BREEDING ARENA College

THE BREEDER'S GUIDE

CAMBRIDGE SCIENCE (PHYSICS)

Mr. Elijah Olorunsagba

YEAR 8

Term Sow 2024/2025

SCHEME OF WORK

PHYSICS

Science & Technology **January 6th – April 13th**

WEEK	TOPIC	SUB-TOPICS
1	Light (I)	➢ Introduction ➢ Light rays ➢ What is Light
2	Light (II)	➢ Classifying Non-luminous objects ➢ Shadows
3	Light (III)	➢ Reflecting light ➢ Objects with smooth surfaces ➢ Two types of images
4	Light (IV)	➢ Periscope ➢ Objects with rough surfaces ➢ Speed of light
5	Light (V)	➢ Passing light through transparent materials ➢ Prism ➢ Rainbows
6	Light (VI)	➢ Colors ➢ Detecting light
7	Continuous Assessment and Midterm Test	
8	Magnetism (I)	➢ Introduction ➢ Behaviors of magnets
9	Magnetism (II)	➢ Inside a magnet ➢ The Earth's magnetic field
10	Magnetism (III)	➢ Early discoveries of magnet ➢ The link between magnet and Electricity ➢ Electromagnets
11	Revision	
12	Examination	
13	Vacation	
WEEK	**TOPIC**	**SUB-TOPICS**

1. LIGHT (I)

Objective: By the end of this class, each student should have understood the basic concept of light.

Duration: 80 mins

Week: 1

Entry Behaviour (*How you plan to start your Class*): Breakdown the term 'LIGHT'.

Light is a form of **energy.** It is a form of **electromagnetic radiation**. Objects that emit light are said to be **luminous** while those that do not emit light are said to be **non-luminous**. Non-luminous objects can only be seen if they are reflecting light from a luminous source. The Moon is a non-luminous body — the 'moonlight' it produces is reflected sunlight. Most luminous objects, such as the Sun, stars, fire and candle flames, release light together with a large amount of heat.

Light rays

Light leaves the surface of a luminous object in all directions but if some of the light is made to pass through a hole, it can be seen to travel in straight lines.
For example, when sunlight shines through a small gap in the clouds it forms broad sunbeams with straight edges. The path of the light can be seen because some of it is reflected from dust in the atmosphere.
Similarly, sunlight shining through a gap in the curtains of a dark room produces a beam of light, which can be seen when the light reflects from the dust in the air of the room.
Smaller lines of light, called rays can be made by shining a lamp through slits in a piece of card.

Figure 15.2 Although the Sun radiates light in all directions, the sides of sunbeams seem almost parallel because the Sun is a very distant luminous object.

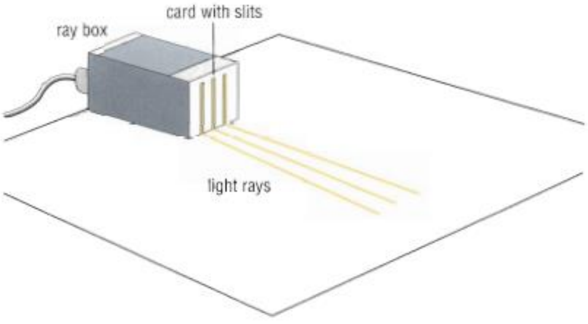


Figure 15.3 Making rays of light

What is light?

Empedocles (about 490-430 BCE) was a Greek philosopher who believed that we see things because our eyes send out rays, which touch objects. Plato (427—347 BCE) built on this idea but believed that objects gave out rays, which the eyes' rays intercepted. Democritus (about 470—380 BCE) believed that objects were made of atoms, some of which passed from the objects through the air to the eye and allowed us to see the objects. Christian Huygens (1629-1695), a Dutch physicist, put toward a wave theory of light in which he claimed that light moved in a similar way to waves of water.

He thought the waves were very small and for most experiments, they did not affect the light rays, which could be considered as travelling in straight lines.

in 1801 Thomas Young (1773-1829), an English physicist, performed an experiment in which he shone a light through narrow, close slits as shown in Figure C.

The result could not be explained if light traveled as particles such as atoms but could be explained by the wave theory. Young believed that the regions where the light was brightest were where the crests of the light waves met together and the regions of darkness were where the troughs of the waves cancelled out the crests (see Figure D).

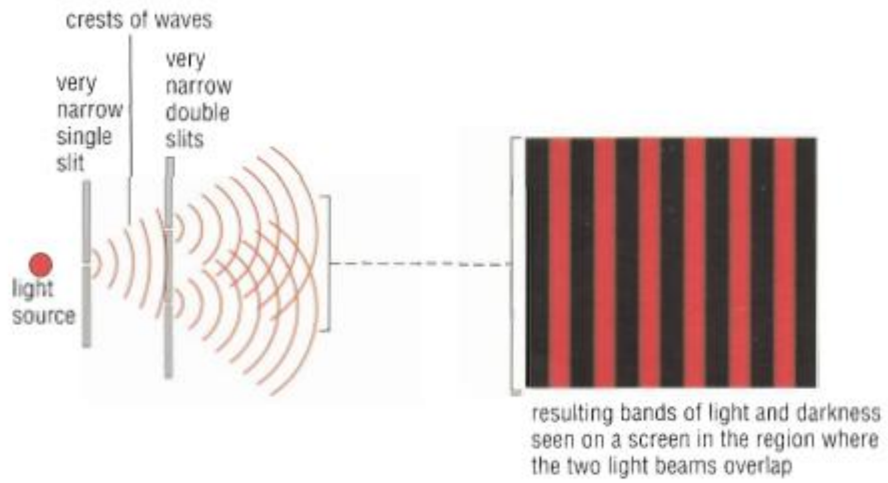


Figure C Young's experiment

Philp von Lenard (1862—1947), a Hungarian physicist, discovered that when light is shore onto certain metals, tiny electrically - charged particles called electrons are released from the metal surface. He found that a bright light released a greater number of electrons than a dim light. This suggested to him that light was made from 'particles of energy', which moved the electrons.

Further investigations into the nature of light reveal that it can be considered either to be waves or particles. The form that you consider it to be depends on the work that you are doing with light. For example, if the way light passes through transparent objects is being studied, the light can be considered to be formed of waves, But if the way in which light makes the solar cells on a calculator generate electricity is being studied, the light can be considered to be made of 'particles' of energy which scientists now call photons.

You may have trouble thinking that light can be considered in two different ways. It may help this problem if think we about how we consider people in different ways. The way you behave when with an older person, such as a parent, is different to the way you behave with people of your age. Both older and younger people see you in different ways. Possibly none of them see the 'real' you!

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Light • Electromagnetic radiation • Luminous • Non-luminous	1. Classify the following into luminous and non-luminous substances; Sun, stars, moon, candle flames, comet, Glass. 2. Briefly explain the evolution of how light was explained.

2. LIGHT (II)

Objective: By the end of this class, each student should be able to (I) Highlight various luminous objects (II) Explain how shadows are made

Duration: 80 mins

Week: 2

Entry Behavior (*How you plan to start your Class*): Use a torch for analogies.

Classifying non-luminous objects

Non-luminous materials can be classified as transparent, translucent or opaque according to the way light behaves when it meets them. When light shines on a transparent material, such as glass in a window, it passes through it and so objects on the other side of it can be seen clearly.
When light shines on a translucent object, such as tracing paper, some of the light passes through but many light rays are scattered. Objects on the other side cannot be seen clearly, unless they are very close to the translucent object.
When light shines on an opaque object none of the light passes through it.

Shadows

When a beam of light shines on an opaque object, the light rays which reach the object are stopped while those rays which pass by the edges continue on their path, A region without light, called a shadow, forms behind the object. The shape of the shadow may not be identical to the shape of the object because the shadow's shape depends on the position of the light source and on where the shadow falls.
The size and intensity of the shadow depends on the size of the light source and the distance between the light source and the object. A small light source gives a sharp shadow that is equally dark all over. A larger light source gives a shadow with a dark central region and a lighter shadow surrounding it.
Shadows can be formed by the Moon and the Earth.
If the light source is close to the object it makes a bigger shadow than if it is further away.

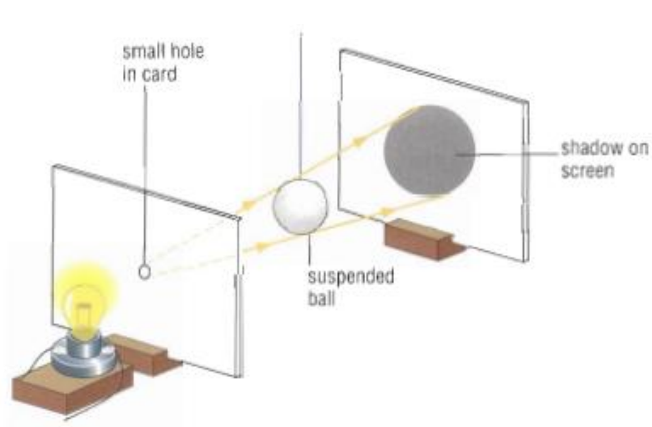


Figure 15.4 The formation of a shadow by a small light source

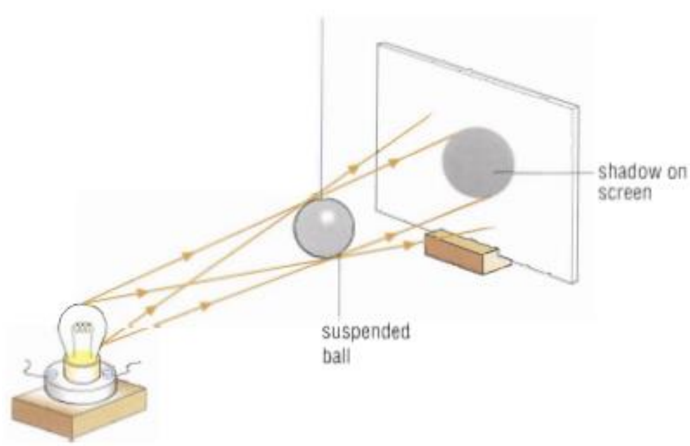


Figure 15.5 The formation of a shadow by a large light source

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Non-luminous • Opaque • Transparent • Translucent • Shadow	1. Differentiate between transparent, translucent and opaque objects 2. To get a bigger shadow, the light source needs to be _______ to the object. |a. closer | b. Farther | c. the same distance 3. When light rays pass through a material but the rays are scattered, such material is said to be ________ |a. Transparent |b. Translucent |c. Opaque

Remark:

3. LIGHT (III)

Objective: By the end of this class, each student should understand how light is reflected.

Duration: 80 mins

Week: 3

Entry Behavior (*How you plan to start your Class*): Demonstrate reflection using a mirror

Reflecting Light

Your bedroom is probably full of objects but if you wake in the middle of the night, you cannot see them clearly, because they are not luminous. You can only see them by reflected light and, unless your room is partially lit by streetlights or other lights, the objects will not be clearly seen until sunrise. The way light is reflected from a surface depends on whether the surface is smooth or rough.

Studying reflections

A few terms are used in the study of light, which make it easier for scientists to describe their investigations and ideas. In the study of reflections the following terms are used:

- **Incident ray**: a light ray that strikes a surface
- **Reflected ray**: a light ray that is reflected from a surface
- **Normal:** a line perpendicular (that is at 90) to the surface where the incident ray strikes
- **Angle of incidence:** the angle between the incident ray and the normal
- **Angle of reflection**: the angle between the reflected ray and the normal
- **Plane mirror**: a mirror with a flat surface
- **Image**: the appearance of an object in a smooth, shiny surface. It is produced by light from the object being reflected by the surface.

The ways in which the incident ray, normal and reflected ray are represented diagrammatically are shown in Figure 15.6. The back surface of a mirror is usually shown as here, as a line with short lines at an angle to it.

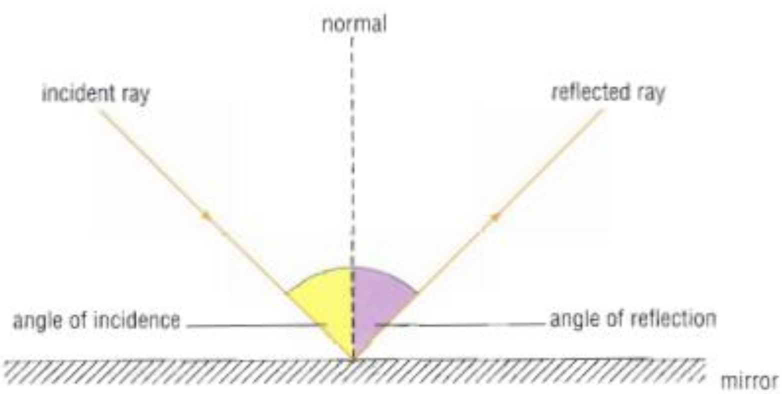


Figure 15.6 The reflection of light from a plane mirror

Objects With smooth surfaces

Glass, still water and polished metal have very smooth surfaces. Light rays striking their flat surfaces are reflected as shown in figure 15.9. The angle of reflection is equal to the angle of incidence. When the reflected light reaches your eyes, you see an image (see Figure 15.10).

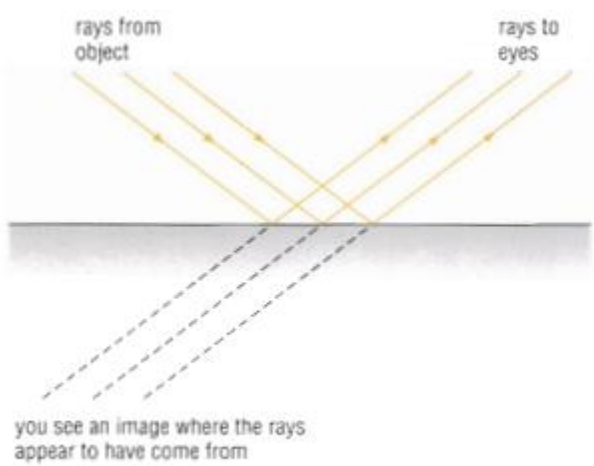


Figure 15.9 Regular reflection from a smooth surface

Figure 15.10 Light reflected from the smooth surface of a lake can produce an image in the water.

Two types of images

There are two types of images that can be formed with light. They are real images, such as those produced on a cinema screen by biconvex lenses, and virtual images, which cannot be projected onto a surface but only appear to exist, such as those in a plane mirror or other smooth, shiny surface.

The virtual image of yourself that you see when you look in a plane mirror is the same way up as you are, is the same size as you are, and is at the same distance from the mirror's surface as you are but behind the mirror instead of in front of it.

The main difference between you and your virtual image is that the virtual image is the 'wrong way round' — for example; your left shoulder appears to be the right shoulder of your virtual image.

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 1	• Reflection • Ray • Light • Incidence	1. Write short notes on the following terms - Incident ray - Reflected ray - Angle of incidence - Angle of reflection 2. The main difference between 'You' and 'Your virtual image' is ________.

Remark:

4. LIGHT (IV)

Objective: By the end of this class, each student should be able to (I) Explain how a periscope works (II) Narrate how the speed of light was measured.

Duration: 80 mins

Week: 4

Entry Behaviour (*How you plan to start your Class*): Breakdown a periscope works.

The periscope

Two plane mirrors may be used together to give a person at the back of a crowd a view of an event. The arrangement of the mirrors in a periscope is shown in Figure 15.13.

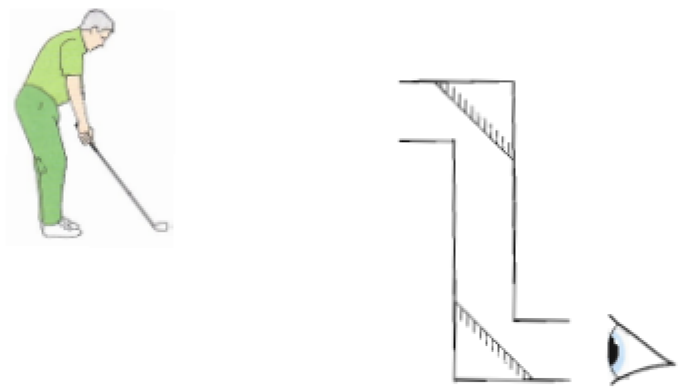


Figure 15.13 A simple periscope

Objects with rough surfaces

Most objects have rough surfaces. They may be very rough like the surface of a woolen pullover or they may be only slightly rough like the surface of paper. When light rays strike any of these surfaces, the rays are scattered in different directions (see Figure 15.14).

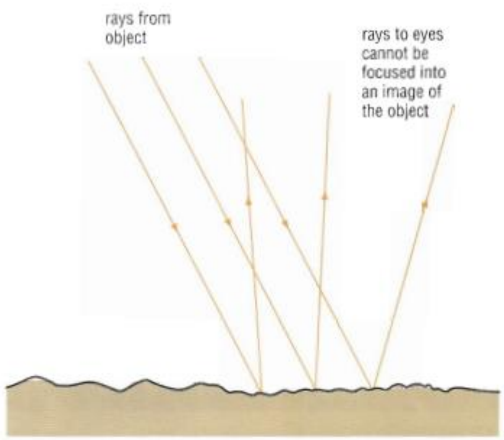
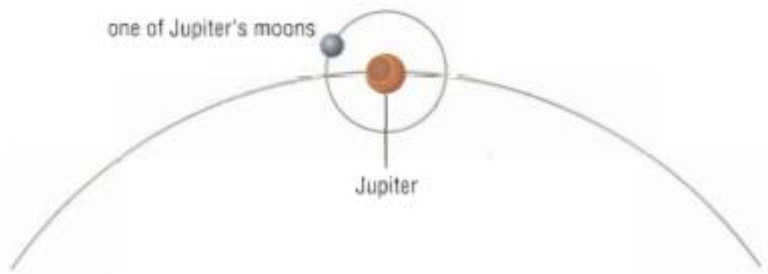


Figure 15.14 Light rays are scattered by a rough surface

You see a pullover or this page by the light scattered from its surface. You do not see your face in a piece of paper because the reflection of light is irregular so does not form an image.

The speed of light

The Ancient Greeks believed that light traveled at infinite speed and this remained unchallenged until Ole Rømer (1644—1710), a Danish astronomer, observed the moons of Jupiter and studied now they travelled around the planet. When Jupiter was between the Earth and one of its moons, the moon could not be seen from the Earth and was said to be eclipsed by Jupiter. The four large moons move around Jupiter quite quickly and other scientists had found it possible to time them. When Ramer studied the eclipses more thoroughly, he discovered that they appeared to occur earlier when the Earth was nearer Jupiter in its orbit than when it was further away.



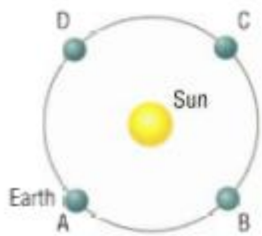


Figure F The positions of the Earth in its orbit when Rømer made his observations

Rømer did not believe that the moons speeded up at different times of year. He believed the difference was due to light having a finite speed and that it took longer to reach the Earth when the Earth was at points A and B than when it was at points C and D. By taking measurements and making calculations, Rømer deduced a speed of light, which showed that light took 11 minutes to get from the Sun to Earth.

James Bradley (1693-1762), an English astronomer, studied the position of the stars at different times of year as the Earth moved in its orbit. From his studies, he calculated the speed of light. His results showed that light took 8 minutes 11 seconds to travel from the Sun to the Earth.

In 1849 Armand Fizeau (1819—1876), a French physicist, made an instrument which measured the speed of light from a candle placed 9 kilometers away. He made many measurements and calculated that light travels at a speed of 314262944 metres per second

Many other scientists refined Fizeau's work by making more complicated pieces of apparatus and today the speed of light has been measured as 299 992 460 metres per second in a vacuum, slightly slower in air and even slower in water and glass. The speed of light in air is often rounded to 300 000 000 metres per second and the average time taken for light to travel from the Sun to the Earth has been measured as 8 minutes and 17 seconds.

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Periscope • Surface • Speed of light	1. Briefly explain how the speed of light was determined. 2. How is a periscope made? 3. If the speed of light is 299,992,460m /s and it takes 8 minutes and 17 seconds for light rays to hit the earth from the sun. What is the distance from the earth to the sun?

Remark:

5. LIGHT (V)

Objective: By the end of this class, each student should be able to (I) Narrate the behavior of light passing through a transparent material (II) Demonstrate how a prism works.

Duration: 80 mins

Week: 5

Entry Behavior (*How you plan to start your Class*): Use a prism for better comprehension.

Passing light through transparent materials

If a ray of light is shone on the side of a glass block as shown in 15.15a the ray passes straight through but, if the block is tilted, the ray of light follows the path shown in Figure 15.15b.

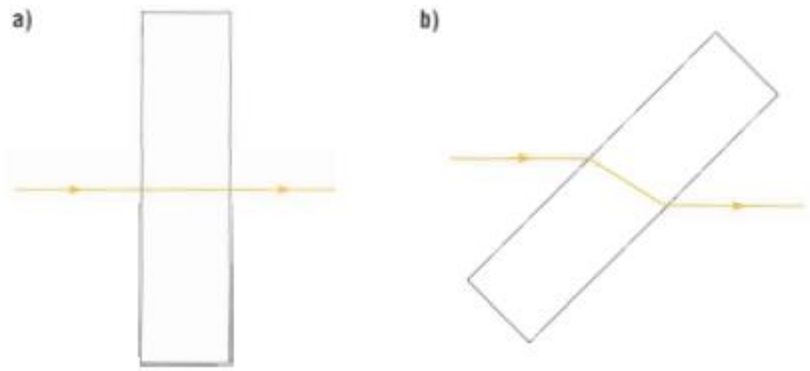


Figure 15.15 Light is refracted if the incident ray is not at 90° to the surface of the transparent material

This 'bending' of the light ray is called refraction. The angle that the refracted ray makes with the normal is called the angle of refraction (see Figure 15.16).

The refraction of light as it passes from one transparent substance or 'medium' to another is due to the change in the speed of the light. Light travels at different speeds in different media. For example, it travels at almost 300 million metres per second in air, but only 200 million metres per second in glass. If the light slows down when it moves from one medium to the other, the ray bends towards the normal. If the light speeds up as it passes from one medium to the next, the ray bends away from the normal.

Light speeds up as it leaves a water surface and enters the air. A light ray appears to have come from a different direction than that of the path it actually travelled (see Figure 15.17). The refraction of the light rays makes the bottom of a swimming pool seem closer to the water surface than it really is. It also makes streams and rivers seem shallower than they really are and this fact must be considered by anyone thinking of wading across a seemingly shallow stretch of water. The refracted light from a straw in a glass of water makes the straw appear to be bent.

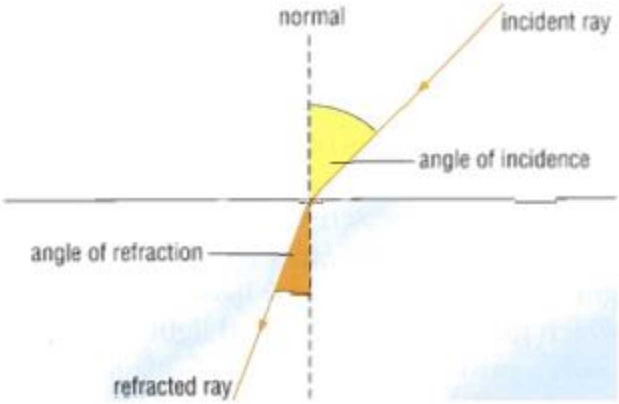


Figure 15.16 The angle of incidence and the angle of refraction

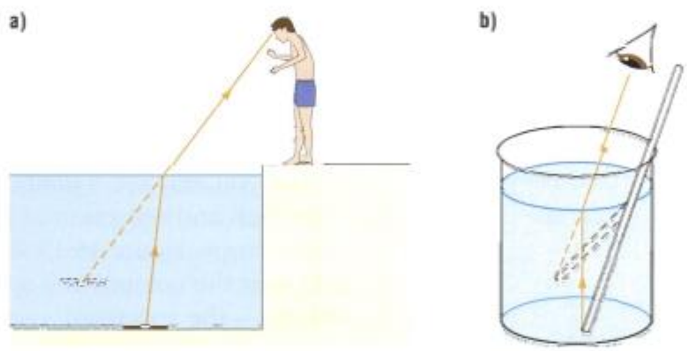


Figure 15.17 Refraction of light as it passes from water to air makes an object appear closer to the surface than it really is.

The prism

A triangular prism is a glass or plastic block with a triangular cross section. When a ray of sunlight is shone through a prism at certain angles of incidence and a white screen stops its path, a range of colors, called a spectrum, can be seen on the screen.

Light behaves as if it travels as waves. The 'white' light from the Sun contains light of different wavelengths, which give different colored light. When they pass through a prism the light waves of different wavelengths travel at slightly different speeds and are spread out, by a process called dispersion, to form the colors of the spectrum. The light waves with the shortest wavelengths are slowed down and refracted the most.

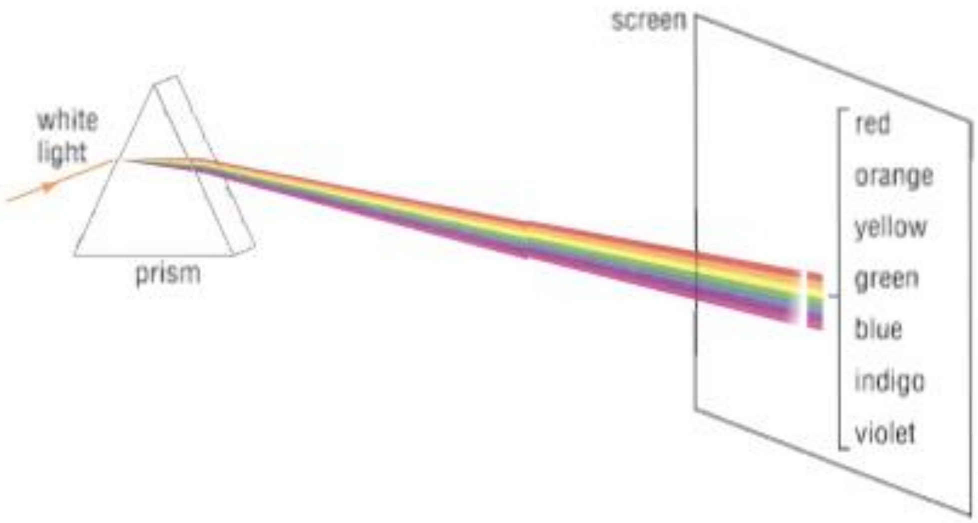


Figure 15.18 White light passing through a prism is split up into its constituent colours, forming a spectrum.

The rainbow

If you stand with your back to the Sun when it is raining or you look into a spray of water from a fountain or a hose you may see a rainbow. It is produced by the refraction and reflection of the Sun's light through the water drops. Figure 15.19 shows the path of a light ray and how the colors in it spread out to form the order of colors — the spectrum — seen in a rainbow.

Sometimes a second, weaker rainbow is seen above the first because two reflections occur in each droplet. In the second rainbow, the order of colors is reversed.

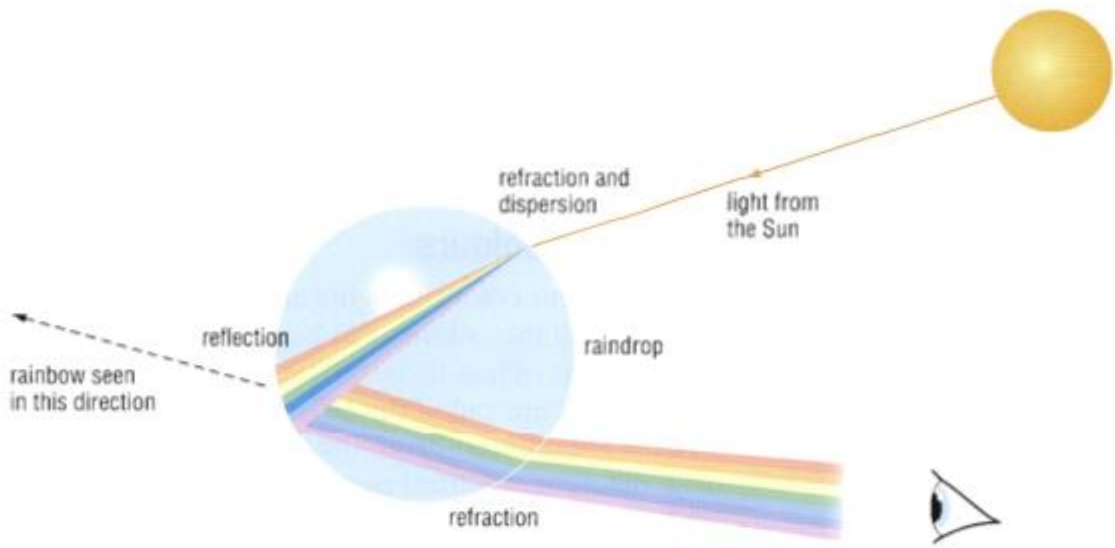


Figure 15.19 The formation of a rainbow

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Refraction • Prism • Dispersion	1. Explain refraction. 2. When white light passes through a glass prism, it splits into ________. 3. What is the difference between the speed of light in air and in glass? 4. What color on the spectrum has the shortest wavelength?

Remark:

6. LIGHT (VI)

Objective: By the end of this class, each student should be able to identify the relationship between light and colour.

Duration: 80 mins

Week:

Entry Behaviour (*How you plan to start your Class*): Breakdown how color and light relates

Color

Absorbing and reflecting colors

When a ray of sunlight strikes the surface of an object, all the different colours in it may be reflected or they may all be absorbed. If all the colours are reflected the object appears white; if all the colours are absorbed the object appears black.

Most objects, however, absorb some colours and reflect others. For example, healthy grass reflects mainly green and absorbs other colours.

Filtering colours

Sheets of coloured plastic or glass can filter the colours in light. They absorb some of the colours and allow other colours to pass through, producing different coloured light. For example, a blue filter allows only blue light to pass through and a red filter allows only red light to pass through.

One of the most spectacular uses of colour filters is in the theatre where the stage is bathed in different coloured lights to give different effects. Blue light used for night scenes or to generate scary feelings or excitement while red and yellow can make dance routines seem even more lively

Colour filters are also used in photography to produce images for art exhibitions and advertising campaigns.

In science, colour filters are used for making parts of a view under investigation easier to see. For example a red filter used in a microscope absorbs the green light coming from chloroplasts and makes them appear dark.

Telescopes can be fitted with filters, which absorb the light produced by Street lamps making objects in space more visible.

Combining colours

When different coloured lights are combined, it is found that all the colours can be made from different combinations of just three colours. They are red, green and blue and are called the primary colours of light. These are different from the primary colours needed to make different coloured paint.

When beams of the three primary colours are shone onto a white screen so that they overlap them, produce three secondary colours of light and white light.

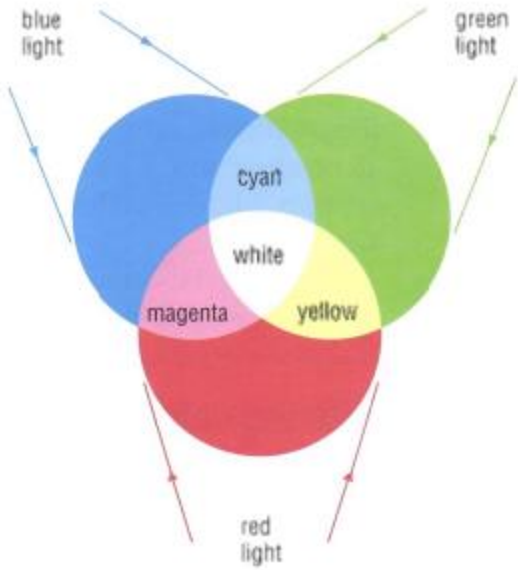


Figure 15.21 Overlapping beams of the primary colours form the secondary colours.

Colours and paint

Paint contains tiny particles called the pigment. The pigment absorbs some of the colours in sunlight and reflects others to give the paint its colour. Three colours of paint can be used to make almost all the other colours of paint. These colours are yellow, magenta and Cyan.

They are mixed together in different proportions to produce a wide range of colours. For example, when yellow and magenta are mixed together reds are produced, when magenta and cyan are mixed blues are produced and when cyan and yellow are mixed greens are produced. Mixing all three produces black.

Three different colours of paint, ink or dye can be used to make almost all the other colours. These three colours are yellow, magenta and cyan. They are mixed together in different proportions to produce a wide range of colours, like those in the photographs in this book. Tiny dots of the three colours form the printed picture.

Detecting light

In our first lesson, we found that Empedocles thought we sent out rays to see and that Democritus thought that atoms from the objects we looked at bombarded our eyes. Today we know these ideas are wrong and some of the contents of this chapter can be brought together to show how our eyes lets us see. Figure 15.23 shows the parts of the eye that are involved with light rays that shine towards us.

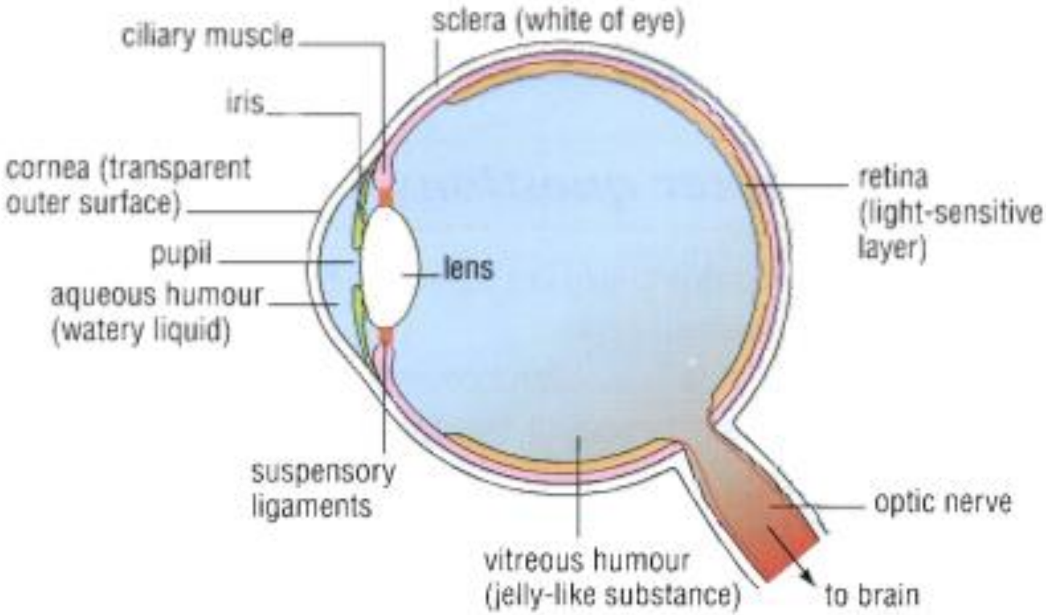


Figure 15.23 The structure of the right eye

Light rays strike the cornea and are refracted so that many of them change path as they move through the transparent aqueous humour and pass through the gap called the pupil. Once through this 'black hole' of the eye they are refracted again by the lens and travel on through the transparent vitreous humour to the retina where they form a picture on the light-sensitive cells. If the light is dim, as at dawn or dusk and at night, it causes rod-shaped cells in the layer to fire off messages along the optic nerve and we see a picture in black and grey. If there is more light, such as in the daytime, cone-shaped cells sensitive to red, green or violet light fire off messages to the brain and the brain merges the messages to produce the coloured picture we see.

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Absorbing colour • Reflecting colour • Filtering colour • Combining colour • Detecting light	1. Draw a diagram showing the overlapping of the three primary colour. 2. Draw and label fully the human eye. 3. If all colours are reflected on an object, it appears to be _____.

Remark:

7. MIDTREM TEST AND BREAK

8. MAGNETISM (I)

Objective: By the end of this class, each student should be able to (I) Explain how a magnet behaves (II) Analyze the strength of a magnet.

Duration: 80 mins

Week: 8

Entry Behaviour (*How you plan to start your Class*): Use a ring magnet for better comprehension

Three metallic elements show strong magnetic properties. They are iron, cobalt and nickel. Steel is a metal alloy, which can show magnetic properties. It is made from iron and carbon. Steel can also be mixed with other metals to make an alloy' which does not show magnetic properties. For example, stainless steel is made from steel, chromium and nickel and it does not show magnetic properties.
Materials that show magnetic properties do not show them all the time. For example, steel paper clips do not generally attract and repel each other. When a material is showing magnetic properties, it is said to be magnetized and is known as a magnet. The most widely used magnets used to be made from steel but most magnets are now made from mixtures of the magnetic metals. Alnico is an example.
It is thought that the word 'magnet' comes from the name of the ancient country of Magnesia, which is now part of Turkey In this region large numbers of black stones were found which had the power to draw pieces of iron to them. The black stone became known as lodestone or leading stone because of the way it could be used to find directions (see page 196). Today it is known as the mineral magnetite and it has been found in many countries.

The behavior of magnets

Magnets can attract or repel other magnets and can attract any magnetic material even if it is not magnetized. When suspended from a thread, a bar magnet aligns itself in a north—south direction.
Non-magnetic materials, such as wood, paper, plastic and most metals cannot be magnetized and so can do none of these things. Some, such as paper and water, can let the force of magnetism pass through them while other materials, such as a steel sheet, do not let the force of magnetism pass through them.

The strength of the magnetic force

At each end of a bar magnet is a place where the magnetic force is stronger than at other places in the magnet. These places where the magnetic force is strongest are called the **poles** of the magnet. The end of the magnet which points towards north when the magnet is free to move is called the north-seeking pole or north pole. At the other end of the magnet is the south-seeking pole or south pole.
When the north pole of one magnet is brought close to the south pole of another magnet that is free to move, the south pole moves towards the north pole. Similarly, a north pole is attracted to a south pole. However,

two south poles repel each other, as do two north poles. These observations can be summarized by the phrase 'different poles attract, similar poles repel'.

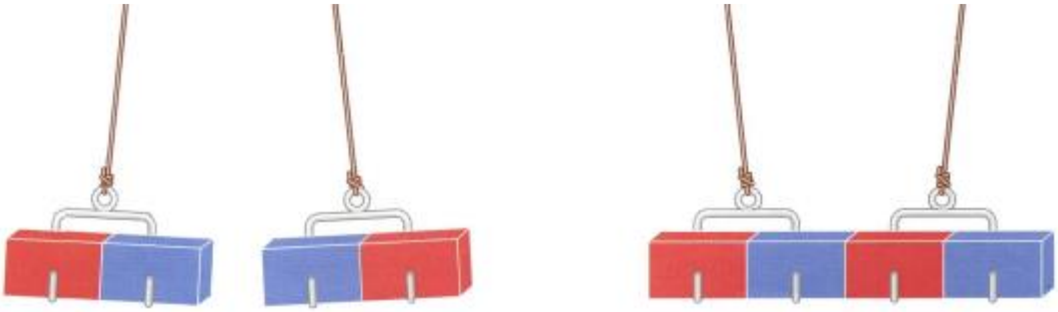


Figure 16.3 Different poles attract and similar poles repel

If you bring a steel paper clip (which is not magnetized) towards either pole of a magnet you will feel the pull of the magnetic force become stronger as the paper clip gets closer to the pole. As you move the paper clip away, again you will feel the pull of the magnet become weaker.

When a material that can show magnetic properties, such as a steel paper clip, is attracted to the end of a magnet, it also becomes a magnet and can attract other magnetic materials to it. The paper clip has been made into a magnet by a process called magnetic induction. When the paper clip is moved away from the magnet, it loses its magnetism.

Figure 16.4 Paper clips attracted by a magnet are themselves magnetised.

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book	• Magnet • Magnesia • Magnetic field • North pole • South pole	1. The process that makes an ordinary metal act like a magnet is called _______. 2. According to the law of magnetism, "similar poles _______, like poles_______".

Remark:

9. MAGNETISM (II)

Objective: By the end of this class, each student should be able to (I) How the inside of a magnet is configured (II) Explain the Earth's magnetic field.

Duration: 80 mins

Week: 9

Entry Behaviour (*How you plan to start your Class*):

Inside a magnet

Groups of particles from which a magnetic material is made from tiny regions are called domains. Each domain behaves like a tiny magnet. If the domains are arranged at random, the material does not attract other magnetic materials to it although it can be attracted to a magnet. It also does not point north—south when it is free to move.

Magnetic domains can be made to arrange themselves in line. Then all their north poles face in one direction and all their south poles face in the opposite direction. This arrangement produces a north and a south pole in the material as a whole. When the material is in this condition, it has been magnetized and so is now a magnet.

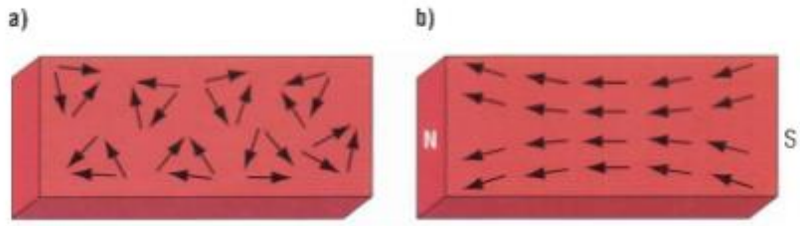


Figure 16.5 Domains in a magnetic material **a)** when it is not a magnetised material and **b)** when it is a magnet

Some materials, such as steel, are magnetically 'hard' and once domains have been aligned, they tend to stay aligned. Others, such as iron, are magnetically 'soft' and domains soon rotate again to random positions, so the material loses its magnetism.

The magnetic field

The region around a magnet in which the pull of the magnetic force acts on magnetic materials is called the magnetic field. The field around a magnet can be shown by using a piece of card and iron filings. The card is laid over the magnet and the iron filings are sprinkled over the paper,

Each iron filing has such a small mass chat it can be moved by the magnetic force of the magnet if the paper is gently tapped. The pattern made by the iron filings is called the magnetic field pattern.

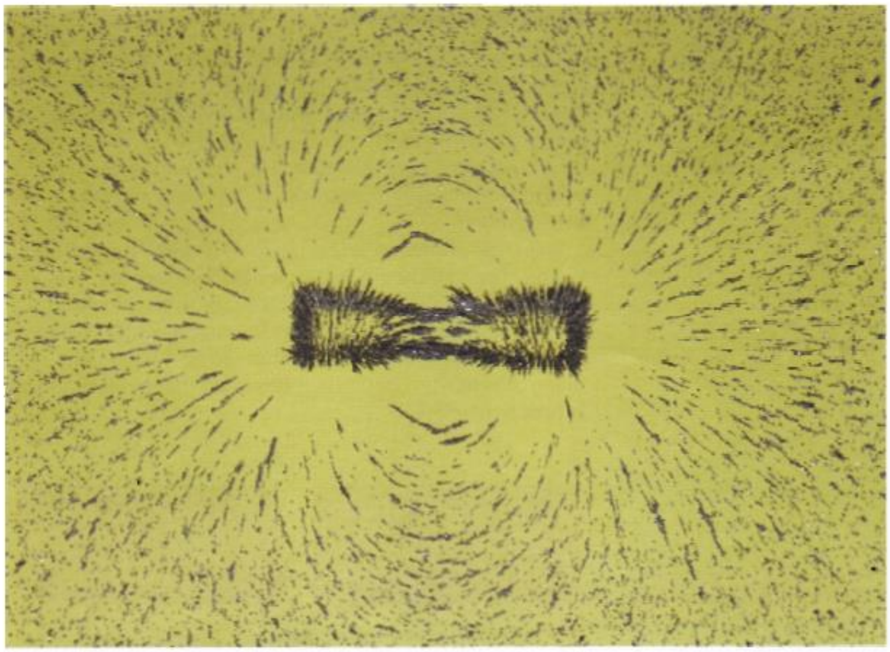


Figure 16.7 The magnetic field pattern of a bar magnet as shown by iron filings

The iron filings appear to form lines around the magnet. This phenomenon can be checked by using a plotting compass and a piece of paper and pencil. The magnet is placed in the centre of the paper and the plotting compass is placed on one side of the magnet close to its north pole. The north pole of the compass will point away from it. The position of the north pole of the compass is marked on the paper and the plotting compass is then moved so that its south pole is over the mark made on the paper. The position of the North Pole is marked again with the plotting compass in the new position and the process is repeated until the plotting compass reaches the south pole of the magnet. The points marking the positions of the north pole of the compass are joined together by a line running from the North Pole to the south pole of the magnet. This line represents one of the magnetic 'lines of force' forming the field pattern. Arrows should be drawn on the lines, pointing from the magnet's North Pole to its south pole.

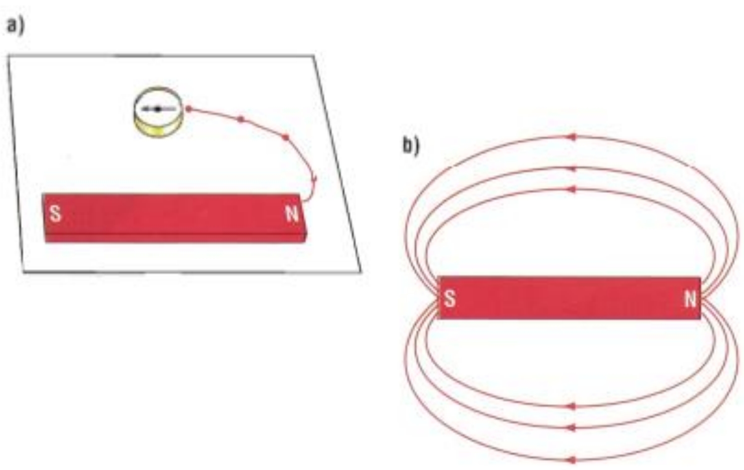


Figure 16.8 a) Drawing a magnetic line of force and **b)** the magnetic field pattern around a bar magnet

The Earth's magnetic field

At the centre of the Earth is the Earth's core. It is made from iron and nickel and is divided into two parts — the inner core made of solid metal and the outer core made of liquid metal. As the Earth spins the two parts of the core move at different speeds and this is thought to generate the magnetic field around the Earth and make the Earth seem to have a large bar magnet inside it.

The Earth spins on its axis, which is an imaginary line that runs through the centre of the planet. The ends of the line are called the geographic North and South Poles. Their positions on the surface of the Earth are fixed. Magnetic north — towards which the free north pole of a magnet points — is not at the same place as the geographic North Pole and it changes position slightly every year.

The magnetic north pole originally got its name because it is the place to which the north poles of bar magnets point. In reality it is the Earth's south magnetic pole because it attracts the north poles of magnets. Similarly the magnetic south pole is really the Earth's north magnetic pole because it attracts the south poles of bar magnets. However for most purposes the old, incorrect names for the magnetic poles are still used.

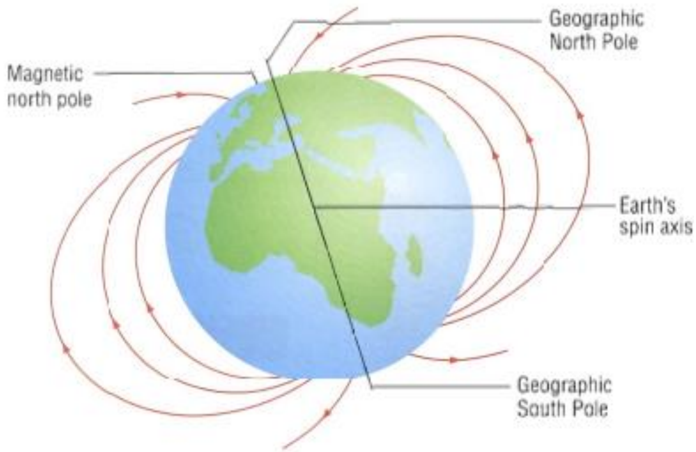


Figure 16.10 The Earth's geographic and magnetic poles do not coincide

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Magnetic field • Magnetic domain • Earth's magnetic field	1. Explain the earth's magnetic field. 2. What is a magnetic field? 3. Explain what takes place in a magnet.

10. MAGNETISM (III)

Objective: By the end of this class, all students should be able to (I) Narrate the early discovery of magnet (II) Explain the link between magnet and Electricity (III) Explain how an electromagnet works.

Duration: 80mins

Week: 10

Entry Behaviour (*How you plan to start your Class*): Practice how an electromagnet works

Early discoveries about magnetism

Probably the first use of a magnet in direction finding was in the practice of Feng Shui by the Ancient Chinese. They used a device called a luopan, which contained a magnet to find a south-pointing direction. They then read off a scale around the magnet to decide on the final position of building foundations.
The first evidence of the magnet being studied scientifically for navigation is found in the writings of the Chinese scientist Shen Kuo (1031-1095). He performed experiments on magnetic needles, described how magnets pointed north and south and how other directions (east and west) could be found using a scale around the magnet. The knowledge of using magnetite for direction finding is believed to have slowly passed to other countries as they traded with one another.
Petrus de Peregrinus (also known as Peter the Pilgrim) was a French engineer who lived in the 13th century. He experimented on the way magnets could attract and repel each other and how they could point north and south, He believed that the magnet pointed to the outer sphere of the heavens. Compasses at that time were made by floating a magnetic needle on water but Peregrinus showed that attaching the needle to a pivot made the compass easier to use.
William Gilbert (1544—1603) was an English scientist and doctor to Elizabeth (l). He made many on magnets and disproved believes such as 'garlic destroys magnet' and 'rubbing a diamond on a piece of iron makes the iron into a magnet'.
Gilbert suspended a magnetic needle so that it could move both horizontally and vertically and discovered that the needle also dipped as it pointed north-south. He extended his investigation by using a model of the Earth made out of a Sphere of lodestone (magnetite). He put a compass with a pivot at different places on the surface of his model Earth and showed that the dip varied with the position of the compass on the sphere, just as it did with compasses at different places on the surface of the Earth.
From this investigation, Gilbert described the Earth as behaving as if it contained a huge magnet.

The link between magnetism and electricity

Hans Christian Oersted (1777—1851) was a Danish physicist who studied electricity. In one of his experiments he was passing an electric current along a wire from a battery when he noticed the movement of a compass needle which had been left near the wire. This chance observation led to many discoveries about how magnetism and electricity are linked together and has many modern applications.

When an electric current passes through a wire it generates a magnetic field around the wire. A compass can be placed at different positions on a card around the wire and the lines of force can be plotted.

When the current flows up through the card, the field shown in Figure 16.12a is produced. When the current flows down through the card, the field shown in Figure 16.12b is produced.

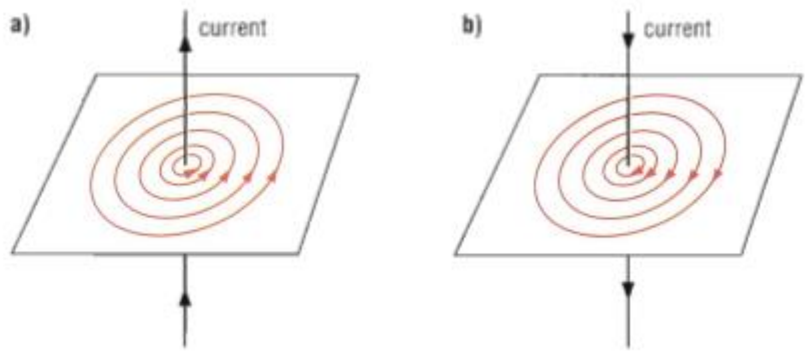


Figure 16.12 The magnetic field around a current-carrying wire

Lines of force on diagrams of magnetic fields show not only the direction of the field as given by a plotting compass but also the strength of the field in different places. The lines of force are close together where the field is strong and further apart where the field is weaker.

If the wire is made into a coil and connected into a circuit, a magnetic field is produced around the coil.

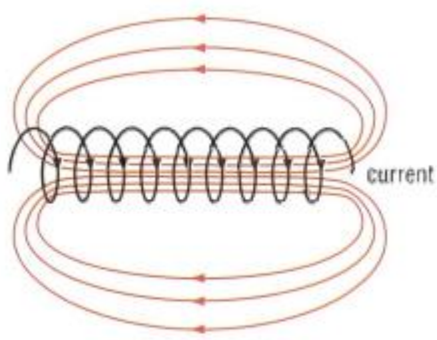


Figure 16.13 The magnetic field around a current-carrying coil

If a piece of steel is placed inside the wire coil and the current is switched on, the magnetism of the coil and the steel is stronger than that of the coil alone. The current flowing through the coil induces magnetism in the steel.

When the current is switched off the steel keeps some of the magnetism it acquired because it is magnetically hard.

If a piece of iron is placed inside the coil it makes an even Stronger magnet when the current is switched on than the steel did.

When the current is switched off the iron loses its magnetism completely because it is magnetically soft.

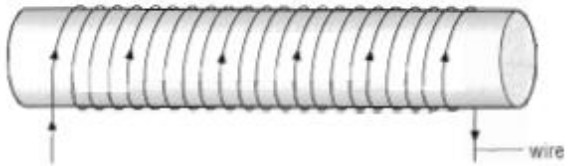


Figure 16.14 A steel bar within a coil

The electromagnet

An electromagnet is made from a coil of wire surrounding a piece of iron. When a current flow through the coil, magnetism is induced in the iron and the coil and iron form a strong electromagnet. When the current is switched off, the electromagnet loses its magnetism completely and, straight away. This device, which can instantly become a magnet and then instantly lose its magnetism, has many uses. For example, an electromagnet is used in a scrap yard to move the steel bodies of cars.

Figure 16.15 An electromagnet in use in a scrap yard

The Electric Bell

When the switch is pushed the current passes through the coil and the electromagnet pulls the armature to it. This makes the hammer strike the gong. When the armature is pulled to the electromagnet, a gap develops between the springy metal strip and the contact screw and the circuit is broken. The current stops flowing and the electromagnet loses its magnetism. This makes the armature swing back to its original position. The springy metal strip and the contact screw now touch again and complete the circuit so the armature is pulled to the electromagnet once more. The bell is made to ring by the repeated beating of the hammer until the push switch is released.

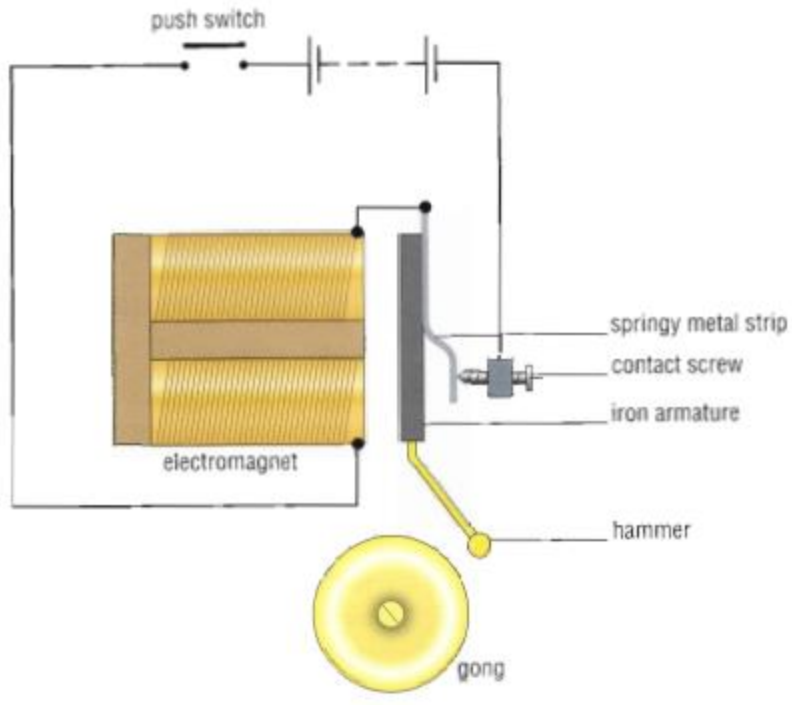


Figure 16.16 The circuit of an electric bell

REFERENCE	KEYWORDS	EVALUATION/ASSESSMENT
Cambridge Checkpoint Science - Book 2	• Magnetism • Electromagnet • Electricity • Electric bell	1. Mention 2 myths William Gilbert disproved. 2. What is an electromagnet made from? 3. When an electric current passes through a wire it generates a ________ around the wire

11. REVISION

<u>Objective:</u> By the end of this class, all students should be able to recall all they have learnt in the term

<u>Duration:</u> 80mins

<u>Week:</u> 11

<u>Entry Behaviour (*How you plan to start your Class*):</u>