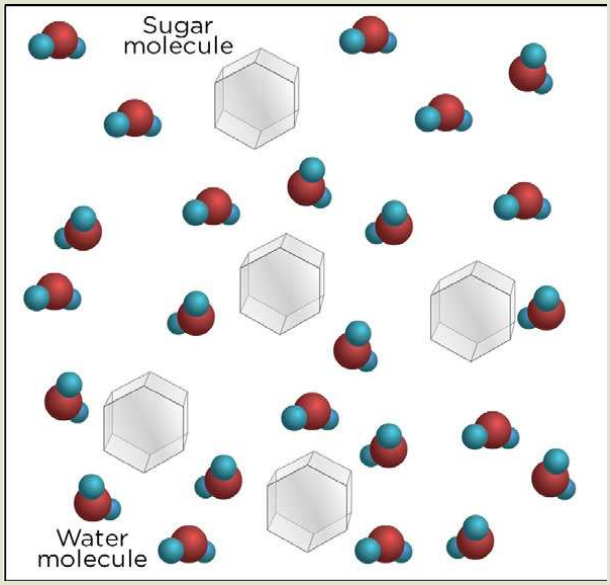
3. Fill in the missing words:

   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)

Do you remember dissolving sugar in water in the previous chapter?

The following picture shows what we would see if we could shrink ourselves down to the size of water and sugar particles (molecules).



A solution of water and sugar molecules (particles).

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

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 picture of the liquid which is shown below?

4. What do we call it when we have two or more substances combined?

5. Can we say that the sugar melts? Give a reason.

NEW WORDS

- temperature
- grain size
- variable
- rate



4.2 Rates of dissolving

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.

Tom likes his coffee sweet, with 3 teaspoons of sugar. For the coffee to taste sweet, the sugar must be dissolved. Here is a picture of a cup of coffee. Answer the questions that follow.



A cup of coffee.



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 Tom 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 3 investigations to explore the factors that affect the rate of dissolving of sugar (a solute) in water (a solvent).

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

INVESTIGATION: Does salt dissolve faster in hot or cold water?



AIM:

_____

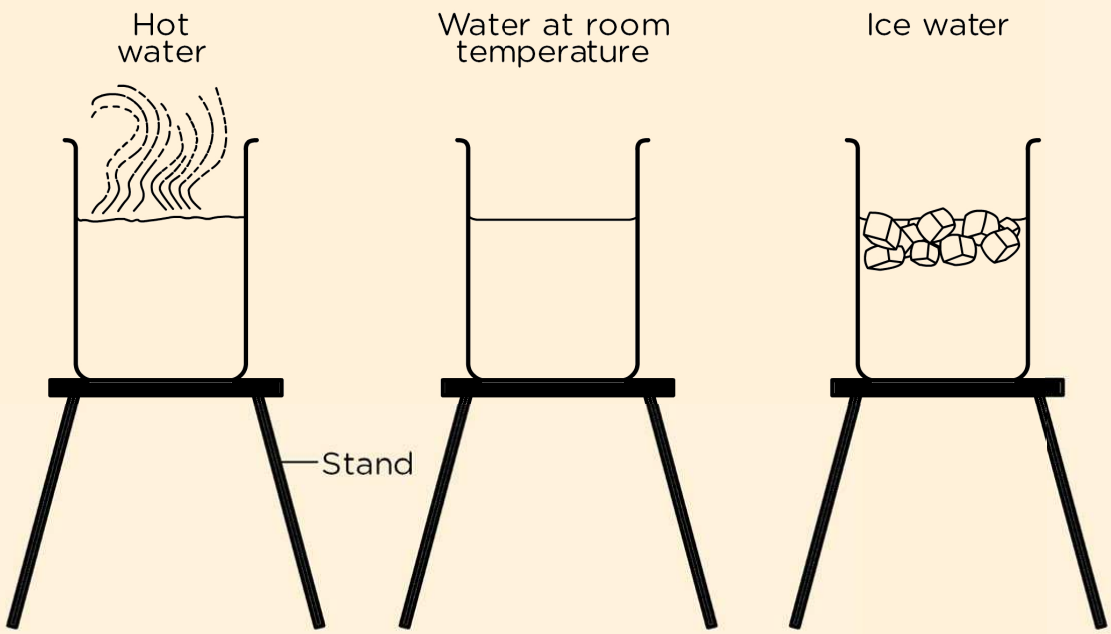
_____

MATERIALS AND APPARATUS:

- 3 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 second hand

METHOD:

1. Measure the same quantity (100 ml) of tap water, hot water and ice water respectively into the three containers. Look at the diagram of the setup.
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. Record the time in the table below.
5. Repeat steps 3-5 with the tap water and record the time it takes for the salt to dissolve in the table.
6. Repeat steps 3-5 with the ice water, and record the time it takes for the salt to dissolve in the table.



RESULTS:

The effect of temperature on dissolving

Situation	**Time to dissolve (in seconds)**
Salt in hot water	
Salt in tap water	
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 conclusion below by filling in the missing word or words.

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: Does fine salt dissolve faster than rock salt?

AIM:

_____

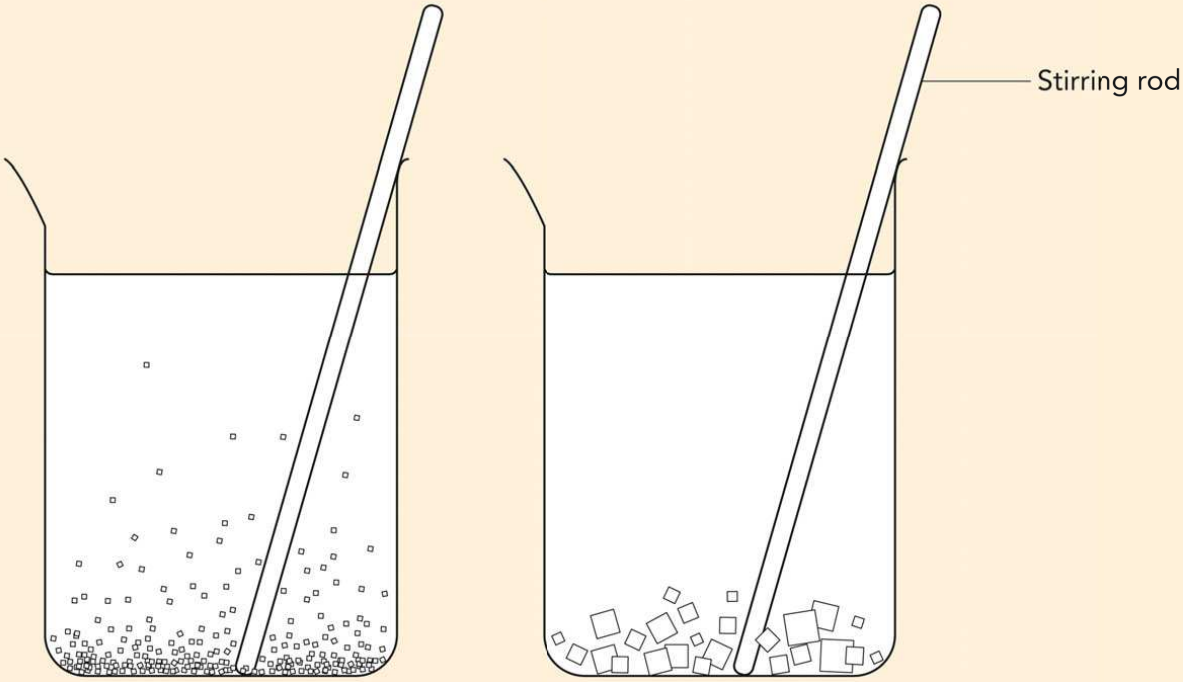
_____

MATERIALS AND APPARATUS:

- 2 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 each container.
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. Record the time in the table below.
4. Repeat steps 2-3 with the coarse rock salt.



Beaker with fine salt

Beaker with coarse salt

RESULTS:

The effect of grain size on dissolving

Situation	Time to dissolve (in seconds)
Fine salt in water	
Coarse salt in 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. What did we measure?

5. Which type of salt dissolved faster?

6. Complete the conclusion below by filling in the missing word or words.

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: 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 experimental design to answer the question. Look at the materials and apparatus that have been provided, as well as the diagram, to design your investigation and then write it out in the spaces below.

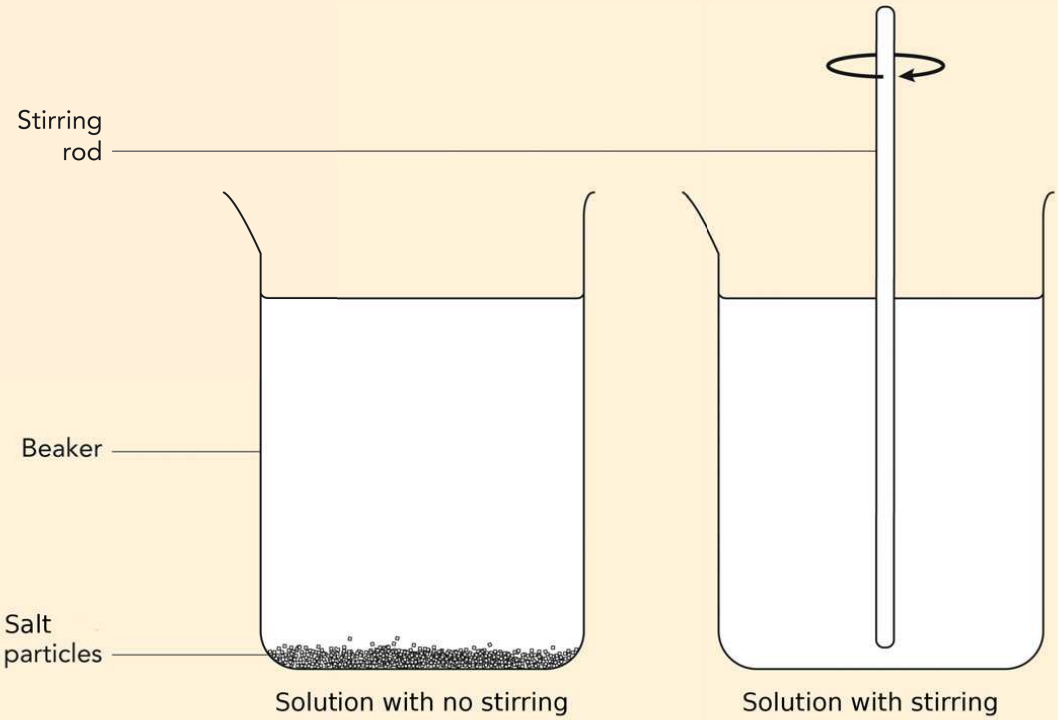
AIM:

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.



RESULTS:

The effect of stirring on dissolving

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

QUESTIONS:

1. What did we **compare** in this investigation?

2. Name 3 things that were the same about the 3 situations.

3. What did we change in this investigation?

4. What made the salt dissolve faster: stirring, or not stirring?

5. Complete the conclusion below by filling in the missing word or words.

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 dissolving rate or the rate of dissolution.
- The rate at which a substance dissolves can be affected by 3 factors, namely:
  - the temperature of the solution;
  - whether or not the solution is stirred (or shaken); and
  - the 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.

REVISION:



1. What are the 3 factors that affect solubility? Write a sentence describing how they affect solubility.

2. Write 3 examples where we use the factors that affect dissolving in our daily lives.

3. Complete the following crossword puzzle:

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

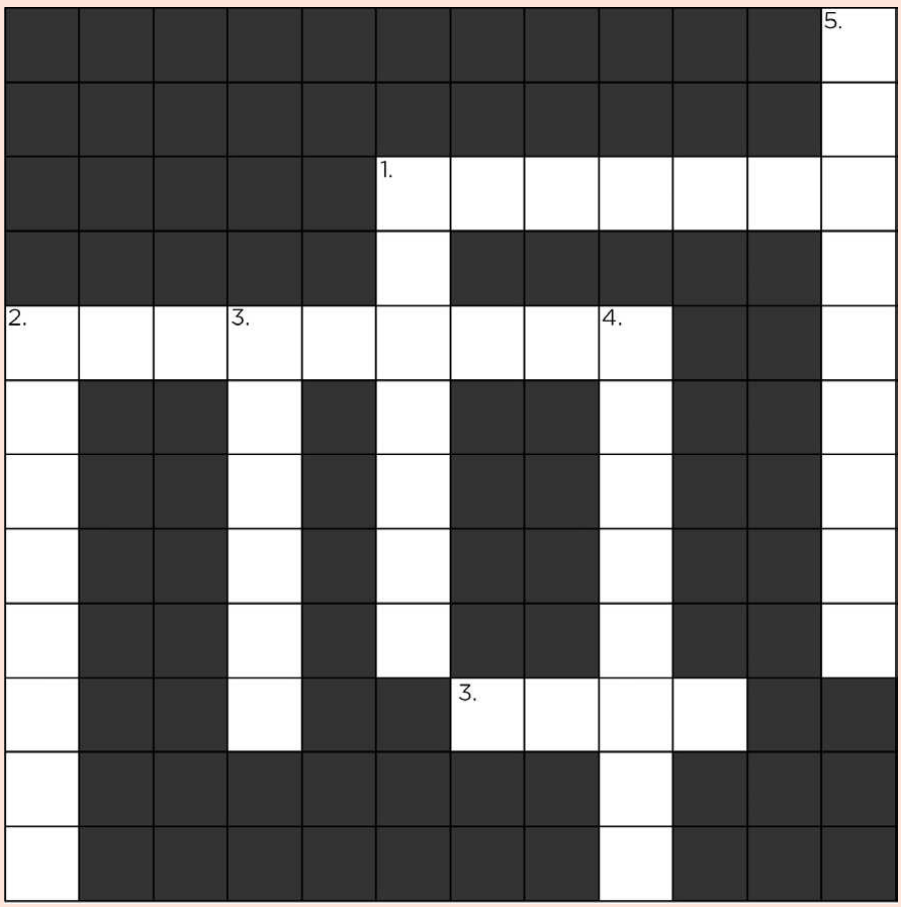
soluble solute solvent dissolves stir decrease solution saturated

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)

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)



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 our precious resource, water, and its importance to all living things!



5 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



5.1 Water pollution

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

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

VISIT

Water pollution (video)
goo.gl/07xDe



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

ACTIVITY: Thinking about pollution



INSTRUCTIONS:

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



Pollution in a pond.



A polluted river.



Pollution on the coast.



People have been using this stream to dump rubbish.



An oil spill.

QUESTIONS:

1. Look at the pictures above 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 illness 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 3 categories of pollutants have in common?

VISIT

BP oil spill in Gulf of Mexico (video).
goo.gl/OCmEG



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.

NEW WORDS

- wetland
- water table
- waterlogged



5.2 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 and
- a 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 are:

- marshes
- floodplains
- swamps
- lakes and pans
- seeps and springs
- estuaries
- river banks

Look at the pictures of different wetlands.












Wetlands are not necessarily wet throughout the year:

- A *temporary wetland* is wet between 1 and 4 months of the year.
- A *seasonal wetland* is wet during the rainy season. This means it will be wet between 5 and 11 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.



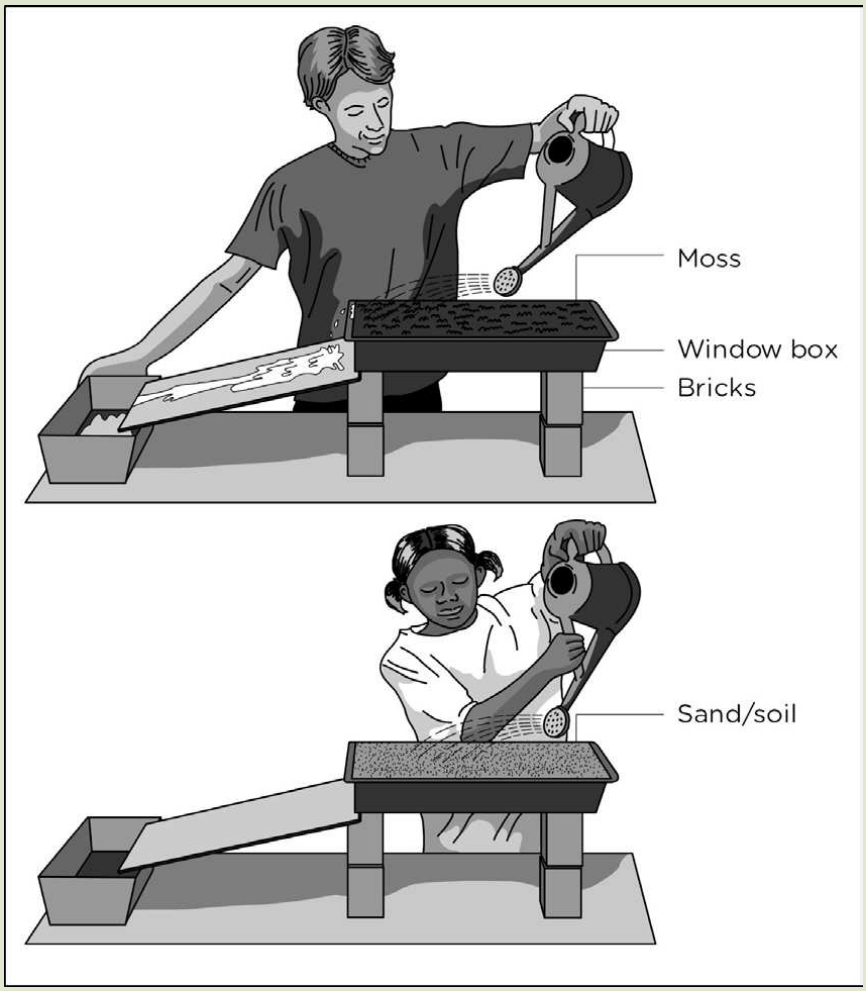
ACTIVITY: Making a model of a wetland

MATERIALS:

- grass moss or other garden moss
- bricks
- sand
- soil
- shallow plastic trays (about 7-10 cm deep)
- hardboard
- watering can
- measuring tool to measure 2 litres of water
- hand or electric drill (to be used only under STRICT ADULT SUPERVISION)
- watch or stopwatch
- plastic window box

INSTRUCTIONS:

1. Drill a hole in the middle and at the bottom of one side of the plastic box.
2. Pack 2 layers of bricks, the window box, and the hardboard as shown in the illustration.
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 2 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 2 litres of 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?

   b. Why do you think it took the water this long to drain off?

QUESTION:

1. 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

Do you remember studying habitats in Gr 4 and Gr 5? What does a habitat provide to an organism?

_____

_____

Discuss with your partner what you understand by the term 'biodiversity' and write it down below.

_____

_____



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

ACTIVITY: Researching 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 and answer the questions below.
3. Present your report as a poster.

QUESTIONS TO ANSWER IN YOUR REPORT:

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

Wetlands should be protected because:

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



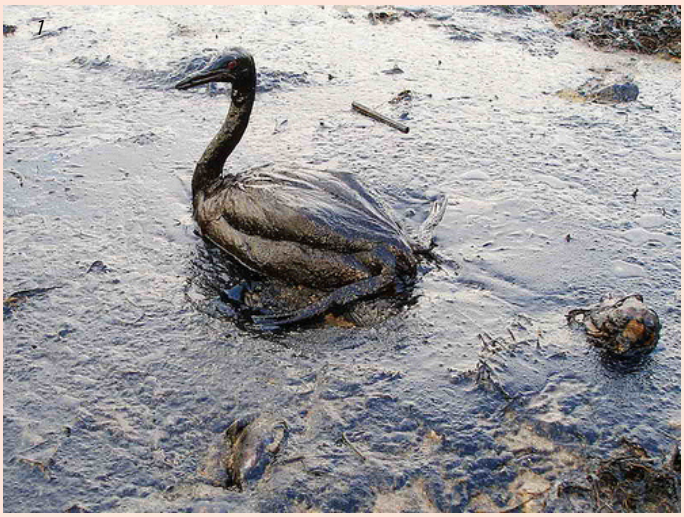
KEY CONCEPTS

- 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 germs.
- 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 picture below of the bird covered in oil and answer the questions.



A bird covered in oil.

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!



6 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?

6.1 Clean water

Have you ever seen a sign like the one in the picture? 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

- purify
- purification
- sewage waste
- raw water
- still



QUESTIONS

1. What does 'clean water' mean to you?

_____

2. Can you remember what pollutants are? Write it down below.

_____

_____



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 section 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 loose water everyday with the waste our bodies produce. 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 waterskiing. We want clean water in our seas and lakes so we can enjoy being in the water without becoming ill.

How can water be cleaned?

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?

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.



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

ACTIVITY: Cleaning water in a still



MATERIALS:

- clean, dry small pot/container
- muddy water
- big, deep cooking pot
- ruler
- 1 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/container inside the bigger pot.
3. Cover the bigger pot with plastic cling wrap.
4. Place a marble or stone in the middle of the plastic wrap so that it is above the small pot/container inside the 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 below.
7. If you have a phone with a camera, you could take pictures of the still and show them to your class.

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 yoghurt tub. You can use words from the following list, 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 container/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 method we used to remove sand from water in the activity: *Mixing a solid and a liquid* in the chapter *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.

ACTIVITY: Design, make and evaluate a filter



The Thunderbolt Kids 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, the Thunderbolt Kids cannot take enough bottles of clean water. So, Tom 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.

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 2 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 and 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?

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?

Use the space to 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 as 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 which comes out.

DO NOT DRINK THE WATER as 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, and finally followed by boiling.

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 which comes out of your filter.

COMMUNICATE:

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. Write a paragraph below where you tell Tom about the filter that you designed and made to take on the camping trip to purify the muddy water in the stream. Tell Tom what you found that worked and what did not work and anything that you would change.

How is water cleaned 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.

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.

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 cleaning 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**, **sedimentation, aeration, settling**, and **disinfection**.

Let us look at them in turn.

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 breaking 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, 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 1 m 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 cleaned by processes such as sieving, filtering, settling, decanting, boiling and adding chemicals to kill germs.
- The water we use in our homes is cleaned 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 5 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.

7 Notes

Chapter 1 Photosynthesis

1. http://www.flickr.com/photos/kewl/6471030841/
2. http://www.flickr.com/photos/aligraney/661789978/

Chapter 3 Nutrition

1. http://www.flickr.com/photos/joanet/5772686658/
2. http://www.flickr.com/photos/seeseecards/7209691478/in/set-72157629756301182/
3. http://www.flickr.com/photos/78428166@N00/4296824658/

Chapter 4 Food processing

1. http://www.flickr.com/photos/salsaboy/2449275663/
2. http://www.flickr.com/photos/55530505@N08/5148999033/
3. http://www.flickr.com/photos/37743612@N05/4685092625/

Chapter 5 Ecosystems and food webs

1. http://www.flickr.com/photos/wrathdelivery/393079740/
2. http://www.flickr.com/photos/graeme/4183321986/
3. http://www.flickr.com/photos/soilscience/5097054849/

Chapter 2 Mixtures

1. http://www.flickr.com/photos/horiavarlan/4268285083/

Chapter 3 Solutions as special mixtures

1. http://www.flickr.com/photos/exfordy/384963651/

Chapter 4 Dissolving

1. http://www.flickr.com/photos/preppybyday/6703560771/

Chapter 5 Mixtures and water resources

1. http://www.flickr.com/photos/19378856@N04/2037098785/

Chapter 6 Processes to purify water

1. http://www.flickr.com/photos/wwarby/4916577404/