Science 6

GULFISHAN SHAFEEU

Educational Development Centre

Written by:
Gulfishan Shafeeu

Edited by:
Gulfishan Shafeeu

Layout & design by:
Mariyam Maalika

Computer Graphics by:
Mariyam Maalika
Hassan Nazim
Khadheeja Abdulla

Illustrations by:
Wajeedha Ismail
Khadheeja Abdulla
Hassan Nazim
Mariyam Maalika

Proof read by:
Mariyam Nashaath
Ahmed Riyaz Jauhary

Cover designed by:
Mohamed Tholal

Cover Photographs by:
Ali Nishan

Photographs by:
Gulfishan Shafeeu
Ahmed Riyaz Jauhary
khadheeja Abdulla
Ali Adam
Mohamed Sujau
Athif Ali
MWSC

First edition: 2005

ISBN: 99915-0-529-6

Ref no: A-48/2004/DPE

Educational Development Centre
Ministry of Education
Republic of Maldives

Printed by:
xxxxxxxxxxxxxxxxxx

بسم الله الرحمن الرحيم

This book is written to meet the requirements of Science in the National Curriculum.

This textbook is designed for teaching Science for grade 6.

Ministry of Education

Preface

This book is designed to foster active learning in science. While teaching science, teachers need to provide opportunities for students to *do* science. Reading about science surely does not promote inquiry or hands-on investigation. Instead science can become nothing more than a succession of reading lessons. To further complicate matters, science books often contain words that are difficult to read and concepts that are difficult to understand. Thus, even good readers may find the content to be abstract and beyond comprehension. For poor readers, of course, this approach is a disaster.

In summary, the passive approach of teaching science often tends to focus too much on content while ignoring activities, process, and inquiry.

The author has tried to make the book as easy to use and understand. The book contains 14 units and each unit is divided into subunits. Each of these units cover one of the ideas of science in biology, chemistry and physics. Biology units are green, physics units are orange, and chemistry units are purple.

The subunits are organized into double-page spreads. Each spread has some questions to check your understanding of the important ideas. It also has key ideas to help you revise. If you finish quickly, each unit has a page that gives some information about a scientist who has done a lot of contribution in the area of science and technology.

None of the activities in these spreads need special equipment or preparation. All the practical activities for the course are in the Student Activity Book.

At the back of the book you will find a list of important scientific words and their meanings.

The author hopes that you find the book interesting and above all hope that you enjoy it!

The author would like to emphasise from teachers presenting information, to students learning science through active involvement.

Acknowledgement

The author is grateful and would like to acknowledge all the professionals who helped in the production of the book, *Science 6.*

Special mention must go to Mrs.Zahiya Zareer(EDC), Mr.Ahmed Manik(EDC) and Mrs.Mariyam Azra(EDC) for the guidance given.

There are many others who have kindly given their assistance. These include MariyamMaalika(EDC), Wajeedha Ismail(EDC),Khadeeja Abdulla(EDC), Hassan Nazim(EDC), Ahmed Riyaz Jauhary(EDC), Mariyam Nashath(EDC), Ali Adam(EDC), Mohamed Tholal(EDC), Aminath Shifana(EDC), Ali Nishan(ITEK), MWSC, Agriculture-nursery and Sosun Plaza.

Contents

1st What is science?

What you will learn

What is science?

The scientific method

Doing experiment

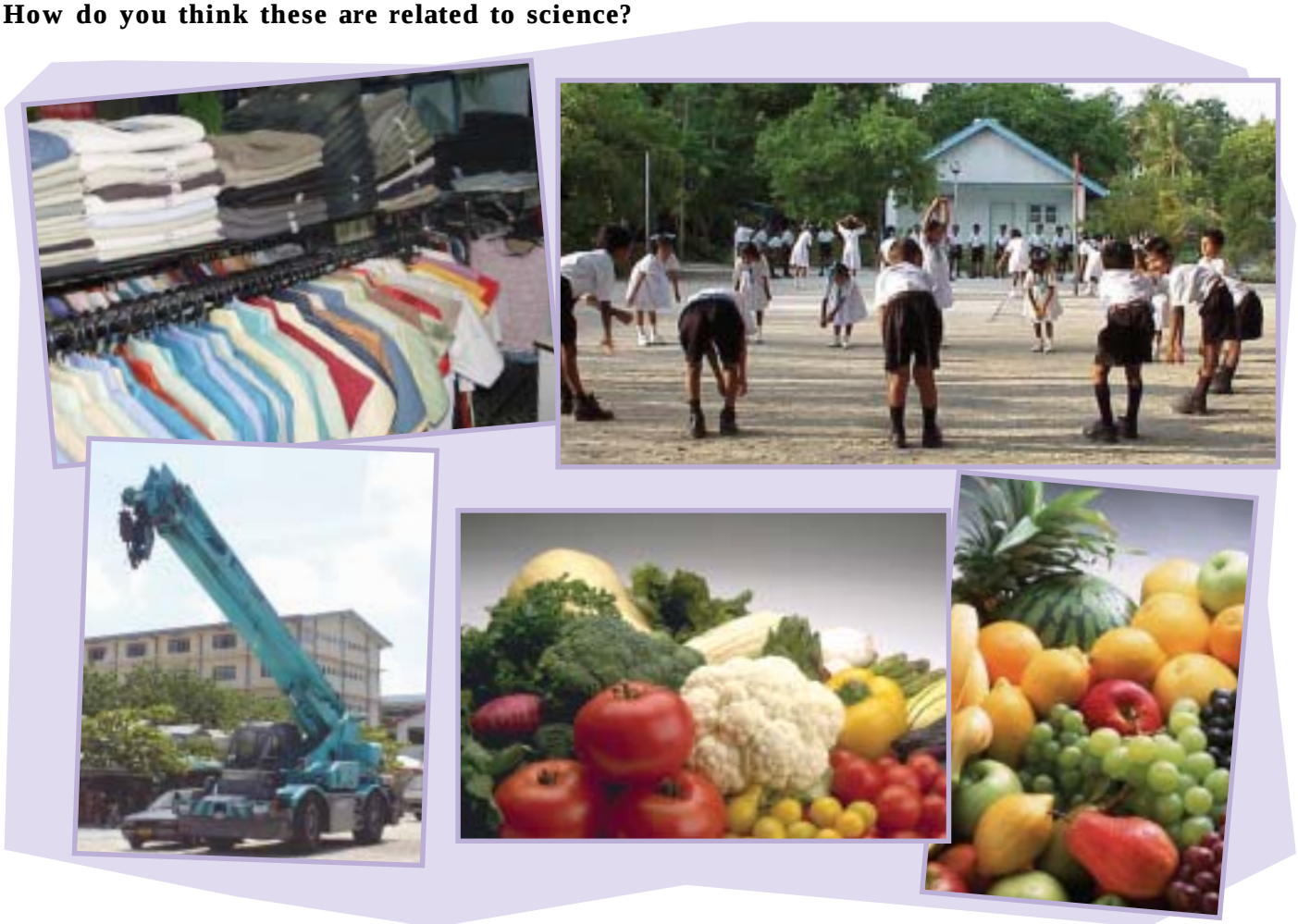
Planning

Keep your eyes open!

What is science?

Have you noticed that our daily lives are closely related to science? Think about the food we eat, the clothes we wear, the transport we take or the energy we use.

How do you think these are related to science?



The study of science is not just for scientists. An artist needs to know the science of mixing colours and painting materials.

A photographer needs to know science to understand the nature of light so that he or she can take better pictures.

A homemaker needs to know science so that he or she can cook well-balanced and nutritious food for the family. Studying science helps us to understand the things around us, solve problems and train our minds to think logically and systematically.

Science is divided into many branches. The following are some examples.

Biology	The study of living things
Chemistry	The study of substances
Physics	The study of matter, energy and natural forces
Astronomy	The study of the Sun, Moon and the stars
Geology	The study of structures of the Earth

Who is a scientist?

Look at the table in the above. All the branches of science listed there have to do with the world around us and with ourselves. They are all concerned with finding out about how things work and how things are made including our selves and other living things.

People who spend their working lives finding out these facts are called **scientists**. Their discoveries often help us to have a more healthy, interesting and useful life.

Science and technology

Science is the systematic study of nature and how it affects us and the environment. With the rapid progress in science, our standard of living has improved greatly. The way in which scientific discoveries are used to build machines and to make our lives easier and more comfortable is called **technology.**

However, the misuse of scientific discoveries has also resulted in pollution, and the invention and use of deadly weapons that are harmful to us and our environment. So we need to use science with great care.

The scientific method

You will do lots of practical activities in your science class. In this unit, you will learn the scientific method which is the most common method used by scientists in their investigations.

Making careful **OBSERVATION** or accurate measurements

You should be able to:

- pick out the important things about an object
- find similarities in a group of objects
- find differences among the objects in a group.

RECORDING the observations or readings in an appropriate way.

You should be able to:

- record observations or measurements appropriately using tables, charts, graphs, labeled drawings etc. for easy future references.

Coming up with a **HYPOTHESIS** or a question that can be tested.

You should be able to:

- make inference and develop a hypothesis.
  An inference is a statement made, based on observation or measurements.
  The skill of making an inference involves thinking and discusing with others to come up with the best possible explanation for an observation.

Planning and carrying out **INVESTIGATION** to test the hypothesis.

You should be able to:

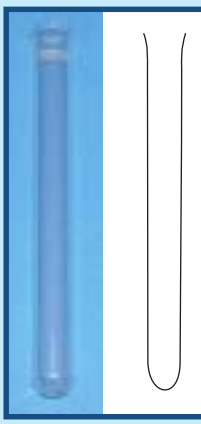
- Design an investigation to solve a problem
- Decide what equipment to use
- Decide what measurements to take
- Decide how to do a fair test.

Laboratory apparatus

Many types of apparatus are used for scientific work in laboratories. They enable us to carry out experiments successfully and make accurate measurements or observations.

Boiling tube

For containing or heating small amounts of substances



Test tube

For containing or heating small amounts of substances

Measuring cylinder

For measuring a volume of liquid to an accuracy of $1cm^3$

Burette

For measuring a volume of liquid to an accuracy of $0.1cm^3$

Beaker

For containing chemicals or collecting liquids

Conical Flask

For containing chemicals or collecting liquids

Doing experiments

A good scientist always thinks carefully about what is happening in an experiment.

What happens in the experiment?
Why does this happen?
These two questions will help you to keep thinking.

■ Look at these drawings of three 'separating' experiments. Try to work out what is happening in each experiment.

Separating sand and gravel

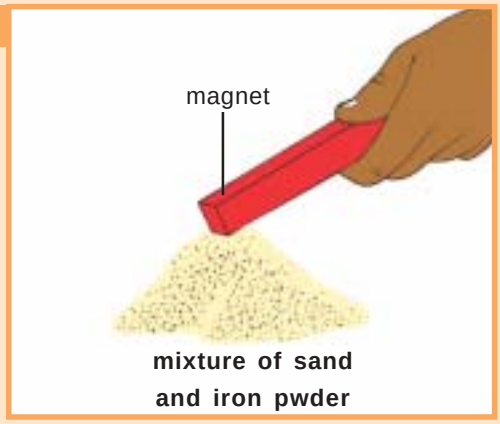
A

the seive is shaken

B

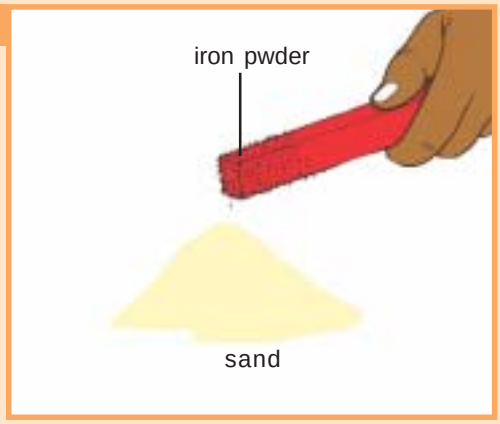
Separating iron and sand

A



mixture of sand and iron pwder

B



Safety rules

Science experiments that you do in a laboratory or your science room or in your class may be fun, but it can be dangerous too, if you are not careful. For your own safety as well as the safety of the others in your class, you must follow safety rules.

General safety rules

- Open all doors and windows unless otherwise instructed by your teacher.
- Do not carry out any test or experiments without the teacher's permission.
- Read the instructions first and understand them before starting your experiment. If you have any doubt, always ask your teacher.
- Handle all apparatus and chemicals carefully and correctly. Always check the label on the container before using the substance in it.
- Do not pour any unused chemical back into its container to avoid contamination.
- Do not taste any chemical unless otherwise instructed by your teacher.
- Do not eat, drink or play in the laboratory.
- Do not play with the electrical mains and other fittings in the laboratory.
- Work neatly. Wash up all used apparatus and dispose waste correctly.
- Keep the apparatus in their proper places after cleaning.
- Do not take away any apparatus or chemical from the laboratory.
- Wash your hands after all laboratory work.

Safety rules when heating or mixing chemicals

⇨Wear goggles when mixing or heating chemicals.

⇨Do not place flammable substances near naked flames.

⇨Do not point the mouth of test tube or a boiling tube, which is being heated towards your self or your friends.

When accidents occur

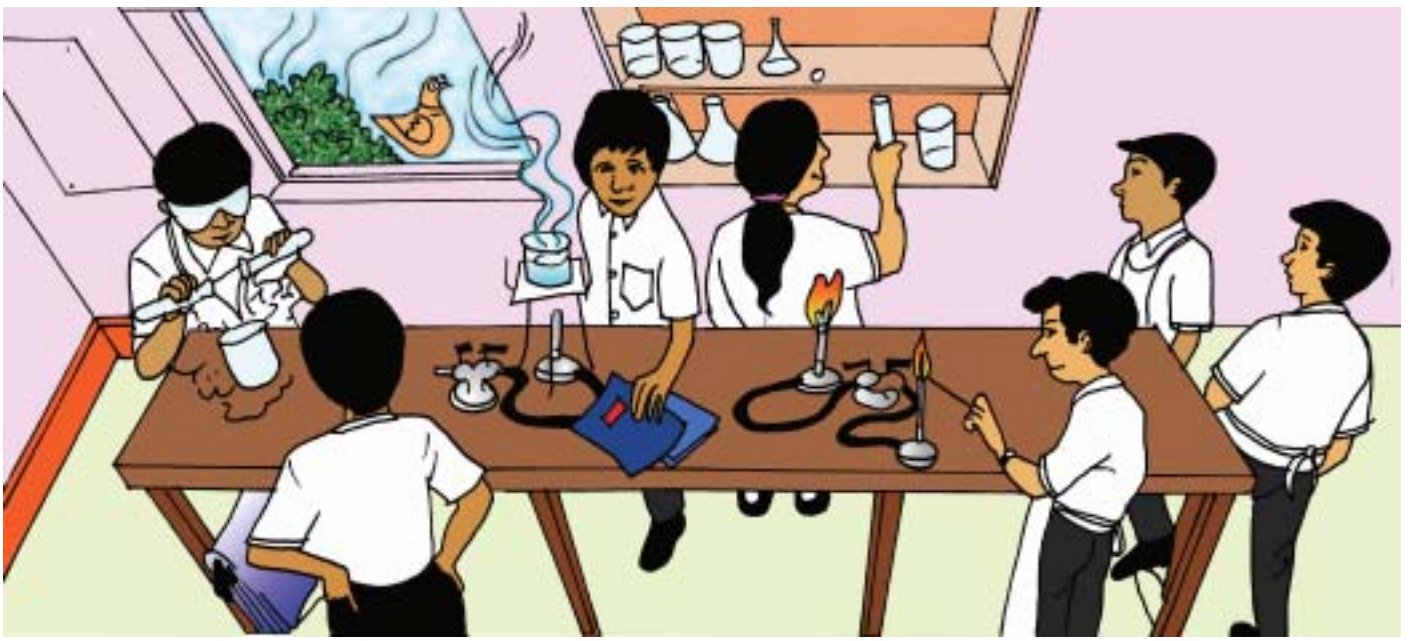
■ Report all accidents, injuries, breakages and spillages immediately to your teacher.

■ Should a chemical come into contact with any part of your body or clothing, wash thoroughly with plenty of water and report to your teacher.

Planning

Inappropriate behaviour in a laboratory

Appropriate behaviour in a laboratory



Planning is necessary

A good scientist plans out each experiment carefully.

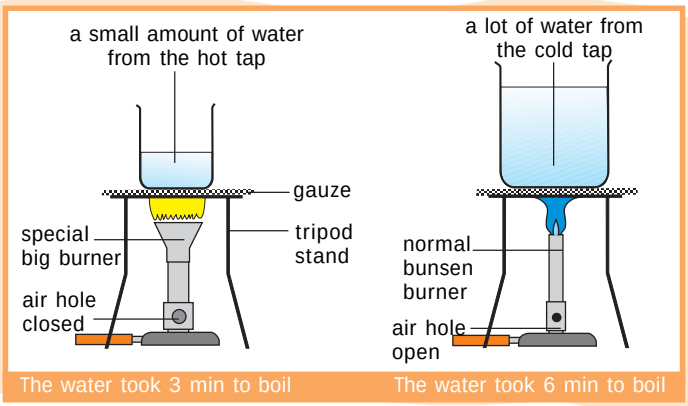
In class 6B Ms Fathimath, the science teacher was telling the students about the experiment for the day. " I want you to get a partner and find out if the yellow flame from a bunsen burner is hotter than the blue flame.

She gave a hint. " You can't do this by putting a thermometer in the flames the bulb will crack. You'll get the answer by using the flames to boil some water".

Ahmed and Aminath was a pair. Shaneez and Kulsooma was another pair. Both pairs did the experiment in very different ways.

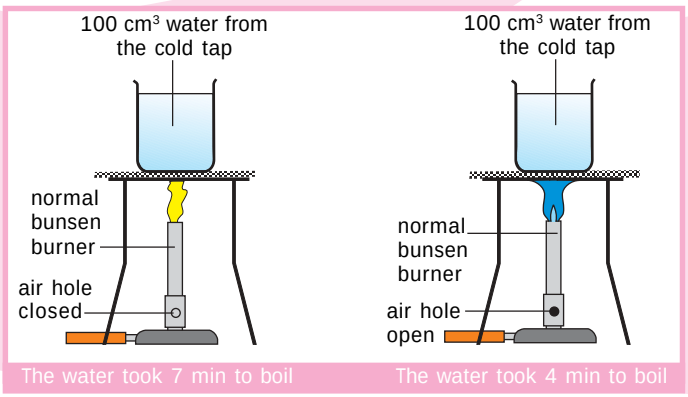
Ahmed and Aminath's rush

They wanted to be the first with the answer. They rushed around the lab, grabbing the first apparatus they could find. They quickly ran water into two beakers. Then they lit the gas and started timing.
Three minutes later they shouted out, 'The yellow flames the winner.'



Shaneez and Kulsooma's plan

Shaneez spent five minutes thinking, on how to make a fair test. Then they searched for the correct apparatus. They set it up carefully, lit the gas, and started timing. Their results showed that the blue flame was the hotter.



Ms Fathimath didn't agree with Ahmed and Aminath. She told them to think again and then repeat the experiment. But she was pleased with Shaneez and Kulsooma. They had worked carefully and found the correct answer.

1. Why did Ahmed and Aminath decide that the yellow flame was hotter?
2. How did Shaneez and Kulsooma make a fair test?
3. Give reasons why Ahmed and Aminath got the wrong answer?

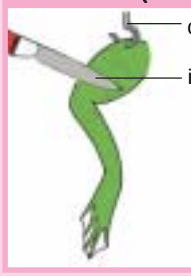
Keep your eyes open!

Many important scientific discoveries have been made after a sharp eyed scientist has noticed and noted down something unusual. These unusual observation leads to great discoveries. Here are two of them.
A good scientist notes down everything he or she **observes**.

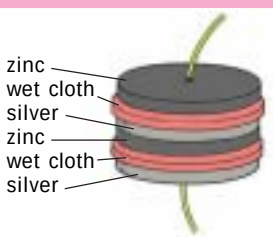
The observation In 1791, an Italian called Galvani was cutting up or dissecting a frog's leg. He hung the leg from a copper hook. When he cut into it with an iron knife,the leg twitched.

And the discovery Galvani's friend, Volta, realized that electricity had made the leg twitch. He discovered that electricity had been produced when the two metals touched moisture in the frog's leg. In 1800 he used this discovery to make the first battery. It was made of silver and zinc discs separated by pieces of cloth soaked in water.

From this (1971) ...



... to this (1800)

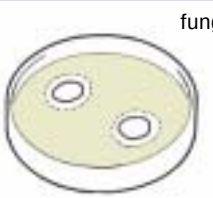


The first battery

The observation In 1928, Sir Alexander Fleming noticed a fungus growing on a dish of bacteria. The fungus was killing the bacteria.

And the discovery It was later discovered that the fungus was producing a bacteria killing chemical called penicillin. The first penicillin drugs were produced in 1943.

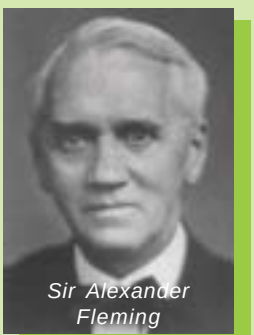
From this (1928) ...



... to this (1943)

The first bacteria-killing drugs

1 What did
a. Sir Alexander Fleming
b. Galvani observe?
Why were these observations important?


Sir Alexander Fleming


Galvani

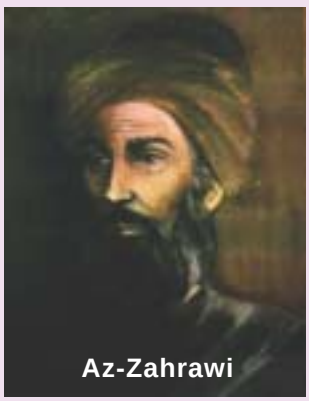
Read about The TRUTH

We were taught to believe that it was the western and /or American minds that invented basic sciences and made great discoveries.
Galileo, Copernicus, Kepler, Bacon, Newton, Da Vinci, Benjamin Franklin, etc were often mentioned names.
Most texts give little or no mention of the advancements made by ancient Indian, Chinese or, particularly, Muslim scholars.

It is true that western civilization has made great contributions to the development of science. So have other cultures and they need to be credited for them.

Unfortunately, Westerners have long been credited with discoveries made many centuries before by Islamic scholars.
Here are just a very few of those discoveries made by Muslim scientists.

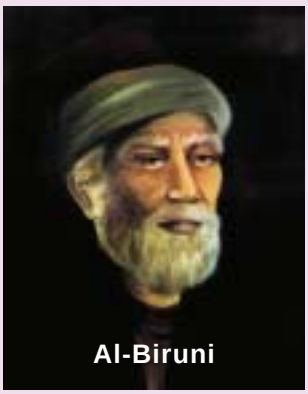
What is Taught: C.W. Long, an American, conducted the **first surgery** performed under inhalation anesthesia in 1845.


Az-Zahrawi


Ibn Zuhr

The truth: Six hundred years before Long, Islamic Spain's **Az-Zahrawi** and **Ibn Zuhr**, among other Muslim surgeons, performed hundreds of surgeries under inhalation anesthesia with the use of narcotic-soaked sponges, which were placed over the face.

What is Taught: Galileo (17th century) was the world's ***first great experimenter***.

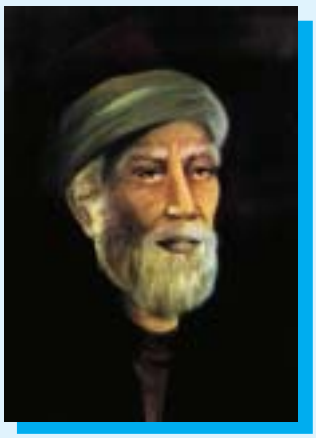

Al-Biruni

The truth: Al-Biruni (d. 1050) was the world's first great experimenter. He wrote over 200 books, many of which discuss his precise experiments.
His literary production in the sciences amounts to some 13,000 pages, far more than that written by Galileo or, even, Galileo and Newton both combined.

What is Taught: The concept of ***quarantine*** was first developed in 1403. In Venice, a law was passed preventing strangers from entering the city until a certain waiting period had passed. If, by then, no sign of illness could be found, they were allowed in.

The truth: The prophet **Muhammad** (peace be upon him), who wisely warned against entering or leaving a region suffering from plague, first introduced the concept of quarantine in the 7th century A.D. As early as the 10th century, Muslim physicians innovated the use of isolation wards for individuals suffering with communicable diseases.

Abu Raihan Al-Biruni
973 - 1048 A.D.

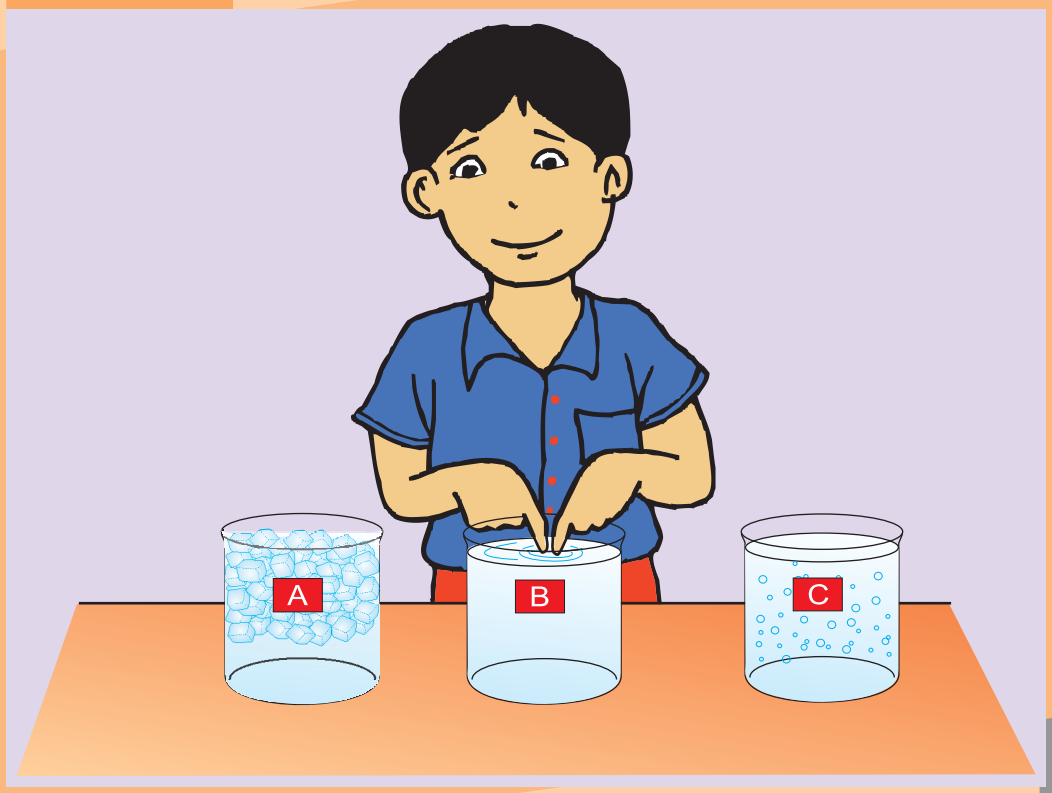


Abu Raihan Mohammad Ibn Ahmad al-Biruni was Born in the city of Kheva near "Ural" in 973 A.D.
Al-Biruni was a multi talented scholar and scientist who had equal facility in physics, metaphysics, mathematics, geography and history.

Al-Biruni wrote his famous book *Qanun-i Masoodi* (*al-Qanun al-Masudi, fi al-Hai'a wa al-Nujum*), which he dedicated to Sultan Masood. The book discusses several theorems of astronomy, trigonometry, solar, lunar, and planetary motions and relative topics. In another well-known book *al-Athar al-Baqia*, he has attempted to write an account of ancient history of nations and the related geographical knowledge. In this book, he has discussed the rotation of the earth and has given correct values of latitudes and longitudes of various places. He has also made considerable contribution to several aspects of physical and economic geography in this book.

His other scientific contributions include the accurate determination of the densities of 18 different stones. He also wrote the *Kitab-al-Saidana*, which is an extensive medical knowledge that combines the then existing Arabic knowledge on the subject with the Indian medicine. His book the *Kitab-al-Jamahir* deals with the properties of various precious stones.
He has been considered as one of the very greatest scientists of Islam, and, all considered, one of the greatest of all times. His critical spirit, love of truth, and scientific approach were combined with a sense of toleration. His enthusiasm for knowledge may be judged from his claim that the phrase *Allah is Omniscient does not justify ignorance*.

1 Measurement



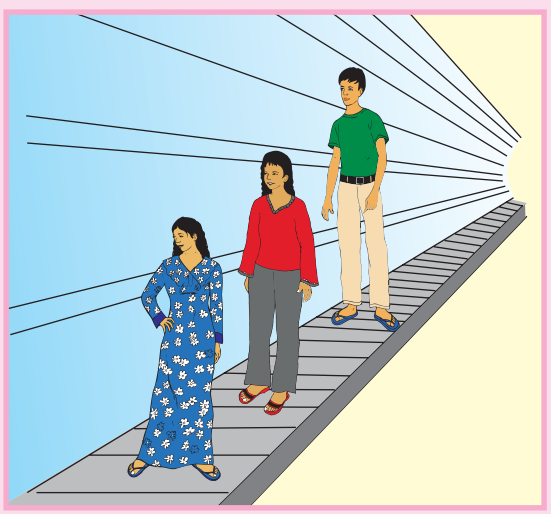
What you will learn

- Your senses need help
- Setting our standards
- Measuring length
- Measuring Area and Volume
- What's the time?
- What is mass?
- Temperature

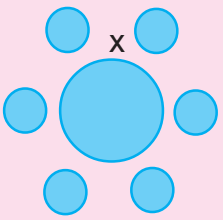
1a

Your senses need help

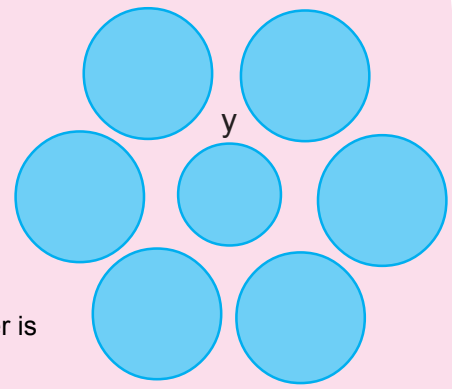
As you learn to be a scientist, you will find out more and more about the things around you. You have five senses to help do this. It has been shown that human senses are not always reliable. Check this for your self.

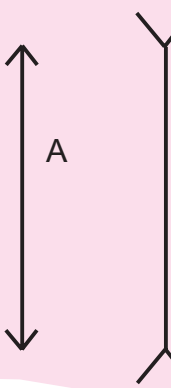


Who is the tallest?



Which circle in the center is larger, X or Y?





Which line is longer?

So we need instruments for making accurate scientific measurements.

Trundlewheel

Measures long distances.

Do you Know?

Airline pilots cannot use their senses to guide the plane through thick clouds. They must depend on the plane's instruments.

Accurate measurements

Before measuring instruments were invented, people used different parts of the body for measuring lengths. That's where units like the foot and the cubit came from.

It's very easy to see how this way of measuring caused problems. The length of the cubit, for example, would vary among people.

Physical quantities

Physical quantity is a quantity, which can be measured. Length, volume, mass, time and temperature are examples of physical quantities.

A non-physical quantity is one, which cannot be measured.
Can you give some examples of such quantities?

In the past, methods of measuring physical quantities were inaccurate and many types of units were used in different parts of the world.
What were the different measurements we used in our daily life in the past?

1. Name your five senses.
2. Why do scientists use measuring instruments whenever they can?
3. Make a list of 5 measuring instruments used in your home.
4. Try to find out something about the instruments, which help pilots to fly planes through thick cloud.

Ideas

- *Physical quantity is a quantity that can be measured.*
- *We cannot depend on our senses only.*

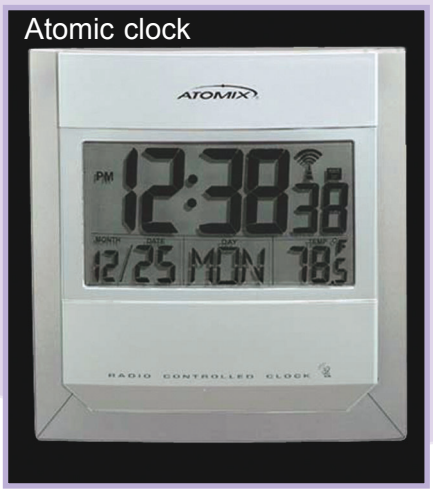
1b

Setting our standards

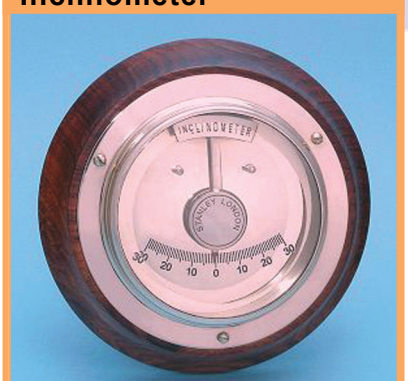
The Egyptians solved the problem of how to measure lengths exactly. They invented a standard cubit. They realized that the length of the cubit didn't really matter as long as everyone used the same length. So they marked out a cubit length on a piece of granite.

Then they made measuring sticks exactly the same length all over Egypt.

That's really how measuring is carried out to day. For each measurement, a **standard** is chosen. Every measuring instrument has to be compared with that standard.



Inclinometer



Measures angles in the field

Do you Know?

An atomic clock only goes wrong by 1 second in 10000 years.

SI units

Today, accurate measurements are obtained by using better developed methods and more accurate instruments. Since 1960, scientists from different parts of the world have agreed to take on a single system of units called the **SI units.**

■ Common physical quantities and units

Physical quantity	SI unit	Symbol for unit
Length	metre	m
Mass	Kilogram	kg
Time	Second	s
Temperature	Kelvin	K
Electric current	ampere	A

■ Some commonly used SI prefixes

Prefix	Symbol	Meaning
Milli	m	One thousandth (1/ 1000)
Centi	c	One hundredth (1/ 100)
Kilo	k	-

Hygrometer

Measures relative humidity

1 Fill in the blanks. An example has been done for you.

a. One milli metre (mm) is equal to one thousandth of a metre (1mm = 1/1000)

b. One centimetre (cm) is equal to .....

c. One Kilometre (km) is equal to .....

2 Convert the following readings to the units indicated.

a. 0.05m = ...cm

b. 50g = ... kg

c. 25mm = ... km

Ideas

The SI units are the standard units which people use for measurement.

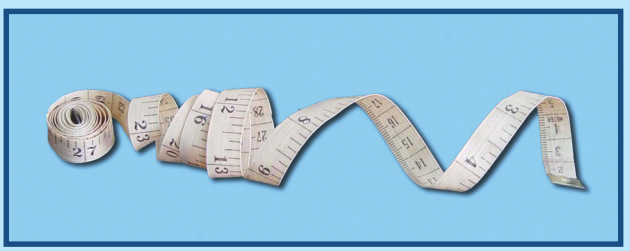
Prefixes such as milli, centi, and kilo are added to SI unit to form smaller or larger units.

1c

Measuring Length

Length is the distance between two points and its SI unit is the metre (m).
Short distances are measured in centimeters (cm) or millimeters (mm).

Long distances are measured in kilometres (km).



Speedometer

Tells you the speed in which the vehicle is travelling.

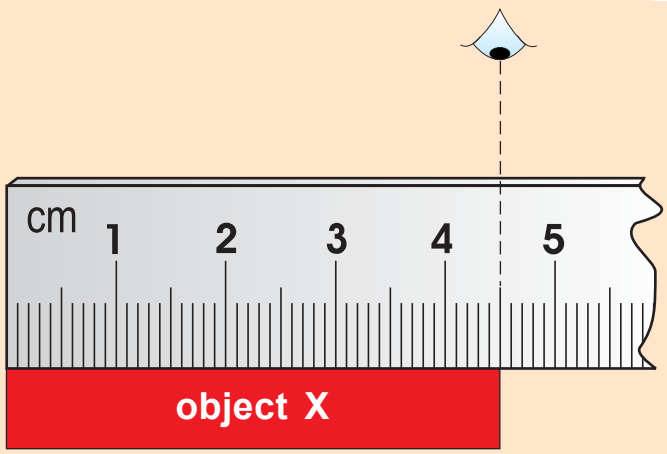
Do you Know?

The standard metre is the distance traveled by light in 1/299 792 458 of a second through a vacuum.

The photographs in the opposite page show two types of measuring tapes. Measuring tapes measure length in centimeters and metres, and sometimes in feet and inches.

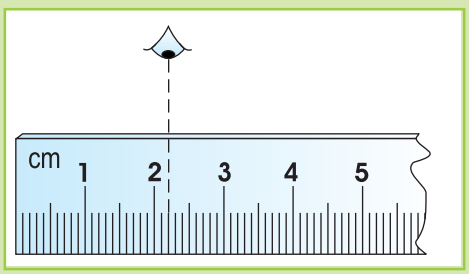
■ Name an occupation associated with each type of measuring tape?

The metre rule and half-metre rule are commonly used to measure length in the laboratory. The metre rule measures length in centimeters, with an accuracy of 0.1cm.



1 Copy and complete the following table.

1 km = ...m = ... cm = ...mm.
..... km = 1m =..... cm = ...mm.
..... km = ...m = 1cm = ...mm.
..... km = ...m = ...cm = 1.mm.



What is the reading shown in the picture?

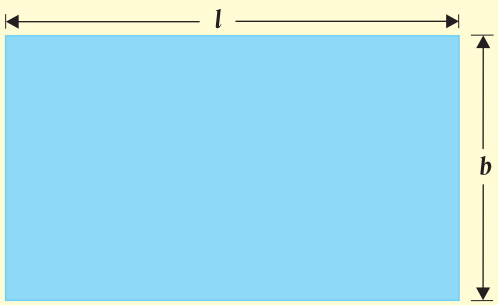
Ideas

- *SI unit for measuring length is in metre (m)*
- *The metre rule and half - metre rule are commonly used to measure length in the laboratory.*
- *The eye must be placed vertically above the mark being read for accurate measurement.*

1d Measuring Area and volume

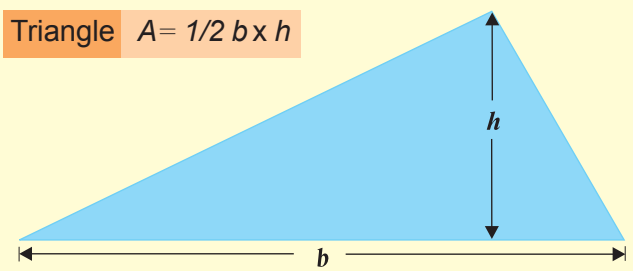
Area is a measure of the extent of a surface.
The SI unit for area is the square metre (m^2).
Other common units for area include mm^2, cm^2 and km^2.
One m^2 is the area of a square, which measures 1m on every side.

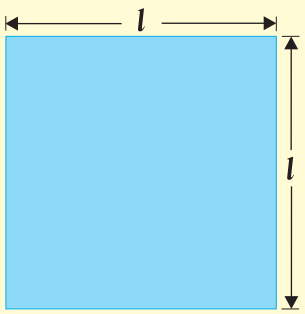
The areas of regular surfaces can be calculated by using formulae.
The formulae for some common regular surfaces are shown below.



Rectangle $A = l \times b$

Triangle $A = 1/2\ b \times h$





Square $A = l \times l$

Calipper

Measures width of an object.

Do you Know?

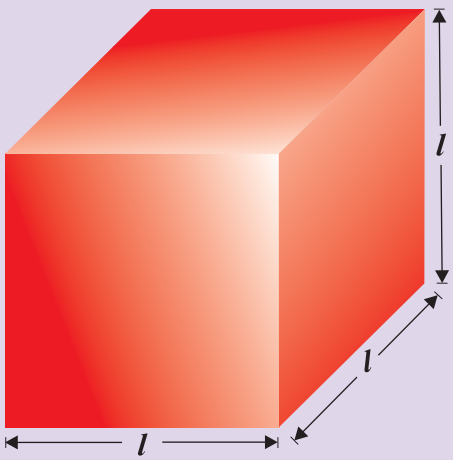
A flu virus is only 0.000 0015cm long.

Measuring Volume

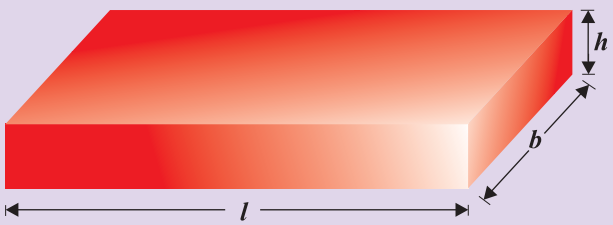
Volume is the measure of the space occupied by a substance.
The SI unit for volume is the cubic metre (m^3).

Volume is the measure of the space occupied by a substance.
The SI unit for volume is the cubic metre (m^3).
Other common units for volume include mm^3, m^3, milliliter (m*l*) and litre (*l*).

Some objects have regular shapes, for example, books.
The volume of regular shaped objects can be calculated using formulae.
The formulae for two regular shaped objects are shown below.



Cube $V = l^3$



Cuboid $V = l \times b \times h$

1 Which instrument would you use to measure:
- **a.** your waste?
- **b.** the height of a table?
- **c.** the width of a door?

2 Ms Shizna lives in a very large house. It has five large bedrooms and a big kitchen. The living area is very big too. Her room measures 4.8m x 3m x 3.3 m. Find out the volume of her room.

Ideas

- *Area is a measure of the extent of a surface.*
- *The SI unit for area is the square meter (m^2).*
- *Volume is the measure of the space occupied by a substance.*
- *The SI unit for volume is the cubic meter (m^3).*

1e

What's the time?

The photographs below show different kinds of measuring instruments.
Which one of the time measuring instruments shown wakes you up in the morning?
Which one estimates time? Which one is the most accurate?


Wrist watch


Alarm clock


Radio clock


Wall clock


Pendulum clock


Atomic clock


Hour glass


Stop watch

The SI unit for time is the **second (s).** Other units for time include minutes (min), hours (hrs), days, months, years, decades and centuries.

Sundial

Estimates time.

Do you Know?

The importance of time is mentioned in Qur'an. In Surah An-Nisa' 103 Aya'th says that all the believers of Allah should pray at fixed hours.

The stopclock

In science class you will be required to carry out experiments involving measuring short intervals of time. Stopwatches and stopclocks are commonly used in the laboratory for measuring time intervals accurately.

The stopclock has a clock face with sixty divisions, each representing a time interval of one second.

The long red hand shows the number of seconds while the slightly shorter black, hand shows the number of minutes. Look at the picture and study the illustration carefully. It will show you how to read the stopclock.

The electronic stopwatch

The electronic stopwatch, gives a higher accuracy than a mechanical stopwatch. It has a digital display of the time and it can measure time intervals accurate to 0.01s.

It can also record time intervals in hours. Look at the photograph above. It will show you how to read the electronic stopwatch.

1 What is the reading shown by this stopwatch?

_____

2 Imagine yourself running on a sandy beach at different speeds, using a stop watch to time your self. Will your footprints be further apart, nearer, or equal in space when you run faster?

Ideas

- *The SI unit for time is the second (s)*
- *Clocks and watches are commonly used for measuring time.*
- *Short time intervals are measured using stopclocks or stopwatches.*

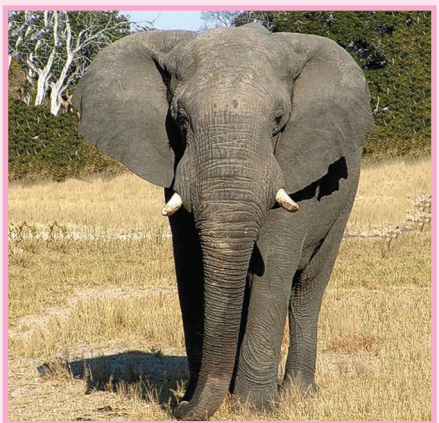
1f

What is mass?

The mass of an object is the measure of the amount of matter in it.
The SI unit for mass is the **kilogram (kg).**

Large masses are measured in tonnes (1 tonne = 1000 kg)
while small masses are measured in grams (g) or milligrams (mg)

Each grain of rice has a mass of about 0.02mg.



An elephant may weigh about 4 tonnes.

An apple has mass of about 40g.

Mass should not be confused with weight, although in daily life, we sometimes use the two interchangeably. The mass of a substance depends on the number and size of particles, which make up that substance.

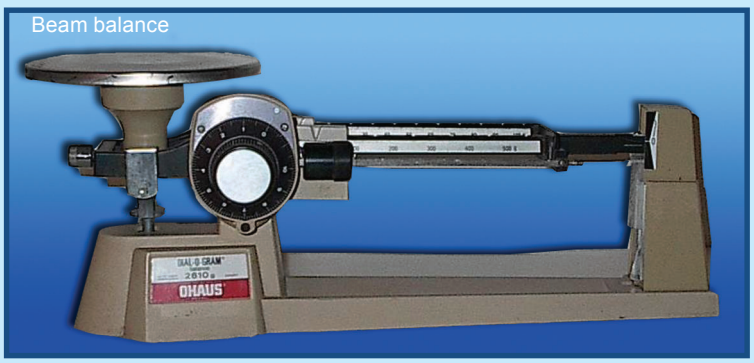
For example, a lump of plasticine having a mass of 50g will still have the same mass even if it is made into the shape of a boat.

Do you Know?

The biggest earthworm ever measured was 6m 70cm long.

Measuring mass

We use a balance to measure mass. A beam balance is still used to give very accurate measurements. However, the electronic balance has become popular due to its easy handling, high accuracy and easy digital reading. You will learn to identify the different types of balances and use the beam balance to measure mass in your exercise book.



1 Define mass.

2 Can the mass of a substance change if you
a. bring it to the moon,
b. distort its shape?

3 10 tonnes = ——————————kg
= —————————— g
= —————————— mg

4 Which instrument can be used to measure mass?

A. beam balance **B.** forcemeter
C. hydrometer **D.** thermometer

Ideas

The SI unit for mass is the kilogram (kg).

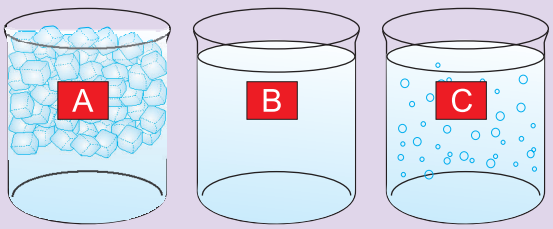
The electronic balance and the beam balance are instruments used for measuring mass.

1g Temperature

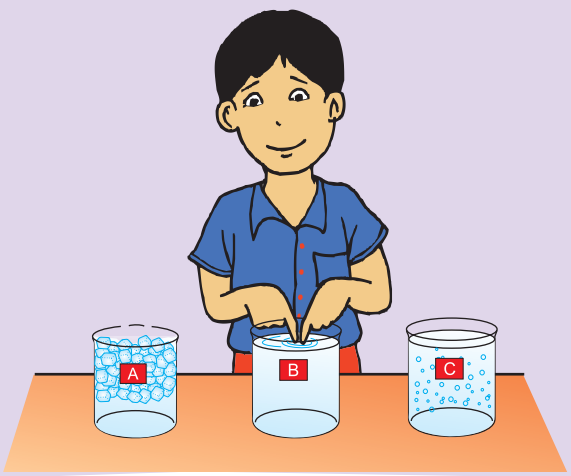
The **temperature** of a substance tells how hot or cold that substance is.
Our sense of touch can tell us if an object is hot or cold, but we cannot tell the accurate measurement, just by touching.

To find out whether our sense of touch is reliable, you can do the following simple experiment.

a) Fill the following beakers as follows:
Beaker A with ice water
Beaker B with tap water
Beaker C with warm water



b) Put your right index finger into the ice water in beaker A and your left index finger into the warm water in beaker C as shown below



c) After about one minute, put both index finger into the tap water in beaker B as shown below.
Does your right index finger feel warm or cold?
Does your left index finger feel warm or cold?
Can you tell if the tap water is warm or cold?

Do you Know?

An airline pilot cannot use his or her senses to guide his or her plane through thick cloud. He must depend on the plane's instruments.

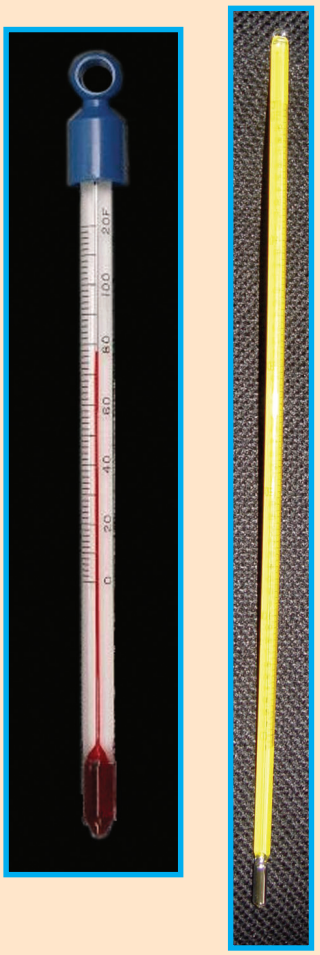
Thermometers

A thermometer is used to measure temperature accurately. The temperature of a substance is commonly measured according to the **Celsius scale.** The unit used in this scale for temperature is **degree Celsius** (°C).

In the laboratory, liquid-in-glass thermometers are commonly used to measure temperature.

Examine the thermometer shown in the photograph on the right.

- What is the highest temperature it can measure?
- What is the lowest temperature it can measure?
- What is the reading on the thermometer?



1 Define temperature.

2 Why is it better to use a thermometer rather than our sense of touch to measure temperature?

3 A cup of water and a large pot of water both have a temperature of 50 degree Celsius.
Which is hotter?
Which has more heat energy?
Can a large iceberg have more heat than a cup of boiling water?

Ideas

Temperature is a measure of the hotness or coldness of an object. A common unit for temperature is the degree Celsius.

Thermometers are used for measuring temperature.

Ibn Sina
980 - 1037 A.D.

Doctor of doctors

Abu Ali al-Hussain Ibn Abdallah Ibn Sina was born in 980 A.D. and died in June 1037 A.D. at Afshana near Bukhara. (Central Asia, now Uzbekistan) The young Abu Ali received his early education in Bukhara. By the age of ten he had become well versed in the study of the Qur'an and various sciences. While still young, he attained a degree of expertise in medicine that his renown spread far and wide.

At the age of 17, he was fortunate in curing Nooh Ibn Mansoor, the King of Bukhhara, of an illness in which all the well-known physicians had given up hope. On his recovery, the King wished to reward him, but the young physician only desired permission to use his uniquely stocked library.

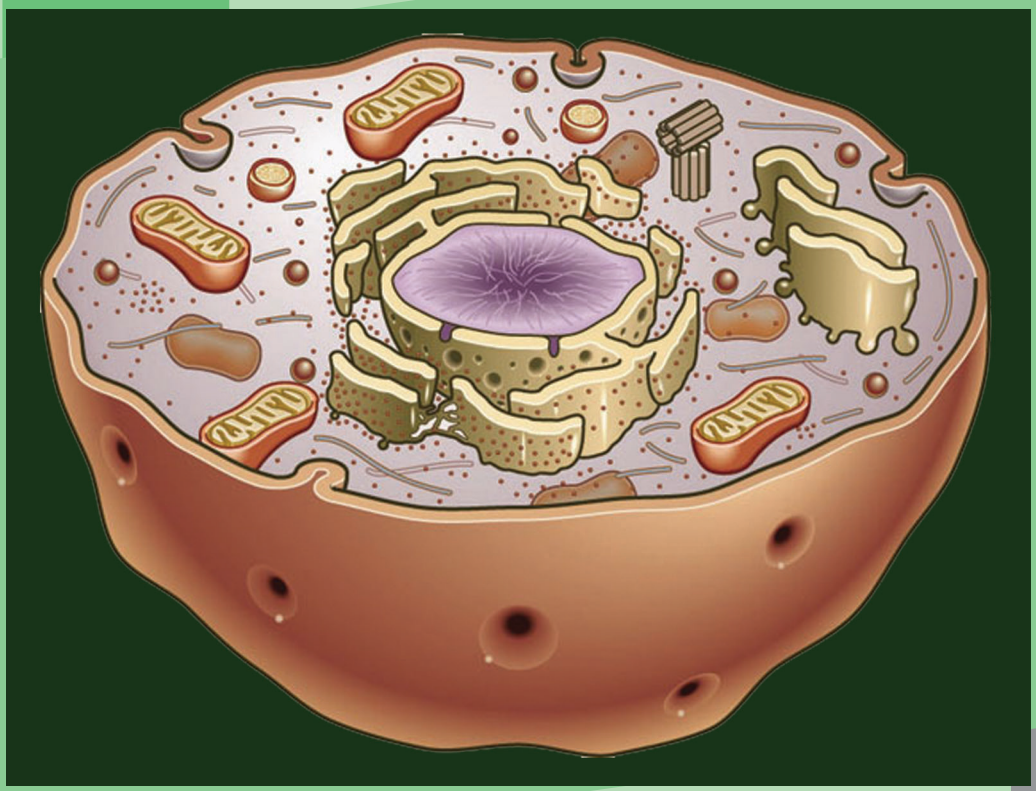
On his father's death, Abu Ali left Bukhara and travelled to Jurjan where Khawarizm Shah welcomed him. Later he moved to Ray and then to Hamadan, where he wrote his famous book *Al-Qanun fial-Tibb*. Here he treated Shams al-Daulah, the King of Hamadan (Persia now Iran)for severe colic.

He was the most famous physician, philosopher, encyclopaedist, mathematician and astronomer of his time. His major contribution to medical science was his famous book *al-Qanun*, known as the "Canon" in the West. The *Qanun fi al-Tibb* is a huge encyclopaedia of medicine extending over a million words. It surveyed the entire medical knowledge available from ancient and Muslim sources. It remained supreme for six centuries". In addition to bringing together the then available knowledge, the book is rich with the author's original contribution.

He was also the first to describe meningitis and made rich contributions to anatomy, gynaecology and child health.

His philosophical encyclopaedia *Kitab al-Shifa* was a monumental work, embodying a vast field of knowledge from philosophy to science. He classified the entire field as follows: theoretical knowledge: physics, mathematics and metaphysics; and practical knowledge: ethics, economics and politics.
He made several astronomical observations, and devised a device similar to the vernier, to increase the precision of instrumental readings. In physics, his contribution comprised the study of different forms of energy, heat, light and mechanical, and such concepts as force, vacuum and infinity.

2 Cells the building block



What you will learn

Alive or ...?

The 'blocks' of life

The blocks

Unicellular organisms

Alive or ...?

Who was the first person to go to the moon?
His most important job was to bring samples from moon back to Earth for testing. Was there life on the moon?

How would you tell if a new and strange object was living or non- living?

Checklist for life

Pictures A and B both show cats, but only the one in A is alive. How do we know?

A

B

Here is a checklist of things that living things do or need. Fill it in for the cat A and cat B

- Does it move some or all of itself?
- Does it need food for energy (fuel)?
- Does it need oxygen?
- Does it produce and get rid of waste?
- Can it grow?
- Can it have offspring (babies)?
- Does it feel things and respond to them?

Do you Know?

The human population of the world is expected to be nearly tripled by the year 2100.

What is the total number now?

What is an organism?

All living things, big or small are known as **organisms**.
The scientific name used for a living thing is an organism. Humans are living, so they are organisms. Living organisms do all the things on your checklist. Non-living things might do some of them, but will never do them all.
There are two main groups or **kingdoms** of organisms. They are **plants** and **animals**.

The characteristics of living things

We all agree that humans are living. But what exactly does this mean? Things, which all living things need or do are given special names. These are called characteristics of living things.

Meet MR GREFS and his family.
MR GREFS will help you remember the characteristics of living things.

1 To a visitor from another planet, a car may seem very much alive. List the things about a car which are like a living organism. Why isn't it alive?

2 All the features of life are shown in the picture of MR GREFS. Look carefully and find an example of each one.

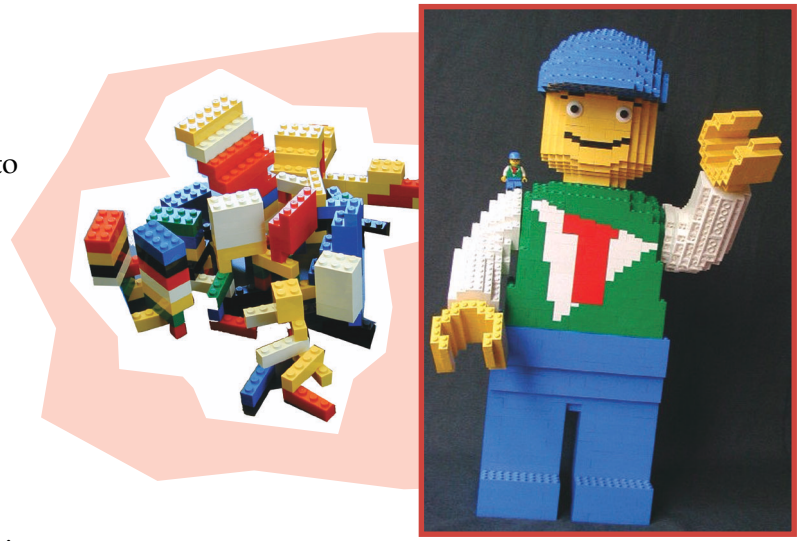
Ideas

- ***Living organisms*** *all carry out the common features of life.*
- ***Non-living*** *material may have some of the features of life, but not all.*

Cells the building block

2b

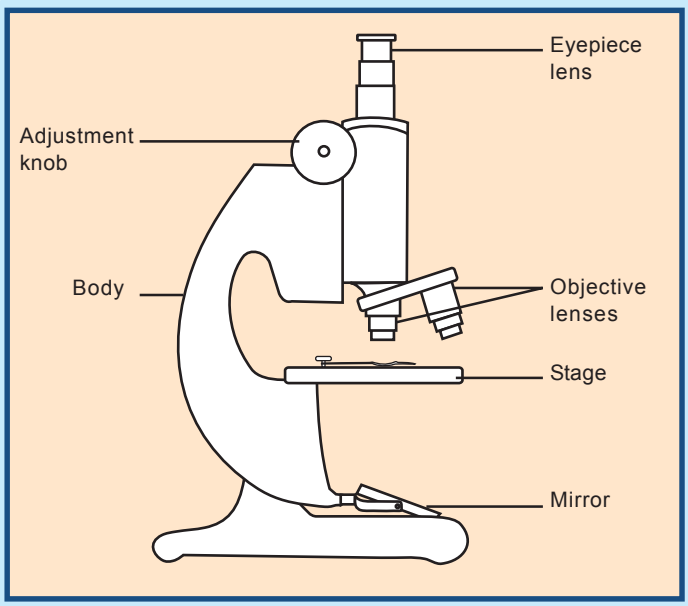
The 'blocks' of life



Look at the picture opposite, the bricks used to make them are all very similar. In the same way, all living things are made of building blocks called **cells.**
Cells are very small. We need a special tool called a **microscope** to see them.

Look small

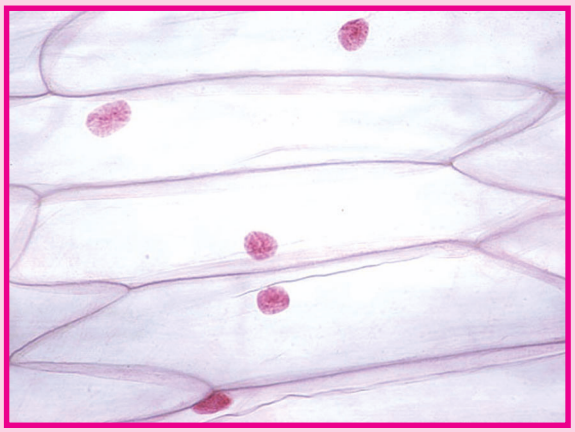
Your eyes need help to see very small things. A microscope magnifies small things, making them appear bigger. There are different kinds of microscopes.



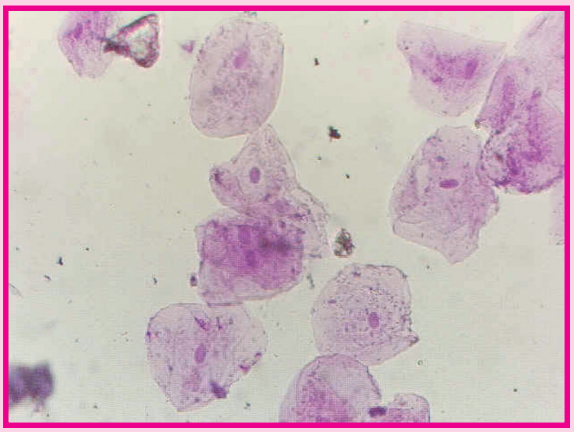
Do you Know?

The largest cell in a human being is the ovum or egg, which is produced by the female reproductive organ. It is slightly smaller than a pinhead.

About 330 years ago, Robert Hooke, an English scientist, observed box like shapes when he looked at thin slices of plants through his microscope. He called them 'cells'. Let us take a look at some cells seen under the microscope as shown in the photographs below.



onion cell



human cheek cells

A cell is the basic unit of all living things. It is the smallest part of a living thing which is fully alive. Thousands of chemical reactions take place in a cell to keep an organism alive.

Cells can grow and divide to make new cells (in other words cells can reproduce). Different cells can do different jobs.

Cells are called the building blocks of organisms (just like the bricks that make up the walls of your house).

1 Complete the diagram below by adding labels.

2 Make a table of two columns in your book to show the parts of the microscope and what each part does.

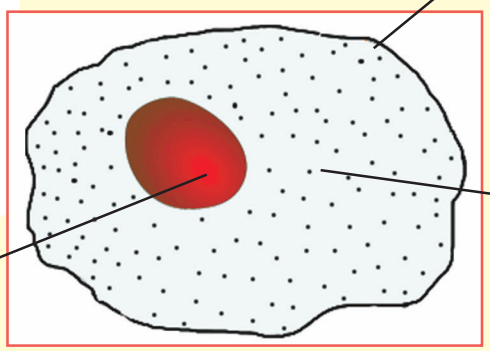
Ideas

- *A cell is the basic unit of living matter. All living things are made up of one or more cells.*
- *We need a special tool called a microscope to see cells.*

The blocks

Animal Cells

Each person is made up of several billion cells. If we look at one of them under a microscope, this is what we see. All animals are made of cells like these.



Cell membrane
It is a thin partially permeable layer, which controls the movement of materials in and out of the cell.

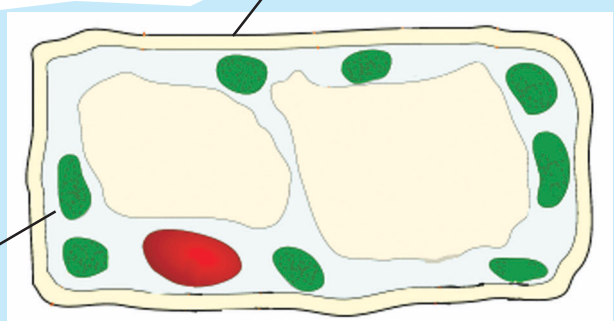
Cytoplasm
It is jell–like substance that contains many tiny structures. Chemical reactions take place in the cytoplasm. The cytoplasm almost fills the cell.

Nucleus
It controls all the chemical reactions that take place in the cell,hence it is known as the 'control centre' of the cell.

Plant Cells

Plant cells are different to animal cells. A quick look at plant cell under a microscope shows us a big difference.

Cellwall
It is made up of a thick layer of cellulose. It supports a plant cell, gives it a regular shape and holds it together with other plant cells.



Chloroplast
These are tiny disc-like structures containing a green substance called chlorophyll. The chlorophyll absorbs energy from the Sun and uses it to make food through the process of photosynthesis.

Do you Know?

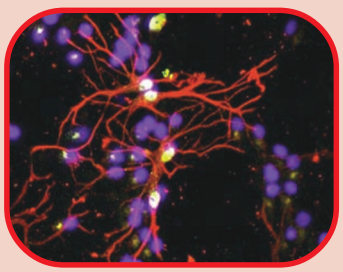
The scientific name of an animal or plant is the same all over the world.

From Cells to Organism

Tools have different shapes and structures designed for doing their particular jobs. Similarly, cells have different shapes and structures to carry out different functions.

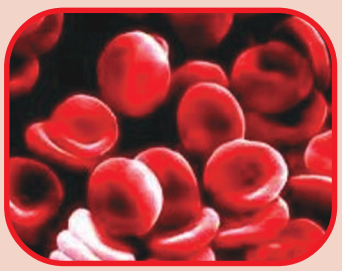
Some cells are designed

.....to carry messages



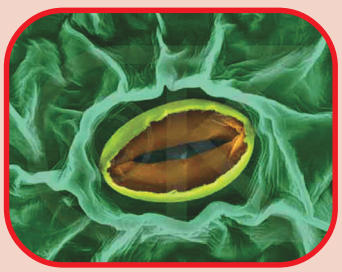
The nerve cell

....to carry oxygen around the body



The red blood cells

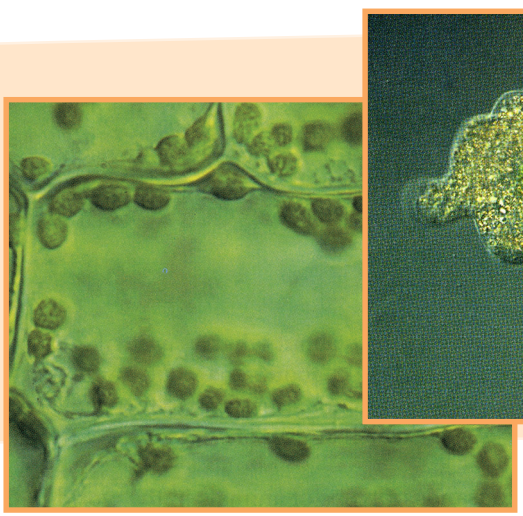
....to control the size of the openings

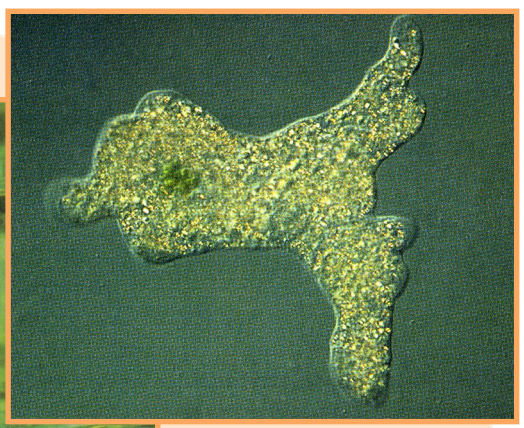


The plant guard cells

Which is which?

Here are an animal cell and a plant cell photographed using a very powerful microscope. Pick out the main parts in each cell and decide which cell is which.





1. Draw an animal cell and a plant cell. Label each one carefully.
2. Write down the differences between plant cells and animals cells?
3. Write down the similarities between an animal cell and a plant cell?

Ideas

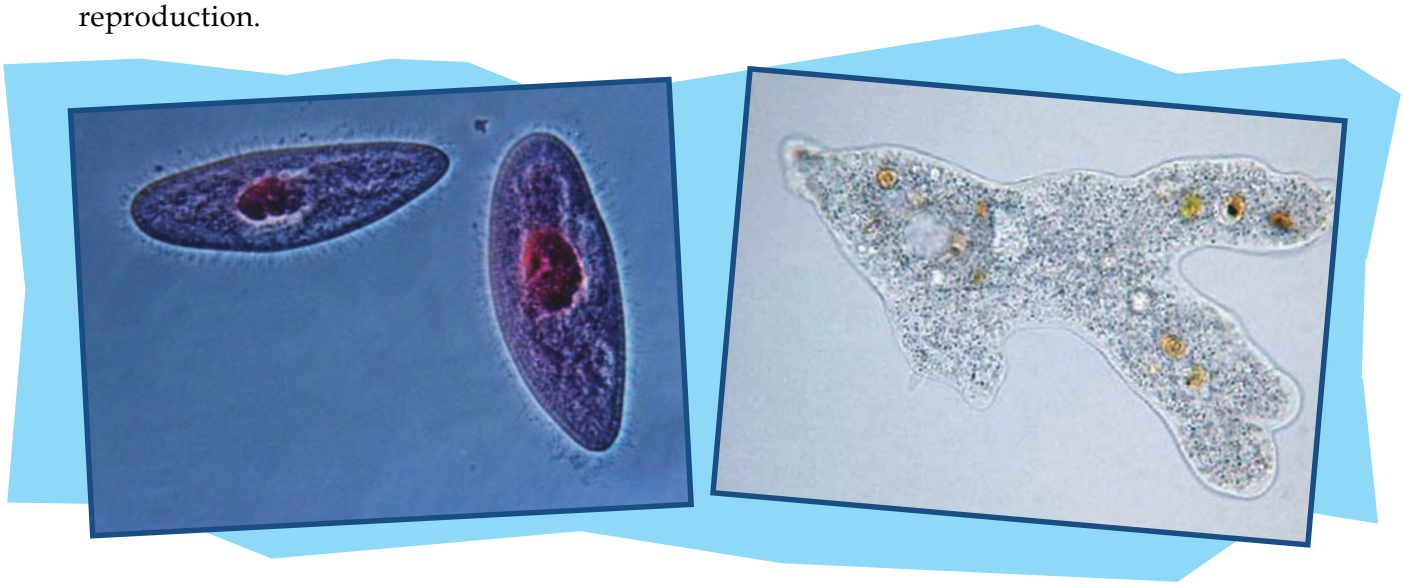
- *All animal cells have a membrane, nucleus and cytoplasm.*
- *All plant cells have a membrane, nucleus, cytoplasm and cellwall. Cells in the green part of plant have chloroplasts*

Cells the building block

2d

Unicellular organisms

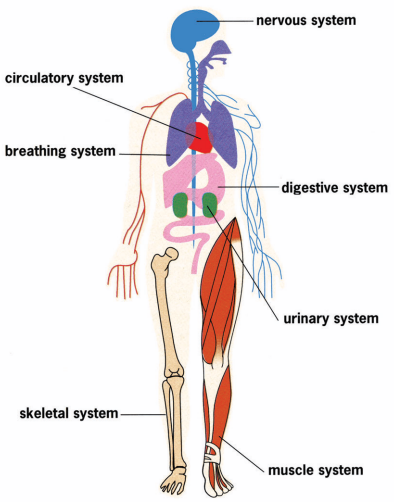
Living things with just one cell are known as **unicellular** organisms. Every unicellular organism has only one cell, which does all its bodily functions such as respiration, digestion and reproduction.



Multi-cellular organisms

Most living things are multi-cellular, that is they are made up of more than one cell. Multi-cellular organism such as human beings has billions of cells.

In multi-cellular organisms, each type of cell specialises in performing one particular function. This is known as division of labour. Different functions in a multicellular organism can be performed at the same time by the division of labour.



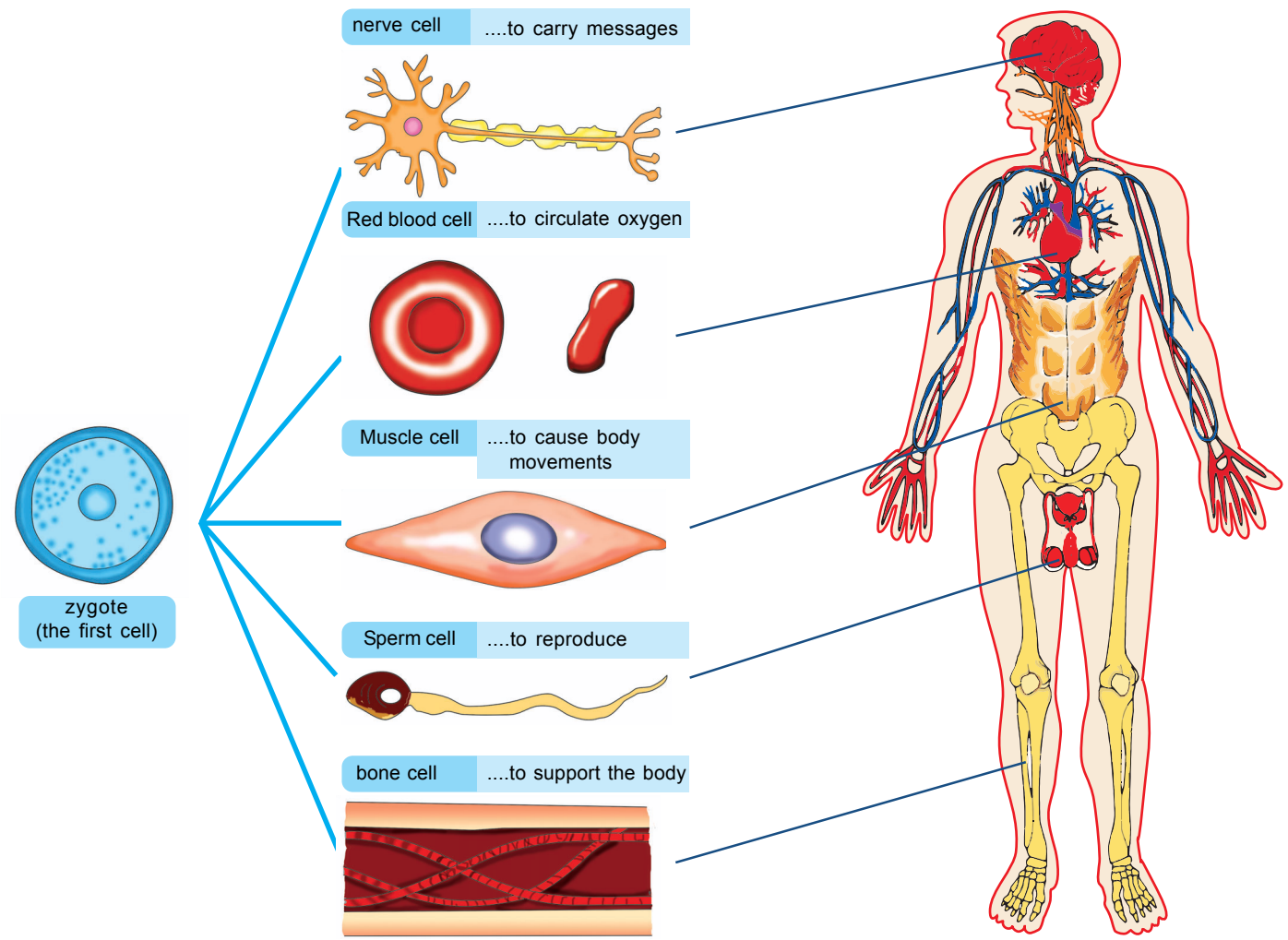
Can you name a few functions that have to be carried out at the same time in your body?

Do you Know?

Most dolphins can swim at 24-32 km/h for long periods of time.

Division of labour

In the production of lines of factories, workers specialise in doing different jobs. This leads to higher productivity and efficiency. Similarly, division of labour among cells, tissues, organs and systems ensures the smooth and efficient functioning of the organism as well as its survival.



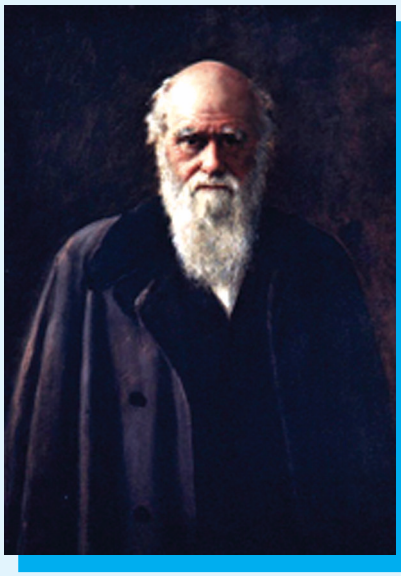
1 Name an example of each of an animal cell, a plant cell, a tissue, an organ and a system. In each case, state the functions.

2 Scientists are experimenting with 'growing' parts of and organs for human beings, e.g. ears, skin, heart valves, and even spinal cords. This is called tissue growth technology. How do you think these experiments, if successful, will benefit humankind?

Ideas

- *Unicellular organism consist of one cell which does all its functions.*
- *Multi-cellular organisms are made up of several cells which join together to form tissues.*

Charles Darwin
Born in 1809



Charles Darwin was born in England in 1809. He was the son of a doctor. When he was about your age, he collected things like postage franks (which are like stamps) and minerals.

In 1831 he volunteered to sail on a survey ship to South America. The voyage was to last five years, and it was the beginning of Charles Darwin's great work.

Whenever the ship stopped, Darwin went ashore in search of interesting animals and plants. He made studies of unusual living things and also of unusual rocks and crystals. He found some very strange animals living on the Galapagos Islands, for example iguanas, which are huge lizards. He also found different varieties of finches. Each kind had a different beak. Darwin was such a good scientist because he noticed details like this. He closely observed things. He then asked himself questions like:

Why are some animals so similar and yet they live on islands far away from each other?
Why are some similar animals slightly different from each other?
What causes the differences?

Darwin sent samples back to Britain so that he could study them in more detail when he returned. He finally worked out how one kind of living thing could change slowly into another kind over a long period of time. This change is called evolution.
(J. Boyd & W.WhiteLaw 1989 John Murray)

3 Variety of life

What you will learn

What is an animal?

Where do we belong?

Pick a plant

How to organise your organisms

Lives in danger

3a

What is an Animal?

We all have our own ideas about what an animal is. But when one scientist talks about a particular animal, it is very important that other scientists all over the world know exactly which animal he or she is talking about.

There are hundreds of millions of different kinds of animals in the world. We can sort animals into groups to help us identify them all. We call this **classifying** them. We start off with big groups, and then split those into smaller and smaller ones.

What do you think are the main groups within the animal world?


lions


Reagal Fish


Snake


Zebras


Penguins


Panda

Who is spineless?

Look at the pictures of animals opposite. You will notice that the animals vary a good deal. There are some that are quite similar.
The mouse and the hamster look alike in shape, both are covered with hair and have four legs. But is the mouse in any way like, say, a goldfish?
No, however, the mouse and the fish do have something in common.
They both have a backbone.


Hamster


Mouse


Gold fish

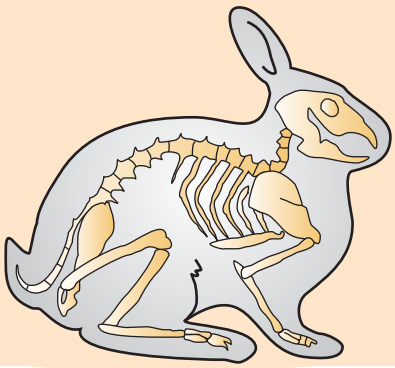
The backbone or spine is a line of bones running inside along the animal's back.
Animals with backbones are called **vertebrates**.
Those which do not have backbones are called **invertebrates.**

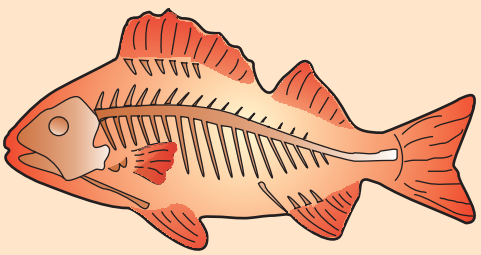
Do you Know?

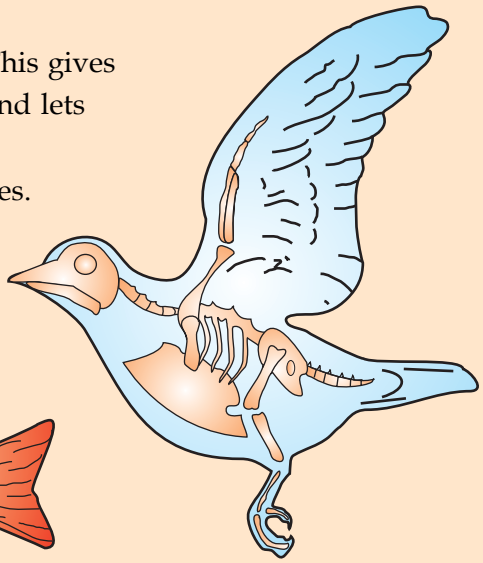
There are about 1200 000 different kinds of invertebrates, but only about 47000 different kinds of vertebrates.

The Vertebrates

Vertebrates have a hard, bony skeleton inside their bodies. This gives them support, protects the delicate organs inside the body and lets them move about.
Vertebrates all have a backbone made up of lots of little bones.







The invertebrates

Invertebrates come in all shapes and sizes. Many of them have soft bodies. Others have shells inside or outside their bodies, or an outer suit of armour. But invertebrates do not have a bony skeleton with a backbone.


Star fish


Worm


Snail

1 Fill in the blanks using the following words.

skeletons	**snails**	**fish**	**backbones**
soft	**without**	**beetles**	**rabbits**

Vertebrates are animals which have ———— ————.
They have ———————— inside their bodies.
Examples of vertebrates are ———————— and ————————.

2 Make a list of about 10 different animals. Decide which are vertebrates and which are invertebrates.

Ideas

- *We **classify** animals and plants by putting them into groups.*
- *The animal world is divided into two main groups, **vertebrates** and **invertebrates**.*
- *Vertebrates are animals with **backbones**.*
- *Invertebrates are animals **without backbones.***

3b Where do we belong?

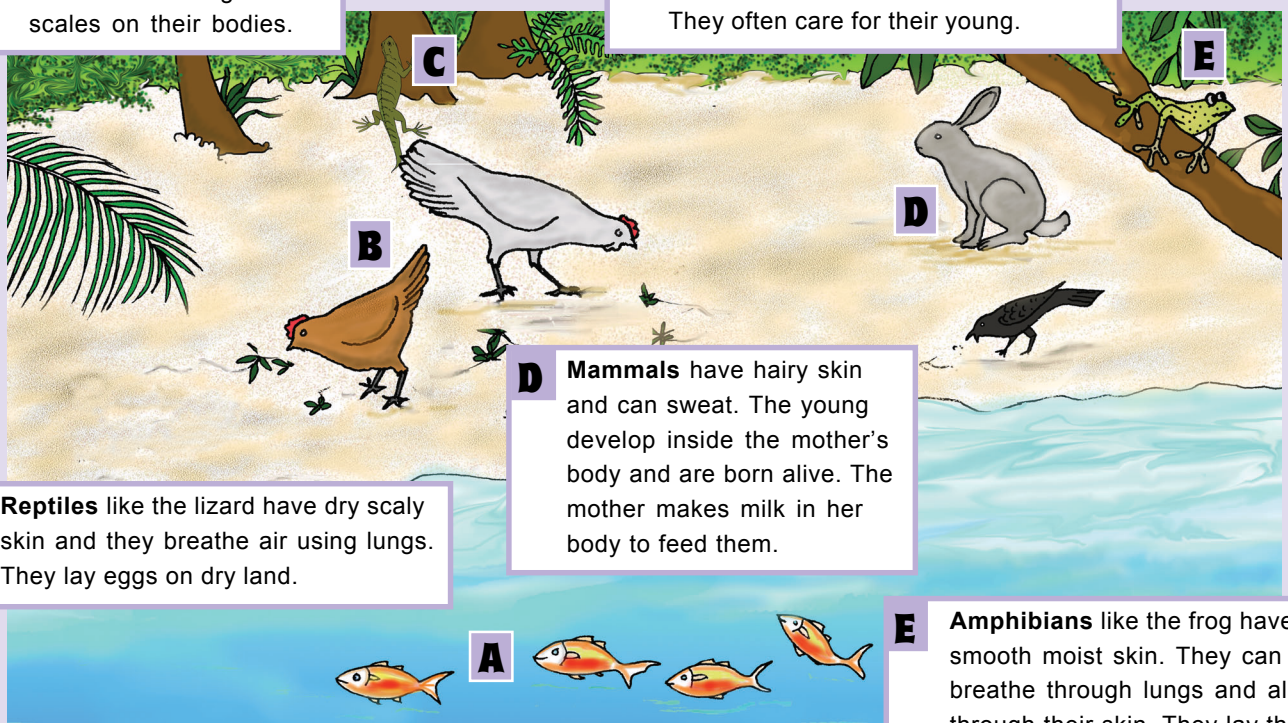
There are more invertebrates than vertebrates. But the vertebrates are much bigger and more noticeable. There are a variety of vertebrates too. To help us identify the animals they are grouped into different families or classes.

Organising the vertebrates

The vertebrates can be divided into these five groups.

A **Fish** live in water. They have gills for breathing, fins for swimming and scales on their bodies.

B **Birds** have feathers and wings and most of them can fly. They have beaks and they lay eggs with hard shells. They often care for their young.



C **Reptiles** like the lizard have dry scaly skin and they breathe air using lungs. They lay eggs on dry land.

D **Mammals** have hairy skin and can sweat. The young develop inside the mother's body and are born alive. The mother makes milk in her body to feed them.

E **Amphibians** like the frog have smooth moist skin. They can breathe through lungs and also through their skin. They lay their eggs in water.

The bodies of fish, amphibians and reptiles have the same temperature as their surroundings. Birds and mammals have their own warm body temperature which stays the same in all weather conditions.

Do you Know?

Next to humans, the dolphin is considered to be the most intelligent creature.

The Sub groups

Each of the main groups of vertebrates can be divided into smaller groups. For example, mammals can be very different. They range from the tiniest mouse to the huge animals like elephant. Here are some of the main groups of mammals.

Whales and dolphins live in water. They breathe air through a blowhole.

Herbivores eat plants.Cows, sheep, giraffes and horses are herbivores.

Carnivores eat meat and have sharp teeth. Dogs and cats are carnivores.

Primates have forward facing eyes and hands which can use tools.

1. I have dry scaly skin and lay eggs on land. What am I?
2. My babies feed on milk produced by my body. My skin is hairy. What am I?
3. I have wings and feathers. My body is always warm and lay eggs with hard shells. What am I?
4. I need water for my eggs. My skin is smooth and moist and I can breathe through it. What am I?
5. I need water to live. I have gills, fins and scales. What am I?

Ideas

- *Vertebrates are divided into five main groups: fish, amphibians, reptiles, birds and mammals.*
- *Each group contain many smaller groups.*

3c Pick a plant

There are about 350,000 different kinds of plants in the world that we know of. The plant world can be divided into smaller groups like the animal world.

Make a list of 10 different plants. How would you divide them into groups.

Moses are small plants that live in damp places. This is because they lose water through their thin leaves, and they don't have a transport system to carry water through the plant. Mosses reproduce by making spores instead of seeds.

Conifers are usually evergreen.They have thin, needle-like leaves which they keep all through the year. They have a water transport system and waterproof leaves. Conifers produce seeds which are formed inside cones.

Flowering plants reproduce using flowers. The flowers produce seeds inside fruits. Flowering plants have a water transport system and usually have broad waterproof leaves.

Ferns are much bigger plants than mosses. They have strong stems, roots and leaves. Their leaves are waterproof, so they don't lose water. Ferns have a transport system for water, so they don't have to live in damp places. Ferns make spores instead of seeds.

Do you Know?

63,000 square miles of rainforests are being destroyed each year.

Flowering Plants

Most of the plants we see around us are flowering plants. They range from very big plants to tiny balsams (dhe than'dimaa). Flowering plants can be sub divided into herbs, shrubs and trees.

Shrubs and trees are woody and can live for many years. Some flowering plants do not seem to have flowers at all. Grass flowers are green and difficult to spot. But they are still flowers. Grass is a flowering plant.

1 Fill in the blanks using the following words.

Mosses cones flowering plants evergreen seeds ferns

..... are small plants that produce spores and need a damp place to live. ..... have a water transport system, but also produce spores. Conifers are often ..... They produce seeds which are carried in ..... The .... produce ..... which grow in fruits.

Ideas

- *The plants can be divided into four major groups. They are moss, fern, conifers and flowering plants.*
- *There are various types of flowering plants and they can be subdivided into herbs, shrubs and trees.*

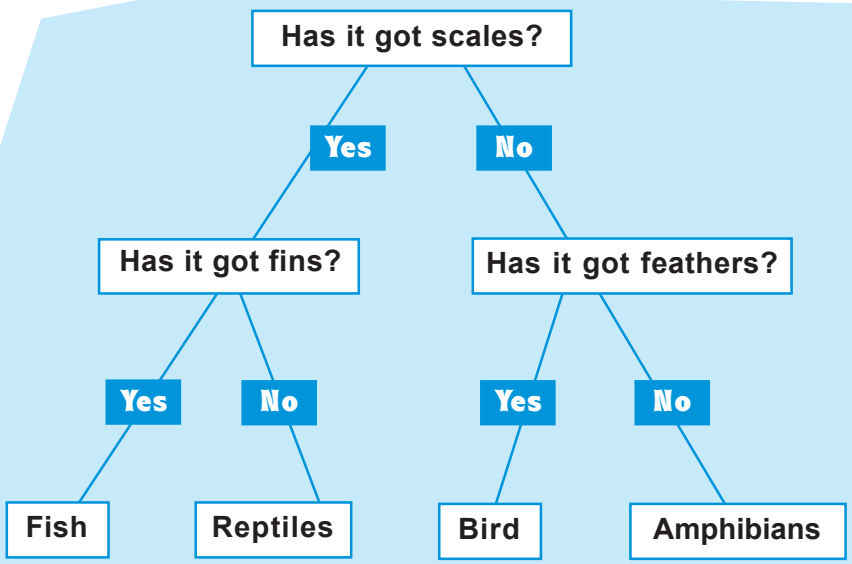
3d How to organise your organisms

How would you classify these two organisms?

We classify living organisms by looking at the things that are similar between them, and also the things that are different.
But if you happen to see a strange organism, how can you decide which group it fits into?

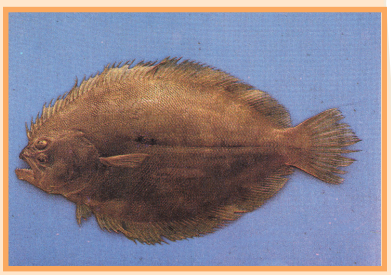
Using Keys

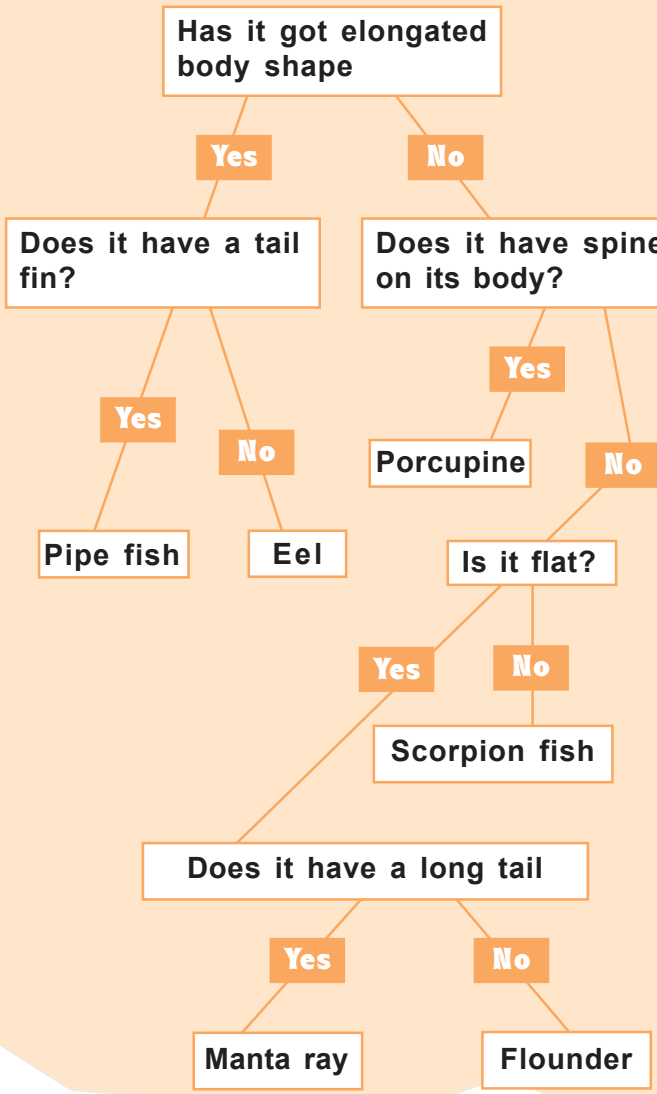
We can find out what an organism is, using a key.
Here is a key you could use to help you identify some of the main groups of vertebrates.



You might be able to sort out these vertebrates without the key, but if you went under the sea you would find more unusual creatures.

Identify these underwater organisms using the key below.





1 Use the key above to help you describe the following organisms.

a. Eel has an ---------- body.

b. A porcupine fish has ---------- on its body.

c. A manta ray has a long ---------- .

d. A pipe fish has a ---------- fin.

2 The vertebrates can be divided into five groups: fish, amphibians, reptiles, birds and mammals. Choose animals that belong to each and see if you can make a branching key.

Ideas

*A **key** identifies organisms using simple questions about the differences between them.*

3e Lives in danger

Do you know that there are some animals in this planet which are very few in number?

Their number became few because of our actions.
For example, Dhon Dheeni became very few in number in our country.

The reason is we:

- destroy the places they live.
- catch them and keep them as pets.
- sometimes use them for food.

So they are in a position called **Endangered species.** That is that types of organisms are in danger of survival. They are going to be wiped out from the Earth sooner or later.

Turtles are another one

Fifty years back thousands of turtles nested every night on the beaches of Maldives islands. But now only a few are seen once a month or so.

The reasons are that they are seriously overused:

- for their meat and eggs
- for their tortoise shells

Do you Know?

Wind speed in tornadoes can be as high as 700kph. In some tornadoes fish, frogs and other animals have been swept up in to the air.

Some endangered animals around the world

Arabian oryx

Found in Jordan, Oman and Saudi Arabia. In 1972 this animal has been almost wiped off from the region. Numbers are now increasing as animals breed.

Giant Panda

There are around 700 animals existing at the moment. There is a real chance that they may become extinct. It means that they may become non-existent.

Blue whale

Blue whale is the largest mammal. There are only 500 individuals today in the southern hemisphere. Before there were about 250,000 blue whales approximately.

Preventive measures

What are your ideas about protecting these animals?

You should know that it is our responsibility to use the resources we have wisely and save them for future generations too.

One of the measures taken by our government was that the export of turtle and turtle products and the sale within the country was banned.

Dhon dheeni was declared as protected. Protected means that you are not allowed to harm the animal by any means. It is against the law to do so.

Many non-governmental organizations were also concerned about these issues.
They started conducting awareness programmes for the public about the matter.

Public awareness, education programmes, research are some of the activities that are carried internationally too.

Ideas

- *Some animals are endangered because of our actions like overusing, destroying their habitats.*
- *Protective measures are taken by the government due to this like making some organisms as protected animals.*

1 You are given a task of running an awarness programme on endagered species and you are asked to make a leaflet. Discuss among groups what you need to include in the leaflet.

ARISTOTLE
Born in 384 B.C.

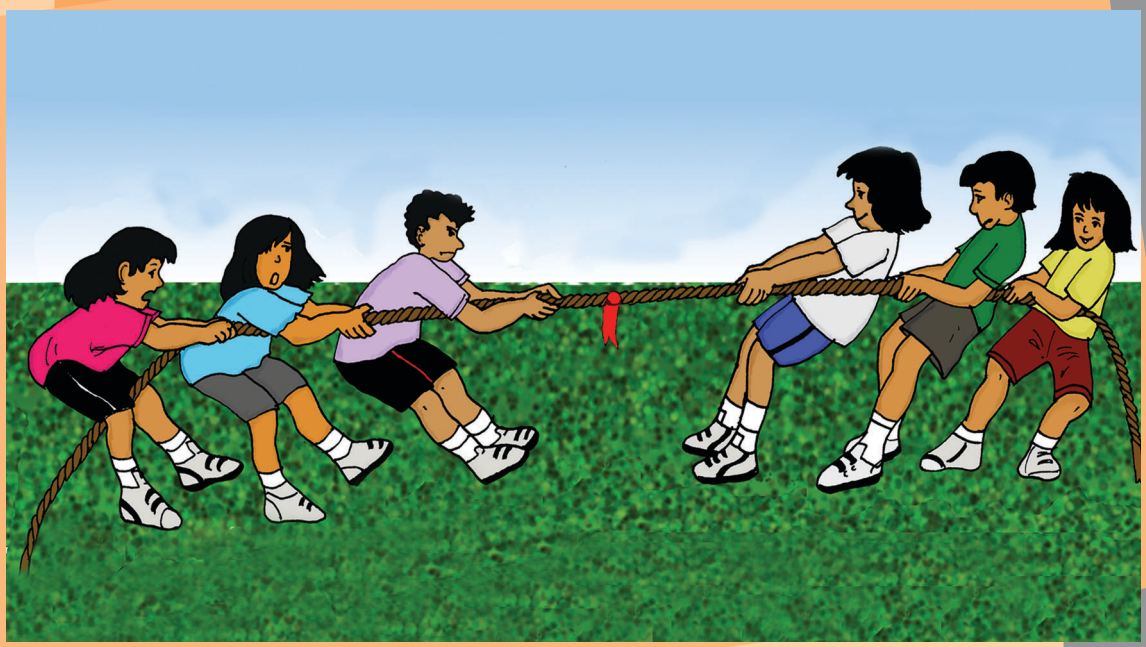
Aristotle was born in Greece in 384 BC. His parents died when he was young. He attended the famous academy in Athens to study and showed an interest in many different things. Aristotle was very observant. Like you, he tried to be exact Aristotle saw something happen, he wanted to know the cause of it.

What ideas did this great man work out? He thought that the world was round. He also thought that the stars and planets moved around the earth and tried to explain this movement. Some of his best work was done in biology. He named over 500 different animals and tried to classify all living things into sets. He wrote the full descriptions of lions ad elephants.

Aristotle described many marine creatures. The mouth of a sea urchin is still known as Aristotle's purse. He also studied bees and knew how they behaved in a hive. Beekeepers expect to get stung from time to time. Perhaps this is how Aristotle found out how a bee sting works.

As well as being an astronomer and a zoologist, Aristotle was also interested in mathematics, botany and medicine. There was hardly a branch of science in which he didn't do important work. Many of his ideas were accepted for over 2000 years. What a brilliant man!
(J. Boyd & W.WhiteLaw 1989 John Murray)

4 Forces and Motion



What you will learn

- What is a force
- Forces around you
- Moving along
- Speed

4a

What is a force?

Sometimes you get lazy and it is difficult to get up while you are lying down watching television or reading a book.

In such instances you may need someone to give you a **push** or a **pull** to start you moving.

Pushes and pulls are forces. You are using forces everyday. Opening a door, squeezing a lemon or kicking a football are examples of forces in use.

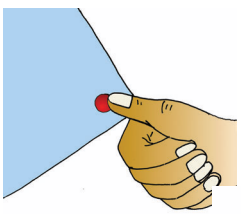
Look at the three pictures opposite and say which one is a push or a pull.

What can forces do?

What do the forces do? You don't see force but you see what they do to objects. You cannot see wind, but you can see a tree bending or a sailing boat moving.

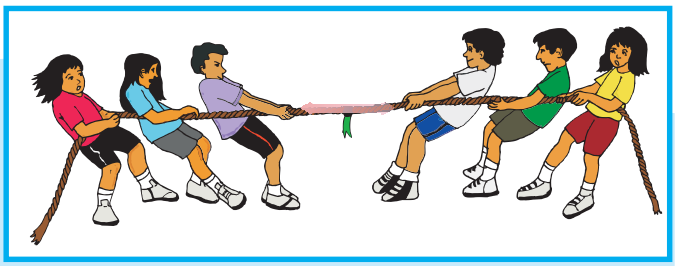
Forces large and small

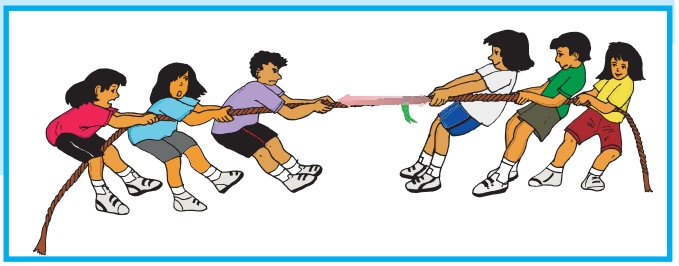
You need a force to make something move which is still.
Here are some forces. Each force is making something to start moving. Some forces are much bigger than others.



Balancing forces

The two teams are often evenly matched in a tug of war. They pull on the rope with equal forces, and the rope does not move. In this case, the two pulling forces are balanced. When one team gets tired and its force gets smaller. The rope starts to move because the forces are unbalanced, and one team wins. You need an unbalanced force to start something moving.





The right direction

The shopper provides the push to start the trolley moving. You can show the force by drawing an arrow. The arrow shows us the direction in which the force is pushing or pulling.

Measuring forces

Forces can be measured. Forces are measured in **newtons(N)**. One newton is a very small force. A mango weighs about one newton. You would need to pull with a force of about 350 newtons to lift an average Grade 6 student up!

To measure forces we use a **force meter**. We can also call it a **newtonmeter.**

1 Draw diagrams to show the following forces and label the arrows.

a. the push of a bat on a ball.
b. the pull of a hand on a drawer.

2 You can easily take a book away from a baby.

a. Draw the book, and add arrows to show your pulling force and the baby's pulling force.
b. Which of these is bigger?
c. Are the forces balanced or unbalanced?

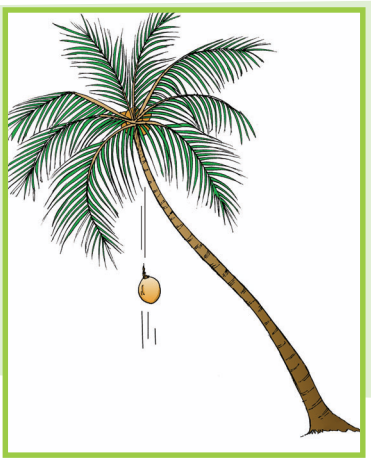
Ideas

- *A force is a **push** or a **pull.***
- *A force can change the shape of an object or move a still object.*
- *An **unbalanced force** is needed to start something moving.*
- *Forces are measured in **newtons (N)** using a **newtonmeter.***

Forces around you

There are different kinds of forces. Here are some of the different forces which act on or around you.

Weight or force of gravity



Gravity is a force which pulls all things towards the Earth. It is this force which makes things feel heavy. Scientists call the force of gravity pulling on an object, its **weight.**

Why does the coconut always fall to the ground and not float away?

What's weight?

This crane is using a force to lift a heavy object. The pull of the crane must be big enough to lift the weight of the object. The weight of the object is the pull of the Earth's gravity on it. If the chain breaks, the object's weight will pull it down to the ground.

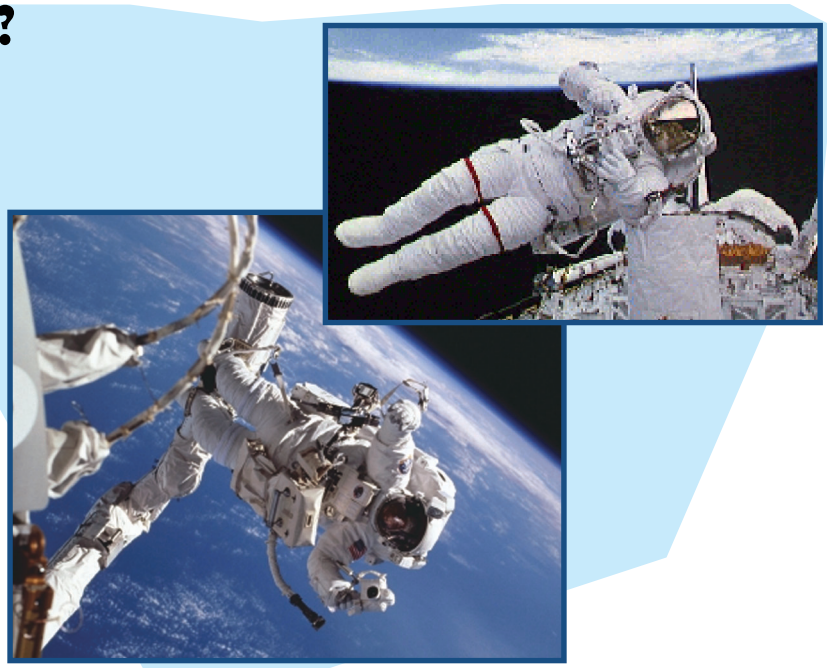
Since weight is a pull, it is a force. So weight is measured in newtons (N). You can measure weight using a newtonmeter.

The weight of a mango is about 1N. Estimate the weight of each of these:

- five mangoes
- ten oranges
- a book
- the person sitting next to you in the class

What's the matter?

If you go to the Moon, you weigh a lot less. But something about you stays the same. You are still made of just as much 'stuff' as when you were on the Earth. Your mass doesn't change.



Mass and weight

If you weigh an object whose mass is 1kg, like a bag of rice, you will find that its weight is 10N. If you know the mass of something (in kg), you can easily work out its weight (in N). You simply multiply by 10.

1 Fill in the blanks using the words below.

Force	weight	gravity	pull

The..... of an object is a ....., caused by the..... of the Earth's ..... on it.

2 Choose the correct words from each pair.

measured in kilograms	mass / weight
a force	mass / weight
less on the Moon	mass / weight
measured in newtons	mass / weight
stays the same in empty space	mass / weight

Ideas

- *The weight of something is the pull of the Earth's gravity on it.*
- *The weight of something is a force measured in newtons (N).*
- *The mass of something tells us how much matter it is made of.*
- *The mass of something is measured in Kilograms (kg).*

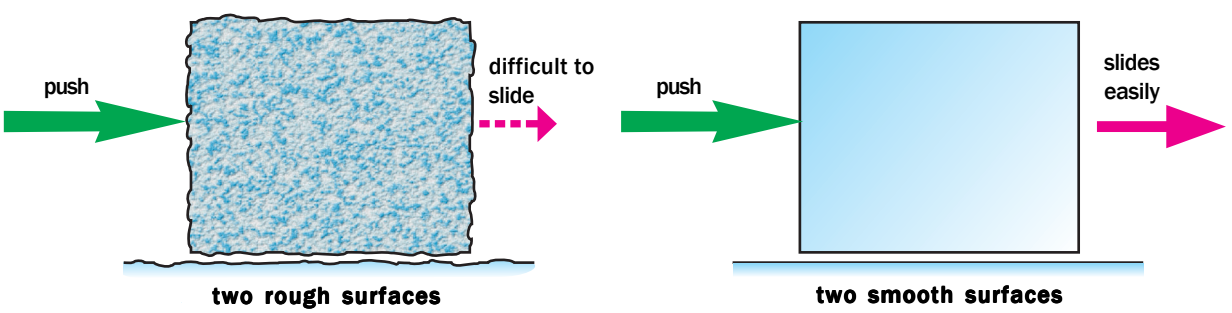
Moving along

The car had a problem with its engine. It wouldn't move. So the people in the car have solved the problem of how to make the car move. They have very strong muscles, and they can push with a big enough force to start the car moving.

Rubbing along

It is easier to move something if you can get rid of friction. You can feel friction when you rub your hands together. If something is moving, friction slows it down. Things would move faster without friction. Friction is a force. We can draw a force arrow to show how friction works.

Smooth surfaces have less friction than rough surfaces. It is difficult for one rough surface to slide over another.



Overcoming friction

Here are some ways of reducing friction, so that it is easier for something to start moving, or to move faster.

How do these things reduce friction?

Increasing friction

Friction can be a nuisance, but it can also be very useful. The brakes on a bicycle use friction to help you stop. The rubber pads press on the wheel rim, and the friction slows the wheel down. Car tyres have a pattern of tread to give good grip on the road. If the tyres are bald, there is less friction. The car may slide out of control.

1 Fill in the blanks using the words below.

start surface less force

Friction is a ..... It is found when one ..... rubs against another. Friction can make it difficult to ..... something moving. Friction is ..... when surfaces are smooth.

Ideas

- *Friction is a force which happens when one surface rubs against another.*
- *Friction can make it difficult to start something moving.*
- *Friction can also be useful because it gives you grip.*

Speed

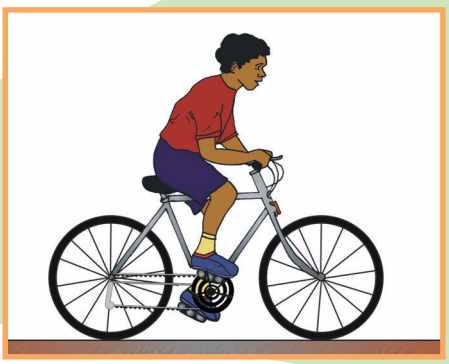
An Olympic runner can run 100 metres in about 10 seconds. A speed boat can travel 120 kilometres in five hours. An aeroplane can fly 2000 kilometres in two hours.

The **speed** of an object is the distance it travels in one second (or one hour). Speed tells us how fast an object is moving. The areoplane has the highest speed because it covers the largest distance in the shortest time.

Getting things moving

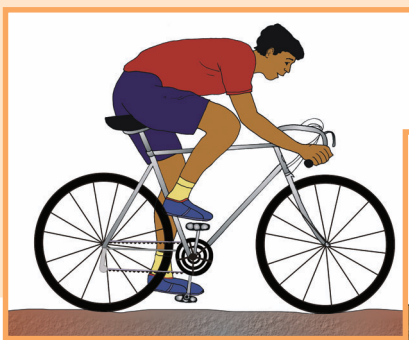
Imagine you getting on a bicycle, you need to push hard on the pedals. Friction makes it difficult to get started.

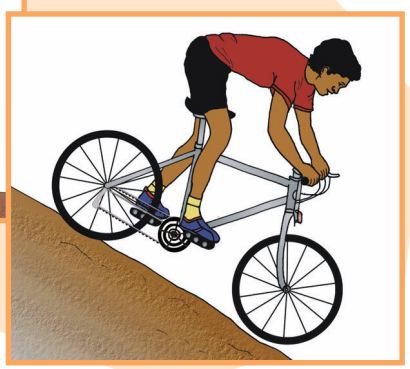
Once you start going, You only need a small force to travel at a steady speed.



Speeding up and slowing down

A bicycle moving at a steady speed increases its speed when you pedal harder. When speed is increasing the bicycle is **accelerating**. When the brakes of a bicycle are put on, its speed decreases. The bicycle is then **decelerating**.





Measuring speed

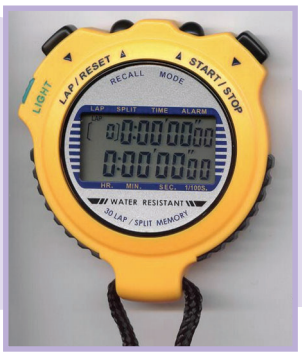
Car drivers need to know the car's speed, to make sure they do not break the speed limit. The speedometer shows how fast the car is travelling.

The police use a radar gun to tell how fast a car is travelling. They will stop anyone who is going too fast.

How can you measure speed?

To work out the speed of a runner, we need to know two things:
The distance she moves. The time she takes.

The tape measure is used to measure the distance she runs, and the stopwatch times how long she takes.



Calculating speed

We can calculate his speed using this formula:

$$\text{Speed} = \frac{\text{distance moved}}{\text{time taken}}$$

In science, we have to be careful about the units we use. The table shows the correct units

Quantity	Unit	Symbol for unit
distance moved	metres	m
time taken	seconds	s
speed	metres per second	m/s

Ideas

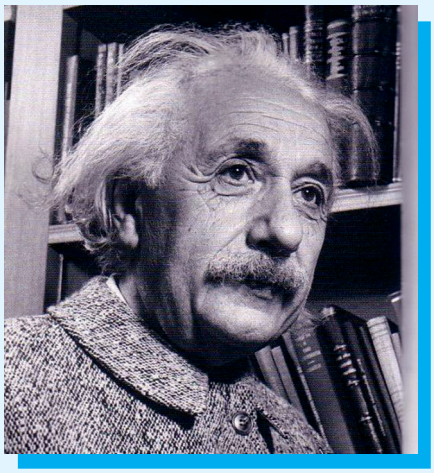
- *Your **speed** tells you how fast you are moving. If you travel a long distance in a short time, your speed is high.*
- *When speed of something is increasing it is accelerating.*
- *When it is slowing down it is decelerating.*

1 A speed boat travels 35km from Male' to Alif atoll in 1 and half hours. What is its speed, in metres per seconds for the journey?

2 On sports day, Ahmed ran 400m in 50s. Aminath ran 1500m in 250s. Who was faster, and what werer their speed?

Albert Einstein

Born in 1879.



Albert Einstein was born in Germany in 1879. He did not enjoy school very much. After going to Zurich Polytechnic, he went to work for the Swiss Patent Office (a patent is a description of a new invention).

While he was there, he did a lot of thinking about the way things move. At the age of 26 he wrote about his thinking. His work was a great success and it was talked about all the world.

Albert Einstein described the movement of objects as being relative and so his theory was called the theory of relativity. He worked out that the speed of light was the fastest possible speed in the universe. Light travels about 300 000 kilometres every second. Light can therefore travel from London to Edinburgh and back 250 times in one second.

He also worked out that there was a connection between mass and energy. The equation $E= mc^2$ describes this. This discovery led to the development of the atomic bomb and nuclear reactors.

Albert Einstein's work has also been important in modern mathematics and astronomy. His ideas predicted some amazing results. For example, did you know that you increase in mass as you move faster? So when you run for the bus you get heavier! Did you know that time goes faster when you stand still? So if you are on a ride at the fair then you are getting older more slowly than a fried who is watching you! However, on earth, these changes in mass and time are very tiny. You will never notice them.
(J. Boyd & W.WhiteLaw 1989 John Murray)

5 Light

What you will learn

Light

Playing with shadows

Light bounces

Rainbow colours

5a

Light

No one can see anything in a completely darkened room. There has to be light before you can see! You see when light enters your eye.

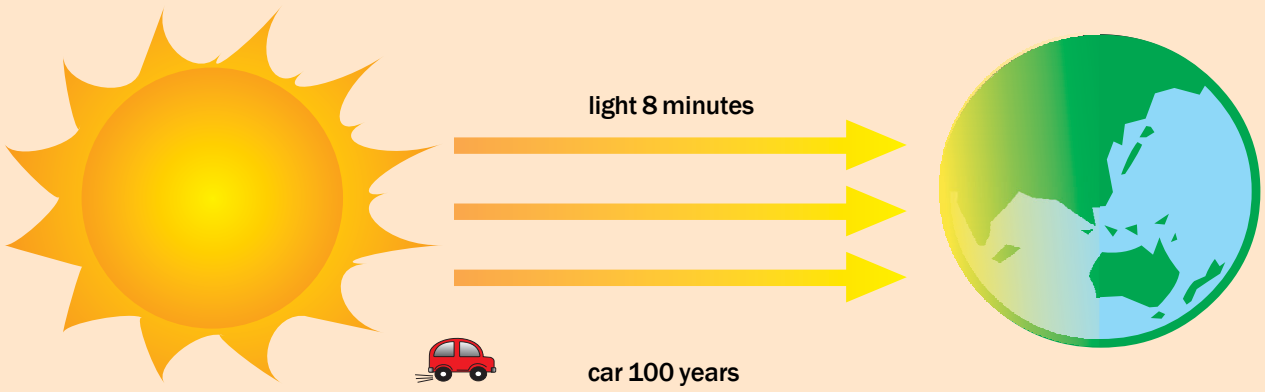
What is light?

Light is a type of energy. Light energy is given off by the Sun, by electric light bulbs, by candles and other light sources.

Light energy travels from one place to another. The light which allows you to see during the day has travelled so many km to the Earth from the Sun!

The speed of light

Light travels at a very high speed. In one second, light can travel a distance of 300,000km. This means that the speed of light is 300,000,000 metres per second. This is about a million times faster than the speed of sound.



Light travels

We can often see the sun shining during the day. In the picture, you can see the Sun's rays shining down on to the Earth, lighting everything up.

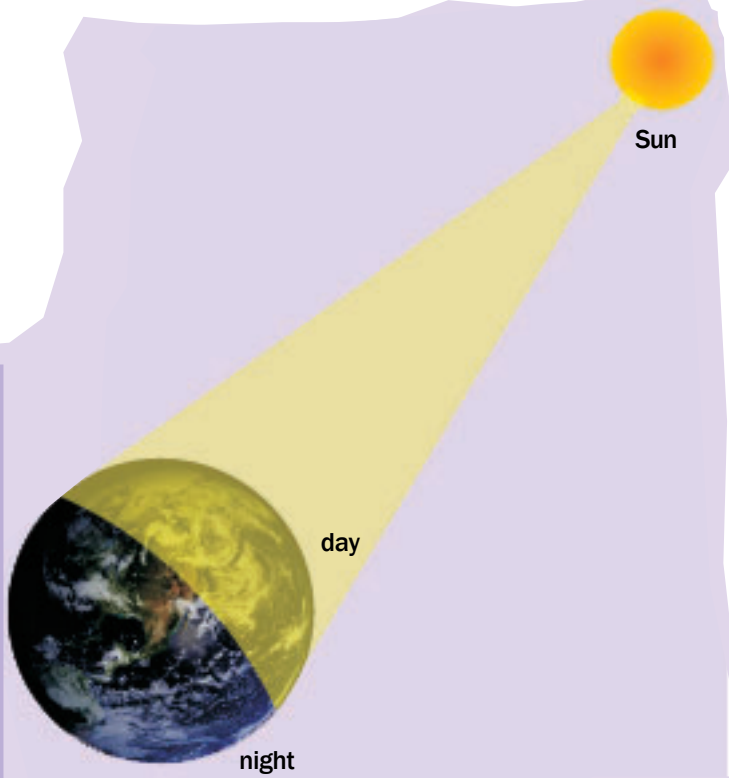
How does light travel? Are the rays in straight lines?

Where else have you seen light travelling in straight lines like this?

Day and night

At night, our side of the Earth is facing away from the Sun and we can no longer see its rays. Everything is dark.

The reason is the Sun's rays cannot bend round and light up the back of the Earth.



1 Fill in the blanks using the words below.

rays	lines	light	bend

We see when ..... enters our eye.
Light travels in straight .....
called ..... . Light cannot .....

Ideas

- *Light is a type of energy.*
- *Light travels at a very high speed.*
- *Light travels in straight lines.*

5b Playing with Shadows

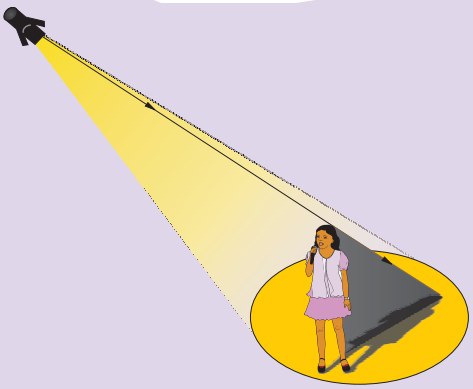
Shadows are made when an object blocks light rays from reaching an object. The shape of the shadow is the same as the shape of the object.

This is because light travels in straight lines.

People on stage often make very clear **shadows**. The light comes from a spotlight. Its rays shine down on the singer to light her up.

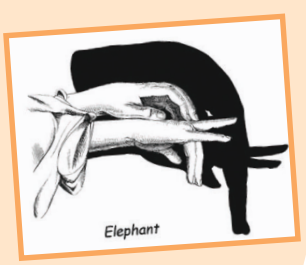
There is a dark shadow on the stage where the rays do not reach.

Because light travels in straight rays, we can draw a straight line to show where the singer 's shadow will be.



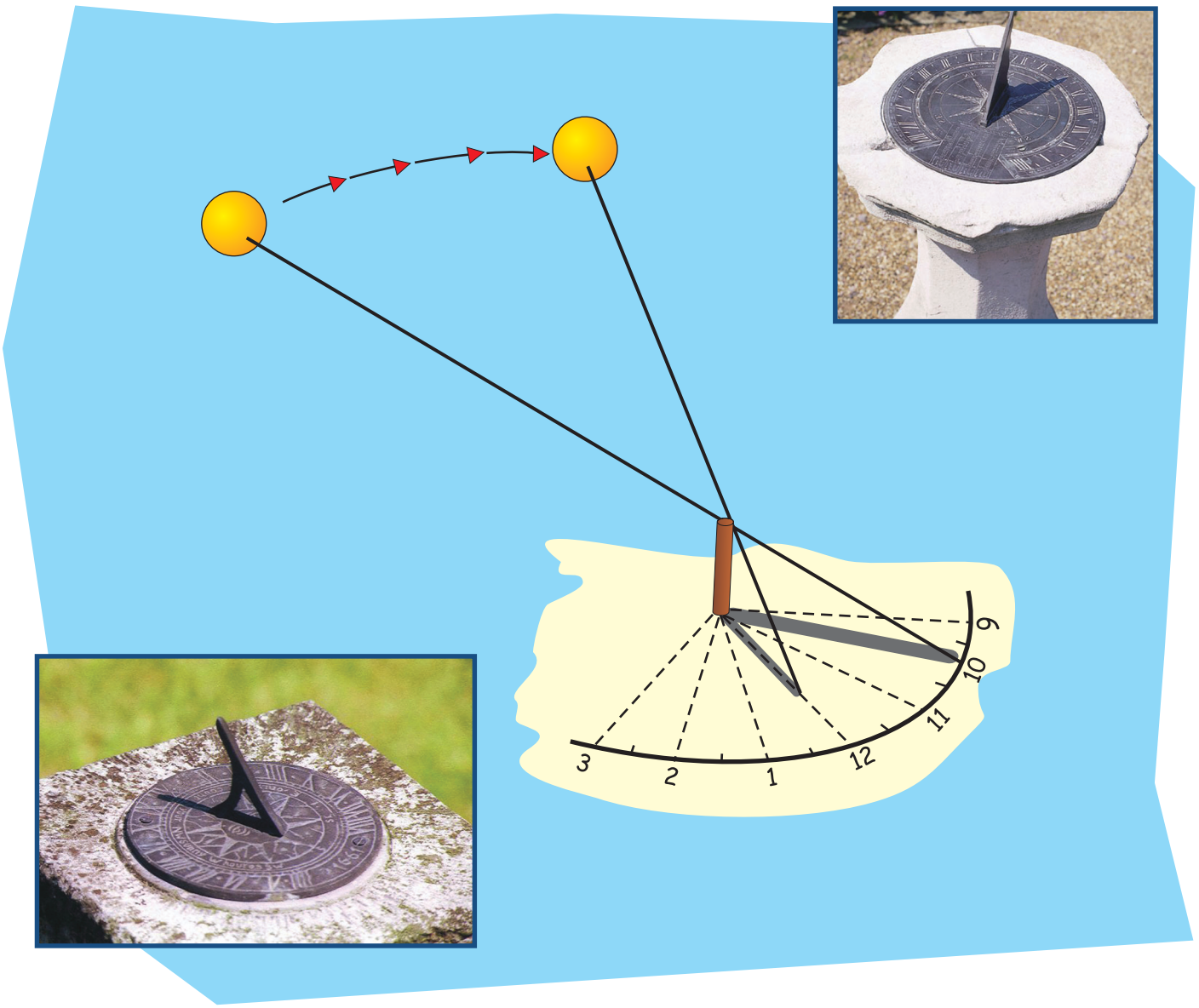
Light and shade

You can make interesting shadows using your hands.



A sundial

When the Sun's rays hit a sundial, a shadow is made. During the day, the Sun moves across the sky. The shadow moves around, and we can use this to tell the time.



1 How does shadow form?

2 You can create stage shows using a toy person for the actor, and two or three torches for the lights.
Draw a diagram to show how three shadows would be formed.

Ideas

A shadow is formed when light rays are blocked by an object. This idea is used in a sundial.

5c

Light bounces

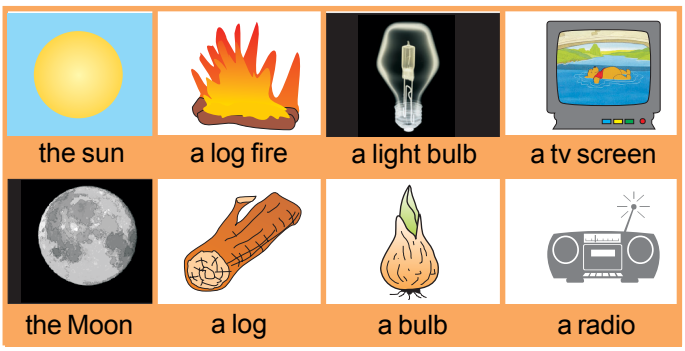
Look at the pictures opposite.
What do you understand from the pictures?

People use mirrors to see things by looking indirectly.

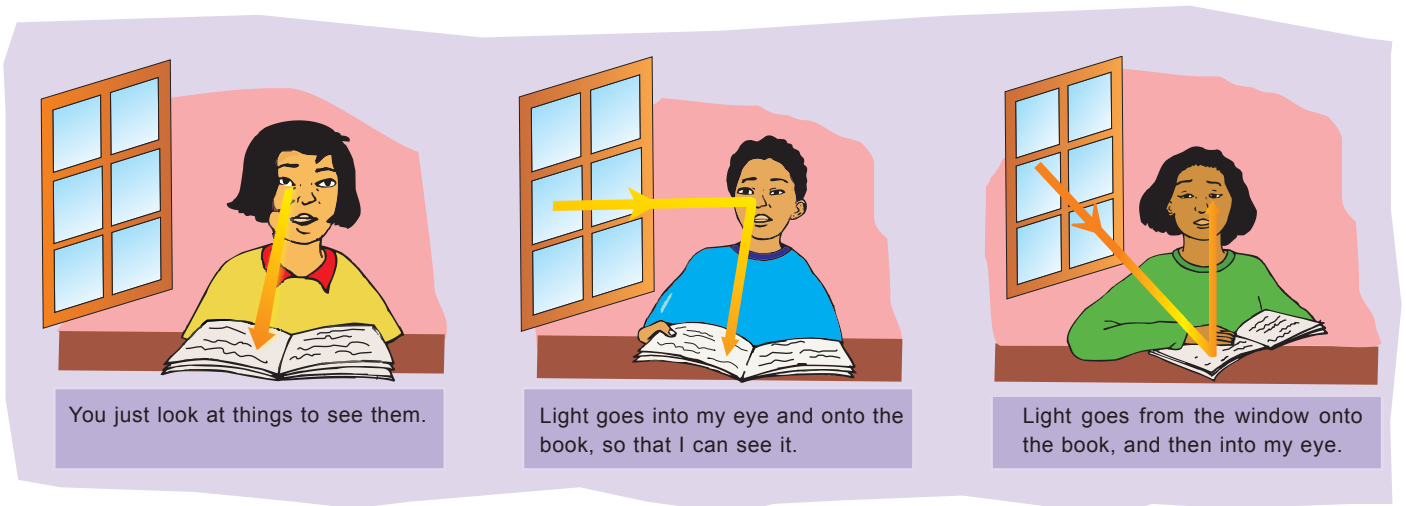
Sources of light

We can see the Sun because it gives out light which shines into our eyes.
The sun is a source of light. Here are some other things that are sources of light.

Here are some other things that we can see. They are not sources of light. We need to shine light on these things to see them. The light is reflected back into our eyes.



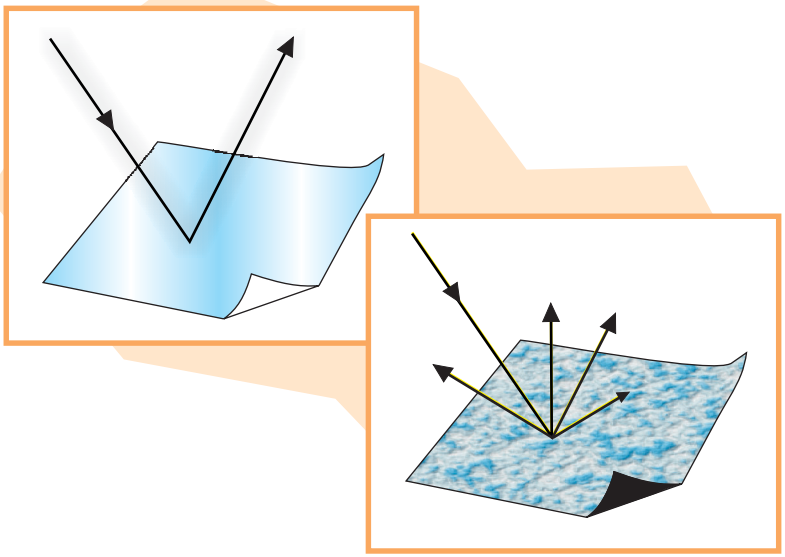
How do you see?



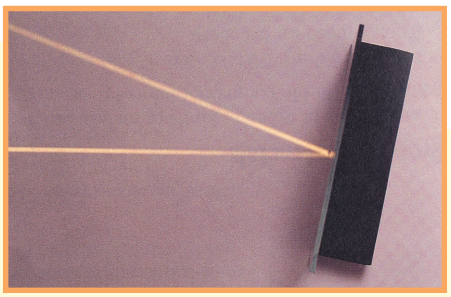
The last one is the correct one. Light rays from the Sun shine on the book.
They are scattered, and some go into your eye.

Light change direction

Light travels in straight lines.
You can make a ray of light change direction using a mirror. The mirror **reflects** the light.



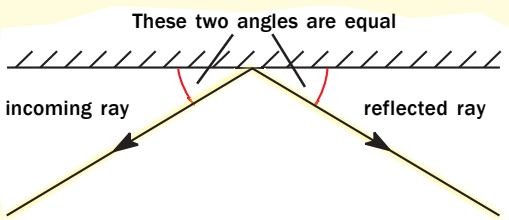
We can see objects because they reflect light into our eyes. When light hit a surface some of it bounces back. This bouncing back is called **reflection.** Smooth surfaces reflect light in a regular way. Rough surfaces scatter light in different directions.



A ray box produces a single, narrow ray of light. You can use a ray box to investigate how a mirror reflects light. The ray shows up on the white paper.

You can see how the ray of light reflects off the mirror. The mirror must be smooth and flat. Then you can see a clear reflected ray.

The diagram shows a plan view of the ray of light reflecting off the mirror. It hits the mirror and bounces off at the same angle.



Ideas

- *Light travels in straight lines.*
- *When light is reflected by a flat, smooth surface, it bounces off at the same angle at which it hit the surface.*
- *When light hits a rough surface, it scatters in many directions.*

1 Fill in the blanks using the following words.

smooth	**narrow**	**rough**	**flat**
straight	**bumpy**		

A ray of light is ..... and .....
To reflect light well, a surface must be ..... and .....
A surface will scatter light if it is ..... and..... .

5d

Rainbow colours

If the Sun is shining and it is raining at the same time, you may be able to see a rainbow. Light from the Sun shines on drops of water in the air, and the light is split up into all the colours of the rainbow.
The colours are red, orange yellow, green, blue, indigo, violet.

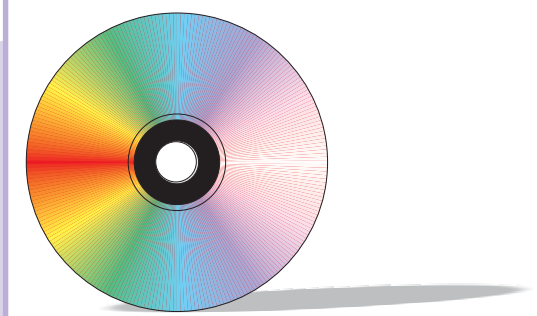
Different people use different ways of remembering the colours of the rainbow.

Some people say "Vibgyor".
How does this help you to remember the colours?

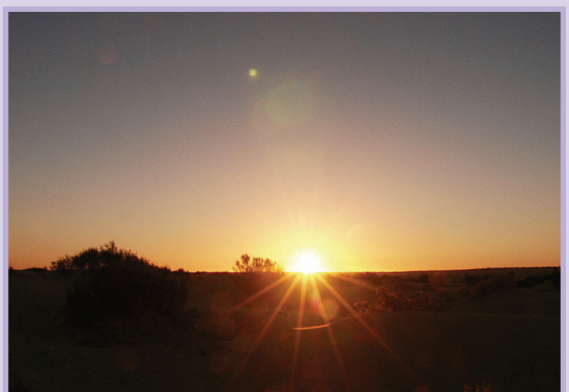
Splitting white light

The Sun is a very hot source of light. It is almost white-hot. We say that light from the Sun is **white light.**

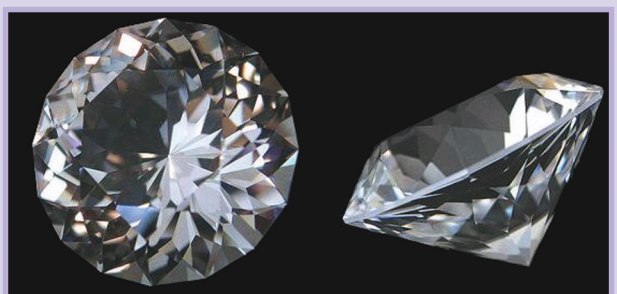
You may have noticed white light getting split up when it shines on certain objects.



A compact disc reflects white light. It splits it up into the colours of the rainbow.



Photographers have special filters which can split up white light to give interesting effects.



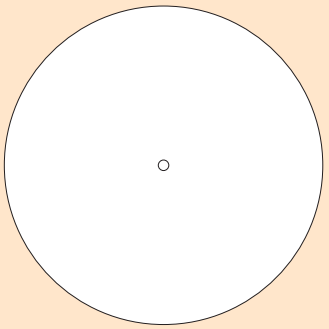
A diamond is clear and colourless. When light shines on it, you can see all the colours of the rainbow.

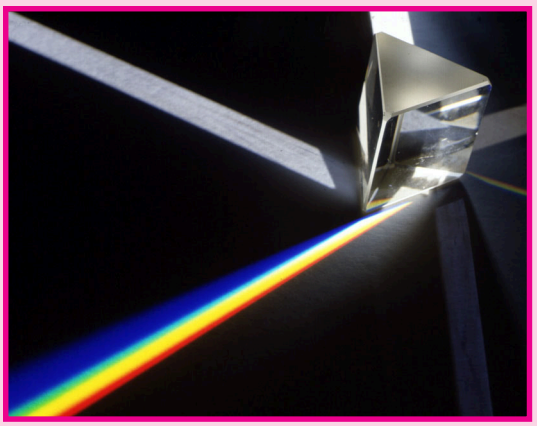
The Spectrum

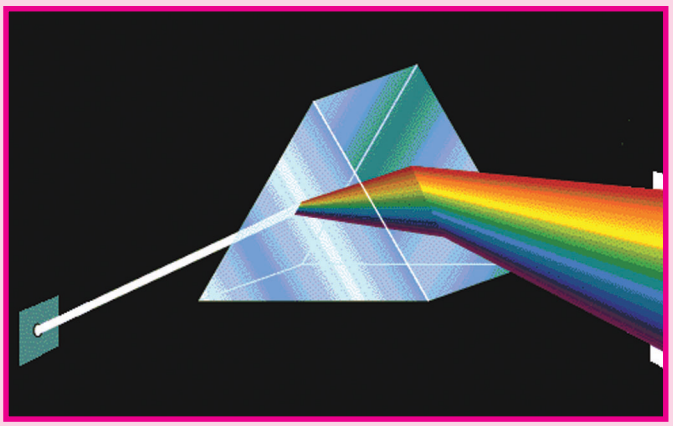
If white light can be split into many colours, can these colours make white again?

It was Isaac Newton who first showed that white light is a mixture of all the colours of the spectrum. He invented an experiment to show that you could make white light by mixing the colours together again.

What he did was, he made a colour disc like the one opposite with all the colours. When it spins round, all the colours blur together. It looks almost white.







1 Fill in the blanks using the words below.

prism **mixture** **spectrum**

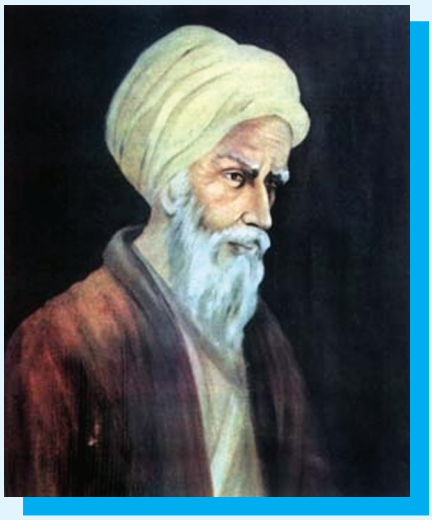
White light is a ..... of all the colours of the ..... It can be split up using a ..... .

Ideas

- ***White light*** *is a mixture of all the colours of the* ***spectrum.***
- *White light can be made by spinning a coloured disc.*

Abu Ali Hasan Ibn Al-Haitham
965 - 1040 C.E.

Father of mordern optics



Abu Ali Hasan Ibn al-Haitham was one of the most eminent physicists, whose contributions to optics and the scientific methods are outstanding. He is known in the West as Alhazen, Ibn al-Haitham He was born in 965 C.E. in Basrah, and was educated in Basrah and Baghdad.

He made a thorough examination of the passage of light through various media and discovered the laws of refraction. He also carried out the first experiments on the dispersion of light into its constituent colours. His book *Kitab-al-Manadhir* was translated into Latin in the Middle Ages, as also his book dealing with the colours of sunset.

He dealt at length with the theory of various physical phenomena like shadows, eclipses, the rainbow, and speculated on the physical nature of light.
He is the first to describe accurately the various parts of the eye and give a scientific explanation of the process of vision.

He contradicted Ptolemy's and Euclid's theory of vision that objects are seen by rays of light emanating from the eyes; according to him the rays originate in the object of vision and not in the eye. Through these extensive researches on optics, he has been considered as the **father of modern Optics.**

His contribution to mathematics and physics was extensive. In mathematics, he developed analytical geometry by establishing linkage between algebra and geometry. He studied the mechanics of motion of a body and was the first to maintain that a body moves perpetually unless an external force stops it or changes its direction of motion. This would seem equivalent to the first law of motion. Ibn al-Haitham's influence on physical sciences in general, and optics in particular, has been held in high esteem and, in fact, it ushered in a new era in optical research, both in theory and practice.

6 Unicellular organisms

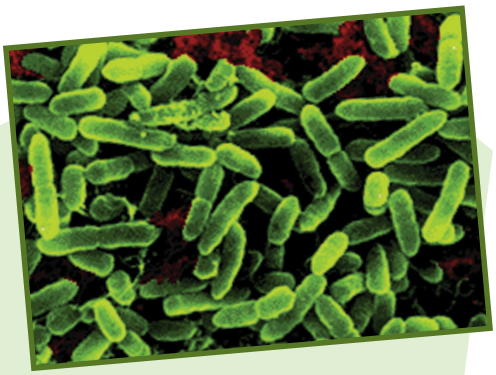
What you will learn

Unicellular organisms

The spread of infection

AIDS

Unicellular organisms



Unicellular organisms are made up of single cells. These are sometimes called microscopic organisms. Bacteria, viruses and some fungi are examples of unicellular organisms.

Bacteria – the good and the bad

Bacteria are very small and they come in lots of shapes and sizes. If you put about 100 of the largest bacteria in a line, they would just about stretch across this full stop. They can reproduce by simply splitting in half.

People used to think that bacteria are always harmful to them. But only a small proportion of bacteria are harmful. They occur every where and are especially abundant in the soil.

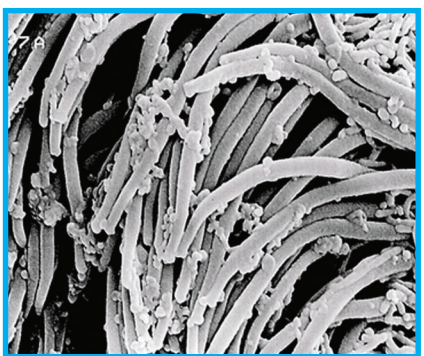
Among the bad ones include bacteria which destroys the lungs, and leprosy which destroys the flesh. They also cause food poisoning. Bacteria cause diseases in other species of animals, and also in plants.

For example, we use bacteria to make cheese, yoghurt, vinegar as well as in treating human sewage.Bacteria help to break down the bodies of dead plants and animals and make the soil fertile too.

A single sneeze releases millions of viruses into the air for other people to breathe in – and catch your cold!

Viruses – just the bad?

Viruses are incredibly small, about 0.0001mm long. Under a very powerful microscope, viruses are seen as strange shapes made of protein. They reproduce, but only when they are inside the living cell of an animal or plant. Viruses don't respire, move themselves, feed or excrete.
All viruses cause diseases in living organisms. Diseases caused by viruses include colds, flu, Chicken pox, measles, polio and aids.



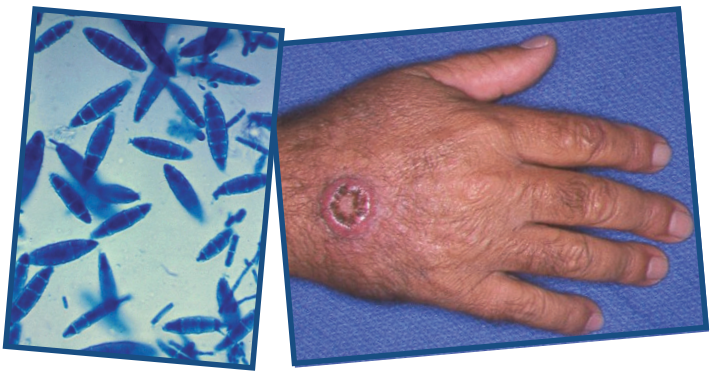
flu virus

Fungi

Mushrooms, toadstools and mould are all fungi. Some fungi look a bit like plants, but they cannot make their own food. Some fungi feed on dead things, like the remains of plants and animals. Others feed on living things and cause disease.

Tinea (ringworm)

There are several type of fungi which give rise to the various forms of this disease. Different parts of the human body are affected. One type of fungi attack the outer layer of the skin and form a ring like patch on the skin. ('ringworm'). One kind affects the scalp and makes circular bold patches. The other type affect the feet causing cracks between the toes. This is known as 'athlete's foot'.



1 Write out these sentences, putting the correct pairs together.

Viruses	chicken-pox, colds and polio
Viruses cause	always cause disease
Bacteria cause disease like	some cause disease.
Many bacteria are useful but	tuberculosis and leprosy.

2 List three ways bacteria are useful to us.

3 Name a disease caused by a virus.

Ideas

- *Bacteria, virus and some fungi are micro -organisms.*
- *Some bacteria cause diseases,many are useful.*
- *Viruses are much smaller than bacteria and they all cause diseases.*
- *Fungi are sometimes harmful and sometimes useful.*

The spread of infection

These are some of the ways you can be infected with germs:

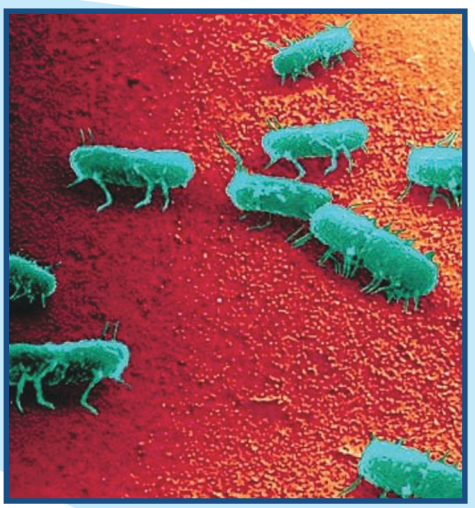
By breathing in germs from infected people, especially when they cough or sneeze near you. So you should always cover your mouth with a handkerchief when you cough and sneeze. Colds, influenza, pneumonia and whooping cough are spread by coughs and sneezes.

By touching infected people, or things they have used such as towels, combs and plates. Chicken pox and measles are spread by touching infected people.

How does it spread?

From infected food and drink. Food and drink can be infected with germs by coughs and sneezes, dirty hands, flies, mice and pet animals. Infected food and drink cause food poisoning.

By having sexual contact. That means that it is almost always caught by having sexual contact with an infected person. Example, gonorrhoea and syphilis are sexually transmitted diseases.



Do you Know?

When you visit a pharmacist, one in every four purchases will have come from a tropical forest.

How can you avoid the infection?

These are some ways you can avoid being infected with germs.

- Keep yourself clean.
- Bathe or shower regularly.
- Clean your teeth twice a day.
- Wash your face regularly
- Wash your hair regularly.

  If you have dandruff or lice, use a special shampoo until it clears up.
- Change underwear and socks daily.
- Boil water you think may be infected with germs.
- Cook food thoroughly and eat it straight away.

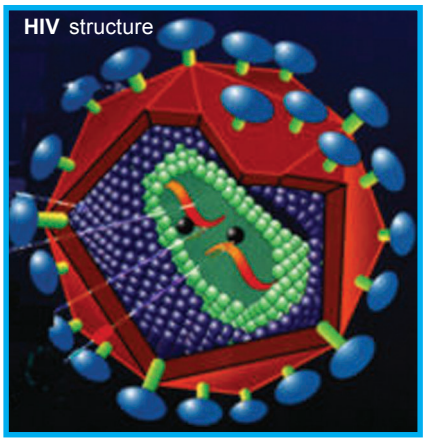
  If you want to store it, keep it in the fridge.

Ideas

- *Infectious diseases may be transmitted by air, water, food or contact.*
- *Sexually transmitted diseases are caught by having sexual contact with an infected person.*
- *The infection can be avoided by keeping your self clean.*

1. Name three viral diseases and three bacterial diseases.
2. List all the ways germs are being spread in the drawing above.
3. Why should you sneeze into a handkerchief?
4. Why must you cook food thoroughly?

6c AIDS



The initials stand for Acquired Immune Deficiency Syndrome. The virus which causes AIDS is the human immunodeficiency virus (**HIV**). It attacks certain kind of the white blood cells and weakens the immune system of the body. As a result AIDS patients are open to normally harmless diseases which uninfected people fight off without difficulty.

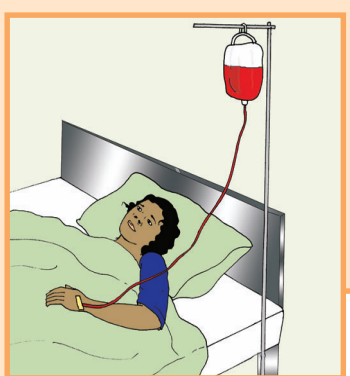
After a person has been infected years may pass before symptoms develop. So people may carry the virus yet not show any symptoms. Once the symptoms appear, the chance for living for a longer period is very less. Death does not result from the virus itself, but from other diseases like pneumonia, skin cancer or damage to the nervous system etc. which the body cannot fight.

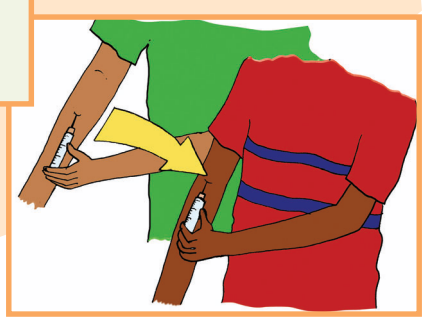
Transmission

Anyone can become infected with HIV, the virus that causes AIDS. It is not who you are ... but what you do that put you at risk for getting HIV.

HIV is spread through the **exchange of bodily fluids** with an infected person.

Having sex with an infected person, sharing needles and syringes with an infected person. In some cases, a mother who is infected with HIV may transmit the virus to her infant during pregnancy, birth, or by breast feeding.

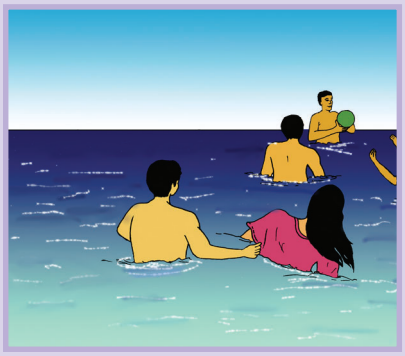




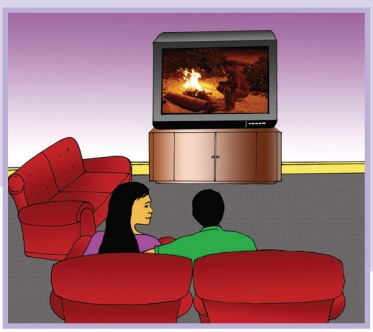
You cannot get AIDS

You cannot get AIDS by sharing a home, school or worlplace with an infected person. You cannot get AIDS by being with an infected person. Look at these pictures.









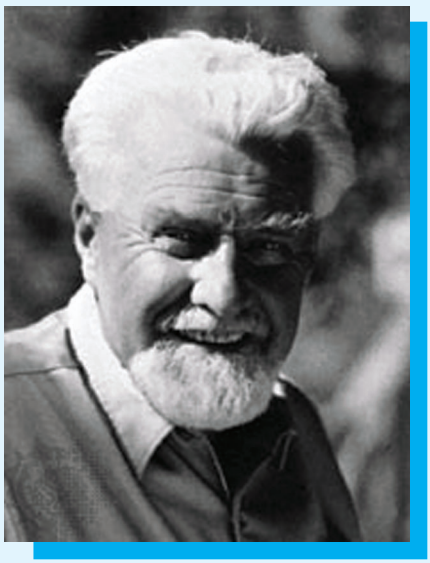

1 Why is it dangerous to share razors and toothbrush with strangers?
2 Why should a first aid worker wear rubber gloves when dealing with patients who are bleeding?
3 If a friend became an AIDS patient why would it be unnecessary and wrong to avoid all contact with him or her? Give reasons for your answer.

Ideas

The virus which causes AIDS is the HIV. The virus attacks the defense system of the body and weakens the system.

HIV is transmitted through the exchange of bodily fluids.

Konrad Lorenz
Born in 1903



Konrad Lorenz was born in Austria in 1903. As a small boy he kept a houseful of all sorts of pets. This love of animals influenced his life's work. He trained as a doctor, but he became interested in how animals behave. Some scientists study animals in the laboratory but Lorenz preferred to observe them outside in their natural surroundings.

Some of his most important work was done with wild geese. He collected and hatched eggs from wild geese. The newly hatched goslings thought that he was their mummy! They followed Lorenz everywhere. If he went shopping in the village then they trailed after him in a line. If he went swimming then they did too. The other villages were very amused. Lorenz realized that following their mother helped the goslings to survive in the wild. He called the behaviour imprinting.

Lorenz went on to study more complicated animal behaviour. He wrote a lot about courtship behaviour in birds. He explained why courtship always came before mating. He also studied aggression.

Lorenz worked with wild animals but some of his ideas have helped other scientists to understand human behaviour. Konrad Lorenz was awarded a Nobel Prize in 1973.
(J. Boyd & W.WhiteLaw 1989 John Murray)

7 Matter and Materials

What you will learn

What's the matter

States of matter

Materials

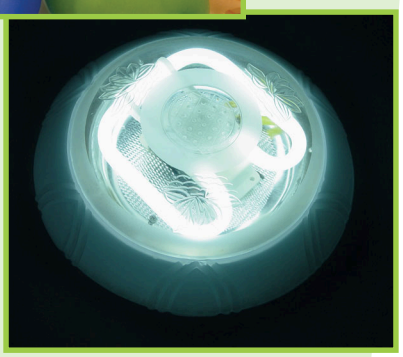
Useful metals

Tiny matters

7a What's the matter?

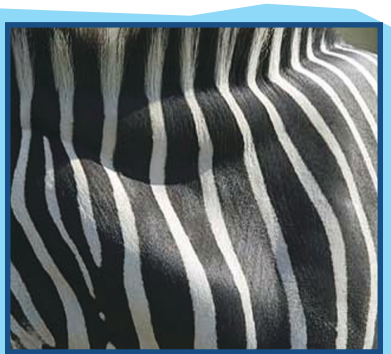
Matter is anything which has mass and occupies space. Do you think it is possible for anything to have mass and yet not occupy space or vice versa?

• Can you identify anything that is not matter in each of the photographs?



Physical properties of matter

Objects or materials are recognised according to their properties.
Can you name these objects? What properties or property did you use to recognise these objects?



Its colour, shape, design and pattern are some of the ways that we recognise objects. These are called properties. Colour, shape and size are some common physical properties of matter which are clearly visible. Other physical properties include elasticity, strength, hardness, solubility, heat conductivity, electrical conductivity.

Do you Know?

The biggest thunder clouds tower 16 kilometres into the air. That's nearly twice the height of Mount Everest.

Elasticity

The elasticity of a material is its ability to return to its original shape and size after being bent, stretched or compressed.

Strength

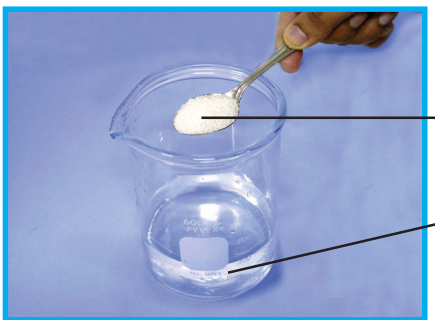
The strength of a material is its ability to support a heavy load without breaking or tearing.

Hardness

The hardness of a material is its ability to withstand scratches and wear. Diamond is extremely hard and can only be cut by other diamonds.

Solubility

The solubility of a substance in a solvent (liquid) is the maximum quantity of that substances which can dissolve in a given quantity of the solvent.



The substance that dissolves is called the **solute.**

The substance that does the dissolving is called the **solvent.**

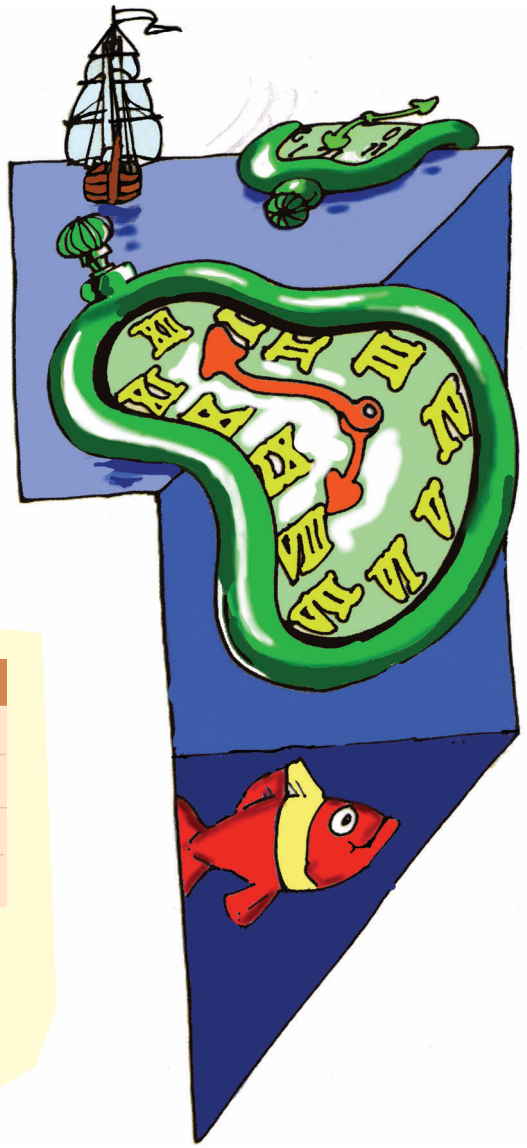
The solute and the solvent together make up a solution.

Ideas

- *Matter is anything that has mass and occupies space.*
- *Objects are recognised according to thier properties.*
- *Colour, shape, size, elasticity, strength, hardness, solubility etc. are examples of properties.*

1. List some physical properties of objects around you.
2. What physical properties should you look for in materials used to make the following products?
   a. furniture
   b. airplane body

States of matter



Matter can exist in three physical states: solid, liquid or gas. All substances can exist in the three states depending on the temperature and pressure.

Think about this picture. Why does it look so odd and dreamlike?

Looking at solids

1 Collect some solid objects to look at.
2 Draw up a table like this. Make a column for each object.

Name of solid	1	2	3
What colour is it?			
Is it rough or smooth?			
Can you change its shape easily?			
Is it heavy or light?			

3 Look at your objects and fill in the table.
4 Some of your answers will be different for each object, others will be the same. Write down two things that all solid objects have in common.

What do all solids have in comon?

One thing about solid objects is their sizes do not change. Another way of saying this is that a solid object always takes up the same amount of space.

This space is called its **volume.**

Another important thing about all solids is that you cannot change their shapes easily.
These two things are the same for all solids, and are called the **properties** of solids.

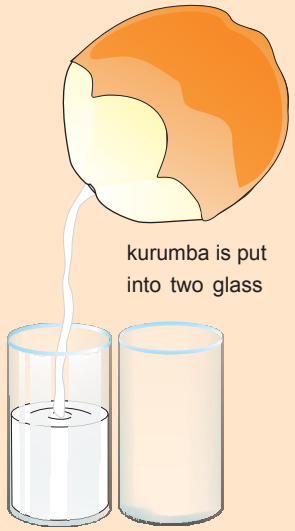
Do you Know?

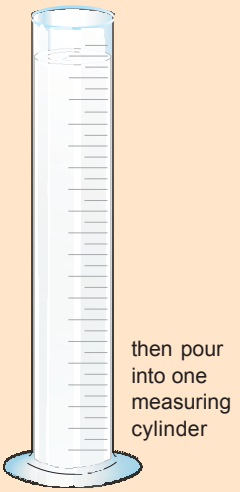
More than 99.99% of the volume taken up by a gas is empty space.

How do liquids behave?

Liquids are soft and runny and change shape easily. This is useful when you pour a kurumba out of its container and into a glass.

Liquids change their shape easily, but their volume always stays the same. Your half litre of kurumba will go into all sorts of different containers, but you will never get more or less than half litre of liquid.

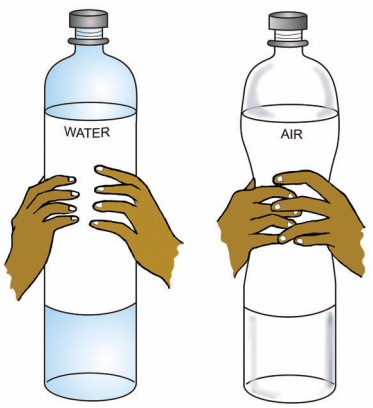


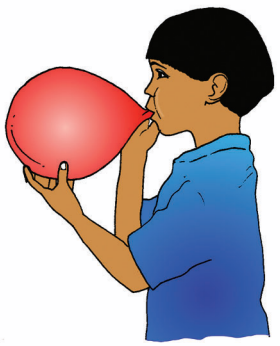


Gases change shape and volume

Gases change shape too. When you breathe in, your lungs get filled with air and take up the shape of lungs. When you breathe out, this 'lung-shaped' air is pushed out again. Sometimes it becomes balloon-shaped.

If you fill a plastic bottle full of air, you can squash it easily. but you cannot squash a bottle full of water. This is because the volume of a gas does not stay the same. It changes with the volume of the container the gas is in.





1 Fill in the blanks using the following words.

gas	solid	liquid	shape	fixed

Your bones are ----------. They are hard and have a ----------shape which supports your body. Your blood is a ----------. It changes its ---------- as it flows through your veins. The air you breathe is a ----------.

2 A bottle of coke has solid, liquid and gas parts. Write sentences like the ones above to describe the three parts and their properties.

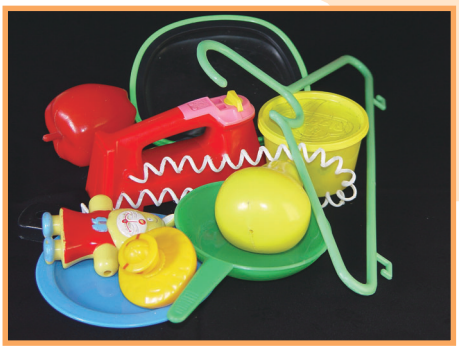
Ideas

- *Liquids have a fixed volume but no fixed shape*
- *Gases have no fixed shape and no fixed volume.*
- *These are called properties of solids, liquids and gases.*

Materials

A material is a substance that is used for making objects. Some materials such as metals occur naturally while others such as plastics are human-made.

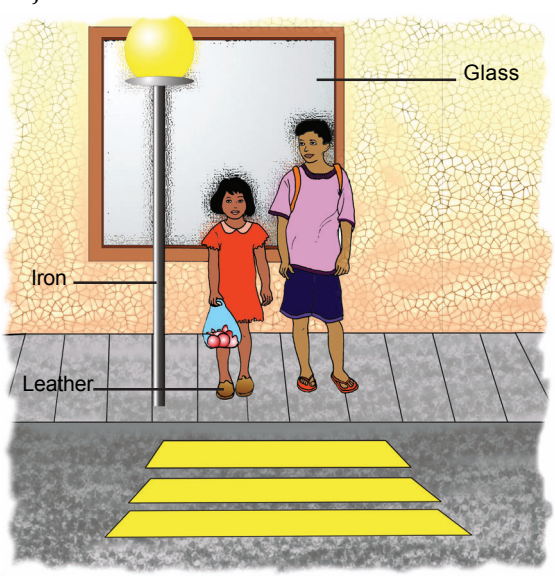




Different materials for different jobs

Different objects are made from different sorts of materials. The properties of the material must be suitable for the object it is being used to make.

Look at the picture and say why you think these materials have been used for these objects.

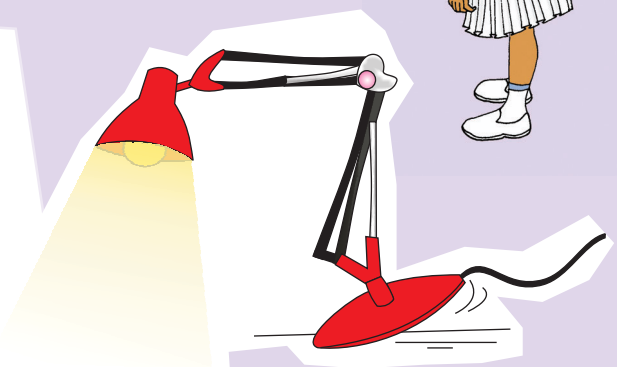


Do you Know?

The Egyptians were one of the first people to write with ink. They made it by mixing black soot with sticky tree sap.

Light or heavy?

You need to know about 'heaviness' when choosing the right material for the job. The frame of a school bag needs to be made of a **light** material . The less you have to carry, the better. The base of a reading lamp needs to be made of something **heavy** such as iron, to stop it toppling over.

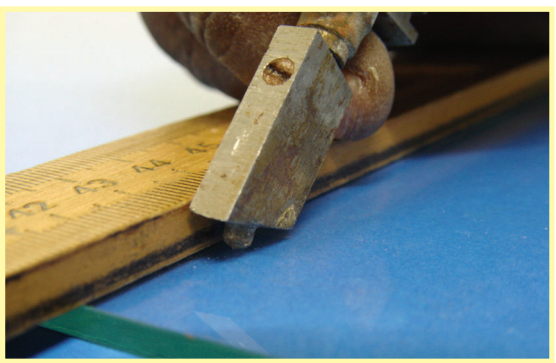


Weak or strong

Straw made of plastic is a weak material. It will break if you pull or push them. So it is not very suitable for building a house. Bricks, however, are strong enough and they won't break easily.
Steel and concrete are strong materials used for building purposes.

Hard or soft

A hard material will not scratch or dent easily. Diamond is extremely hard. It will scratch glass or metal easily. The 'lead' in your pencil is a soft material. It wears away as you write.



A tiny diamond at the tip is used to scratch the glass.

1 Fill in the blanks.
Bricks and concrete are used for building because they are .....solids. Aluminium window frames are used these days because they are ..... Pencils use a solid called graphite which is so ---------- that it rubs off on paper.

2 Which of the materials in brackets would you use to make the following , and why?

a. A ten story building (expanded polystyrene, brick, lead)

b. A ladder (lead, aluminium, rubber)

c. An anchor (steel, wood, glass)

Ideas

Materials can have many different properties. They may be heavy or light, weak or strong, hard or soft.

To choose a right material you have to match these properties against those needed for the job.

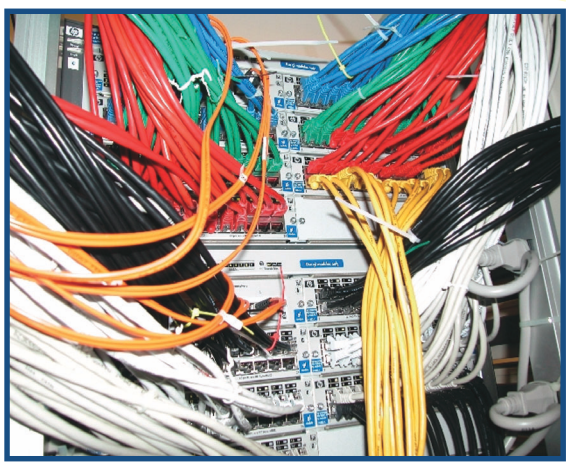
Useful metals

Metals are used for variety of purposes. Metals are used for their strength. Iron and steel are used to support large buildings.

Sometimes metals are used for their hardness. Saw blades are made of steel. It will cut through wood.

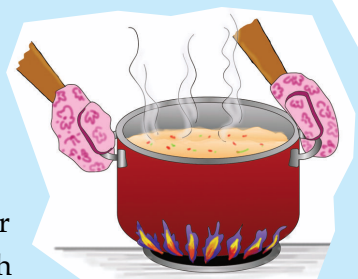
Metals conduct electricity

Metals allow electric current to flow through them. They **conduct electricity.** Copper is a good **conductor of electricity.**



You are also a conductor of electricity. If you touched a wire that had an electric current flowing through it, you would get a shock. To stop this happening, wires are coated with plastic. Plastic do not conduct electiricy. They are insulators.

Metals conduct heat



Metals also allow heat to flow through them. They conduct heat. When you boil water in a kettle, the heat is conducted to the water from the flame through the metal. The metal is a **heat conductor.** You need to hold the kettle using an insulator like cloth or you may burn your fingers. Most non metals are good **heat insulators.**

Do you Know?

One of the buildings at Disney World in Florida, USA looks like a giant golf ball. Its walls are made up of hundreds of metal triangles.

Metals can be shaped

Metals are so useful that they are easy to mould into different shapes.

Metals can corrode

When a metal is new the surface is shiny. However, most metals become dull after some time. Only a few metals like gold keep their shine and so are used for jewellery.

1 Fill in the blanks.
In an electric plug, the pins are made of brass because this metal is a good ---------- of electricity. The case is made of ..... as this is an ---------- and so stops you getting an electric shock.

2 Graphite is a soft, easily broken, dull, black solid that conducts electricity. Look back at your list of properties. Is it a metal or non-metal? Why is graphite unusual?

Ideas

- *Metals are good conductors of heat and electricity.*
- *Metals are useful because they are hard and strong and can be shaped in many ways.*
- *Non- metals are insulators of both heat and electricity.*

7e

Tiny matters

You have seen that materials can have lots of different properties. Why is this?

All materials are made up of billions of tiny particles that we cannot see, even with a microscope. You need to understand how these particles behave. But if you cannot see these particles behave how can you tell what is happening?

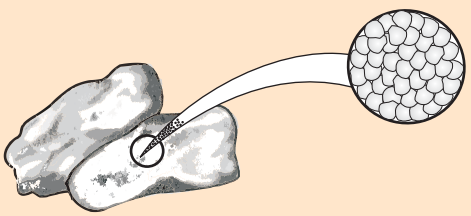
The answer is to use a model. A model acts like a real thing?

A simple model for materials

Here is a model that helps to explain the differences between solids, liquids and gases.

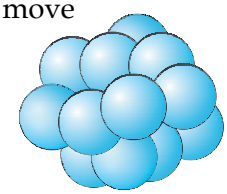
Stones and bricks are used for building. If you take a brick or a stone and break it into pieces, you would end up with individual grains of sand.

Assume the grains of sand in the brick as billions of tiny particles that we cannot see. It would help you to understand how the materials behave.



Properties of solids

The brick keep its shape because all the sand grains are stuck together, so they can't move about easily. You can't squash a brick because all the sand grains are packed as close as possible.



The tiny particles in solids behave similarly. The particles must be closely packed, because solids cannot be squashed easily. The particles must also be stuck together, because solids keep their shape.

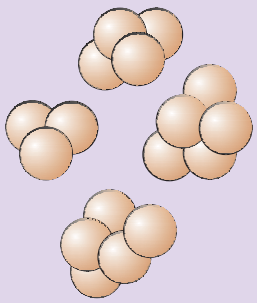
Do you Know?

More than 1 000 000 000 atoms are needed for the ink to make this dot.

Properties of liquids

Dry sand behaves in a similar way to a liquid. You can pour it from one bucket to another. Sand is made from closely packed sand grains. But unlike bricks, these grains are not stuck together. They are free to move against one another.

The particles in a liquid must behave in a similar way. They must be closley packed, because liquids cannot be squashed. But they cannot all be stuck together, as they must be free to move about, like the grains of sand.



Properties of gases

Sometimes in very windy days when you try to walk against the wind you get sand in your eyes. What happens is that the wind whips up sand on the road. Individual sand grains separate out from one another and are kept far apart.

In a gas the particles are also separated out. When you squash a gas, for example air in a plastic bottle, you are pushing the particles close together again.

Ideas

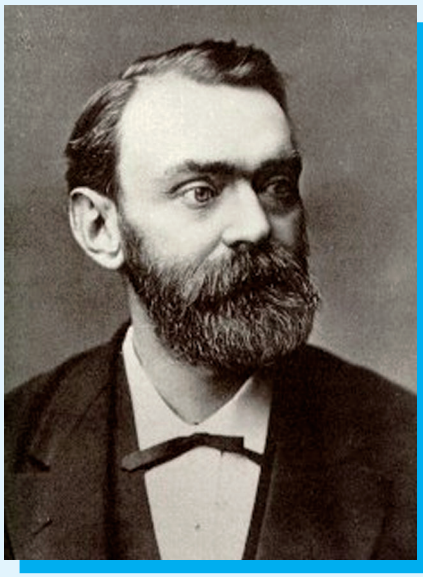
- *In solids, the particles are closely packed, and are stuck together.*
- *In liquids, the particles are closely packed but are free to move.*
- *In gases, the particles are far apart.*

1 Draw diagrams of the particles in a solid, a liquid and a gas.

2 Explain the following

a. Why can you squash a gas, but not a liquid?
b. Why do solids keep their shape?
c. Why are some solids harder than others?

Alfred Nobel
1833 - 1896 A.D.



Alfred Nobel was born in Sweden in 1833. He was a scientist and a businessman. In 1866 he invented dynamite and later on he discovered other explosives that were even more powerful. He then set up factories to make explosives and became very rich indeed.

Alfred Nobel was worried that his inventions might be misused. He wanted to encourage people to work for the good of humanity. He decided to set up a fund to award prizes for the very best work in science, medicine, literature and peace. Nobel died in 1896 and the first Nobel Prizes were awarded in 1901.

Today most research scientists dream of the honour of receiving a Nobel Prize. Perhaps one of you will produce work that Alfred Nobel would have wanted to reward!
(J. Boyd & W.WhiteLaw 1989 John Murray)

8 Soil

What you will learn

An advantage to live in the soil

Soil type

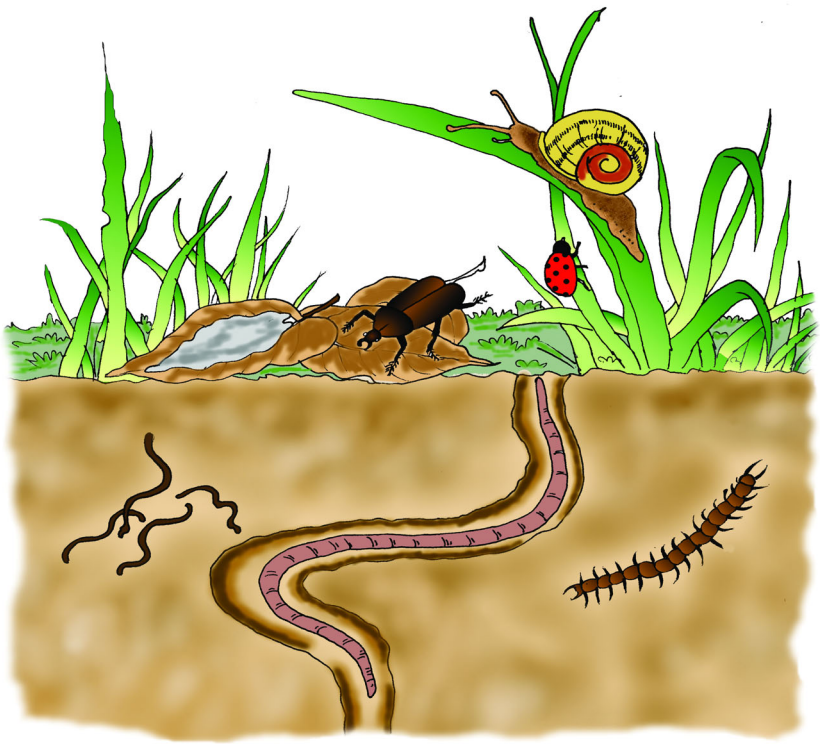
Soil fertility

Soil erosion

8a An advantage to live in the soil

A little way below the surface, the soil temperature stays much the same all year round. Underground homes provide warmth, shelter and protection from bad weather. Without the soil there would be very little life on land.

Millions of small animals live in the soil: millipedes, centipedes, worms, beetles, ants and other insects.




Millipedes


Centipede


Worms

Could you name a few bigger animals which live in the soil?

Do you Know?

The world's no. 1 food plant is wheat.

The soil

Once you step out onto a piece of ground, you step out onto something that is alive. Soil is not just a piece of dirt.

Soil is made up of living and non-living material spread as a very thin layer over the entire surface of the planet we call earth.

Humus is mostly made up of dead plant material which is slowly rotting.

Humus helps to keep the soil in good condition in different ways. For one thing, it breaks down to give chemicals which help plants to grow.

When freshly dug soil is left in a dry place, it slowly loses weight. The moisture in it slowly evaporates.

Soil moisture is important. Plants need a constant supply of water which they get through their roots.

When soil is covered with water, the water level slowly drops. The soil has air trapped in it, between the grains of sand and clay. The water slowly soaks into the soil and the air escapes.

This air in soil is important, too. Oxygen is needed by the roots of plants, and by soil animals.

1 What is humus? Why is it important?

2 Why is soil air important?

3 Why is soil moisture imoprtant?

Ideas

- *Soil consist of air, moisture and humus.*
- *Soil contains several living organisms.*

8b Soil types


Soil profile

People describe soil types in all kinds of ways such as heavy, light, sandy, clay, loam, poor or good. Soil scientists describe soil types by how much sand, silt and clay is present. This is called texture.
It is possible to change the texture by adding different things. Changing texture can help in providing the right conditions needed for plant growth.

Sand is the largest particle in the soil. When you rub it, it feels rough. This is because it has sharp edges. Sand doesn't hold many nutrients.

Clay is the smallest of particles. Clay is smooth when dry and sticky when wet. Soils high in clay content are called heavy soils. Clay also can hold a lot of nutrients, but doesn't let air and water run through it well.

Silt is a soil particle whose size is between sand and clay. Silt feels smooth and powdery. When wet it feels smooth but not sticky.


clay and silt

Sand and soil in Maldives

Sand and soil found in other countries does not come from coral like our sand. It is made from rocks that form the outer layer of the earth – the crust. In Maldives we talk about black soil – *kalhufas*, dust and sand – *alhifas*, and white beach sand- *hudhufas*.

Alhifas and *hudhufas* are examples of sand, they are not soil. *Kalhufas* is soil, but it contains a lot of sand so we call it **sandy soil**. Soils rich in humus are often brown or black in colour. You may have observed that plants grow well in black soil (*kalhufas*).

Do you Know?

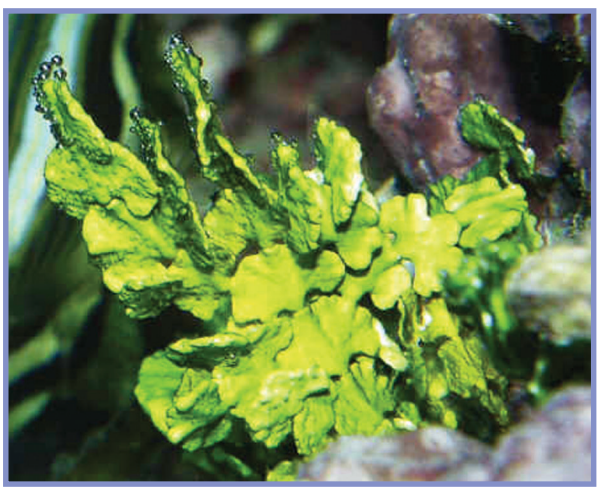
Corn is the crop that is used to sweeten most of the non-diet soft drinks in the US.

Sand from animals

Sand in the Maldives is formed from the skeletons of sea animals and plants especially corals. You may have seen stones of different sizes on the islands or near the beach. These stones are different kinds of corals. Coral stones and sea shells break down to form sand.

Sand from plants

A lot of sand in the Maldives comes from special types of sea plants called coralline algae. Coralline algae are plants which form skeletons of a compound called limestone. When the plant dies the skeletons break down to make sand.



Halimeda (Mashi) is a coralline algae which forms small flakes of sand. A large proportion of coarse sand (kashiveli), found on our beaches is from *halimeda.*

Ideas

- *Soil types can be determined by how much sand, silt and clay is present.*
- *Sand in Maldives is formed from the skeletons of sea animals and plants.*
- *A lot of sand in Mlaldives comes from special types of sea plants called coralline algae.*

1. How can you determine the soil type of a given sample of soil?
2. How would you find out which types of soil are best to grow plants?

8c

Soil fertility

A fertile soil is one where a lot of strong, healthy plants can grow. Plants need water and minerals from the soil for healthy growth. A fertile soil will provide enough minerals, water and air spaces for plants to grow.

When plants die they decay and eventually turn into humus. The minerals which the plant took from the soil now go back into it. In this way the soil stays fertile.

This is a desert. Very few plants grow here.
Can you explain why?

Do you Know?

A common estimate on the length of time needed to naturally produce an inch of the topsoil is a century.

Improving our soil

In Maldives we have very sandy soil which does not hold water well. Also our soil may not contain much humus because few plants and animals have died and left their remains in it. These problems can prevent us growing as much food as we could. We need to find ways of improving our soil.

Composting

This is a method we can use to improve our soil. Compost is a natural fertiliser. This is made by piling up layers of sand, soil and plant and animal remains. The remains include things like dry leaves, green leaves, wood chips, ash, vegetable and fruit peels, fish waste, egg shells, strips of paper and cardboard and coconut husks.

There are very small living things inside the pile of compost. These could either be bacteria or fungi. They feed on the plant and animal remains, breaking them down and releasing the minerals into the soil.

Soil can be improved by adding artificial fertilisers. These are made in factories and contain minerals which plants need for growth.

Compost

Artificial fertilisers

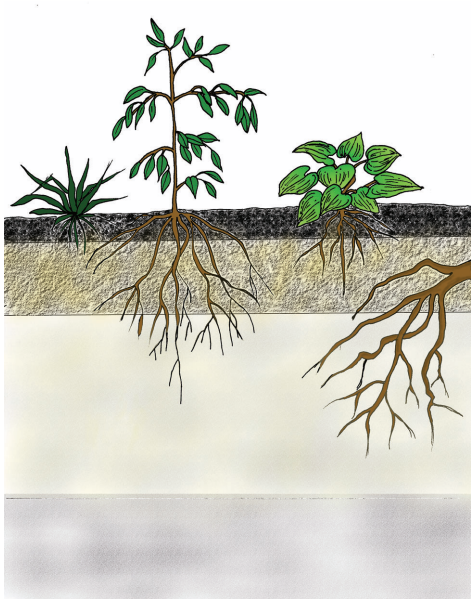
1. Make a table showing what components fertile soil must have and the reasons why.
2. Discuss the advantages and disadvantages of composting.
3. Discuss the advantages and disadvantages of using artificial fertilisers.

Ideas

- *In Maldives we have very sandy soil*
- *Composting is a natural method of fertilising the soil*
- *Soil can also be improved by adding artificial fertiliser*

8d

Soil Erosion



The upper layer of the soil is very important. This topsoil is where plants grow. It has taken thousands of years for this layer of topsoil to form. However, it takes much less time to have this soil blown away or washed away by the action of wind and water. The process that causes sand and soil particles and even rocks to be carried away by wind and rain is known as erosion.

Causes of erosion

Wind, water and waves are causes of erosion. They help carry sand and soil from place to place.

Wind	wind removes sand and soil in areas where there are few trees and the soil is loose and light.
Water	water washes away the loose sand and soil from bare areas of land.
Waves	strong waves lash against the shore, loosening the sand and soil. These are then carried away by the current.
Humans	Humans clears land for various reasons. This allows wind, water and waves to erode the land.

Do you Know?

The largest sand desert in the world is the Sahara Desert, located in North Africa.

Saving our soil

Soil can get washed away if we do not care for it properly. People remove coral rocks from the reef to build houses. They cut down forests and clear land for farming. These activities are sometimes necessary. However, we are also helping wind and water to remove fertile soil. If we keep cutting down trees and destroying the reefs, our islands can get washed away. The fertile soil will be eroded and plants will not grow well. It is important for us to stop and think of ways to save or **conserve** our soil.

Ideas

- *It takes thousands of years for a layer of top soil to form and it is where plants grow.*
- *We need to take preventive measures to conserve our soil.*
- *Wind, water and waves are causes of erosion.*

1. Make table showing the causes of soil erosion and the action that can be taken to prevent it.
2. Discuss what possible ways you could conserve soil.

El-Zahrawi
936 - 940

Father of surgery

El Zahrawi is believed to have been born in the city of El-Zahra, six miles northwest of Cordoba, sometime between 936 and 940.

He was known as El Zahrawi, though in European languages his name is written in over a dozen different ways: Abulcases, Albucasis, Bulcasis, Bulcasim, Bulcari, Alzahawi, Ezzahrawi, Zahravius, Alcarani, Alsarani, Aicaravi, Alcaravius, Alsahrawi etc.

It is clear from El Zahrawi's life history and from his writings that he devoted his entire life and genius to the advancement of medicine as a whole and surgery in particular. El Zahrawi wrote a medical encyclopaedia spanning 30 volumes which included sections on surgery, medicine, orthopaedics, ophthalmology, pharmacology, nutrition etc. This book was known as At-Tasrif and contained data that El Zahrawi had accumulated during a career that spanned almost 50 years of training, teaching and practice. He apparently travelled very little but had wide experience in treating accident victims and war casualties.
The variety of operations covered is amazing.

In fact 'Kocher's method' for reducing a dislocated shoulder was described in At-Tasrif long before Kocher was born! So this means that he was not the first person to invent the method.

Once At-Tasrif was translated into Latin in the 12th century, El Zahrawi had a tremendous influence on surgery in the West.
The French surgeon Guy de Chauliac in his 'Great Surgery', completed in about 1363, quoted At-Tasrif over 200 times. El Zahrawi was described by Pietro Argallata (died 1423) as *"without doubt the chief of all surgeons"*. Jaques Delechamps (1513-1588), another French surgeon, made extensive use of At-Tasrif in his elaborate commentary, confirming the great prestige of El Zahrawi throughout the Middle Ages and up to the Renaissance.

9 Element

What you will learn

The elements

Atoms and molecules

Metals and non-metals

Element

9a

The elements

In Science, an element is a substance that is made of only one kind of atom. There are just over 100 different elements. Each has its own kind of atom. Around 90 elements have been found in nature. The rest have been made by scientists. So that means there are 90 different kind of atoms of which these elements are made.

Most elements are solids. Ten elements are gases at room temperature, and only two elements are liquids.

Carbon

Coal, charcoal and even the 'lead' in your pencil are all made from the element carbon. Carbon is a solid at room temperature. Its melting point is very high, nearly 4000C.

Carbon is usually black and soft, but one form of carbon is colourless and very hard.

What is it?

Do you Know?

The word atom is derived from the Ancient Greek word atomos, meaning 'indivisible'.

Sulphur

Yellow crystals of sulphur are often found in rocks around volcanoes. Sulphur melts easily but it also catches fire, giving off choking fumes. Since ancient times it has been mixed with carbon and other chemicals to make gunpowder. Today it is used in making rubber hard and medicine.

Copper

Copper is usually found in nature in association with sulphur.

Copper is one of the oldest metals ever used and has been one of the important materials in the development of civilisation.

Because of its properties like it is a good conductor of heat and electricity, high ductility, malleability and its resistance to corrosion, copper has become a major industrial metal, ranking third after iron and aluminium in terms of quantities consumed.

Oxygen

Oxygen is a gas in the air. You need oxygen when you breathe.
Oxygen is the most common element on Earth.

1 Fill in the blanks using the following words.

sulphur	90	element	atoms

Everything is made up of_____ . There are about _____ different kinds of atoms. A substance that is made up of one kind of atom only is called and _____ .

Ideas

- *Element is a substance made up of only one kind of atom.*
- *Around 90 elements have been found in nature.*

Element

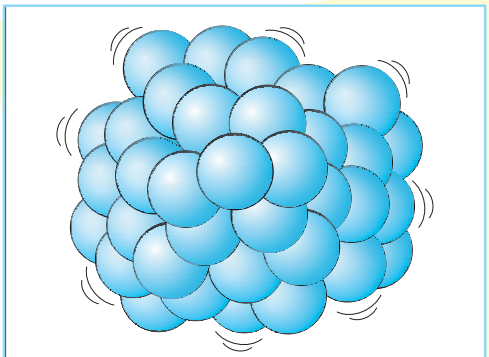
9b

Atoms and molecules

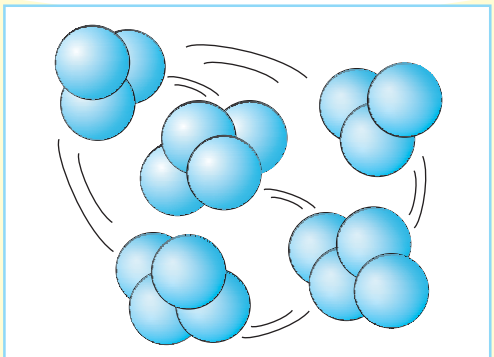
All materials are made up of particles that are too small to see, even with a microscope.

How many particles do you think there are on the head of this pin?

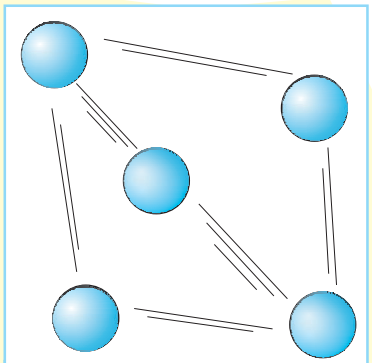
Millions and millions.



In solids, the particles are closely packed and stuck together.



In liquids, the particles are closely packed but free to move.



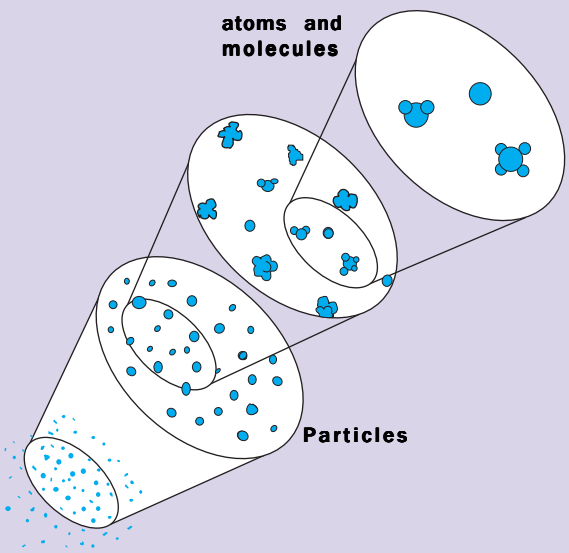
In gases, they are widely spaced.

Magnify a lot more

You probably drew these particles as little round balls in your book. But imagine you could make them enlarge, so you could see them more clearly. You would find that different particles come in different shapes and sizes.

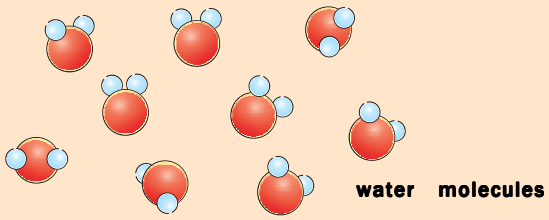
The clumpy- looking particles in the picture are called molecules. They are made up of smaller round particles called atoms.

Different molecules are made of different collections of atoms, so they have different shapes.

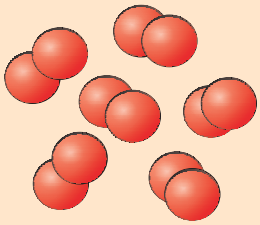


Shape of molecules

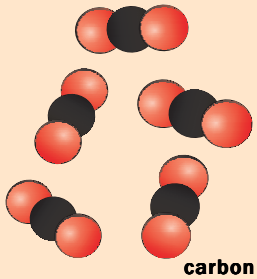
The moleucles in any one substance are always the same. Water molecules are made from three atoms. They look rather like famous cartoon mouse!



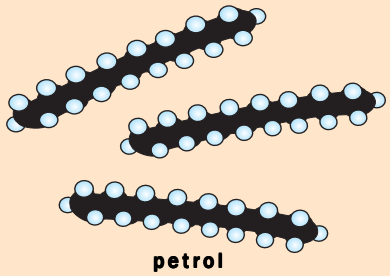
water molecules



oxygen



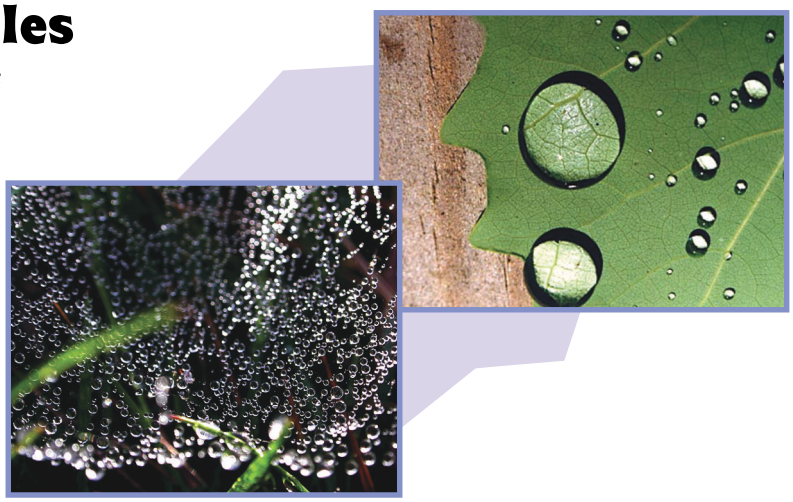
carbon dioxide



petrol

Breaking up molecules

If you splash some water, you get lots of little droplets of water. If you could break up these little droplets again and again, you would get tinier and tinier droplets of water.



Imagine you could break the tiny droplets up into molecules of water. Now imagine breaking the molecules up into separate atoms. You would no longer have water! The water molecule is the smallest particle of water that you can get. If you break up the water molecule, you change it into different substances.

Ideas

- *Many substances are made up of particles called* ***molecules.***
- *Different substances have different molecules.*
- *Molecules are made up of smaller particles called* ***atoms.***
- *If you break up a molecule, you no longer have the same substance.*

1 Fill in the blanks using the following words.

atoms different molecule smaller same

The smallest particle in many substances is a ..... . All the molecules of one substance are the ..... Different substances have ..... molecules. Molecules are made up of ..... particles called ..... .

Element

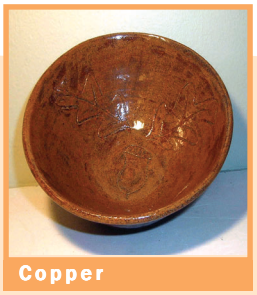
9c

Metals and non-metals

Scientists have classified elements into two main groups, **metals** and **non-metals.** Out of all the elements that occur naturally, seventy of them are metals and they are solids except mercury.

All metals conduct electricity and heat, and have a shiny metallic appearance.

The remaining 22 elements are non-metals. These generally do not conduct eletricity or heat well. Some non-metals, like carbon and sulphur, are solids. Others, like chlorine and oxygen, are gases.

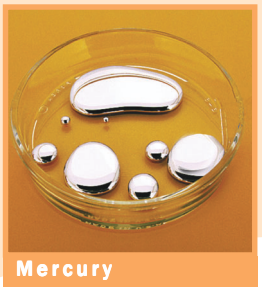

Copper


Gold


Silver


Chlorine Gas


Bromine


Mercury

Using metals

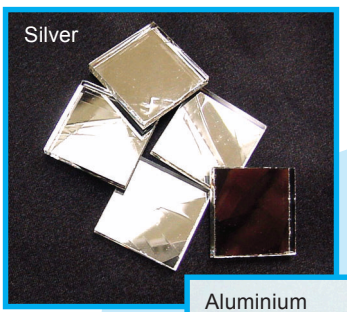
Gold is used to make jewellery and ornaments because of its shiny appearance.

Silver reflects light so well that it is plated onto glass to make mirrors.

Aluminium is used to make aircraft body because it is light and resists corrosion.

Tin is used for coating food cans. The tin coating will protect the steel (which is used to make the cans) from being corroded by the food.

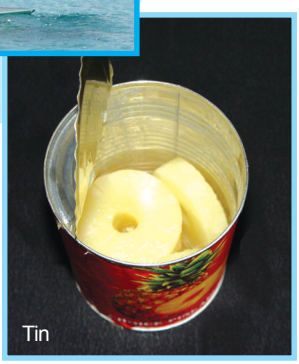
Steel conducts heat well and has a high melting point. Hence, it is suitable for making cooking utencils.


Silver


Gold


Aluminium


Steel


Tin

Using non-metals

Sulphur is used for making insecticides, for making medicinal drugs, for hardening rubber that is used in making car tyres.

Hydrogen is used as rocket fuel, for making margarine, for filling weather balloons.

Oxygen is used for respiration, for oxyacetylene flames for welding.

Carbon is used for the formation of living tissues, as a fuel and in pencil leads.


Sulphur


carbon


Oxygen cylinder


Hydrogen (waether balloons)

A shorthand for elements

We use symbols containing one or two letters as a kind of shorthand for the elements. The first letter is always a capital letter. Some symbols are obvious from the name of the element. Others are based on older names for the elements that are no longer used.

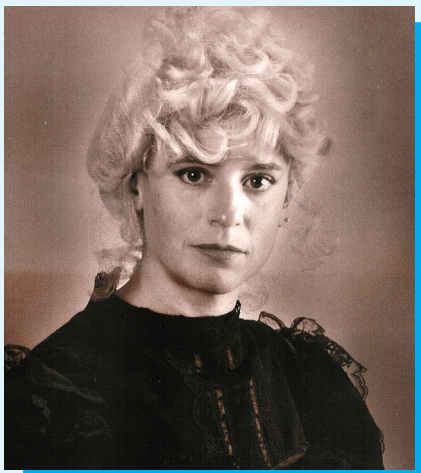
Metals		Non-metals	
Al	Aluminium	**H**	Hydrogen
Ag	Silver	**N**	Nitrogen
Au	Gold	**C**	Carbon
Fe	Iron	**Si**	Silicon
Cu	Copper		

Ideas

- *More than three- quarters of all the elements are metals.*
- *Metals are used for different purposes according to their characteristics.*
- *Every element has its own **symbol.***

1. List the properties of metallic and non - metallic elements.
2. Why is carbon an element?
3. How many kinds of atoms are in a lump of copper? Explain.

Marie Curie
Born in 1867



Marie Sklodowska was born in 1867 in Poland. Although she came from a poor family, she went to Paris to study science at the University. She was often hungry and cold, but she still managed to become the best student in her class.

She married a French physicist called Pierre Curie when she was 28. Together they worked with a rock called pitchblende. It was interesting because it gave out rays that could go through solid objects. They called these rays radioactivity. Marie Curie wanted to find out what was causing this radioactivity.

The Curies' laboratory was just a horrible damp shed. Nevertheless, after eight years, the two scientists managed to separate two new radioactive elements from the pitchblende. They called the two elements polonium (after Poland) and radium.

In 1906 Pierre Curie was knocked down in the road by a horse-drawn carriage and killed. Marie Curie went on to become a professor at the Sorbonne (a university in Paris). She won two Nobel prizes for science and her work became famous throughout the world.

One of the two elements that she discovered, radium, is now used to save many cancer patients. The radiation from radium kills the cancer cells.

(J. Boyd & W.WhiteLaw 1989 John Murray)

10 Water

What you will learn

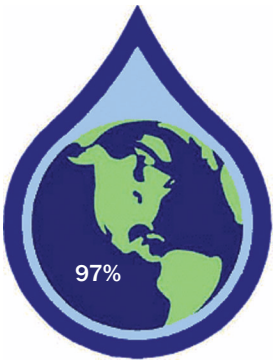
Water

Where do we get water?

Water Pollution

Pure Water

10a Water



About four-fifths of the Earth's surface is covered with water. More than 97% of the water found on the surface of the earth is in the oceans. The oceans contain salt water. Where do you think we get water?

Before reading any further just think for a while and write down as much as you can write, about water.

Hint: Use your senses to start with.


Ice berg


Swamp


Waterfall

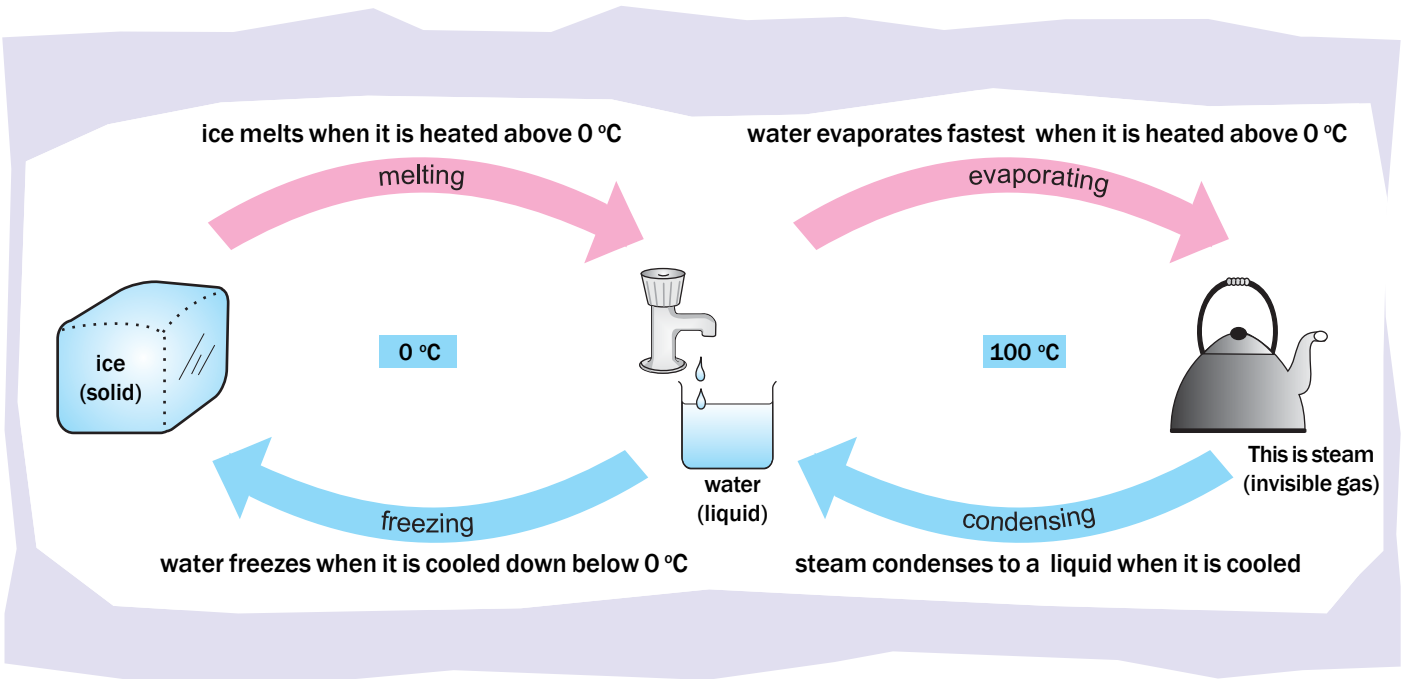

Swimming Pool

Do you Know?

The world's fresh and salt water lakes contain about 180,000km3 of water or 0.01% of the Earth's water resources.

Water

Water is usually found as a liquid, but it can also be found as a solid and a gas. The solid is called ice. Steam and water vapour are names used for the gas.



0^0C is called the **melting point** of ice. It is also the **freezing point** of water! 100^0C is the **boiling point** of water. Water evaporates quickly when it is boiling at 100^0C. It can also evaporate at lower temperatures. But then evaporation is slower.

1 Write down the ways water is useful to us.

2 How do you get water?

3 How can you save water?

Ideas

- *Most of the Earth's surface is covered with water.*
- *Water is found in three states. Solid, liquid and gas.*

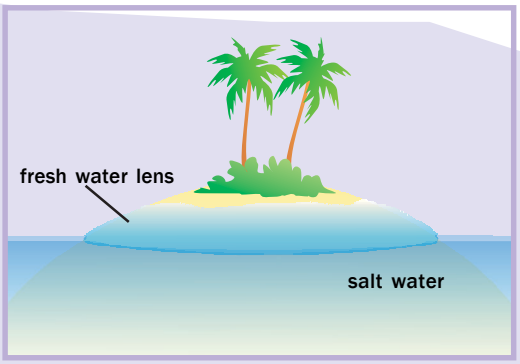
10b Where do we get water?

- List down the ways you get water in your house.

Probably the two main sources would be rain and ground water in our country.

Ground water

Ground water comes from the ground. Since the sea surrounds our islands, the seawater seeps into the ground. When rain falls on the land the fresh water, too, seeps into the ground. It settles on top of the salt water. Fresh water is lighter or less dense than salt water. There fore the fresh water stays on top of the salt water and forms a **fresh water lens.**



We dig wells to take out fresh water. The water taken from the ground may have some taste due to the minerals dissolved in it.

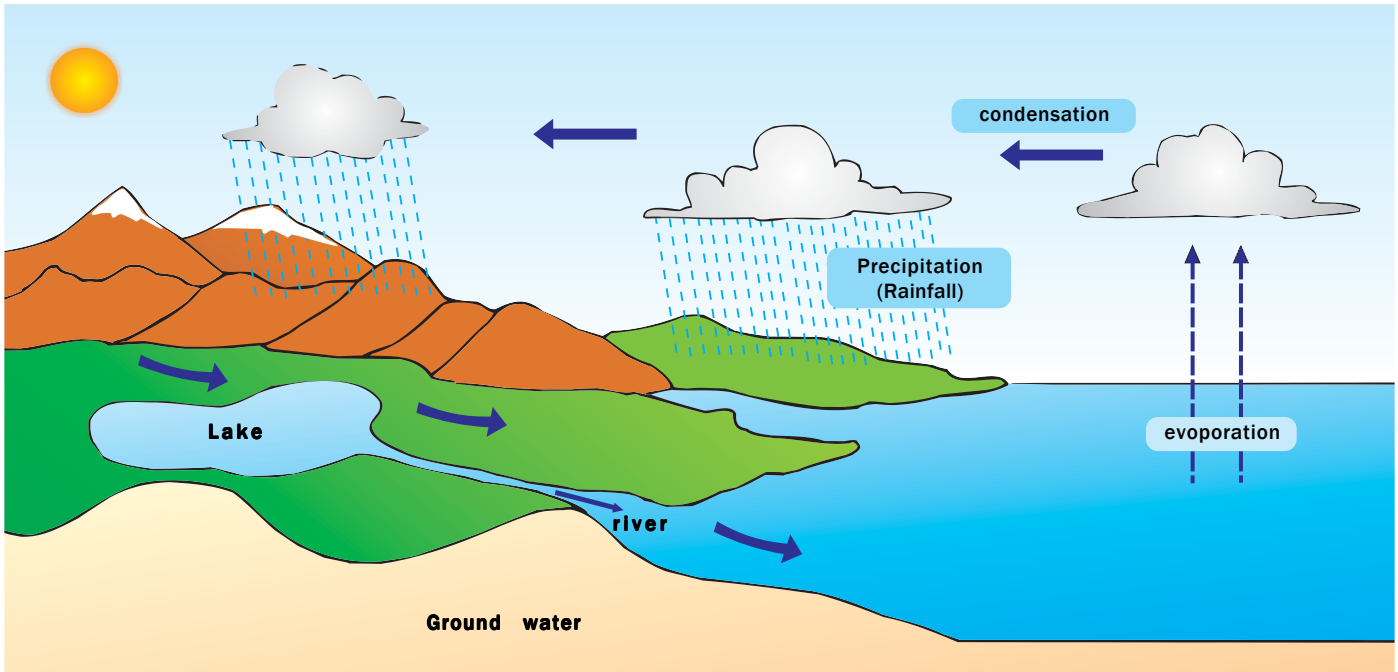
In Male', people take a lot of water from the ground. The amount of rainfall is not enough to replace the amount of water that is being taken. Therefore the amount of ground water is becoming smaller and smaller. Many people are now forced to use salty water. Desalinated seawater is now being pumped to all the houses in Male'.

Do you Know?

The shortest river in the world is the North Fork Roe River, located near the Great Falls of Montana, USA – it is only 17.7m long.

It's a cycle!

Have you wondered why the ground water supply does not run out quickly? It is because the used and unused water gets recycled. This happens in a cycle called the **water cycle.** There are three main events in the cycle.



Heat from the sun **evaporates** the water from the seas, oceans and ground. The water vapour rises, cools and **condenses** to form tiny droplets of water. These droplets form clouds.

The wind carries the clouds. When the air cools, the tiny droplets of water join to form larger drops. These fall as rain.

Some rain water seeps into the ground to form ground water. Some flows along the ground to form streams and rivers. These flow back into the sea. The water evaporates again from the seas and rivers. The cycle then repeats.

Ideas

- *Rain and ground water are the two main source of water in our country.*
- *In Male'ground water is becoming contaminated with other minerals and water is very salty.*
- *Water cycle is the process by which we get water.*

1. Discuss and write down the ways how you can improve the ground water.
2. Write down in your own words the events or stages of water cycle.

10c

Water Pollution

Water is not always as clean as it should be. Harmful substances called water pollutants are constantly being released into water mainly by human activity. These activities include direct discharge of waste matter into the seas and oceans. In our country although we don't have industrial discharge, a lot of municipal waste is dumped into our seas and oceans.

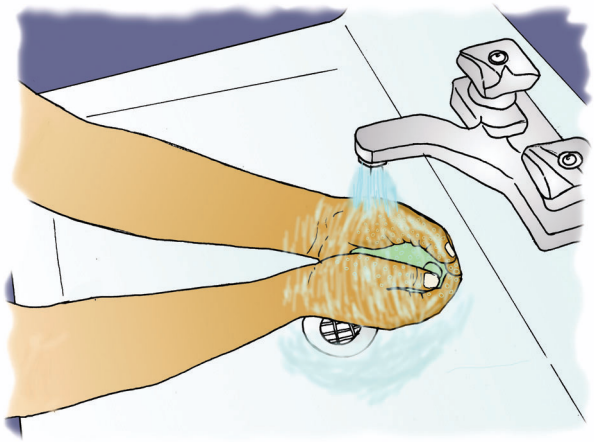
At present, the signs and consequences of human activity can be found everywhere on the Earth.

Sources and effects of marine pollution

TYPE	SOURCE	EFFECTS
Nutrients	Excess from forestry, farming and other land use. Also airborne nitrogen oxides from power plants, cars etc.	Increase algae growth. Rotting of algae reduces oxygen, which would kill other marine life.
Sediments	Erosion from mining, forestry, farming, coastal dredging	Slowdown photosynthesis below surface waters, block gills of fish
Pathogens	Sewage, livestock	Contaminate (pollute) coastal swimming areas and seafood, spreading cholera, typhoid and other diseases.
Oil	Cars, heavy machinery, industry, oil tanker operations, shipping, accidents at sea	Kill larvae and cause disease in marine life. Oil slicks kill marine life
Plastics	Fishing nets, cargo, cruise ships, beach litter, wastes from plastic industry	Discarded fishing gear continues to catch fish. Plastic waste trap marine life or is mistaken for food. These may remain as long as 200 to 400 years.
Radioactive substances	Discarded nuclear submarine, military waste, industrial waste	Can enter food chain and cause disease in marine life and people.
Noise	Super tankers, other large vessels and machinery	Can be heard thousands of kilometers away under water. May stress and disrupt marine life.

Hard or soft?

Some of the ground water we get in our islands are hard. It feels no different from a pool of soft water. But you notice the difference when you try to wash your hands with soap. If the water is hard you need a lot of soap to get a lather, and scum forms round the edge of the container you used. If the water is soft you can get a good lather with little soap and no scum forms.



How does water become hard?

Water become hard due to the presence of two minerals - calcium and magnesium. When soap is added to hard water the soap combines with calcium ions to form a greasy scum. The formation of scum wastes soap and makes it more difficult to make things clean.

How can hardness be removed?

Boiling is an inexpensive way of softening water and it does not remove all the hardness.

Find information on another ways of removing hardness of water!

Ideas

- *Pollutants are constantly being released into water mainly by human activitty.*
- *Water becomes hard due to the presence of calcium and magnesium ions.*
- *Some of the ground water we get in our islands are hard.*
- *Boiling is one method of softening water.*

1. Think of ways of reducing marine pollution and present your ideas to the class.
2. How can you show that water is hard or not?

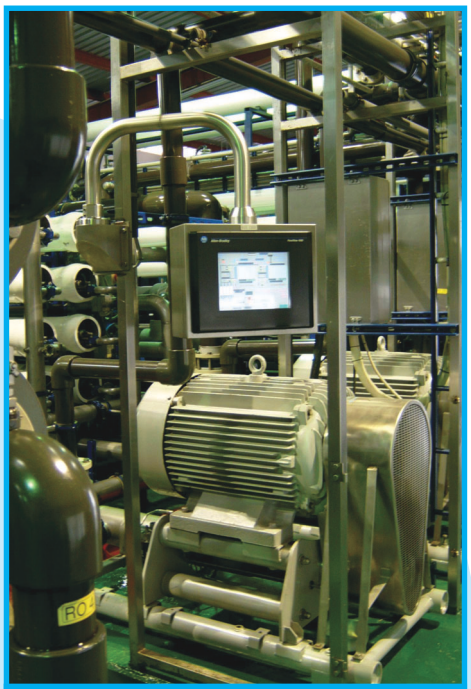
10d Pure water

A safe water supply makes a huge contribution to our health.

• Name some water borne diseases.

Typhoid, cholera, dysentery can be spread if untreated sewage contaminates drinking water. According to world Health organization about 80% of all known diseases are related to water. Water can carry tiny living things called germs which cause diseases.
Hard water when used for drinking for long periods can lead to stomach disorders. Especially hard water contains magnesium sulphate which can weaken the stomach permanently.

This is particularly important for people living in the islands other than Male' where some of the sewage goes directly into the ground and people drink well water from a nearby well.



Part of water treatment plant

Removing impurities from water

Impurities are substances which pollute the water making it dirty and unsafe to drink.

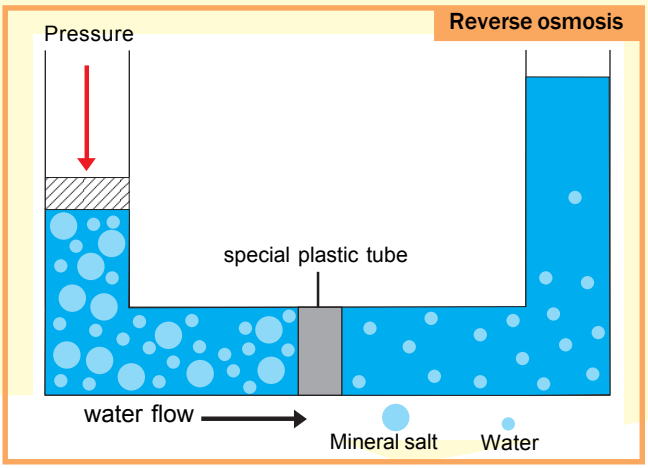
We can remove some impurities using some methods we already know:

- Filtration – to remove solid substances
- Distillation – to remove dissolved substances
- Boiling – to kill some germs (but not all)
- Adding chemicals like chlorine – to kill most germs.

Desalination of sea water

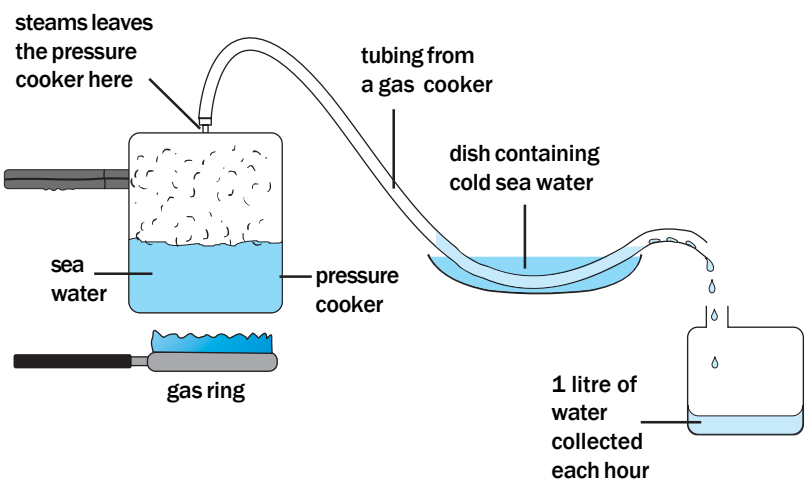
Sea water has mineral salts dissolved in it. Common salt or sodium chloride is the main salt present. Removal of salts from sea water is called desalination.

There are about ten different methods of desalination. In Maldives two methods are being used: simple distillation and reverse osmosis.



Distillation

Distillation process can be used to get fresh water from seawater. In distillation, the water is evaporated and then the steam is condensed. Distillation is not normally used to get drinking water from sea water. It is very expensive because it uses up so much energy. It is only used on a large scale in countries like Saudi Arabia where water is in short supply and energy is cheap.



Ideas

- *Drinking pure water is necessary to stay healthy.*
- *Impurities in water can be removed by filtration, distillation, boiling and adding chemicals.*
- *Desalination is the method used to remove salt from sea water.*

1. Why does distillation produce pure water from sea water?
2. Do you know what method is used in Maldives water supply and Sewerage Company? Try and get information from them.

Ibn Al-Nafis
1213 - 1288 C.E

His name is Allauddin Abul-Hassan Ibn Hazam Al-Qureshi Al-Damashqi Al-Masri. He was born in 607 A.H. of Damascus. He was educated at the Medical College-cum-Hospital founded by Nural Din Zangi. Apart from medicine, Ibn al-Nafis learnt jurisprudence, literature and theology.

After acquiring his expertise in medicine and jurisprudence, he moved to Cairo where he was appointed as the Principal at the famous Nasri Hospital. Here he trained a large number of medical specialists, including Ibn al-Quff al-Masihi, the famous surgeon. He also served at the Mansuriya School at Cairo.

His major contribution lies in medicine. His approach comprised writing detailed commentaries on early works, critically evaluating them and adding his own original contribution. His major original contribution of great significance was his discovery of the blood's circulatory system, which was re-discovered by modern science after a lapse of three centuries. He was the first to correctly describe the constitution of the lungs and gave a description of the bronchi and the interaction between the human body's vessels for air and blood. Also, he elaborated the function of the coronary arteries as feeding the cardiac muscle (heart muscle).

He was devout and it was said, that before his death, some of other physicians said to him, "Why don't you have some alcohol to help you out of this disease? And he said, "No, I can not meet God the Compassionate, with a drop of alcohol in my body". He died in Cairo at the age of 80, in 1288 and gave all his wealth and books and belongings to Mansuriya Hospital.

11 Mixtures

What you will learn

It's a mixed up world

Separating mixtures

Solids in liquids

Separating solutions

To get the water back

What's in mixtures...

11a It's a mixed up world

Not many of the materials that we come across in our daily lives are made up of just one type of element or compound. The food we eat, the air we breathe and the milk we drink are all mixtures.

Many advertisements use the word 'pure' a lot. Pure orange juice is made only from squeezed oranges.

What does "pure' mean?

What is pure and what is not

Scientists use the word 'pure' in a slightly different way. Orange juice may be made from only oranges, but it is a complex mixture of compounds dissolved in water. Orange juice contains natural sugars, vitamin C and many other substances.

In Science, pure substances contain only one compound or element. All its particles are the same.

Almost all natural substances are mixtures of chemicals.

What particles would a bottle of pure water contain?

The air you breathe

The air you breathe is a mixture. It consists of elements such as nitrogen, oxygen and inert gases (e.g. helium, neon) as well as compounds such as carbon dioxide and water vapour.

Do you know?

98% of the Earth's crust is made up of just eight elements – oxygen, silicon, aluminium, iron, calcium, sodium, magnesium and potassium.

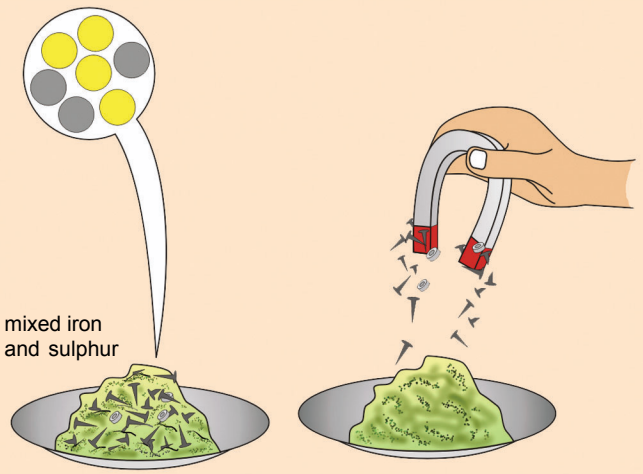
Mixing them up

Iron is an element. It is made from iron atoms only, and it has its own special properties.

Sulphur is an element. It is made from sulphur atoms only, and has its own special properties.

If you mix iron and sulphur, you mix up the iron and sulphur atoms. But the iron and sulphur still keep their special properties. You just have a **mixture** of iron and sulphur.

How could you separate the iron from a mixture of iron and sulphur?



Naturally pure

Is anything naturally pure? The answer is not much! Rainwater in pollution-free areas is almost pure water, but even this contains some dissolved carbon dioxide, oxygen and nitrogen.

White sugar and salt are almost pure substances. Sugar is found mixed up in the sap of sugarcane. Before you use them, they are separated out from their natural mixtures by physical processes such as dissolving, filtration and evaporation.

1 Fill in the blanks using the following words.

particles	**mixtures**	**different**
pure	**same**	

If a substance is ....., it contains only one chemical compound, so all its particles are the ..... Most natural substances are ..... They are made up of ..... chemical compounds, with their different .... all mixed together.

Explain why mineral water is not pure in the scientific sense.

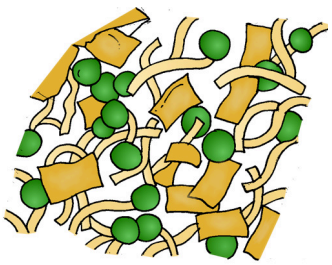
Ideas

- *In nature, most substances are mixtures.*
- *In Science, a pure substance contains just one chemical compound or element.*
- *In a pure substance, all the particles are the same.*
- *A mixture has the properties of the substances that make up the mixture.*

11b Separating mixtures

How do you separate a mixture?
Decide how you would separate:

- the green peas
- the pieces of noodles from the soup
- the different coins.



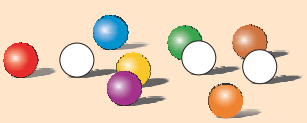
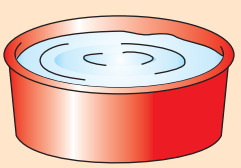
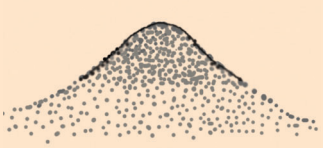
Sorting by size

If you had a mixture of rice and sand, you could pick the rice out, grain by grain but that would take ages. There is a faster way to separate them. Rice grains are larger than grains of sand, so you could put the mixture through a sieve.This lets the sand through but not the rice.

Other types of sorting

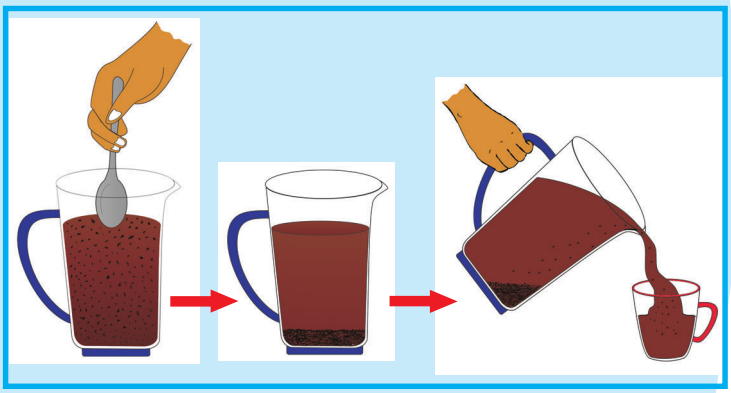
To separate mixtures, you need to find a difference between the mixed substances which you can use to separate them out.

Use the information to work out how to separate:

			What a mix - up!	Helpful hints
1	**snooker balls** size about 4cm sink in water various colours	**ping - pong balls** size about 4cm float in water white		
2	**iron filings** grey sink in water magnetic	**copper filings** brown sink in water non-magnetic		

Solids from liquids: decanting

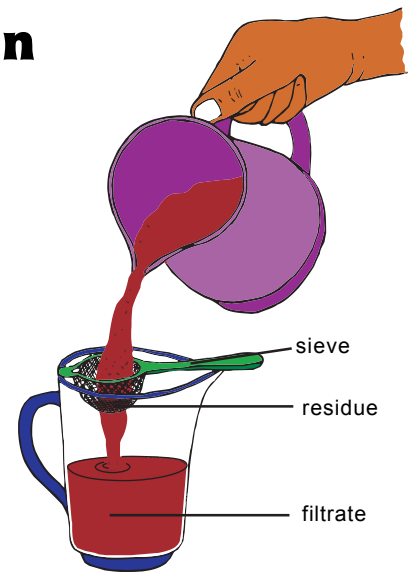
How do you make tea at your home? Some people use tea bags while others use tea packets where you need to put tea into the kettle. In this case if you left the kettle for sometime, most of the tea would settle at the bottom of the kettle. This is called **sediment**. If you are careful, you can pour the clear tea off, leaving the solid behind. This method of separation is called **decanting.**



Solids from liquids: filtration

After the tea has been decanted, it is often still not very clear. There are still some tea mixed up with the liquid. These are in **suspension.**

They can be separated out using a sieve with very tiny holes. The liquid can get through the holes, but any solids in suspension are trapped. This process is called **filtration.** The solid left behind in the sieve is the **residue**. The clear liquid in the cup or the mug is the **filtrate**.



1 Peas are green and sand grains are offwhite. Why can't you use this difference to separate peas and sand?

2 A car engine will not work properly if dust or dirt gets mixed up with the petrol. The petrol going to the engine passes through a container filled with matted fibres.

a. What is this for?

b. How does it work?

Ideas

- *Solids of different sizes can often be separated through a sieve.*
- *If a mixture of liquid and solid settles out, the liquid can be decanted off.*
- *Solids can be filtered out of liquids.*

11c Solids in liquids

Gardens are often sprayed with a special mixture to protect them from disease. Gardeners make this spray by mixing a substance with water.

Solid copper sulphate comes in beautiful blue crystals. Sometimes these crystals are mixed with water and lime and they are sprayed to the field to prevent from disease.

These crystals seem to disappear when you mix them with water, but water turns into a blue solution. So copper sulphate must be there. What do you think happend?

Dissolve it

Copper sulphate **dissolves** in water and makes a **solution**. This makes it easy to spray onto the leaves. Substances that dissolve in water to form a solution are described as soluble. The liquid is called the **solvent** and the solid is called the solute. Copper sulphate is soluble in water. Water is the solvent and copper sulphate is the solute.

How much copper sulphate could you dissolve in water? Could you go on adding more and more, making the solution stronger and stronger?

The answer is no. You would eventually find that no more copper sulphate would dissolve, no matter how long you stirred the mixture. When this happens, the solution is **saturated.**

What dissolves?

Everything does not dissolve in water. A lot of things, such as chalk and oil, will not dissolve. They are **insoluble.**

Think of solids that are soluble and insoluble.

Dissolve it..... slowly or faster

If you drop some cubes of sugar into water and leave them alone, you can watch them dissolve. The crystals will slowly dissolve. It would take a lot of time to dissolve it completely.

Fortunately, you can make things dissolve faster. You can speed up the process.

1 Heat it up. Heat makes solids dissolve faster.

2 Shake or stir the mixture. This mixes the solid with the liquid faster.

3 Crush it. Small peices of solid dissolve faster than large ones.

1 Copy the following and match the correct word to its description. One has been done for you.

the solid that dissolves	**insoluble**
the liquid that does the dissolving	**solution**
It will dissolve	**solute**
it's completely full with solid	**soluble**
It will not dissolve at all	**solvent**
a liquid with solid dissolved in it	**saturated**

Ideas

- *Some solids **dissolve** in water to form a **solution.***
- *The water is the **solvent,** and the solid is the **solute.***
- *The solution is called a saturated solution if no more solid will dissolve.*
- *There are ways you could speed up dissolving.*

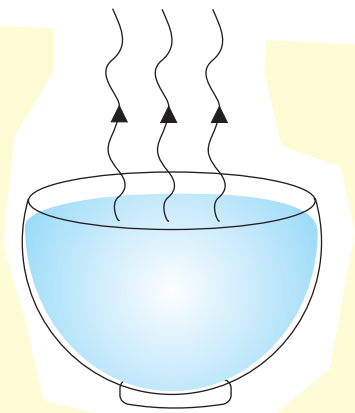
11d Separating solutions

When it rains, everything gets wet. But if it stops raining and the sun comes out, everything dries up again. Where does all the water go?



Evaporating out

Water can slowly turn into a gas at any temperature. If you leave water in an open bowl at home, some of the water turns to a gas called **water vapour** and mixes with the air. This process is called **evaporation.**



Evaporation dries up puddles, and dries out clothes on the line. The hotter it is, the faster evaporation happens.

Evaporation is useful

When salt dissolves in water, the salt particles are far too small to be filtered out by filter paper. The sea contains salt in solution. How can you get the salt out?

The simplest way is to let the water evaporate away. When water gets lost the salt particles would join back together and crystals start to grow. It's like dissolving in reverse.

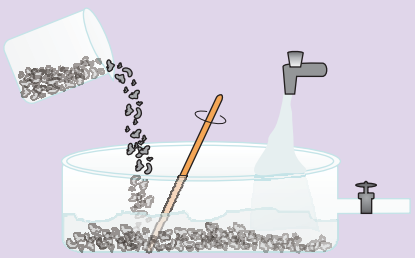
Pure salt by other methods

In some countries salt is dug from underground mines. The rock salt that is dug up is mixed up with sand and clay. How can it be separated?

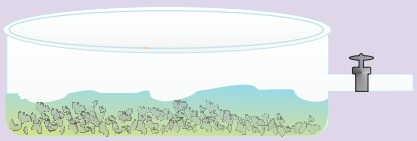
A useful difference between salt, sand and clay is that only the salt is soluble in water. This difference is used to purify the salt.

The purification stages

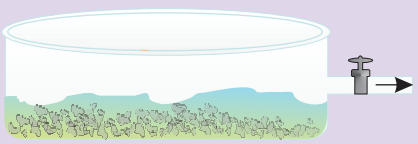
Here are the stages that are used to purify rock salt.



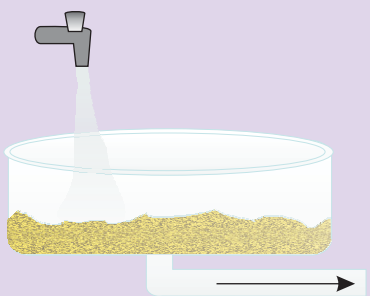
Stage 1 The rock salt is mixed with water.



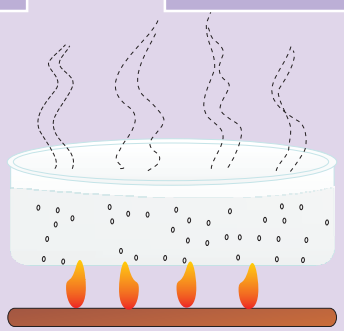
Stage 2 The mixture is allowed to stand.



Stage 3 The liquid is run off.



Stage 4 The liquid is filtered through fine sand.



Stage 5 The liquid is heated.

1. Have you ever used washing machines to spin-dry your clothes? What is being separated in this case? How is it done?
2. Think of a way how you could get fresh water from sea water.
3. Where does the water go when a rain puddle dries up in the sun?

Ideas

- *Water will slowly evaporate into the thin air.*
- *Evaporation happens faster if the water is heated.*
- *If a solution is allowed to evaporate, the solute is left behind.*

11e

To get the water back

Evaporation is a good way to get the salt back from a salt solution. But what if it is the water you want? How could you get that back?

There is a clue. You can see the answer in a glass of very cold water on a hot day .....

Condensation

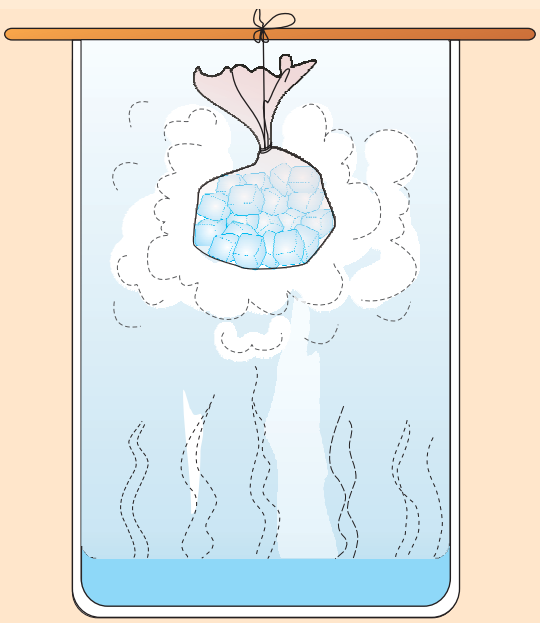
Evaporation is a good way to get the salt back from a salt solution. But what if it is the water you want? How could you get that back?

Water vapour in the air is invisible. On a hot day this vapour is hotter than the water that you put in the glass. Some of the water vapour that is nearer to the glass cools slightly and some of it turns back into tiny droplets of water. It **condenses.**

Make your own clouds

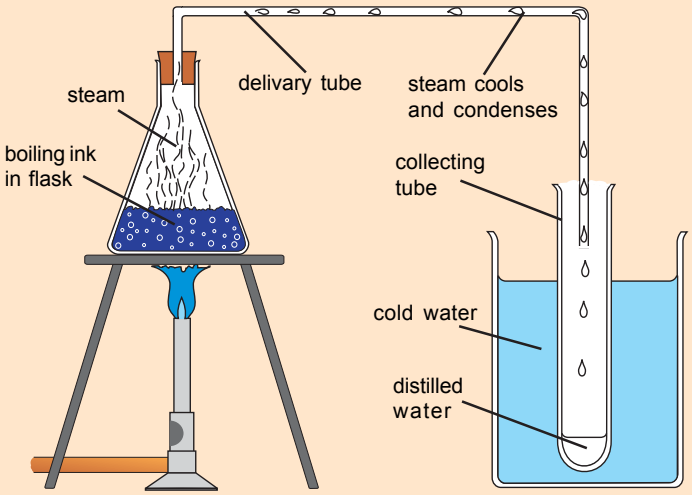
Water vapour in the air cools and condenses as it rises above the land or sea.

You can make your own clouds in a tall jar. Just hang a bag of ice over some very hot water.



Collecting water

The warmer water is, the faster it evaporates. You can turn all the water into a gas (water vapour) if you heat the water until it bubbles and boils.
To get the water back, you collect the gas and cools it, so that it condenses back to liquid water. This process of boiling and condensing water is called **distillation**.
The pure water that is collected is called **distilled water**.
What do you think is the purpose of the beaker of cold water?

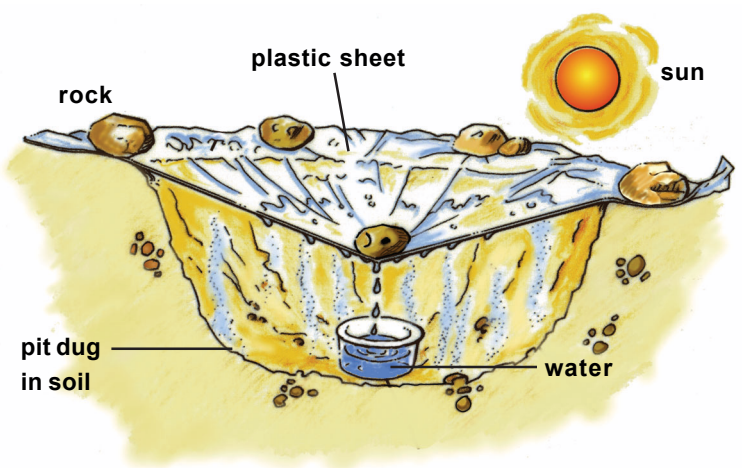


What happens if you get lost?

Imagine you are lost in a desert with no water and nothing but a clear plastic sheet and an empty jar.

No need to fear! The soil contains some moisture even in the desert. The heat from the sun can be used to collect this moisture.

See if you could explain what happens.



1 Fill in the blanks using the following words.

water vapour		**liquid**	**boil**
evaporation	**condenses**		

Water can slowly turn into a gas at low tempera ture by ..... If you keep heating, the water starts to ..... .
A lot of .... escapes into the air.
If it is cooled, it ..... and turns back to ..... water.

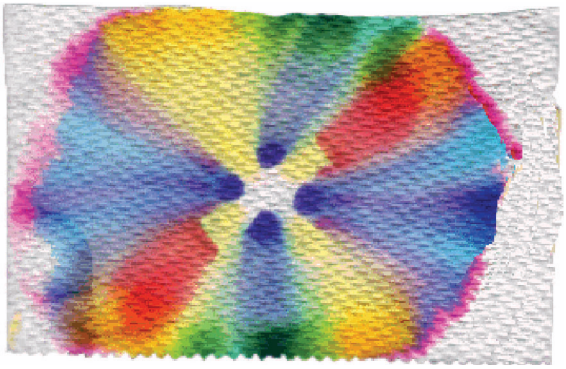
Ideas

*Water vapour in the air can **condense** back to form liquid water if it is cooled.*

*Pure water can be collected from a solution by **distillation**.*

11f

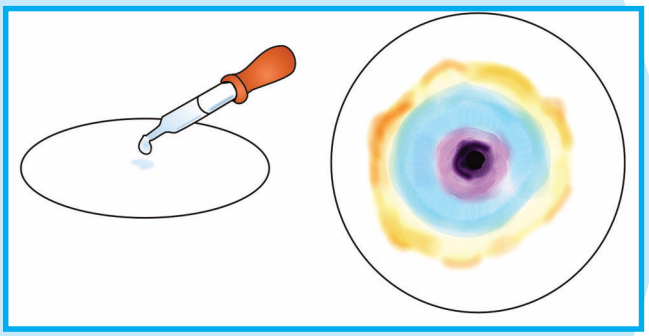
What's in mixtures..



Have you ever got wet in the rain on the way to school?
Have you ever spilt water onto your exercise book?
Sometimes the ink dissolves in the water and makes a mess.
Sometimes it also forms lots of different colours.
Why does this happen?

Chromatography

Chromatography is used to separate and identify the different coloured components in dyes or inks.



If you put a drop of mixed ink onto filter paper and add water drop by drop, the water spreads out into the filter paper, spreading the ink with it. But the dyes in the ink do not move at the same speed. Some move as faster as the water, while some stays behind or move much slowly. The result is the dyes separate into a series of coloured rings. This process is called **chromatography.**

Chromatography at everyday life

It is often used to test a substance for purity and is also widely used in the testing of dyes in food and other industries.

Chromatography is very useful in scientific research because it gives quick results. It is easy to handle and requires very small amounts of the mixture.

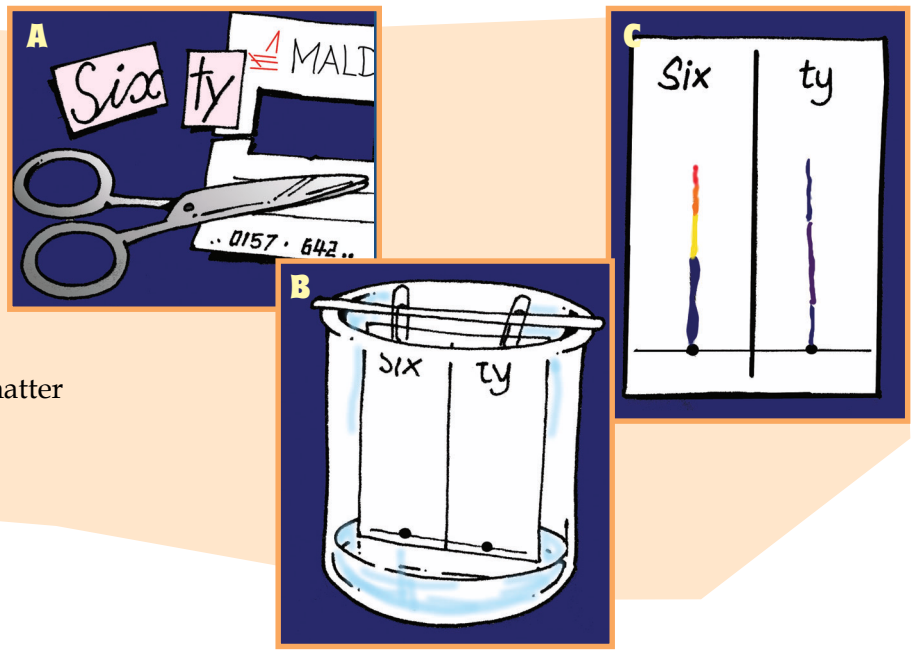
Do you know?

Smog is a mixture of fog and smoke particles. Smog used to be a big problem in British cities. Over 20,000 people died in one week during a bad smog in 1925. Now there are laws to control smoke emissions. Smog is no longer a problem in Britian.

Be a detective

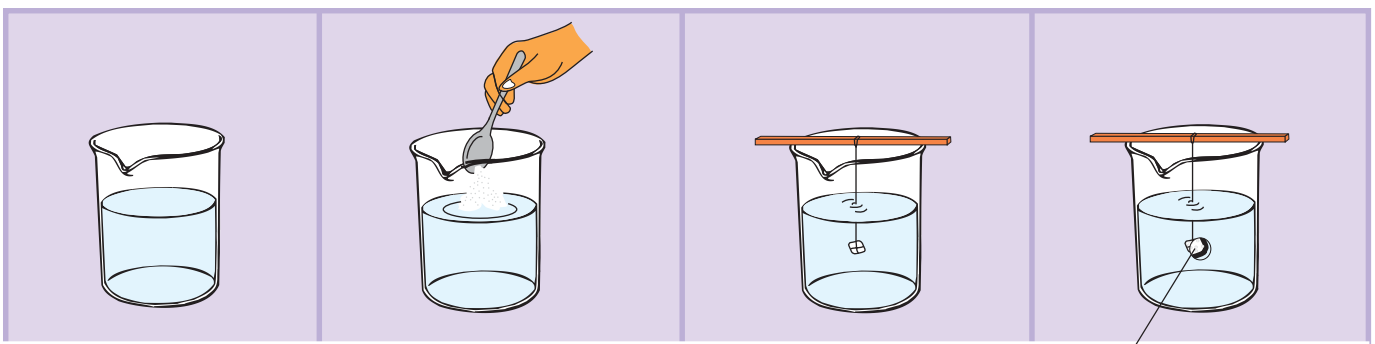
Inspector fauzee thinks that this cheque has been faked. Sombody has changed six to sixty. The black ink looks the same, but perhaps the ink is different.

How can you investigate the matter using the chromatography?



Crystallisation

Crystallisation is used to separate a soluble solid from its solution. Using this method, the solid is obtained in the form of crytals.



Sugar solution.	Add more sugar until it is saturated.	Suspend a sugar cube in the solution.	Sugar crystals grow around the cube when the solution cools.

1 Fill in the blanks using the following words.

speeds	**chroamtography**
separates	**dyes**

When water soaks up into paper, it carries any soluble ..... with it. The different dyes are carried along at different ..... This ..... out the diferent dyes. The pro cess is called ..... .

Ideas

- *You can separate out mixtures of dyes using chromatography.*
- *Chromatography can be used to identify the dyes in a mixture.*

Jabir ibn Haiyan

Died 803 C.E

Father of modern chemistry

Jabir Ibn Haiyan, the alchemist Geber of the Middle Ages, is generally known as the father of chemistry. Abu Musa Jabir Ibn Hayyan, sometimes called al-Harrani and al-Sufi, was the son of the druggist (*Attar*).

In his early days, he practised medicine and was under the patronage of the Barmaki Vizir during the Abbssid Caliphate of Haroon al-Rashid.

Jabir's major contribution was in the field of chemistry.

He introduced experimental investigation into alchemy, which rapidly changed its character into modern chemistry.

His contribution of fundamental importance to chemistry includes perfection of scientific techniques such as crystalization, distillation, calcination, sublimation and evaporation and development of several instruments for the same. The fact of early development of chemistry as a distinct branch of science by the Arabs, instead of the earlier vague ideas, is well-established and the very name chemistry is derived from the Arabic word *al-Kimya*, which was studied and developed extensively by the Muslim scientists.

Several technical terms devised by Jabir, such as alkali, are today found in various European languages and have become part of scientific vocabulary. Only a few of his books have been edited and published, while several others preserved in Arabic have yet to be annotated and published

His various breakthroughs e.g., preparation of acids for the first time, notably nitric, hydrochloric, citric and tartaric acids, and emphasis on systematic experimentation are outstanding and it is on the basis of such work that he can justly be regarded as the father of modern chemistry.

He made several astronomical observations, and devised a device similar to the vernier, to increase the precision of instrumental readings. In physics, his contribution comprised the study of different forms of energy, heat, light and mechanical, and such concepts as force, vacuum and infinity.

12 Air around us

What you will learn

Air

Does air have mass?

Properties of gases

12a Air

The air is all around us. Although we do not see it we know it by its actions. Moving air or wind can move objects. When we hang our washing to dry we can see it flapping in the breeze (a light wind). Strong wind can move large objects and can cause damage.

A thick layer of air surrounds the earth. This layer of air is called the **atmosphere**. This protects the Earth from the harmful rays of the Sun and also prevents the Earth from getting too hot or too cold.

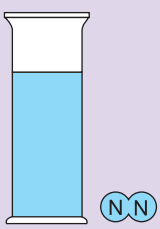
Air supports life!
What other ways is air useful?

The gases in the air

Air is considered a mixture because its composition varies and the gases in the air can be separated by physical methods.

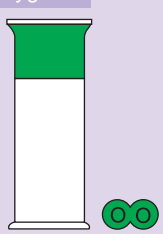
Can you give another reason why air is considered a mixture?
The main gases mixed together in the air are nitrogen, oxygen, argon and carbon dioxide. There are a few other gases, in tiny amounts.

Nitrogen

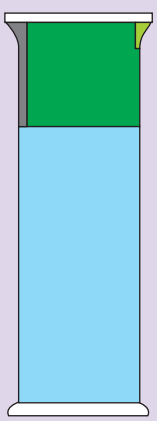


Colourless and odourless gas. Inactive and does not combine easily with other substances.

Oxygen



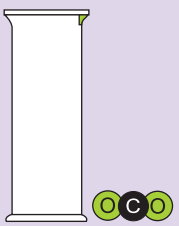
Colourless and odourlessgas. Very active and readily combines with many substances to form new substances.



A gas jar of air

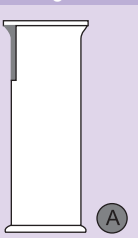
Carbon dioxide

Colourless and odourless gas. Produced when living things respire.



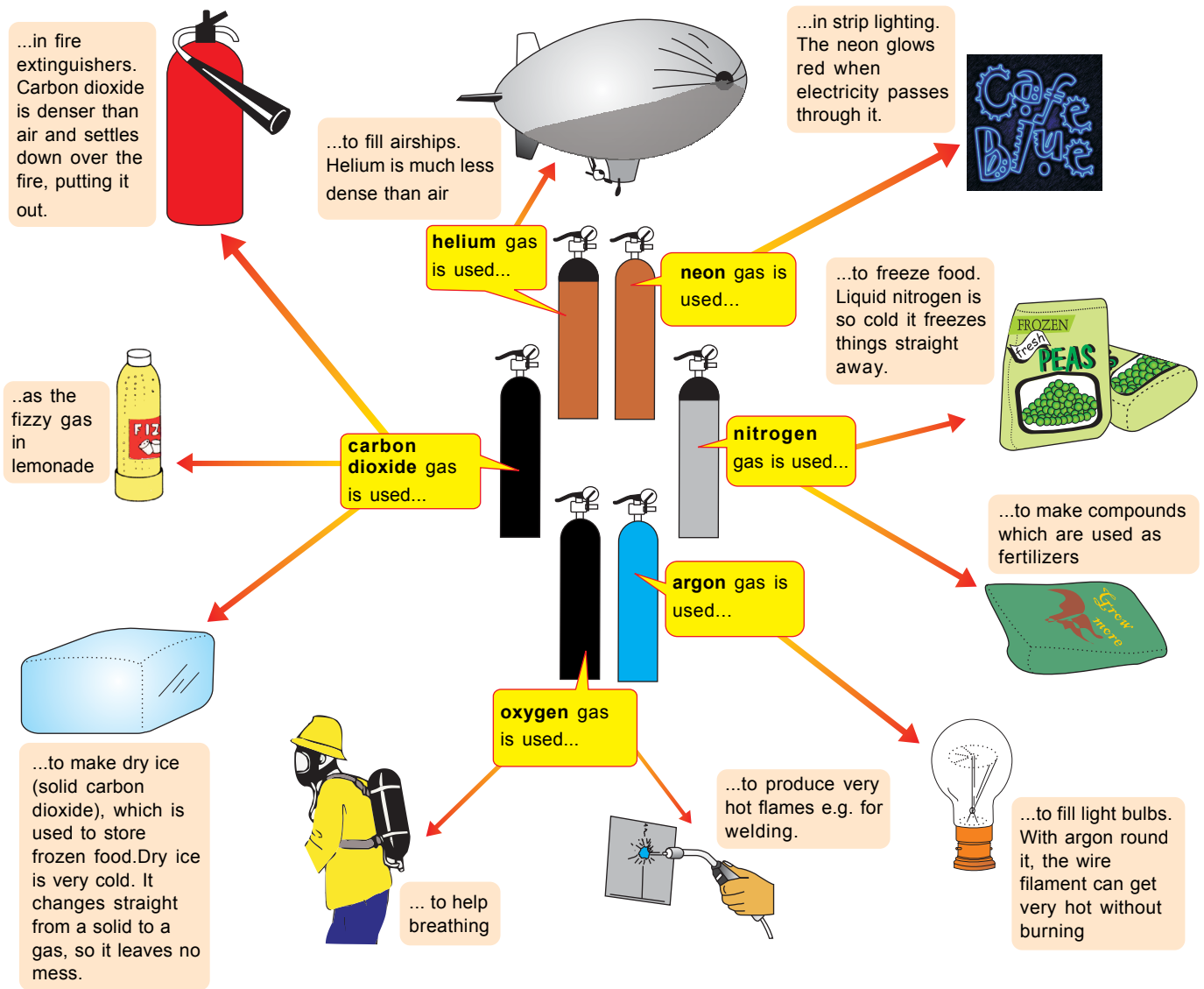
Noble gases

A group of very inactive or inert gases. Do not usually combine chemically with other substances.



Using the gases

The gases in the air are used for variety of purpose. For this reason gases are separated from each other and stored in cylinders. The cylinders have colour codes that tell you which gas is inside. Some of the few uses are:



Ideas

- *Clean air is a mixture of gases containing nitrogen, oxygen, carbon dioxide and noble gases.*
- *Air supports life, allows fires to burn, and has many other uses.*

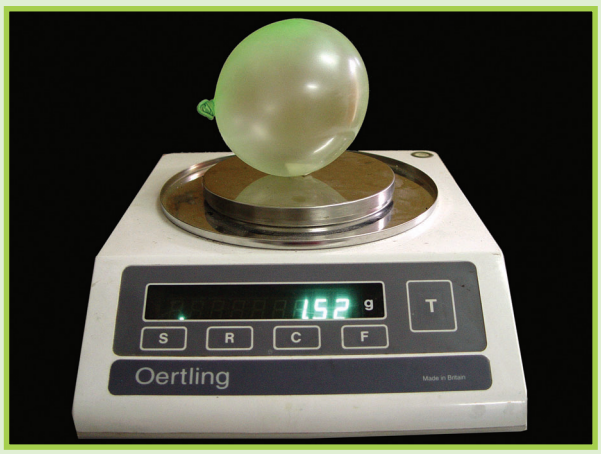
1. Write down the composition of air by volume.
2. Why is air considered a mixture?
3. Our Moon has no atmosphere. Suggest how this affects
   - **a** the day and night temperatures of the Moon,
   - **b** the changes on the surface of the Moon.

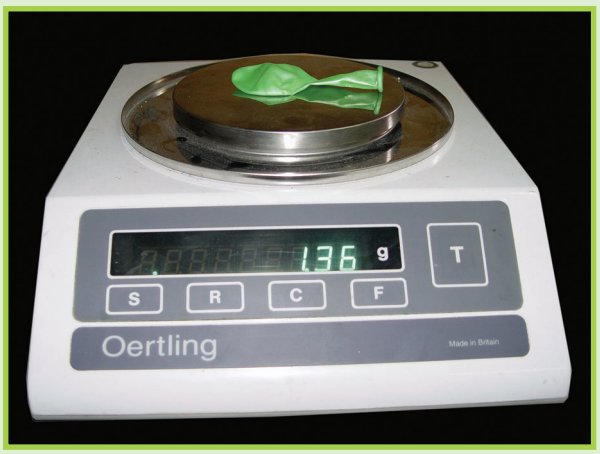
12b Does air have mass?

Yes, it does. It just isn't very dense, so there isn't as much matter in a cup of air as there is in a cup of water. However, it does have mass, and you can calculate it too.

Lets calculate!

- Weigh an empty Ziploc bag or a balloon.
- Blow air into the bag or balloon and close it tightly.
- Reweigh the bag or balloon.
- What have you observed?





Have a variety of sizes of balloons and do a class graph on a poster. Students who do not believe air has mass, this shows them that it does.

Air occupies space

Take a deflated balloon and blow air into it so it is partly filled. What is in the balloon? Now, blow up the balloon until it is full. Is there more air in the balloon now than there was before? Obviously, air takes up space.

Do you Know?

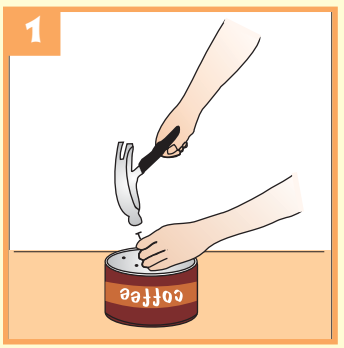
One in four people worldwide is breathing air which is damaging their health.

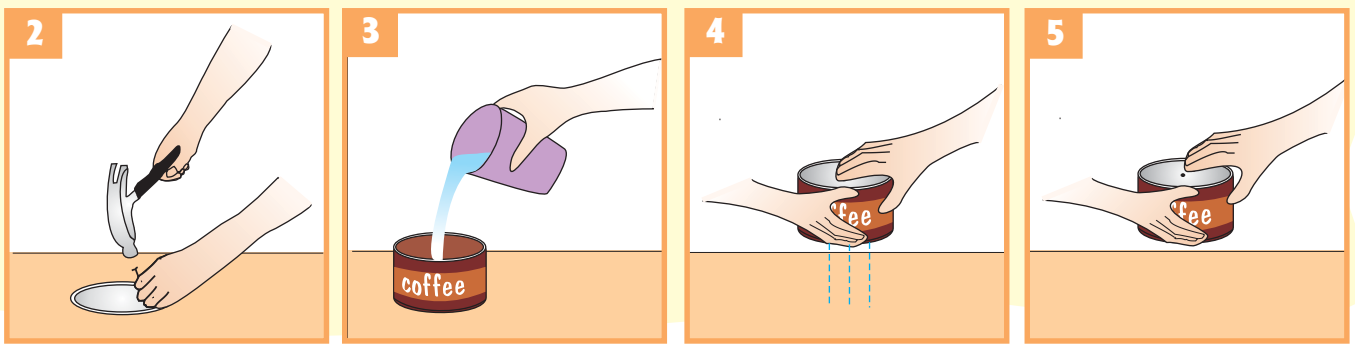
Does air have pressure?

The pushing force of air is called air pressure. The closer you are to Earth, the greater the air pressure. The farther away from Earth (in other words the higher your altitude), the less the air pressure. And remember, pressure is coming from all around us.

The magic can - a demonstration of pressure

- Take a coffee can and punch 3 small holes in the bottom.
- Also punch one hole in the lid.
- Now fill the coffee about 1/2 full of water and put the lid on.
- Place your hand over the hole and press down on the lid. Notice how the water streams out of the holes on the bottom due to the pressure you are exerting on the lid.
- Now slowly stop applying pressure to the lid.Notice how the stream of water stops.
- You can stop and start the flow of water simply by removing your finger from the hole.





1. What is happening with the magic can?see if you can come up with an explanation!
2. Think of some other way you could demonstrate that air have pressure?
3. Think of some other method to show that air have mass.

Ideas

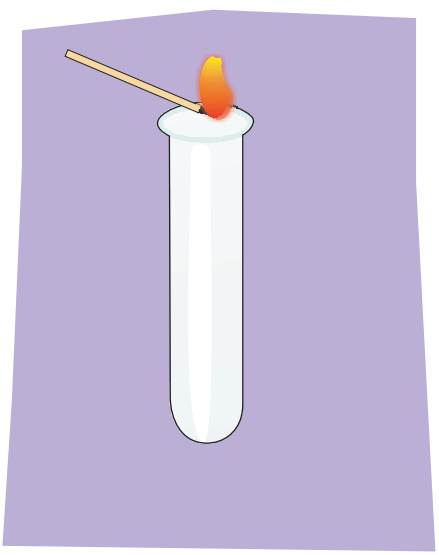
- *Although we cannot see air, it has mass.*
- *The pushing force of air is called air pressure.*
- *Air pressure is less in high altitude.*

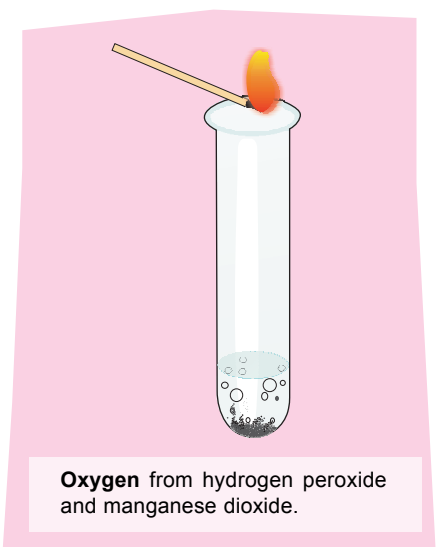
12c Properties of gases

NITROGEN	OXYGEN	CARBON DIOXIDE
Colourless and odourless	Colourless and odourless	Colourless and odourless
Inactive; does not combine readily with other substances	very active; combines readily with many substances	Inactive

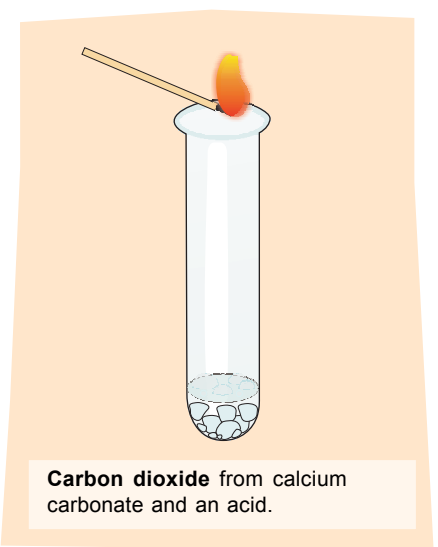
Gases! Are they really there at all?

Some gases are easy to make.
Try putting a burning wooden splint into each of these tubes of gases to compare what happens.

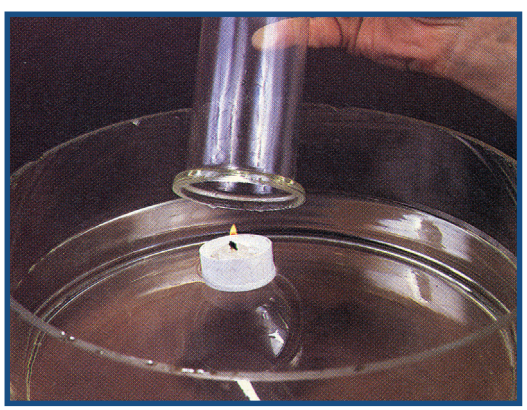




Oxygen from hydrogen peroxide and manganese dioxide.



Carbon dioxide from calcium carbonate and an acid.



What do you think is left in the cover jar at the end?
How could you test your ideas?

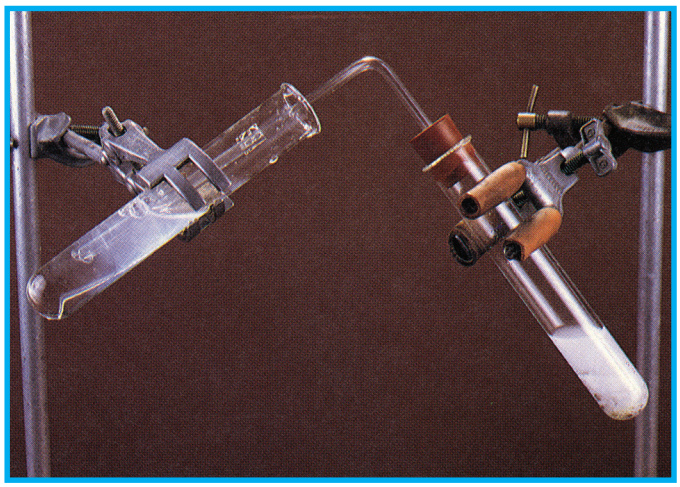
Do you Know?

The highest recorded air temperature at an official reporting station was 58°C at Al'azizyah, Libya.

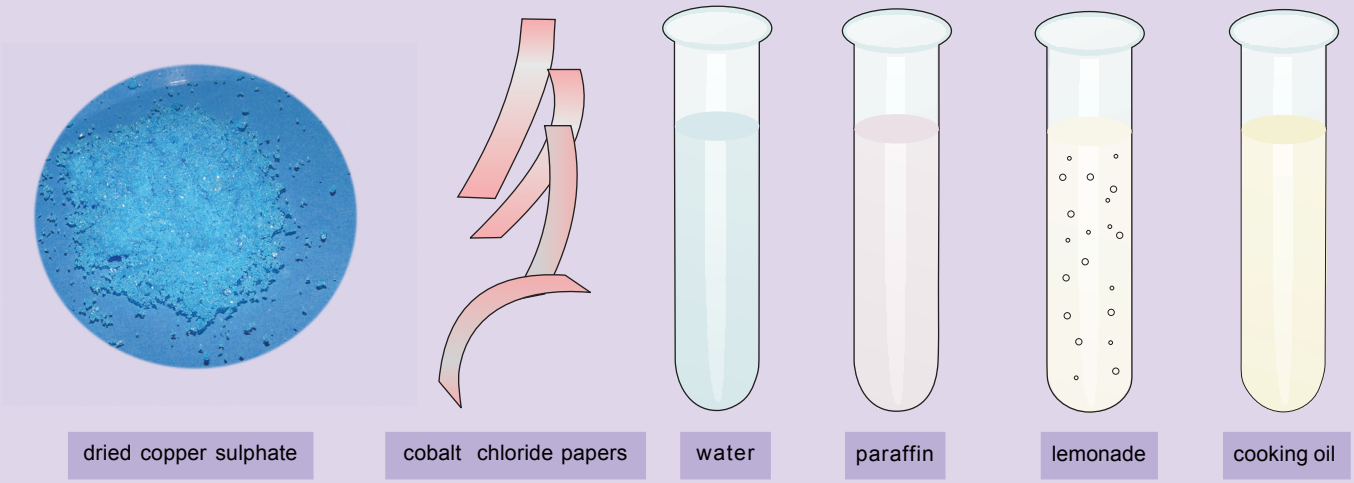
The carbon dioxide test

You already know the glowing splint test for oxygen. Here is a test for carbon dioxide.

When you add acid to calcium carbonate, gas is produced. If you let the gas bubble through limewater, you should see a change. What happens to the lime water?



The water test



• Put some dried copper sulphate powder or cobalt chloride paper in each tube.

What colour does the powder or paper in the tube containing water go?
Do any of the liquids in other tubes contain water?

1. You are given a test tube of oxygen gas and a test tube of carbon dioxide gas. How can you identify them?
2. The humidity in the air tells us how much ---------- there is in the air.
3. The footprints left by the astronauts, Neil Armstrong and Edwin Aldrin on the Moon in 1969 are still there today. Can you explain why?

Ideas

- *Oxygen is present when a glowing splint relights.*
- *Carbon dioxide is present when limewater turns milky.*
- *Water vapour is present when cobalt chloride turns blue.*

Omar Al-Khayyam
1038 - 1048

Ghiyath al-Din Abul Fateh Omar Ibn Ibrahim al-Khayyam was born at Nishapur, the provincial capital of Khurasan around 1044 A.D. (c. 1038 to 1048).

He was a mathematician, astronomer, philosopher, physician and poet. He is commonly known as Omar Khayyam.

Little is known about his early life, except for the fact that he was educated in Nishapur and lived there and in Samarqand for most of his life.

He did not like to be employed at the King's court and led a calm life devoted all his time for knowledge. He traveled to the great centers of learning, Samarqand, Bukhara, Balkh and Isphahan in order to study further and exchange views with the scholars there. While at Samarqand he was patronized by a dignitary, Abu Tahir.

Algebra would seem to rank first among the fields to which he contributed.

The Saljuq Sultan, Malikshah Jalal ad-Din, called him to the new observatory at Ray around 1074 and assigned him the task of determining a correct solar calendar.
Khayyam introduced a calendar that was remarkably accurate, and was named Al-Tarikh-al-Jalali. It had an error of one day in 3770 years and was thus even superior to the Georgian calendar (error of 1 day in 3330 years).

Apart from being a scientist, Khayyam was also a well-known poet.

13 Changes

What you will learn

What causes change?

Useful changes

Electric changes

Physical or chemical

13a

What causes change?

We talked about matter and materials before. Now we want to look at changes in matter. Changes in matter are happening around us all the time. Some of these changes such as our physical growth take place quietly while others such as explosions occur with a big bang.

Heat, light, electricity and mixing can change matter.

Look at the photographs and write down what causes the change in matter for each of them.

Changes caused by heat

Heat can produce many changes to a substance. Heat can change the physical state of matter. Hold an ice block in your palm. What do you feel? What happens to the ice after sometime?

Your palm feel cold. The ice melts (Changes from solid to liquid) using the heat from your hand.

Scientific explanation would be, the ice melts by **absorbing** heat from the hand.

Do you Know?

The Earth was formed 4500 million years ago.

Expansion and contraction

Look at the cartoon below. Can you explain what is going on?

When an object is heated, it **expands** (i.e. its volume increases) and when it cools, it contracts (i.e. its volume decreases).

Join together

Heat can also cause the **combination** of two or more substances to form a new substance.

+

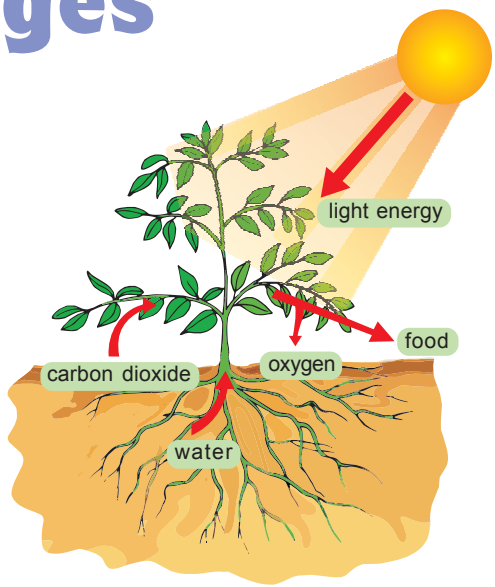
Ideas

- *Changes can be very fast or slow.*
- *Heat changes the state of matter.*
- *Heat can combine two substances to form a new substance.*

1. Write down the effects of heating matter, giving an example of each.
2. Write down the effects of heating matter, giving an example of each.

13b

Useful changes



Light is needed by green plants to make food. Green plants use water and carbon dioxide and the energy from sunlight to produce sugar (glucose) and oxygen.

The food that is made by green plants provides food for other living things like us who cannot make food on our own.


Rice field


Rice grains


Plate of rice

Light can change

Light can be changed into other forms of energy such as electricity. You may have seen on the roof top of some houses, solar panel. A solar panel changes light into electricity.

There are calculators too which is powered by solar. It also changes light into electricity.

Do you Know?

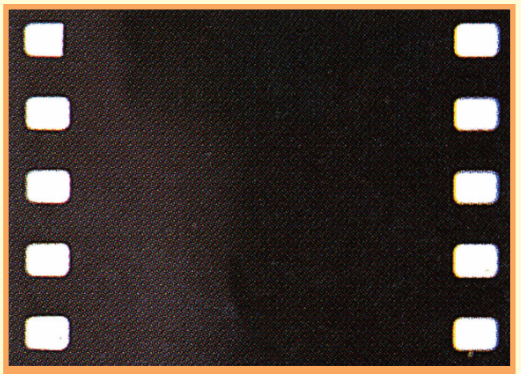
The Apollo 17 mission in 1972 was the last manned expedition to the Moon.

Photography

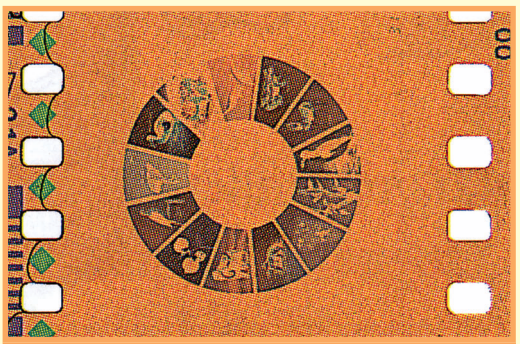
When a substance is split into two or more simpler substances, it is called **decomposing.**

When you take photographs, light decomposes the silver bromide coating on photographic film into silver.

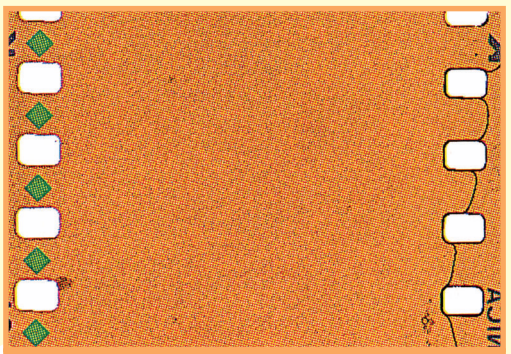
When film is developed into a negative, the silver creates a dark area on the film. This dark area is the image.



Negative of film that is overexposed to light.

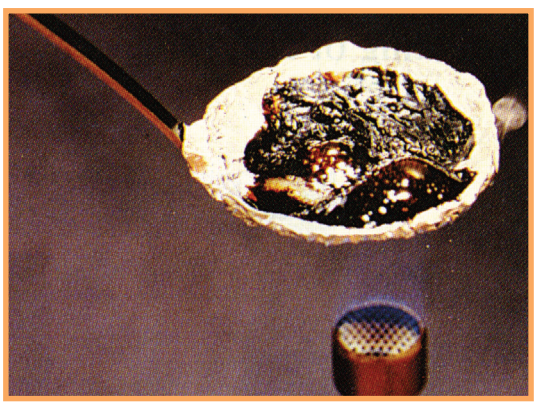


Negative of film that is not exposed to light.



Negative of film that is exposed to some light.

What happens when you burn sugar? How does it look like?



Ideas

- *Matter can be changed when it is exposed to light.*
- *Light can be used to combine substances as in making food by plants.*
- *Light can be changed into other forms of energy such as electricity.*
- *Light can split susbtances.*

1 What causes the changes in photographic film when taking a photograph, and during photo synthesis? Describe these changes.

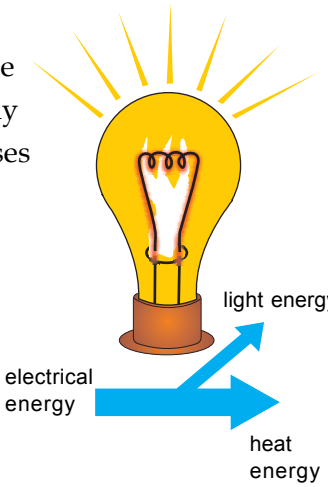
13c

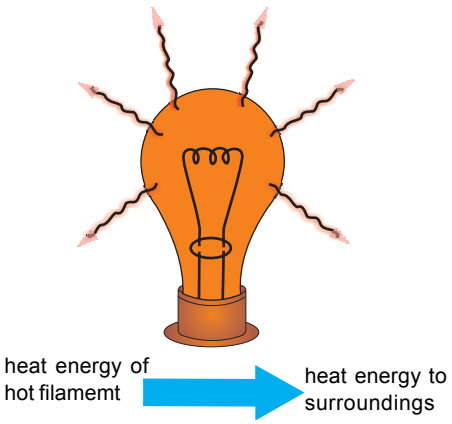
Electric changes

Passing electric current through a substance may change its properties either temporarily or permanently. When electric current passes through the filament in an electric bulb, the filament heats up and glows.

What happens when electric current stops flowing?

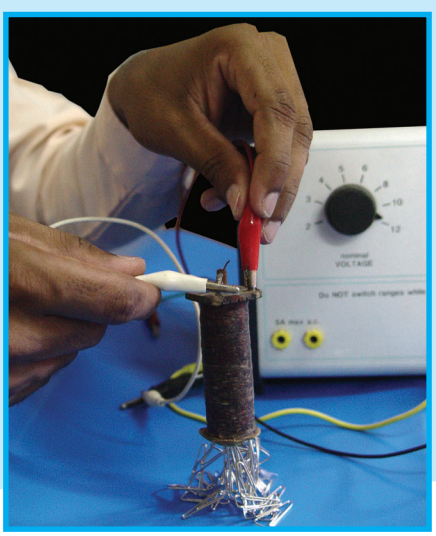
The filament will cool down and no light will be given out.

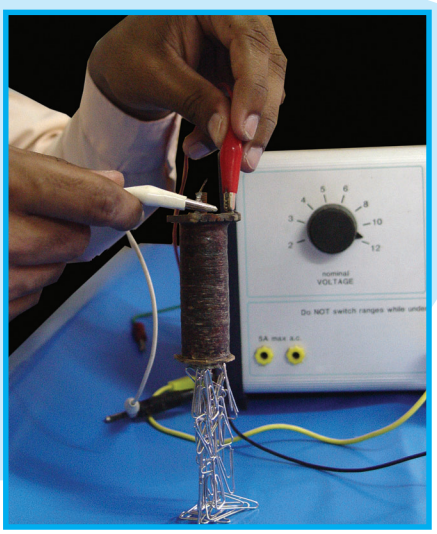




Act like a magnet

Electricity can also cause a piece of iron rod to have a magnetic effect. When electricity is passed through a wire wound round an iron rod, the rod is able to attract the paper cilps as shown.





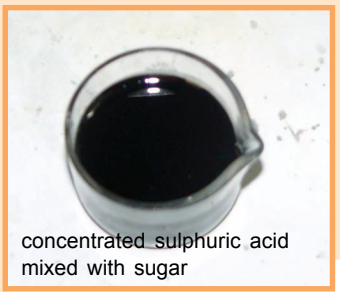
Do you Know?

In 1646 the word 'electricity' was made by Dir Thomas Brown (1605-82).

Mixing changes

Changes occur when we mix two or more substances together. This may not happen all the time. Mixing water and sand will not produce a new substance, but mixing water, sand and cement produces a new substance called mortar.

If you mix sugar with water, you would notice that the sugar crystals disappear after a while and the water becomes sweet. When concentrated sulphuric acid is mixed with sugar in a beaker, a black substance is formed.



concentrated sulphuric acid mixed with sugar

Could you identify the change that is going to occur to the people in the picture opposite?

Clue ... A very useful and not very useful change occurs.

1 Which of the following statements about two different substances is true?

- **a.** A mixture is always formed.
- **b.** A new substance is always formed.
- **c.** A mixture and a new substance are formed.
- **d.** A mixture or new substance may be formed.

2 Which of the following statements about two different substances is true?

- **a.** a coil of wire wound round an iron nail.
- **b.** the tungsten filament of a bulb?

Ideas

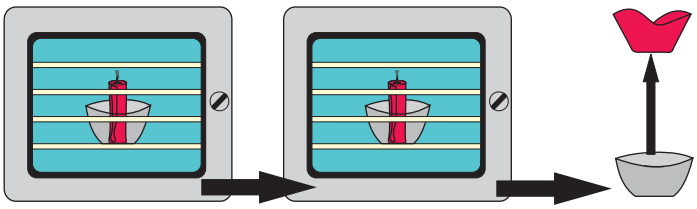
Passing an electric current through a substance may produce a temporary change or a parmanent change.

Mixing a substances may produce a mixture or a new substance.

13d

Physical or chemical

If you heat a candle either by putting in an oven or using the stove, it melts. The wax has changed state, but it is still the same substance. When it cools down, you get the solid wax back. **Physical changes** like this are reversible.

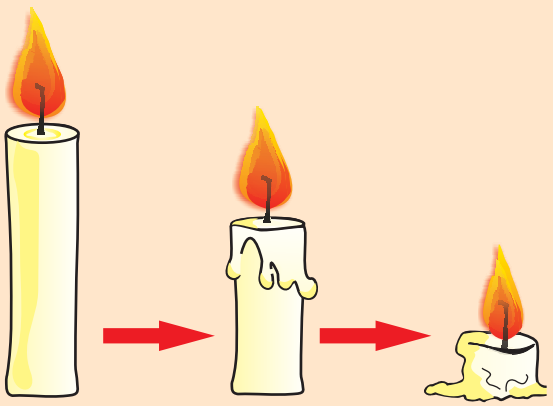


If you heat a candle, the wax just melts, so you can get it back.

If you light a candle, the wax melts at first, but then it seems to vanish. Where has the wax gone? It cannot be a physical change, as you cannot get the wax back. So what is happening?

The wax burns

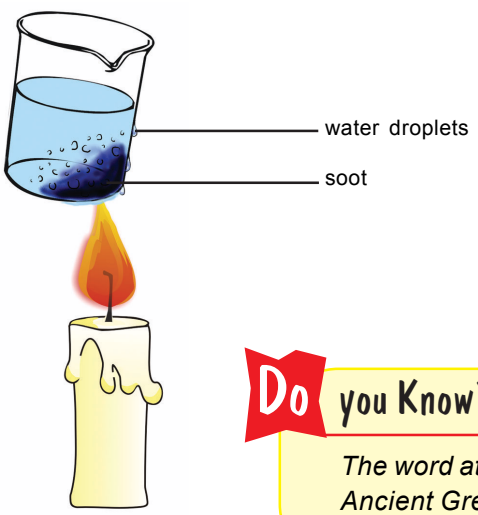
When you light a candle, the wax burns. The heat from the flame makes the wax change into something different. This type of change is called a chemical change. Chemical changes are not easily reversible.



If you light a candle, the wax is lost, and you cannot get it back.

New substances

If you hold a beaker of water over a candle flame, candle burns, and you will see two new substances forming. The beaker gets covered in black soot. This is a form of carbon, like coal. You also see drops of water condensing on the cold glass. You might be surprised to find that water is formed when a candle burns!



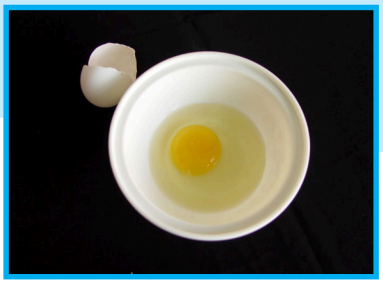
A third substance is formed which you cannot see. It is the gas carbon dioxide.

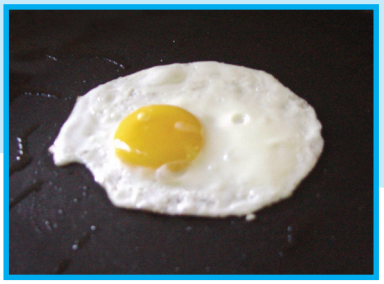
Do you Know?

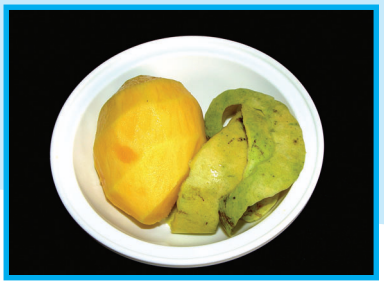
The word atom is derived from the Ancient Greek word atomos, *meaning 'indivisible'.*

A chemical change

How do you spot a chemical change? It is not always easy! A change is probably a chemical change if: a completely new substance has formed, or the change cannot be reversed.







Give off energy

Chemical changes often give out energy such as light, heat ot even electricity.

A car moves only if it has energy. This energy comes from burning petrol.

There are several forms (or kinds) of energy. Electrical, chemical, heat, sound and light are some forms of energy we come across.

Fire works give off plenty of heat and light.

1 Are these physical or chemical changes? Give reasons for your answers.

a. Burning a match
b. wood decaying
c. Ice cube turn into water
d. If you spill water on your page, the ink runs.
e. Frying an egg.

Ideas

- *Changes of state are physical changes.*
- *Physical changes are reversible.*
- *chemical changes are not reversible.*
- *Burning is an example of a chemical change.*

Alessandro Volta

Born in 1745

Alessandro Volta was an Italian. He was born in 1745. At this time, electricity was a mystery. Most people thought it was a form of magic and they gave themselves static shocks to cure illness. Alessandro Volta invented a machine which could give quite a big shock.

Alessandro Volta got a job as a university professor. He became interested in the discovery that two metals could make a dead frog's leg twitch. Another scientist called Galvani thought this twitching was caused by electricity produced by the leg. Alessandro Volta disagreed. He used experiments to show that the twitching only occurred when the frog's leg was placed between the two metals, and the two metals were connected together.

In 1799 he built a big pile of copper and zinc discs which gave out electricity. This was the first chemical battery. Volta continued to improve his invention. He made batteries that gave out a high current. He made batteries that other scientists could learn from.

Napolean was so impressed that he made Alessandro Volta a Count. Count Volta's name lives on in the electrical unit called the volt.

(J. Boyd & W.WhiteLaw 1989 John Murray)

14 Science and Technology

What you will learn

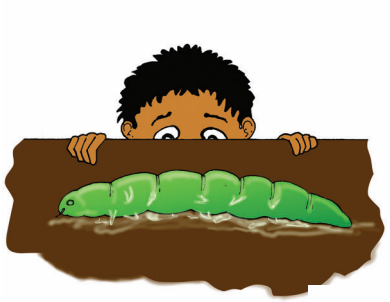
Science and Technology

Medicine

Telecommunications

The first vehicles

Science and technology



If it's green and slimy,
..... It's biology.
If you stub your foot against it,
..... It's geology.
If it stinks,
..... It's chemistry.
If it doesn't work,
..... It's physics.

Before you go any further with this chapter, write a short paragraph starting with 'Science is.....'. Try to describe what you think characterises science, and what makes it different from other human activities.

Science is concerned with understanding the way things are and why they behave as they do.

What is technology?
Technology is concerned with finding practical solutions to problems, especially creating something which meets a human need.

Each photo shows a technological solutions to a common everyday problem.

In each case describe the object in the illustration and the problem that it solves.

Robot Surgoens

Read the following cutting from *The Guardian* (15th August 1989).

Scalpel ... forceps.... Software...as robot surgeon starts operating

Aileen Ballantyne and Peter Large

SURGERY requiring more precision than the human hand can achieve could be performed by robots within the next 10 to 20 years as a result of a Government –funded research project announced yesterday.

The robot would operate the knife and handle probes under the surgeon's instructions for operations such as correcting short-sightedness, the detection and removal of cancerous tumours and prostate gland and joint surgery.

Professor Barrie Jay said it was 'not science fiction' to suggest that robots could carry out surgery to correct short-sightedness. "Obviously there would have to be an over-ride for the surgeon, but they could be used for operations which require a very accurate series of cuts within the next 20 years". At present, surgery to correct short-sightedness had "many complications".

Mr Peter Jenkins said the robot's main use would be for movements which could not be achieved by a human hand.

Dr John Dawson was amazed at the thought of a robot-controlled knife or laser operating in the abdomen, where there were wide differences in fatty layers and blood-vessel distribution.

The surgeon's skills in such cases went far beyond the craftsman aspects. Robot help for the surgeon might be useful in more uniform areas like the eye but, even there, basic computer science – let alone artificial intelligence – still could not guarantee reliable software running on reliably designed machines.

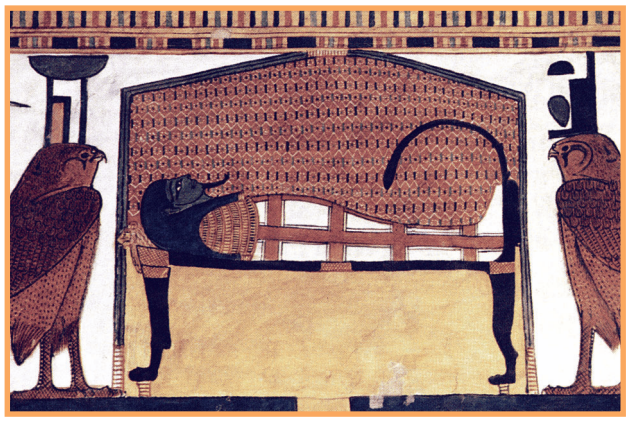
Source :The Guardian (15th August 1989)

1. This is a story about new medical technology. What would the new technology operate?
2. What does professor Barrie Jay think this new technology could be used for?
3. What does Mr Peter Jenkins think this new technology could be used for?
4. Does Dr John Dawson think the idea is a good or bad one?
5. Do you think the idea is a good or bad one? Give your reasons.

Ideas

- *Science is understanding the way things are and thier behaviour.*
- *Technology tries to find practical solutions to problems.*

Medicine



What makes you ill?

In the early days people had some very strange explanations for feeling ill.

Different people from different parts of the world used many remedies for diseases.
For example Egyptians thought diseases were caused by their many gods.
Treatments always included sacrifices to the gods.

What did our ancestors thought of diseases?

During the last 300 years people have discovered bacteria and viruses. They have discovered how these organisms causes disease.

Vaccination against some diseases was invented. Thanks to these pioneers, we have vaccines today to protect or immunize us against many infectious diseases.

Surgical Operations

Operations were made far less painful by the invention of anaesthetics.

Surgery (earlier)

Surgery (modern)

Inhaling aneasthetics

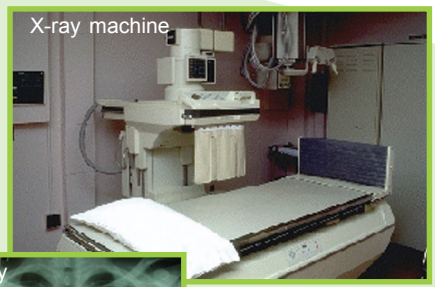
Drugs against Disease

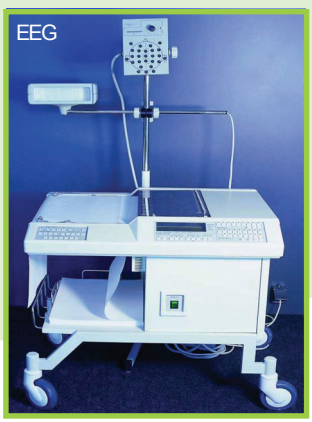
A whole range of powerful microbe-killing drugs were invented.

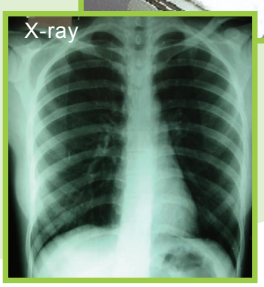
Recent medical drugs include those designed to prevent a patient rejecting a new heart or other transplanted organ. Yet more new drugs have been invented to control mental illness, allowing patients to live normal lives.

Scanning Machine

X- rays, which penetrate human body were discovered. More recently body scanners have been invented which include ultra sound machines, which are used to examine babies still inside their mother's wombs. Other scanners are ECG machine which records details of heartbeat, and the EEG machine, which records electrical waves given out by the brain.







Ideas

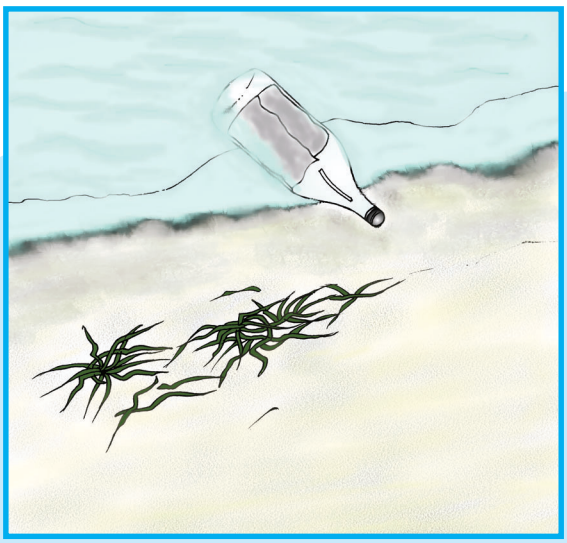
- *In the early days people were not aware of how they get ill.*
- *Now medical technology has improved so much that they can find out the cause and give treatment well.*

1 Find out information of the advancement in technology in the following area of medicine:

a. Thalassaemia

b. Transplants

Telecommunications



In the early days we had to depend on letters carried by land and sea to communicate with one another at considerable distances.

A letter to reach from one person to another could take weeks or months.

What did our ancestors do to communicate?

By the mid-nineteenth century, new discoveries and inventions in electricity made this faster communication possible.

Telegraph

This is an instrument for sending electrical messages from one place to another through a wire cable. But these messages were sent to a distance of about 39 miles.

However, later messages were able to be sent right around the world instantly. Messages typed out at one end were almost immediately printed out automatically at the other end.

Telephone

A telegraph message along a cable needs to be in code, but a telephone allows people to talk to each other directly.
The video telephone is really a new invention, the person making and receiving a call can see, as well as hear, one another.
Mobile phones have become so common that it is a basic necessity now.

Telemetry

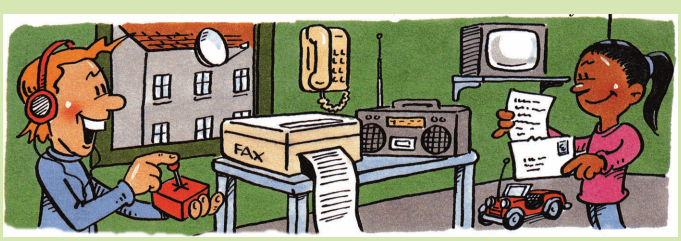
Scientists were sending balloons high up into the Earth's atmosphere to record the weather. These sent back their scientific data automatically in the form of radio messages.

Other objects in the sky, such as aircraft, could be remote controlled by radio signals. This is called telemetry. Examples of telemetry today include the control and relay of automatic messages from space satellites and probes.

Computers

The use of computers in telecommunication was a huge breakthrough. These days it is common to speak about close friends from the internet, whom we have never actually met in the flesh.

1 Examine the cartoon of telecommunication devices below. List all the devices you can spot and write down a short description for each.



Ideas

Telecommunication has improved to an extent that we are able to talk to people around the world instantly.

The first vehicles

With the invention of wheel, method of transport has changed dramatically. Personal cars, large trucks, high speed trains all run on wheels were invented.

The earliest methods of vehicle was wheel barrow. The next improvement of vehicles was four wheeled war chariots.

To travel by river or across lakes or sea people built rafts or canoes. Ancient rafts sometimes made sea journeys of many thousand of miles.

Bigger and better ships came into existence afterwards. Maps and compasses to show the exact direction in which the ship was travelling were invented.

More recently radars and global positioning systems (GPS) were invented.

large truck


Wheel barrow

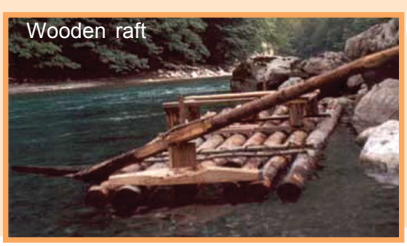

Canoe


Ship


Riyalu dhoani


Air taxi


Passenger line


Wooden raft

What were the methods of transport that our ancestors relied?

Look at the pictures.
Can you put these in order from earliest to latest ones.

What are the disadvantages of these?

Hobby horse

First ancestor of the bicycle was the 'hobby horse', a crude two-wheeled vehicle. Later pedal driven bicycle was invented. Inflatable rubber tires were invented later.

Motor cycle

A year later, a gas-engined motor bicycle was built.

Aircraft

Balloons

People first used to fly through the air using a hot air balloon. Later balloon filled with hydrogen gas were more often used. Hydrogen gas is much lighter than air, but it is dangerously flammable.
So a safer gas, helium was used. Since hydrogen was dangerous and helium expensive, giant airships soon became a thing of the past.

Airplanes

The earliest airplanes were model gliders. The real beginnings of modern airplane started when a gas-engined biplane started flying. It flew to a distance of 850ft. Gas-engined airplanes rapidly increased in size, speed, and safety.
The fastest and biggest airplanes today are the jet airplanes.

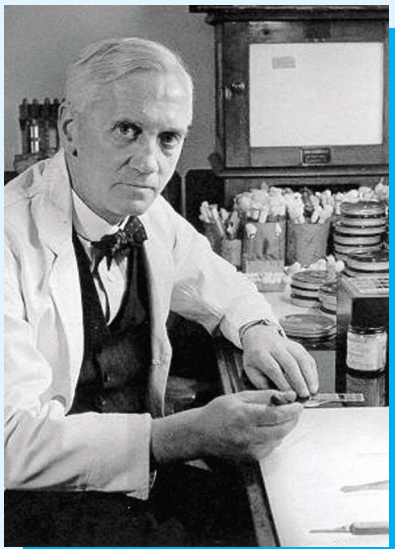
1 Students create a presentation comparing past and present technology to explain how science has benefitted different modes of transport.

Ideas

The vehicles that we used to travel by sea , air and land has improved to a very great extent.

Sir Alexander Fleming

Born in 1867



Sir Alexander Fleming was born near Darvel, Scotland. He got educated at Saint Mary's Hospital Medical School of the University of London. He is a British bacteriologist and a Nobel laureate. He is best known for his discovery of PENICILLIN. He served as professor of bacteriology at St. Mary's Hospital Medical School from 1928 to 1948, when he became professor emeritus.

Fleming conducted outstanding research in bacteriology, chemotherapy, and immunology. In 1922 he discovered lysozyme, an antiseptic found in tears, body secretions, albumen, and certain fish plants. His discovery of penicillin came about accidentally in 1928 in the course of research on influenza. His observation that the mold contaminating one of his culture plates had destroyed the bacteria laid the basis for the development of penicillin therapy.

Fleming was knighted in 1944. In 1945 he shared the Nobel Prize in physiology or medicine with the British scientists Howard Walter Florey and Ernst Boris Chain for their contributions to the development of penicillin.

(J. Boyd & W.WhiteLaw 1989 John Murray)

Glossary

A

Absorb: the process of taking in.
Accelerate: increasing the speed.
AIDS: Acquired Immune Deficiency Syndrome, a disease caused by the HIV virus.
Atmosphere: the layer of air surrounding the earth.
Atom: the smallest particle of a chemical element.

C

Cells: Basic unit of living matter.
Chariot: a two wheeled horse-drawn carriage used in ancient times.
Chromatography: a method used to separate and identify the different components in dyes or inks.
Combination: the chemical reaction in which two or more substances combine to form a new substance.
Compost: a mixture of decaying substances used as a fertilizer.
Condensation: the process in which a gas changes into a liquid.
Condense: the process of changing a gas into a liquid.
Conductivity: a process of allowing heat or electricity to flow through easily.
Conserve: to save something for future use.

D

Decanting: it is a process of pouring a liquid from one container to the other without disturbing the sediment.
Decelerate: decreasing the speed.
Decomposition: the chemical reaction in which a substance is broken down into two or more simpler substances.
Dense: massed closely together.
Distillation: a method of obtaining a liquid from a solution by heating the solution until the liquid boils off from the solution.
Ductile: can be drawn into wires.

E

Elasticity: the ability of a material to return to its original shape and size after being bent, stretched or compressed.
Endangered: an organism is set to be so when it is danger of becoming extinct.
Evaporation: the process in which a liquid changes into a gas below its boiling point.
Element: the simplest kind of matter which cannot be split into two or more simpler substances by chemical reactions.
Expand: the process of increasing volume.

F

Filtrate: the clear liquid that gets filtered.
Force: something which changes the size, shape or speed of an object e.g. a push or a pull
Forcemeter: an instrument used for measuring force.
Freezing point: the temperature at which a liquid freezes.
Friction: a force which slows down or stops motion.

G

Global Positioning System (GPS): A system for identifying locations in land, air or sea.

H

Hardness: the ability of material to withstand scratch and wear.
HIV: Human immunodeficiency virus.

I

Immunize: the ability of an animal or plant to resist infection.
Impurities: substances that make another sub stance impure by being present in it.
Infect: to affect or contaminate with a disease
Insoluble: When a substance does not dissolve.
Insulator: a material that does not allow heat or electricity to flow through easily.
Invertebrates: animals without a backbone.

M

Malleable: can be made into sheets.

Melting point: the temperature at which a solid melts.

Microscope: a tool used to observe very small things that cannot be seen by the naked eye.

Molecule: the smallest unit (usually consisting of a group of atoms) into which a substance can be divided while still retaining the substance's chemical qualities.

Multi-cellular organism: living things made of many cells.

O

Organism: The scientific name used for a living thing.

P

Photosynthesis: the process by which green plants make food in the presence of light and chlorophyll, using water and carbon dioxide as raw materials

Pollutants: a substance causing pollution.

Pollute: to make dirty or impure by adding waste or harmful substances.

Pressure: defined as force per unit area.

Probe (space): an unmanned exploratory space-craft transmitting information about its environment.

Protected: keep an oraganism safe and from harm.

R

Reflection: When light rays hit a surface they bounce back.

Radar: a system for detecting the presence, position or movement of objects by sending out short radio waves which they reflect.

Raft: a flat floating structure made of wood or other materials, used especially as a substitute for a boat.

S

Satellite: (artificial), a human made object intended to move around the Earth, moon, etc. for some purpose.

Saturated: when a solute cannot be dissolved any further in a solution.

Science: the systematic study of nature and how it affects us and the environment.

Sediment: very fine particles of solid matter suspended in a liquid or settling to the bottom.

Shadows: the image that is formed when light rays are blocked.

Solubility: the maximum quantity of a substance which can dissolve in a given quantity of a solvent at a particular temperature.

Solute: the substance that dissolves in a solution.

Solution: a mixture which is made up of solute (s) dissolving in a solvent.

Solvent: the substance that dissolves the solute in a solution.

Speed: define as the distance traveled per unit time.

Suspension: a substance consisting of a fluid in which particles are suspended.

T

Technology: the application of scientific knowledge for the benefit of humankind.

Transplant: to transfer living tissue or an organ from one part of the body or one person or animal to another.

U

Unicellular organism: livings things made of one cell.

V

Vertebrates: animals with a backbone.

W

Weight: the force of gravity acting on an object.

Bibliography

A.J. Mee 1981 *Science 2000* Heinemann Educational Books.

B. George *etal* 1995 *Integrated Science 2* Oxford University Press.

B. Joe and W. Walter 1990 *Understand Science series* John Murray Publishers.

B. Paul *etal* 1989 *Science Watch 2* Cambridge University Press.

C. Gerry *etal* 1982 *Reading About Science* Heinemann Educational Books.

F. Alan and G. Ian 1985 *Starting Science* Oxford University Press.

F. Ann etal 1996 Science Now series Heinemann Educational Publishers.

G. Richard *etal* 1991 *Active Science* Collins Educational.

H. Tho Lai *etal* 1998 *Lower Secondary Science 1* Pan Pacific Publications.

J. J. Wellington 1984 *Beginning Science – Physics* Oxford University Press.

O. Ray 1991 *Science Years 7-9* Stanley Thornes Publishers Ltd.

P. Andrew *etal* 1991 *Science Companions* Stanley Thornes Publishers Ltd.

W. Jay 1987 *Science in Process* Heinemann Educational Books Ltd.

http://www.ummah.net/history/scholars/

http://www.cyberistan.org/islamic/