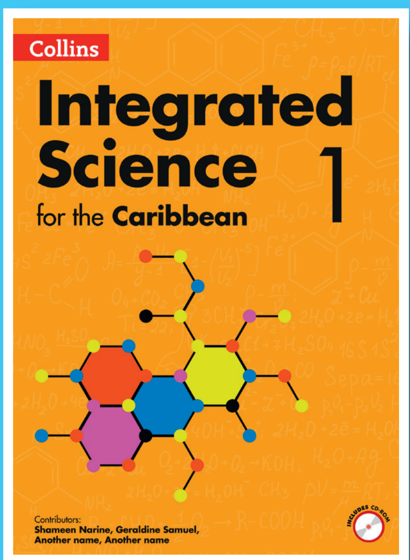
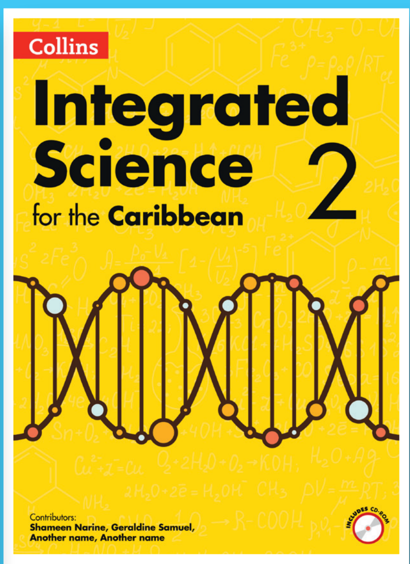
Collins

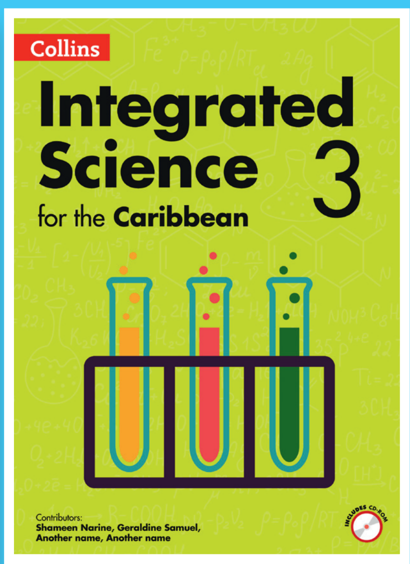
Integrated Science

for the Caribbean

Sample Units





Covers subject to change

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Integrated Science

for the **Caribbean**

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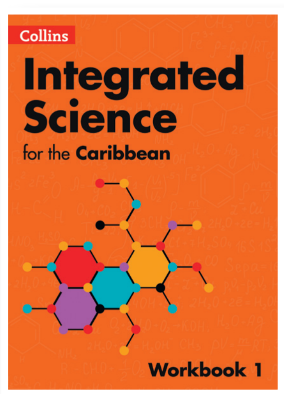

Workbooks

Workbooks are available to accompany each of the Student Books

Sample Units

Features

Learning objectives tell students what they will be learning about in this section

Diagrams present complex concepts in a clear, manageable way

Did you know...? contains fascinating extra facts and information

Form 2

Thermal energy

We are learning how to:

- distinguish between temperature and heat

Heat and temperature

The terms **heat** and **temperature** are connected but they have different meanings and should not be confused.

Heat is a form of energy and, like all energy, is measured in **joules**. When we heat an object we are giving it energy and when we cool an object we are taking energy away.

Temperature is a measure of how hot or how cold a body is. Temperature is measured in degrees **centigrade**, which has the symbol °C. It is also sometimes called the Celsius scale.

Hot and cold

You should already know from your everyday experience that objects lose and gain heat energy. Let's look at this more closely.

Activity 1.5.2

Here is what you need

- Beaker × 2
- Warm water
- Cold water

Here is what you should do

1. At the start of the lesson, half fill a beaker with warm water.
2. Place your finger in the water and confirm that it is warm.
3. Half fill a second beaker with cold water.
4. Place your finger in the water and confirm that it is cold.
5. Leave the beakers of water on the table for the whole of the lesson.
6. Near the end of the lesson place your finger in each beaker of water.
7. What has happened to the water in the two beakers?
8. Is it still possible to tell which beaker contained warm water and which beaker contained cold water?

FIG 2.7.1 Objects lose and gain heat energy

4 Lower Secondary Integrated Sciences: Thermal energy

2.7

When a warm object is left in a room, it loses heat energy until its temperature is the same as the room. Conversely when a cold object is left in a room, it gains heat energy until its temperature is the same as the room.

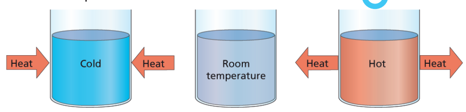

FIG 2.7.2 Temperature changes when heat is gained or lost

Heat is energy that passes between bodies which are at different temperatures.

The Law of Conservation of Energy states that energy cannot be created nor destroyed. It follows therefore that when we heat or cool an object the **internal energy** of its particles must increase or decrease respectively.

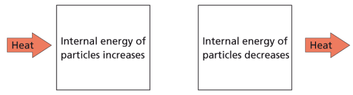

FIG 2.7.3 Effects of heating and cooling on internal energy

A change in temperature is a measure of a change in the internal energy of an object.

The transfer of heat between hot and cold objects is impossible to prevent but there are ways of slowing it down. You will learn more about this later in this unit.

Check your understanding

Use the words 'heat' or 'temperature' to complete each of the following sentences.

1. When a body receives .... energy its .... increases.
2. .... is a form of energy while .... is a measure of how hot or cold a body is.
3. When an object is cooled its .... falls because it loses ....
4. The .... of a pond increases during the day because it receives .... from the Sun.

Did you know...?

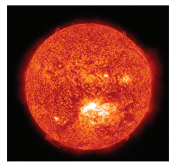

FIG 2.7.4 The Sun

The temperature in the centre of the Sun is thought to be around 15 000 000 °C.

Key terms

- **heat**
- **temperature**
- **joule**
- **centigrade**
- **internal energy**

5

Each spread has interesting science **activities** to help students explore the subject

Colour photographs help to bring the scientific concepts to life

Check your understanding contains questions to check students' understanding of each section

Key vocabulary contains the most important new science words in this section. Students can look up their meanings in the Glossary.

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Form 1

Classifying life according to cellular structure

We are learning how to:

- compare plant and animal cells according to their structure and function.

Preparing a specimen of animal cells

Although there are many different kinds of animal cells, a convenient source on cells is the lining of the cheek inside the mouth.

In order to see detail more clearly, specimens are sometimes stained with a dye. In the case of **cheek cells**, the dye **methylene blue** is used. This makes the cells look blue when examined.

To apply a dye, the specimen should be placed on a microscope in a drop of water. A drop or two of dye is then added. The specimen should be left for a few minutes to allow the dye time to pass into the cells. After this the excess water can be removed with a tissue.

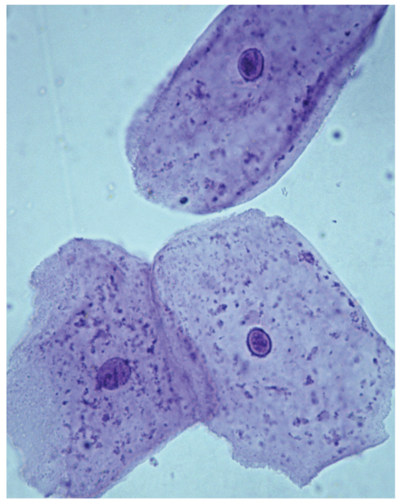

FIG 1.5.11 Stained cheek cells

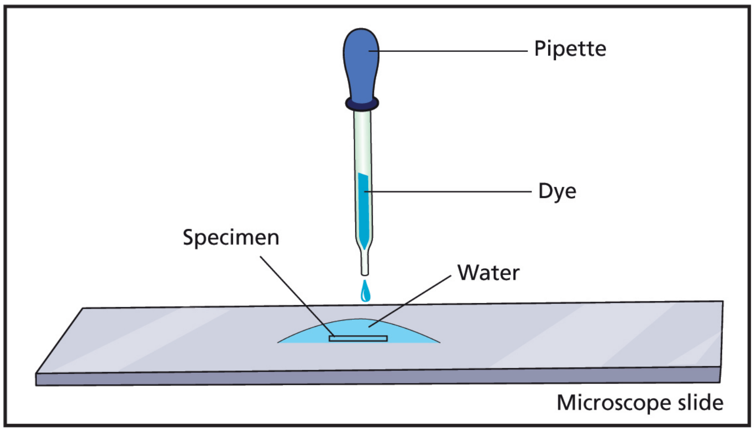

FIG 1.5.12 Applying stain to a specimen

Activity 1.5.2

Preparing and observing cheek cells

Here is what you need

- microscope
- microscope slide
- cover slip
- methylene blue dye
- tissue paper
- wooden spill
- distilled water

Here is what you should do:

1. It is not necessary to cut the cheek in order to obtain a sample of animal cells. Cells are continually being worn off the surface of the body including the inside of the cheek. Cheek cells are obtained by gently scraping the inside of the cheek with a suitable blunt object such as the flat end of a tooth pick or a wooden spill.

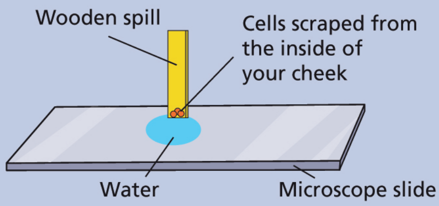

FIG 1.5.13

2. Place some cheek cells from inside your mouth and place them in the drop of water on the slide.
3. Place a single drop of methylene blue solution on the specimen and leave it for about one minute.
4. After this, carefully lower a cover slip onto the specimen. You will probably find that the cover slip sits on top of the water. Before the specimen can be observed the excess water and dye must be removed.

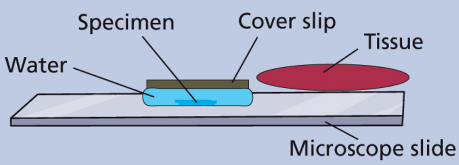

FIG 1.5.14

5. Place a tissue next to the cover slip so that it is just touching the water.
6. Start by observing your cheek cells under low power. It is much easier to see the arrangement of cells.
7. Move the slide so that the part you want to focus on is in the centre of the image. Alter the combination of lens to see the image under higher power. Draw your cheek cells.

Check your understanding

1. Why is it important that the mouth is clean i.e. contains no particles of food, before obtaining cheek cells?
2. Suggest why it is not a good idea to scrap off cheek cells using a finger nail.
3. Why is it essential that the dye used to colour a specimen does not come into contact with clothing?

Did you know...?

Cells are sometimes stained with combinations of different dyes.

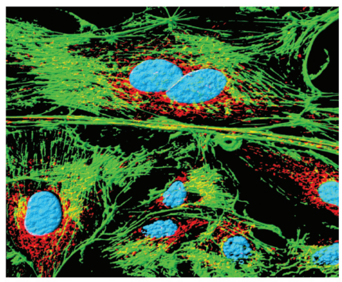

FIG 1.5.15 Different parts of a cell show up different colours

Each dye is absorbed by a different part of the cell so that the parts are easier to see.

Key terms

cheek cell

methylene blue

wicking

Classifying life according to cellular structure

We are learning how to:

- compare plant and animal cells according to their structure and function.

Structure of an animal cell

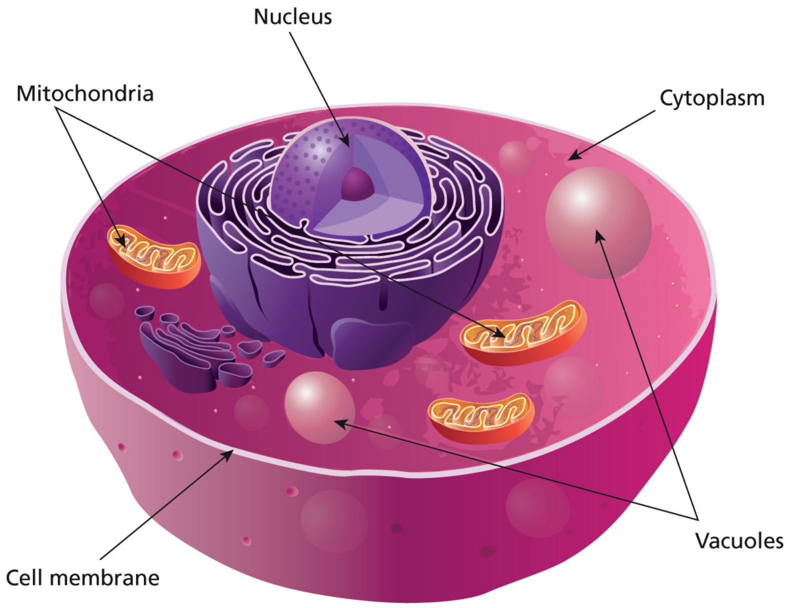

FIG 1.5.16 Structure of an animal cell

Fig 1.5.16 shows the structure of a typical animal cell. The cell has three main parts.

1. The **nucleus** is a small dark structure inside the cell. It contains structures called **chromosomes**.
2. The **cytoplasm** is a jelly substance that fills the cell. It contains a number of important structures:
   - Mitochondria (singular mitochondrion)
   - Glycogen grains
   - Small **vacuoles**
3. The **cell membrane** is a thin layer which surrounds the cell.

Nucleus

The nucleus controls and coordinates all of the processes, such as respiration, that take place within the cell. If you imagine a cell to be like a computer, then the nucleus would be the central processor.

Did you know...?

The first cells were observed by Robert Hooke in 1665 using a crude microscope of low magnification. One observation was from very thin slices of cork. He saw many tiny pores that we now know are filled with air. He didn't know what they were but called them cells from the Latin word cella, which meant a small room like the ones where monks lived.

1.5

One important structure found in the nucleus is chromosomes. They look like shoe laces when viewed under a very powerful microscope.

The chromosomes are important because they contain all of the information the cell needs to function and to replicate itself. It is called genetic information.

Cytoplasm

The cytoplasm is the part of the cell where many complex chemical reactions take place. It has a number of important components including the following:

- **Mitochondria**
  These are sometimes the described as the cell's power plant because they provide the cell with energy. In the human body some cells have only one mitochondrion while others have several hundred.
- **Glycogen grains**
  All cells need glucose to carry out cell respiration. Glucose is stored inside cells in the form of another chemical called glycogen.
- **Small vacuoles**
  Small vacuoles are often found in animal cells. They are bubbles filled with water containing dissolved substances.

Cell membrane

The cell membrane surrounds the cell. It has an important function in controlling the movement of materials into and out of the cell. For example, for respiration to take place, glucose and oxygen must pass it the cell. The waste products of this process, carbon dioxide and water, must then pass out of the cell.

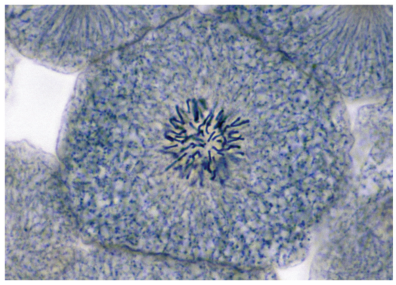

FIG 1.5.17 Chromosomes are found in the nucleus of a cell

Check your understanding

1. Fig 1.5.18 represents an animal cell.

a) What are the parts labelled X, Y and Z?

b) Which of these parts:

i) contains **mitochondria;**

ii) controls the activity of the cell;

iii) controls the movement of substances into and out of the cell?

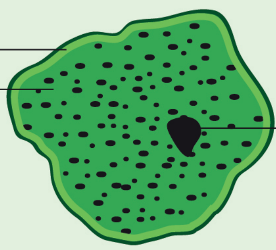

FIG 1.5.18

Key terms

nucleus
cytoplasm
cell membrane
chromosomes
mitochondria
glycogen grains
vacuoles

7

Form 2

Thermal energy

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Hot and cold

You should already know from your everyday experience that objects lose and gain heat energy. Let's look at this more closely.

FIG 2.7.1 Objects lose and gain heat energy

Activity 1.5.2

Here is what you need

- Beaker × 2
- Warm water
- Cold water

Here is what you should do

1. At the start of the lesson, half fill a beaker with warm water.
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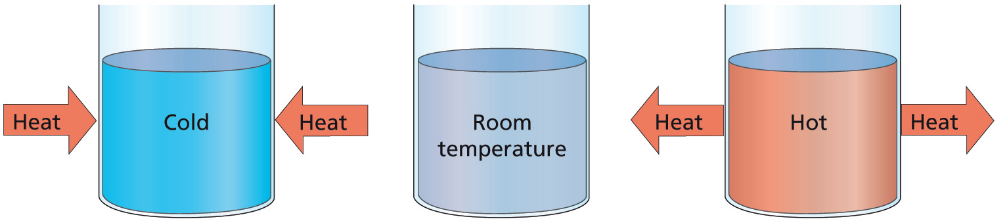

FIG 2.7.2 Temperature changes when heat is gained or lost

Heat is energy that passes between bodies which are at different temperatures.

The Law of Conservation of Energy states that energy cannot be created nor destroyed. It follows therefore that when we heat or cool an object the **internal energy** of its particles must increase or decrease respectively.

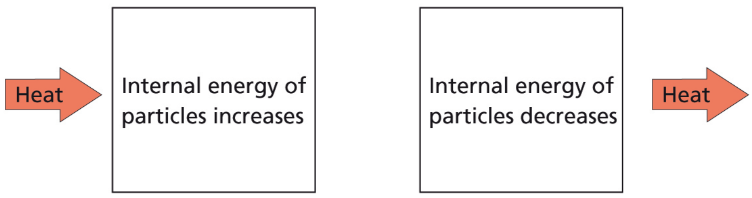

FIG 2.7.3 Effects of heating and cooling on internal energy

A change in temperature is a measure of a change in the internal energy of an object.

The transfer of heat between hot and cold objects is impossible to prevent but there are ways of slowing it down. You will learn more about this later in this unit.

Check your understanding

Use the words 'heat' or 'temperature' to complete each of the following sentences.

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2. .... is a form of energy while .... is a measure of how hot or cold a body is.
3. When an object is cooled its .... falls because it loses ....
4. The .... of a pond increases during the day because it receives .... from the Sun.

Did you know...?

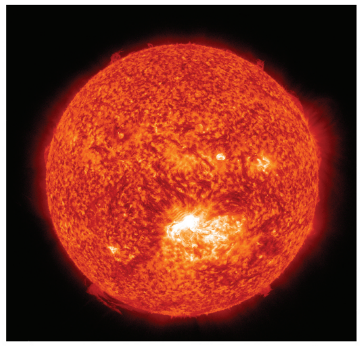


FIG 2.7.4 The Sun

The temperature in the centre of the Sun is thought to be around 15 000 000 °C.

Key terms

heat

temperature

joule

centigrade

internal energy

Thermal energy

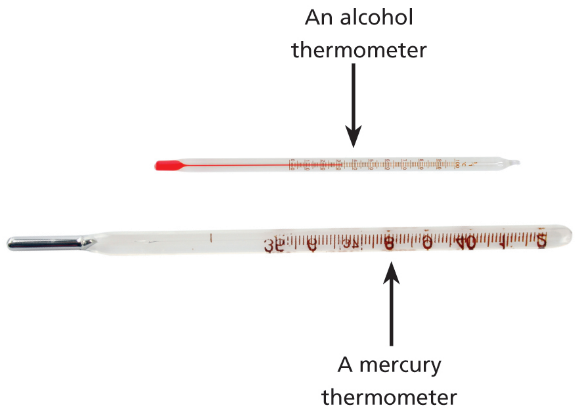
We are learning how to:

- distinguish between temperature and heat

Measuring temperature

Thermometers

We measure temperature using a **thermometer**. The thermometers used in the laboratory are described as **liquid-in-glass** thermometers. They consist of a length of capillary tube with a bulb at one end. Inside the tube is either alcohol (ethanol) or mercury. Pure alcohol is colourless so a red dye is often added to make the level of liquid easier to see.



When liquid is contained in a tube a meniscus forms at the surface. The **meniscus** formed by alcohol is lower at the centre than it is at the sides while the meniscus formed by mercury is higher at the centre.

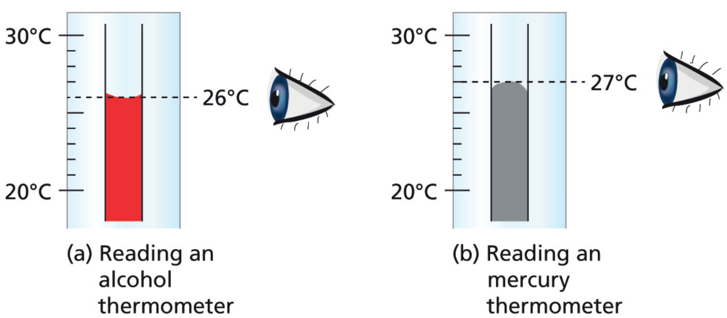


FIG 2.7.6 Reading thermometers accurately

In order to read any thermometer accurately, your eye must be level with the meniscus. On an alcohol thermometer the reading is taken from the bottom of the meniscus while on a mercury thermometer the reading is taken from the top.

How to do it

1. The boiling point of ethanol is 78 °C. What is this expressed in **kelvin**?
2. The melting point of mercury is 234 K. What is this expressed in degrees centigrade?

Solution

1. To convert from centigrade to kelvin add 273: 78 + 273 = 351 K.
2. To convert from kelvin to centigrade subtract 273: 234 – 273 = –39 °C.

Key terms

thermometer

liquid-in-glass

meniscus

centigrade

kelvin

Temperature scales

Temperature is measured in degrees **centigrade**, (°C). This is also sometimes called the Celsius scale because a similar scale was devised by the Swedish astronomer Anders Celsius. On the centigrade scale the melting point of pure ice is taken to be 0 °C and the boiling point of pure water is taken to be 100 °C.

Although centigrade is widely used in science it has one drawback. The melting point and boiling point of some substances are below 0 °C and therefore must be written as negative values. For example, the melting point of ethanol is –114 °C and the boiling point of chlorine is –34 °C.

In order to avoid this problem a new scale was devised by the physicist Lord Kelvin. This scale starts at the lowest theoretical temperature it was possible to achieve, which is called absolute zero.

This was calculated to be –273.16 °C but for practical purposes, the start of the Kelvin scale, 0 K, is taken to be –273 °C. Notice that the unit is the kelvin and not the degree kelvin, and it is written as K and not °K.

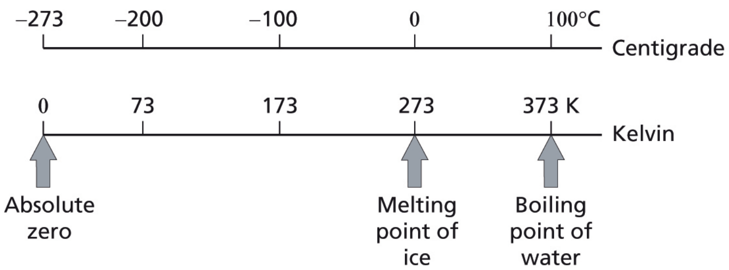


FIG 2.7.7 Centigrade and kelvin scales

Converting between centigrade and kelvin is simply a matter of adding or subtracting 273.

degrees centigrade + 273 = kelvin
kelvin – 273 = degrees centigrade

Did you know...?

Can you guess what the device shown in Fig 2.7.9 is used for without reading the caption?

FIG 2.7.9 A Galilean thermometer

This is a thermometer devised by a group of Italian scientists around 1600. It is named in honour of the famous Italian scientist Galileo Galilei. It works because changes in temperature cause changes to the density of the liquid in the tube.

Check your understanding

1. What is the reading on each of the following thermometers to the nearest half of a degree centigrade?

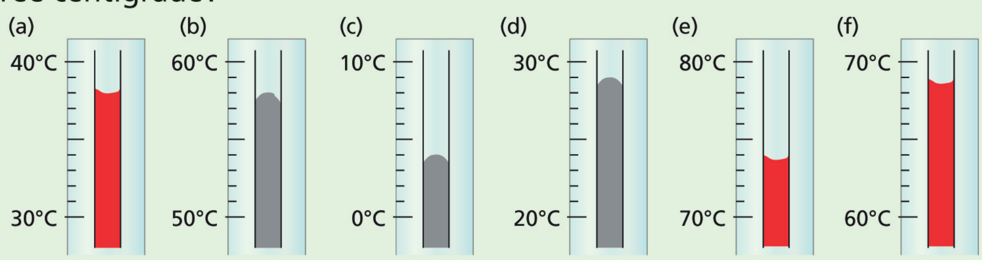


FIG 2.7.8

Magnetism

We are learning how to:

- demonstrate the effects of magnetic forces

Magnets

Over a thousand years ago, people discovered that a type of rock called lodestone had a very unusual property.

Lodestone attracts objects made of iron, like pins and nails. Lodestone is an oxide of iron. It is also called magnetite. Materials like magnetite that keep their magnetism for a long time are called permanent magnets.

Metals that have permanent magnetism are iron, mild steel, cobalt and nickel. Modern magnets are often made of special **alloys** that contain these metals. Alloys of the metal neodymium are used to make very powerful permanent magnets.

FIG 3.5.1 Lodestone

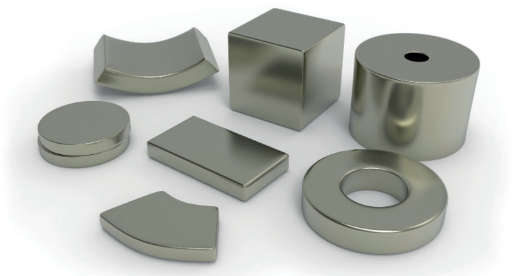


FIG 3.5.2 Neodymium magnets

Magnetic materials

Materials like iron and steel which are attracted to a magnet are magnetic while materials like brass, copper and aluminium, which are not attracted to a magnet, are non-magnetic.

Activity 3.5.1

Here is what you need

- Magnet
- Pieces of metals: aluminium, copper, iron, lead, steel

Here is what you should do

1. Hold the magnet close to each metal and see if the metal is attracted to it.
2. Make a list of metals that are attracted by a magnet and metals which are not.

3.5

Law of magnetic poles

Bar magnets are commonly used in the laboratory. A horseshoe magnet is simply a bar magnet that has been bent into the shape of a horseshoe.

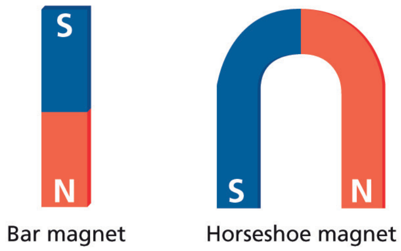


FIG 3.5.3 Bar magnet and horseshoe magnet

A magnet has two poles: a north pole and a south pole. These poles are usually labelled 'N' and 'S' and sometimes coloured differently so they can be easily identified.

Activity 3.5.1

Here is what you need

- Magnets × 2
- Cotton
- Pencil
- Heavy book

Here is what you should do

1. Place a pencil overhanging the edge of the table and hold it in place with a heavy book.
2. Suspend a magnet below the pencil in a loop of cotton
3. Bring the N pole of a second magnet towards the N pole of the suspended magnet and observe what happens.
4. Bring the S pole of a second magnet towards the N pole of the suspended magnet and see what happens.
5. Repeat steps 3 + 4 but bringing the second magnet towards the S pole of the suspended magnet.

When two magnetic poles are brought together:

- if the poles are unlike i.e. N and S or S and N they will attract
- If the poles are like i.e. N and N or S and S they will repel

Check your understanding

1. How can you use a magnet to test if an iron bar is a magnet or not?

Did you know...?

Ceramic or ferrite magnets are made by baking iron oxide and other metal oxides in a ceramic matrix.

FIG 3.5.5 Ceramic magnet

Ceramic magnets can be made in any shape but they are very brittle.

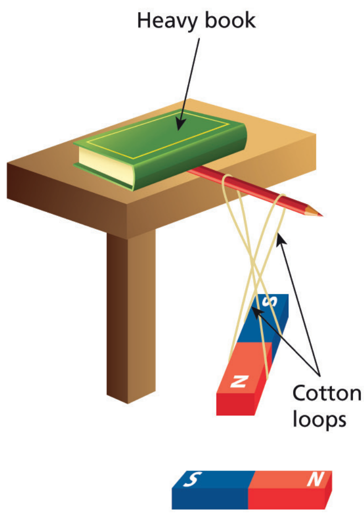


FIG 3.5.4

Key terms

magnet
alloy
magnetic material
non-magnetic material

Form 3

Magnetism

We are learning how to:

- demonstrate the effects of magnetic forces

Magnetic fields

A magnet is surrounded by a magnetic field. This field can be represented by a pattern of field lines.

We can investigate the field around a magnet using a plotting compass. This is a magnetic needle that rotates on a point. The arrow always points north.

FIG 3.5.6 Plotting compass

Activity 1.5.2

Here is what you need

- Bar magnet
- Plotting compass
- Plain paper
- Pencil

Here is what you should do

1. Place a bar magnet at the centre of a piece of plain paper and draw around it.
2. Remove the magnet and mark the N and S poles on the outline.
3. Replace the magnet on the outline.
4. Place a plotting compass at one end of the magnet and mark the direction that the compass points by drawing an arrow in the direction of the compass.

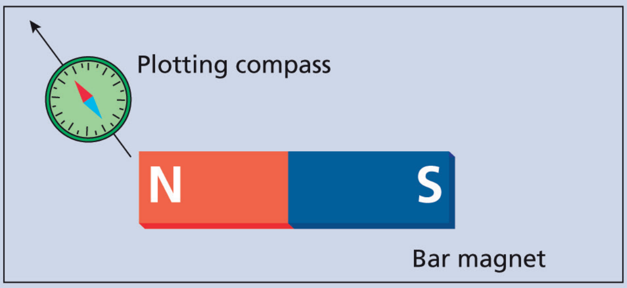


FIG 3.5.7

5. Repeat this method, placing the plotting compass in different positions until you have built up a map of the field lines around the magnet.

3.5

The magnetic field around a magnet can be represented by a set of **magnetic field lines**.

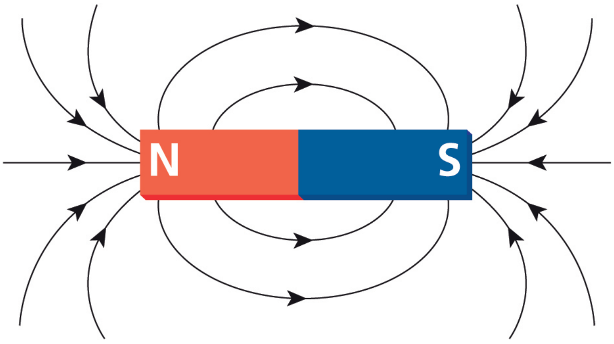


FIG 3.5.8 Field lines around a bar magnet

When drawing magnetic fields you should remember that:

- magnetic field lines are always shown moving away from a north pole and towards a south pole;
- the strength of the magnetic field is shown by the density of field lines;
- the magnetic field is strongest at the poles of a magnet where the field lines are most dense.
- field lines must never cross each other

Did you know...?

The Earth has a magnetic field surrounding it.

The Earth's North Pole is actually magnetic south. This is why a compass needle always points north.

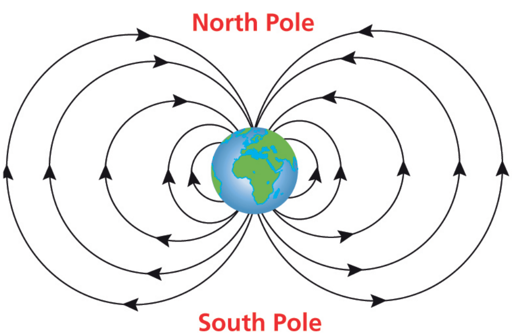


FIG 3.5.10

Check your understanding

1. Copy the horseshoe magnet in Fig 3.5.9 and draw the field between the two poles.

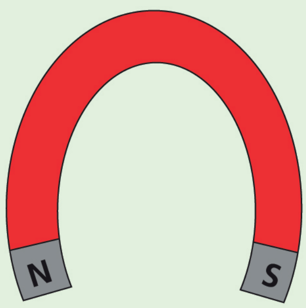


FIG 3.5.9

Key terms

plotting compass

magnetic field lines

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