6 Magnets

There are instances where magnets are used in our day-to-day life. Recalling what we have learnt about magnets in grade 6, let us do Activity 6.1 to identify materials that show magnetic properties.

Activity 6.1

You will need:- A permanent magnet, a piece of thread, a stand, various types of coins, an iron nail, a brass nail, a pebble, a plastic ruler, several other things that you like to test for magnetic properties.

Figure 6.1

Method:-

- Hang the magnet on the stand using the piece of thread as shown in Figure 6.1
- Bring each substance, one at a time, clos to the magnet, when the magnet remains still. Enter the observations in Table 6.1

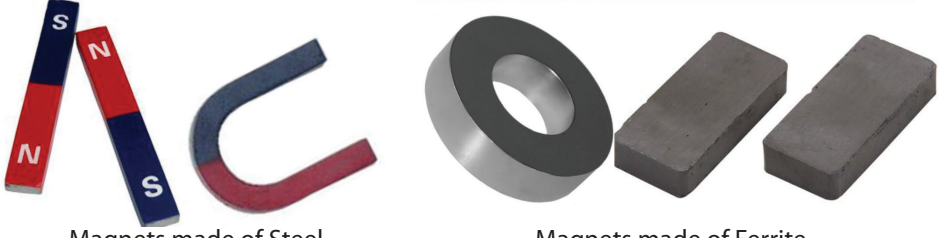
Table 6.1

Material	Attract / does not attract to the magnet
1. Plastic ruler	Does not attract.

It will be clear to you that only certain materials attract towards magnets. **Materials which attract towards magnets are known as magnetic materials.**

Metals such as iron, nickel, chromium and alloys like steel and ferrite are magnetic materials.

Alloy ferrite is used to make more powerful magnets.



Magnets made of Steel Magnets made of Ferrite

Figure 6.2 Magnets made of various materials

Magnetic property or magnetism is a property of a material.

6.1 Poles of a magnet

Let us do Activity 6.2 to study further how magnetic power exists around a magnet.

Activity 6.2

You will need:- A bar magnet, iron filings, a thin polythene sheet or a polythene bag, a sheet of paper

Method:-

- Cover the bar magnet completely with the polythene bag.
- Heap iron filings on the sheet of paper.
- Dip the magnet on the heap of iron filings.
- Take the magnet out of the heap of iron filings and observe the pattern of iron filings attracted to the magnet.

Regions where iron filings are thickly attracted can be easily identified. Magnetic power is concentrated in these regions.

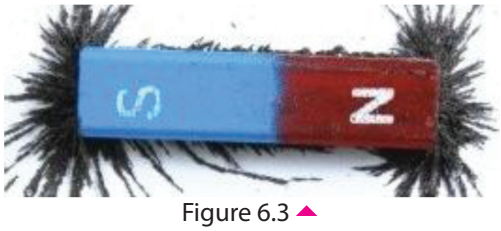


Figure 6.3

Regions of a magnet, where magnetic power is concentrated are called magnetic poles. There are two of them.

- North pole (N)
- South pole (S)

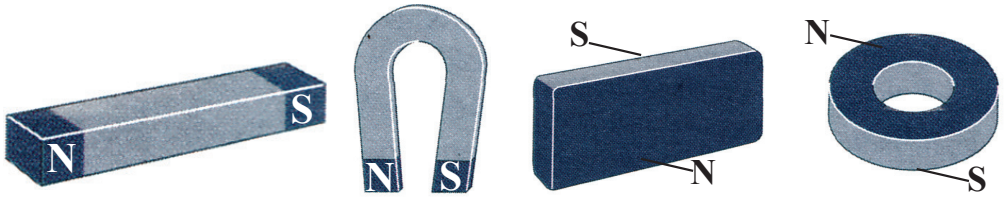


Figure 6.4 How poles are located in different types of magnets

Identifying magnetic poles

We have learnt earlier that north and south poles are marked in most of the magnets. Now, let us consider how the poles of a magnet can be identified when they are not marked.

Figure 6.5 ▲ Magnets with poles marked

Figure 6.6 ▲ A magnet on which poles are not marked

Let us do Activity 6.3 to study the methods of identifying the poles of a magnet.

Activity 6.3

You will need : - A magnet on which poles are not marked, a magnet on which poles are marked, a compass, a piece of thread, a stand, a piece of cork or a piece of styrofoam, a basin of water, two watch glasses

Method : -

- Let us find out various methods to identify the poles of a magnet using given materials. Following methods can be tried out for this.

Figure 6.7 ▲ Using a compass

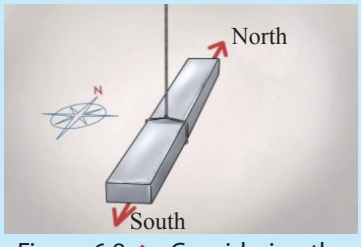


Figure 6.8 ▲ Considering the direction that a magnet turns, when it is hung by a thread.

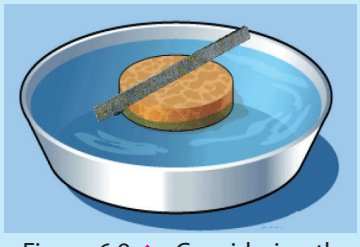


Figure 6.9 ▲ Considering the direction, that magnet turns, when it is floated on water using a piece of cork or styrofoam.

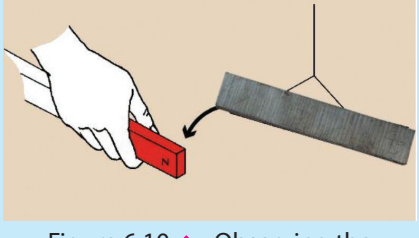


Figure 6.10 ▲ Observing the attraction or repulsion when a magnet with known poles is brought closer

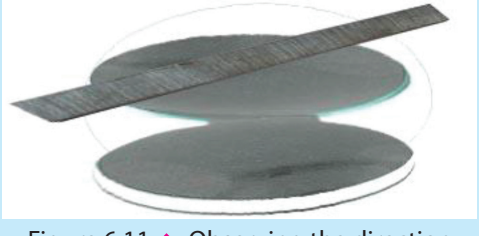


Figure 6.11 ▲ Observing the direction that the magnet turns when it is kept on a watch glass and moved freely on another watch glass

Investigate whether there are methods, other than those mentioned, to identify the poles of a magnet.

6.2 Magnetic field of a magnet

Let us do Activity 6.4 to find out about the area that magnetic power is distributed around a magnet.

Activity 6.4

You will need : - A bar magnet, iron filings, a piece of cardboard

Method : -

- Spread a thin layer of iron filings on the sheet of cardboard.
- Gently place the sheet of cardboard on the bar magnet.
- Tap on the sheet of cardboard gently.
- Observe the pattern in which iron filings are arranged.
- Can you suggest the reason for the arrangement of iron filings on the sheet of cardboard, according to a pattern?

Let us do Activity 6.5 to study the magnetic field around a bar magnet.

Activity 6.5

You will need : - A bar magnet, iron filings, A test tube of the size to insert the magnet, a beaker of tall form, glycerine or coconut oil

Method : -

- Fill the beaker with glycerine or coconut oil mixed with iron filings.
- Insert the bar magnet into the test tube and dip it slowly in the beaker.
- Observe the pattern of iron filings arranged around the magnet.

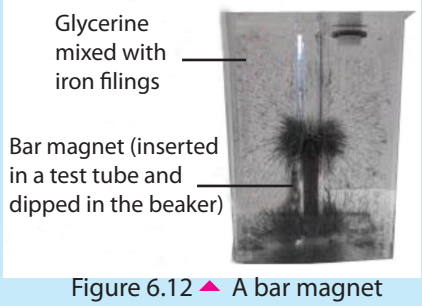


Figure 6.12 ▲ A bar magnet dipped in glycerine mixed with iron filings

It can be observed that iron filings are arranged in a pattern, within a certain area around the magnet.

Area that the magnetic power is spread around a magnet is called the magnetic field of that magnet.

Imaginary lines used to denote the magnetic power around a magnet are known as magnetic field lines.

Let us do Activity 6.6 to demonstrate the magnetic fields between magnetic poles.

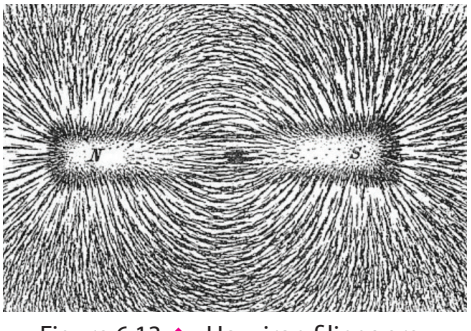


Figure 6.13 ▲ How iron filings are arranged around a bar magnet

Activity 6.6

You will need : - Two short bar magnets, a styrofoam board of A4 size, 4 pieces of cardboard of A4 size, binder gum, iron filings

Method : - • Carve two grooves in the styrofoam board.

- Insert two short bar magnets into the grooves, so that like poles are directed against each other, as shown in Figure 6.14.

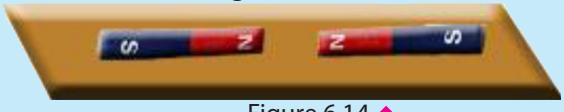


Figure 6.14

- Place one piece of cardboard on the styrofoam board.
- Spread a thin layer of iron filings on the cardboard.
- Tap gently to a corner of the cardboard sheet.
- Observe the pattern in which iron filings are arranged.
- Apply a layer of binder gum on another cardboard sheet and allow it to dry.
- Place the side of the cardboard applied with gum, on the pattern of iron filings and press gently.
- Take away the cardboard sheet applied with gum and observe. The pattern of magnetic field lines are imprinted on it.
- Now change the poles of one magnet so that the set-up is changed to demonstrate the magnetic field between unlike magnetic poles. (Figure 6.15)

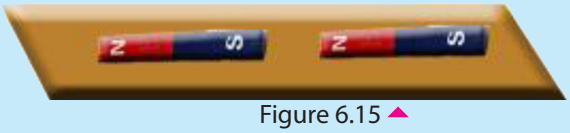
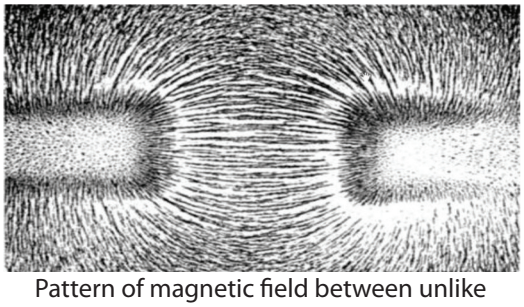


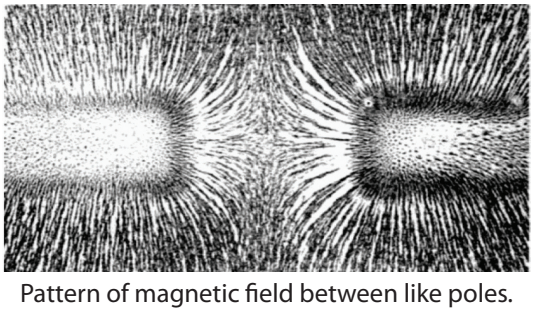
Figure 6.15

- Repeat the above steps and obtain the pattern of iron filings corresponding to the magnetic field between two unlike poles.
- Exhibit your creations in the classroom.

It may be clear to you that iron filings are arranged around a magnet along the patterns of magnetic field lines.



Pattern of magnetic field between unlike poles.



Pattern of magnetic field between like poles.

Figure 6.16 Pattern of magnetic field lines between magnetic poles

6.3 Compass

You may have heard that an instrument called compass is used to find the direction. Compass was invented by the chinese about thousand years back. Today various types of compasses are in use. A compass is made from a magnetic needle (this is like a small magnet) which can freely float on a liquid or turn round a pivotted point.

Figure 6.17 ▲ Types of compasses

Let us do Activity 6.7 to make a simple compass.

Activity 6.7

You will need : - A large needle, a cork bung, a small knife, a bar magnet, a plastic basin full of water, red paint.

Method : -

- Magnetize the needle by contact method using the bar magnet.
- Cut a thin slice of the cork bung and fix the needle on it. (Figure 6.17)
- Float the slice of cork, with the needle on the basin of water.
- Test whether the floating needle is always turned in the same direction.
- Colour the end of the needle, which is always turned to the geographical north with red paint.
- What you have constructed is a simple compass.
- Make your compass more attractive.

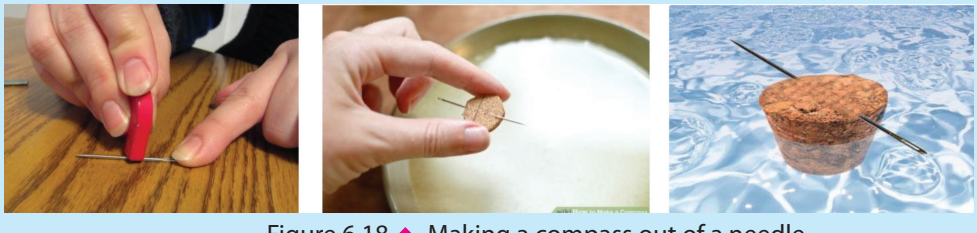


Figure 6.18 ▲ Making a compass out of a needle.

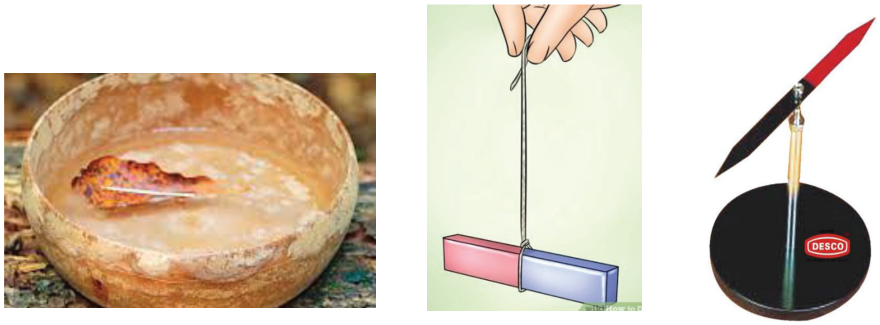


Figure 6.19 ▲ Several compasses constructed in various ways

When a compass is kept near a magnet, the needle turns towards the direction of the magnetic field. Therefore, the position of the magnetic field of a magnet can be identified, using a compass.

Let us do Activity 6.8 to identify the direction of magnatic field using a compass.

Activity 6.8

You will need : - A bar magnet, a compass, a sheet of white paper

Method : -

- Place the bar magnet on the sheet of white paper.
- Draw the outline of the magnet on the paper, using a pencil.
- Label the north and south poles of the magnet on the paper.
- Place the compass on the paper as shown in Figure 6.20 and mark the positions of the compass needle.
- If you are unable to find several compasses, you can use the same compass for each location.
- Try to build up the pattern of the magnetic field by connecting the positions of the compass needle.

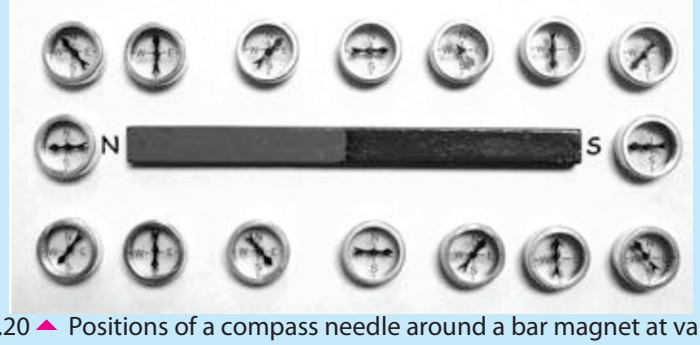


Figure 6.20 ▲ Positions of a compass needle around a bar magnet at various locations

Magnetic field lines of a permanent magnet direct from North pole to South pole.

Hence, **the direction of magnetic field is from North pole to South pole.**

The Figure 6.21 illustrate the arrangement of magnetic field lines around a bar magnet.

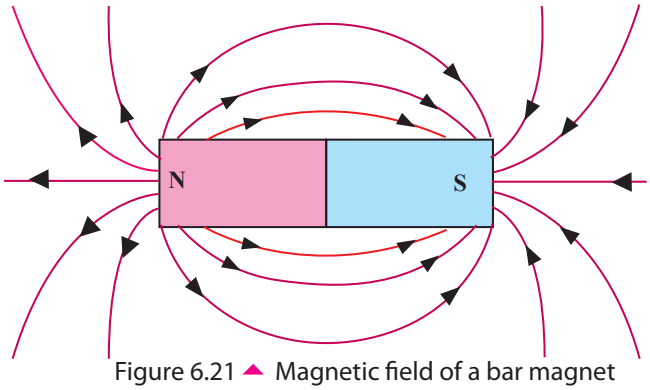


Figure 6.21 ▲ Magnetic field of a bar magnet

6.4 Geomagnetism

You know that north - south directions of the earth can be identified using a compass. When a compass is kept horizontally near the surface of the earth, its needle turns along the north-south direction.

Let us do Activity 6.9 to find the direction of the magnetic field of the earth.

Activity 6.9

You will need : - Two compasses, a bar magnet, a piece of thread, a stand

Method : -

- Hang one bar magnet horizontally on the stand, using the piece of thread.
- Keep the bar magnet, hung on the stand, and two compasses about two meters apart from each other.
- Take another bar magnet and bring one of its poles closer to each compass and to the magnet hung on the stand.
- Record your observations.
- Take away the bar magnet and observe the directions of the poles of compass needles and the bar magnet which is hung.
- Repeat the activity, changing the locations of compasses.
- Discuss the reasons for the observations in the classroom.

Figure 6.22 ▲

The compasses and the magnet which is hung turned when another magnet is brought closer to them. Thus it is clear that magnets and compasses turn, when they are under the influence of a magnetic field.

When bar magnets and compasses are free from the influence of other magnets, their north poles always turn to one direction and south poles to the opposite direction. Though the position of bar magnets and compasses are changed, their poles turn to the same directions. The reason for this is the existence of a large magnetic field around the earth through north and south poles.

This magnetic field existing near the earth is known as geomagnetism.

Liquified metal currents circulate around the axis of the earth, because of the high temperature at the core of the earth. The magnetic field of the earth is the result of the electric currents thus generated.

When a compass or a magnet is kept freely near the earth, its north and south poles are directed along the magnetic field of the earth.

The direction that the north pole of a magnet or a compass, kept in that manner is known as the magnetic north of the earth.

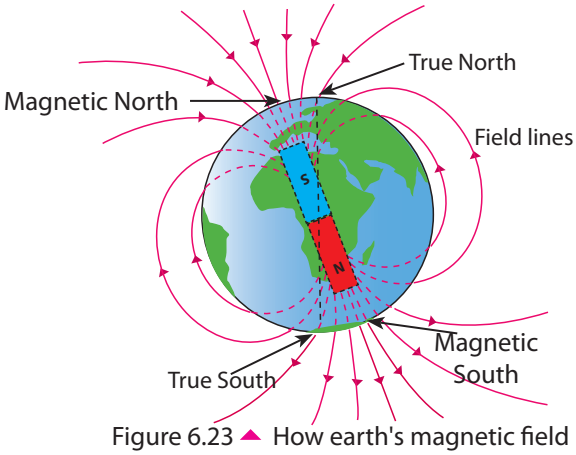


Figure 6.23 ▲ How earth's magnetic field is located

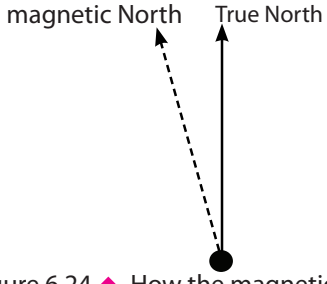


Figure 6.24 ▲ How the magnetic North and real North are denoted on a map

There is a little difference between the real north and the magnetic north of the earth. The magnetic north lies a few degrees north west from the real north.

6.5 Temporary magnets and permanent magnets

Two types of magnets can be identified when considering the uses of magnets.

- Permanent magnets
- Temporary magnets

Let us do Activity 6.10 to understand more about permanent magnents and temporary magnets.

Activity 6.10

You will need : - Iron nail or iron rod of 2 inch length, two meters of insulated copper wire of 32 SWG, two dry cells, cellotape, a bar magnet, few file clips or pins, a switch

Method : -

- Wind the insulated copper wire of 32 SWG, around the iron nail or iron rod, to make a coil.
- Scrape both ends of the coil and connect it to the dry cells.
- Bring the coil close to the file clips while supplying electrcity and see what happens.
- Disconnect the electrical supply and bring the coil close to the clips, again
- Bring the bar magnet close to the clips and see what happens.
- Discuss your observations in the classroom.

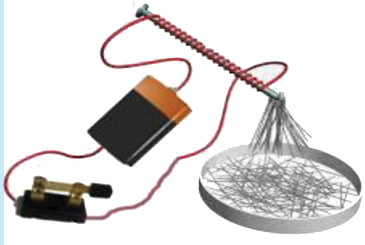


Figure 6.25 ▲ File clips are attracted when electricity is supplied

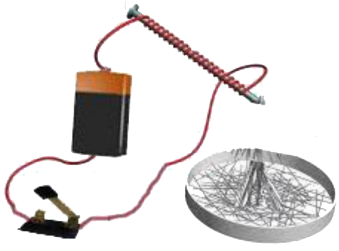


Figure 6.26 ▲ File clips fall off (do not attract) when electrical supply is disconnected

Figure 6.27 ▲ File clips are attracted to a permanent magnet

A set-up that becomes a magnet, only when electricity is supplied is known as an **electromagnet.**

In an electromagnet, magnetic power remains only when electricity is supplied. Therefore, they are called **temporary magnets.**

Magnetic power remains for a long time in bar magnets. Therefore, they are called **permanent magnets.**

Making a permanent magnet

Magnets of various shapes and sizes are used for various purposes. Let us consider how these magnets are constructed.

Materials that show magnetic properties are used to make magnets. Steel, ferrite and soft iron are some magnetic materials which are used to make magnets. Various materials are used to produce various types of magnets.

Magnetic power is not retained in soft iron for a long time. Therefore, soft iron is used to make electromagnets and other temporary magnets.

Magnets, in which magnetic power is retained for a long time, are known as premanent magnets. Steel or ferrite is used to make permanent magnets. Ferrite is used to make more powerful permanent magnets.

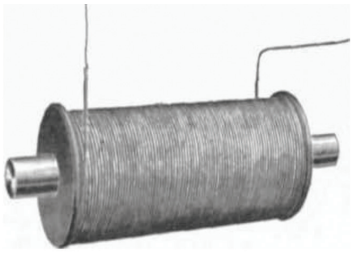


Figure 6.28 ▲ An electromagnet

Figure 6.29 ▲ Permanent magnets made of steel

Figure 6.30 ▲ Permanent magnets make of ferrite

Construction of permanent magnets using magnetic materials can be done in two ways.

1. Electrical method
2. Contact method

Let us do Activities 6.11 and 6.12 to make magnets using electrical method and contact method.

Activity 6.11

You will need :- Iron nail or iron hacksow blade of 2 inches, two meters of insulated copper wire of 32 SWG (Standard Wire Gauge), two dry cells, cellotape, a piece of cardboard, few file clips

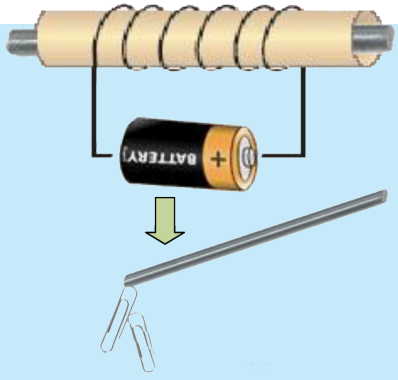


Figure 6.31 ▲

Method : -

- Make a 5 cm long tube (about the size of a pencil) using the piece of cardboard.
- Wind the copper wire of 32 SWG, around that tube to make a coil.
- Bring the iron nail close to the file clips to check whether it has magnetic power.
- Then insert the iron nail into the cardboard tube.
- Scrape both ends of the coil and connect it to the dry cell and supply the current several times to the circuit.
- Take the iron nail/ iron hacksow blade away and observe while bringing it close to the file clips.
- Discuss your observations in the classroom.

The electric current should be supplied, several times to the circuit for a long time until permanent magnetism is observed.

Activity 6.12

You will need : - A steel needle or steel hacksaw blade of two inches, a few file clips, a bar magnet

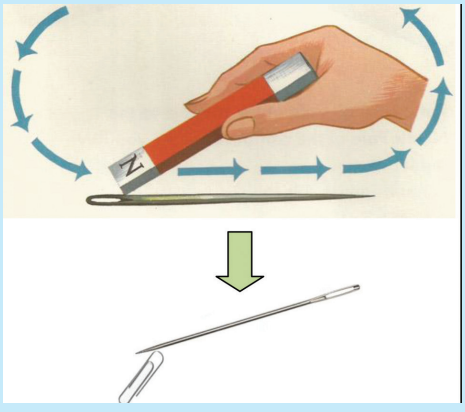


Figure 6.32

Method : -

- Bring the needle/hacksaw blade close to the file clips to check whether it has magnetic power.
- Now, place the needle horizontally on a table.
- Place one end of the bar magnet on the needle and drag it along the same direction as shown in Figure 6.32.
- Repeat this process several times.
- Now bring the needle/hacksaw blade close to the file clips and see what happens.
- Discuss your observations in the classroom.

It will be clear to you that a permanent magnet can be made using electrical method and contact method according to Activities 6.11 and 6.12.

Does the magnetic power of permanent magnets retain for ever? The answer is 'No'. The magnetic power of permanent magnets are lost due to various reasons. Some of the reasons are given below.

- Ageing
- Subjected to high temperatures
- Subjected to strong magnetic fields
- Subjected to vibrations

Let us do Activity 6.13 to test how magnetic power is lost.

The rubbing should be continued for a long time until permanent magnetism is observed.

Activity 6.13

You will need : - Three identical iron nails which are magnetized by a permanent magnet, a few pins, a bunsen burner, a hammer, a pair of crucible tongs, a strong permanent magnet

Method : -

- Bring the pins close to each magnetized iron nail, separately, and note down the maximum number of pins attracted to each nail.
- Subject each nail to each of the following treatments.
  - (a) Vibrate by hammering.
  - (b) Heat to a high temperature.
  - (c) Move to and fro close to the strong magnet.
- Bring the pins close to each nail again and count the number of pins attracted to each nail. Fill Table 6.2.

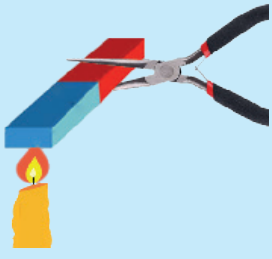


Figure 6.33 ▲ Heating strongly

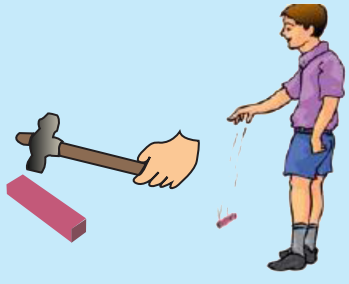


Figure 6.34 ▲ Subjected to vibrations

Figure 6.35 ▲ Subjected to strong magnetic fields

Table 6.2

Action done	Number of pins attracted before action	Number pins attracted after action
Hammering		
Heating		
Subjecting to strong magnetic fields		

It may be clear to you that magnetic power fades off because of vibrations, temperature and being subjected to strong magnetic fields. Magnetic power also fades due to ageing. To maintain magnetic power for a long time, magnets should be stored in an orderly manner without being subjected to vibrations, temperature and strong magnetic fields.

Storage of permanent magnets

Magnetic power of a permanent magnet can be protected for a long time, if it is stored in such a way that its magnetic field is not scattered.

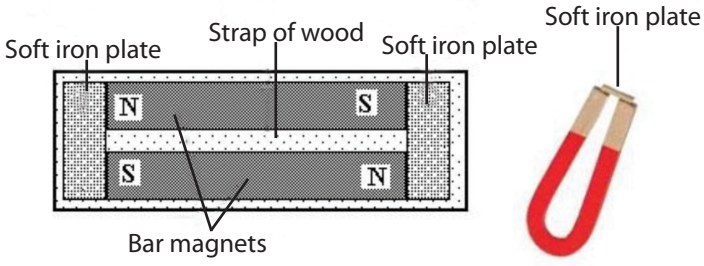


Figure 6.36 ▲ How magnets are stored

Use of permanent magnets

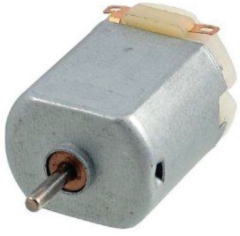
There are various equipments found in day-to-day life, where permanent magnets are used.

Assignment 6.1

List out instances where permanent magnets are used.

Check whether permanent magnets are used in the following instances.

In loud speakers and speakers



In small electric motors

In some door locks

Bags

In some toys

In compasses

In pencil boxes

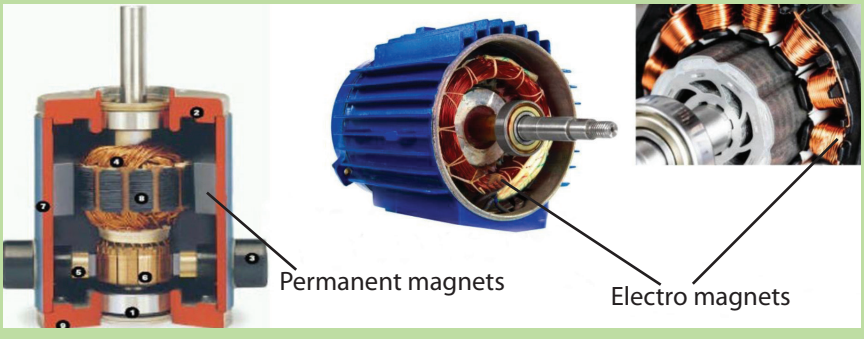
Stickers on refrigerators

Phone covers

Figure 6.37

For extra knowledge

There are permanent magnets as well as electro-magnets found in most of the small electric motors. But there are some motors only with electro-magnets.



Summary

- Magnetism is a property of materials.
- Material which attract to magnets are magnetic materials.
- Iron, nickel, chromium, steel and ferrite are some examples for magnetic materials.
- The area that the magnetic force exists around a magnet is called the magnetic field.
- Imaginary lines used to denote the influence of magnetic field are known as magnetic field lines.
- The direction of magnetic field is from the north pole to the south pole.
- A compass is important to detect magnetic fields.

- Terminals of a magnet, where magnetic force is concentrated are called magnetic poles.
- There is a magnetic field on the earth. It is known as geomagnetism. When a compass is placed near the earth the direction that its pointer indicates is the direction of earth's magnetic field.
- The direction indicated by the compass is the magnetic north. It lies a little north-western to the real north.
- Permanent magnets are made of steel and ferrite, and temporary magnets are made of soft iron.
- Contact method and electrical method are used to make permanent magnets.
- Power of a magnet may wear off with time, because of high temperature, strong vibrations and the influence of strong magnetic fields.
- Power of a magnet can be retained for a long time by proper storage.
- Permanent magnets and electromagnets are widely used in day-to-day life.

Exercise

1. Select the appropriate words from the brackets and fill in the blanks of the paragraph given below.

(Soft iron, magnetic materials, magnetic poles, magnetic field lines, ferrite, magnetic field).

Materials that show magnetic properties are called ..... . The best material to make permanent magnets is ..... . To make temporary magnets, ... is commonly used. The area in which magnetic forces exist is called ..... . Influence of a magnetic field can be observed using ..... . The area on a magnet, where the magnetic forces are concentrated is known as the ..... .

2. Given below is a rough sketch of a pencil box that closes with the help of a magnet. Suggest a method to test whether the magnet is fixed on the box or on the lid.

3. A student who checked some magnets in the school laboratory found out that their magnetic force is worn out. Give three reasons for that.

4. Explain scientific reasons for the following.
   (a) North pole of a bar magnet, hung freely by a thread is directed towards north.
   (b) A piece of iron is attracted towards a magnet, but a piece of copper is not.

5. An iron rod, placed on a table was contacted several times with a bar magnet. Then, it was observed that pins and small pieces of wire are attracted to the iron rod.
   (a) Give reasons for the above incident.
   (b) What is the term used for the above process?
   (c) Suggest another method to get the same result without using a permanent magnet.

Technical Terms

Magnet	-	චුම්බක	-	காந்தம்
Permanent magnet	-	ස්ථිර චුම්බක	-	நிலையான காந்தம்
Magnetic field	-	චුම්බක ක්ෂේත්‍රය	-	காந்தப்புலம்
Geomagnetism	-	භූ චුම්බකත්වය	-	புவிக்காந்தவியல்
Compass	-	මාලිමාව	-	திசைகாட்டி
Electro magnet	-	විද්‍යුත් චුම්බක	-	மின்காந்தம்
Magnetic pole	-	චුම්බක ධ්‍රැව	-	காந்தமுனைவு
Magnetic materials	-	චුම්බක ද්‍රව්‍ය	-	காந்தத்திரவியம்
Steel	-	වානේ	-	உருக்கு
Ferrite	-	ෆෙරයිට්	-	பெரைற்று
Soft iron	-	මෘදු යකඩ	-	மென்னிரும்பு
North pole	-	උත්තර ධ්‍රැවය	-	வடமுனைவு
South pole	-	දක්ෂිණ ධ්‍රැවය	-	தென்முனைவு