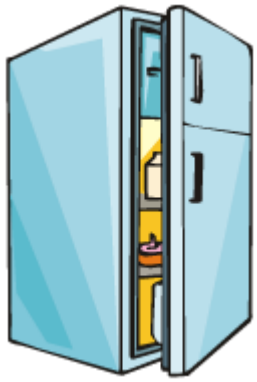
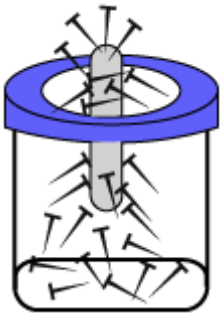
Fun with Magnets

Magnet - An Introduction

You are familiar with the fact that magnets have a variety of applications in our daily lives. Magnets are used in refrigerator doors, in junkyards, as pin holders, in screwdrivers, etc.






A question that can arise in our minds is how magnet was discovered. In this section, we will tell you an interesting story about the accidental discovery of magnet.

Around 2,000 B.C., a shepherd named **Magnes** lived in an area named **Magnesia** (situated in Northern Greece). He used to take his herd of sheep to graze in the nearby mountains. He used to control his herd with a long stick that had an iron tip. Also, a few iron nails were fixed to his shoes.

It is said that one day while he was herding his sheep, he observed that his shoes and the tip of the stick were stuck to a large black-coloured rock. It was very difficult for

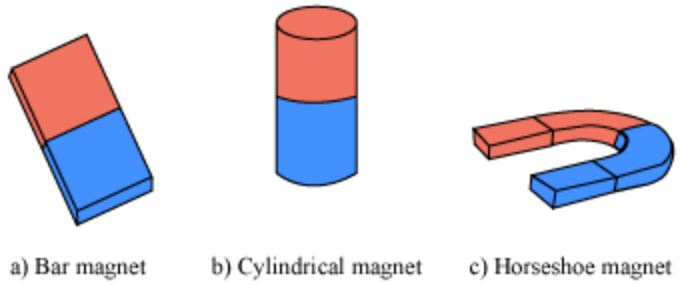
him to move on that black rock. Later, this rock and similar rocks were named **magnetite** (after either his name or that of the place). Magnetite has the property to attract objects made up of iron. The substances that can attract iron are now known as **magnets**.

Do You Know:

Lucretius was the first person who wrote magical stories about magnets around the first century BC.

Magnetite is the natural magnet. It is found in the form of rocks. Sometimes, magnetite is found in large quantities in beach sand. It is also found in the brain of bees, some birds, and in humans

With the passage of time, people learned to make magnets from iron pieces. These magnets are known as **artificial magnets**. Like natural magnets, these artificial magnets can also attract iron objects. With the help of modern technology, artificial magnets having different shapes (for example, bar magnets, cylindrical magnets, and horseshoe magnets, spherical magnets) are also made.



a) Bar magnet b) Cylindrical magnet c) Horseshoe magnet

Remember, all the magnets, natural or artificial, always have two poles know as North-Pole (N) and South-Pole (S).

Let us have some fun with a magnet.

Properties of a Magnet

Attractive Property

Attach a magnet to one end of a long stick. Now, hold the stick and drag the other end (the one having the magnet attached to it) on the soil present in areas such as your garden, backyard, playground, and school. You will find that some soil particles stick to the magnet. When you observe these small particles carefully, you will see that they are iron filings. Make a table listing the amount of iron filings present in the soil at different locations. **Where do you find the greatest amount of iron filings?**

Naina has a box in which she keeps all the materials that are required during stitching such as spools of thread, wool, buttons, needles, and small bits of cloth. She is not able to find the needle in her box. **What is the easiest way to find the lost needle?**

Refrigerator stickers: Have you seen stickers that remain attached to the surface of refrigerators? These stickers have magnets attached to them. **Why do the stickers stick to the door of a refrigerator?**

Refrigerators are made up of magnetic material (iron). Hence, stickers having magnets stick to refrigerators.

From the given examples, you can easily make out the most important property of a magnet—**a magnet attracts objects made up of iron**. **This is called attractive property of magnet.** Apart from iron, the other materials that a magnet attracts are nickel, cobalt.

Identifying Directions Using a Magnet

Ramdin is a fisherman who often sails in the sea to catch fish. He always carries a marked magnet to help him in identifying the directions. **How does this magnet help him in locating the correct direction?**

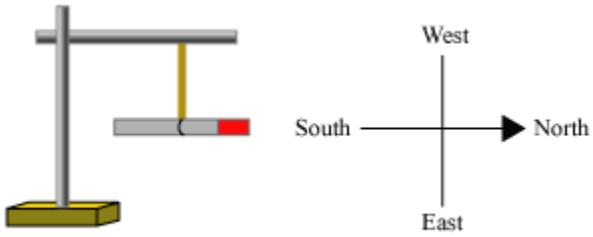
Do you know that **a bar magnet, when suspended freely, always comes to rest in the North-South direction.** You can confirm this fact by suspending a marked magnet by a thread. Notice the direction pointed by its marked end when it comes to rest.

Marking a bar magnet using the position of the sun

Stand on your roof with your face toward the sun in the morning. Since you are facing the East, your left hand will be toward the North and your right hand will be toward the South. Suspend a bar magnet and allow it to rotate freely. When it comes to rest, mark the end that points toward your left with red ink. Hence, your magnet becomes a **marked magnet**. The marked end of the magnet will indicate the North direction when suspended freely with a thread.

Identifying the four directions

To identify the four directions using your marked magnet (the marked end points toward the North), suspend the marked magnet with a thread, and wait until it comes to rest. The marked end will point toward the North, while the unmarked end will point toward the South, as shown in the given figure.



The magnet helps Ramdin in identifying the directions because when suspended freely, a magnet always aligns itself in the North-South direction.

In the making and working of a magnetic compass, the property of the North-South alignment of a magnetic needle is used.

In ancient times, sea travellers used to identify the directions with the help of marked bar magnets suspended by threads.

Rajeev's teacher gives him two identical, red-coloured needles. His teacher tells him that one is a magnetised needle, while the other is an ordinary iron needle and asks him to identify the magnetised one. How can Rajeev do so?

A simple magnetic compass

Magnetic compass

With the help of a magnetic compass, you can know the directions at a particular place. The red end of the needle indicates the North direction. Rotate the compass in such a way that its red end directly points to the letter 'N' of the compass. Now, observe all the four alphabets marked on the compass. These letters indicate the four directions at that particular place, in the same order.

Take a bar magnet and label its ends as **A** and **B**. **How would you determine which letter is on the north pole of this magnet?**

A bar magnet

Do You Know:

A Chinese emperor named Hoang Ti had a specially designed chariot having a statue of a lady fixed on it. The statue, which could freely rotate about an axis, had an extended arm to show the direction.

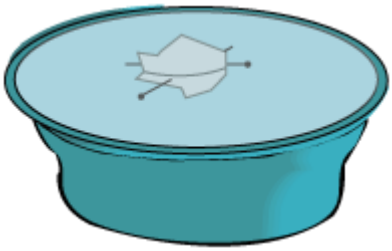
It was said that the extended arm of the lady always pointed toward the South when it came to rest. In this way, the emperor could locate his way when he was at a new place.

Why did the extended arm of the lady always point toward the South?

Artificial Magnets

Try to convert a nail into an artificial magnet by the touch-stroke method.

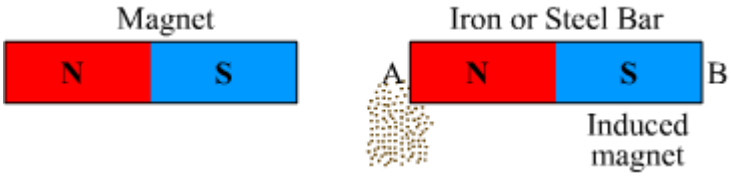
Take two identical iron pins and magnetize them by the touch and stroke method. Make sure that you are stroking both the pins with equal number of strokes so that they have the same strength as magnets. Now, take a small piece of thermocol and insert both the pins, as shown in the given figure. Place this piece in a small tub filled with water so that it can float. Gently rotate the piece in a particular direction and then observe its motion. **Can you guess when this piece of thermocol will stop rotating?**



Collect some objects. For example, a comb, a blade, a toothbrush, a nail, a needle, a stainless steel spoon, etc. Now, try to magnetize them one by one by stroking them about 100 times with a magnet. After stroking them, bring a pin near each of these objects. **Do all the objects attract the pin?**

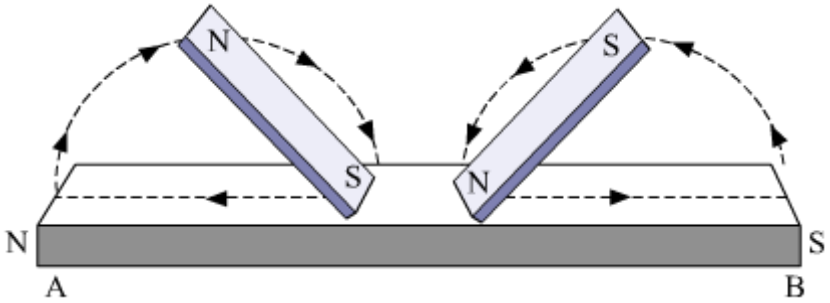
Induced Magnetism

When an unmagnetised magnetic material such as soft iron or steel is placed near or in contact with a permanent magnet, it acquires the property of magnet and gets magnetised. Now if the permanent magnet in contact with the material is removed, then the material loses its magnetism. This temporarily acquired magnetism is known as induced magnetism.



Try to convert an iron bar into an artificial magnet by double touch method.

Place an iron bar on a table. Take two bar magnets and place them vertically at the centre of the iron bar with their unlike poles facing each other. Move the magnets on the iron bar several times without changing the poles and direction. Now, when this iron bar is brought near some iron fillings, it is going to attract them showing that the iron bar is magnetised.



Magnetic and Non-Magnetic Materials

A visit to the junkyard

In a junkyard, there are many materials that can be recycled. First, the materials that are to be recycled have to be separated from the materials that cannot be recycled. This is usually done by using cranes. A crane has a large magnet at the end of its long mechanical arm. This is used to separate materials made up of iron from the rest of the junk. **How can the crane separate materials made up of iron so easily?**

All materials can be classified into two categories based on their behaviour towards a magnet.

*Materials that get attracted toward magnets are known as **magnetic materials***.

*Materials that do not get attracted toward magnet are known as **non-magnetic materials***.

Iron balls, nails, and coins are made up of magnetic materials as they are attracted toward magnets. Plastic scales, leather shoes, and candles are made up of non-magnetic materials as they are not attracted toward magnets.

Shamsher is a carpenter. One day, he accidentally drops some iron nails in a heap of wooden shavings. **How can he easily separate the nails from the wooden shavings?**

The magnet attached at the end of the mechanical arm of a crane is used to separate magnetic materials, i.e., those made up of iron, from the rest of the junk.

The given table lists some common materials/objects as magnetic and non-magnetic.

Material/Object	**Is it attracted by a magnet?**	**Magnetic or non-magnetic**
Iron nail	Yes	Magnetic
Plastic scale	No	Non-magnetic
Wooden block	No	Non-magnetic
Paper	No	Non-magnetic

Glass	No	Non-magnetic
Coin	Yes	Magnetic
Metallic clip	Yes	Magnetic
Drawing pin	Yes	Magnetic

Identifying magnetic materials

Get a magnet, try sticking it on various materials around you, and classify them as magnetic and non-magnetic. The magnet will be attracted only toward magnetic materials.

Iron in sand!

Attach a magnet to one end of a long stick. Now, hold the stick and drag the other end (the one having the magnet attached to it) on the soil present in areas such as your garden, backyard, playground, and school. You will find that some soil particles stick to the magnet. When you observe these small particles carefully, you will see that they are iron filings. Make a table listing the amount of iron filings present in the soil at different locations. **Where do you find the greatest amount of iron filings?**

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Refrigerator stickers:

Have you seen stickers that remain attached to the surface of refrigerators? These stickers have magnets attached to them. **Why do the stickers stick to the door of a refrigerator?**

Refrigerators are made up of magnetic material (iron). Hence, stickers having magnets stick to refrigerators.

Pin Holders:

You must have seen that in some pin holders, the pins stick to the cap of the holder. **Why do the pins stick to the cap?**

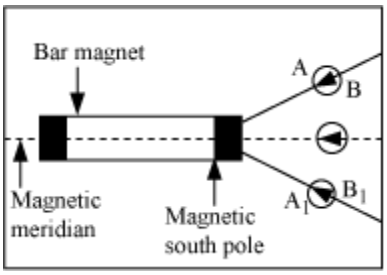
The pins are made up of magnetic material and the cap of the holder houses a magnet. Hence, the pins stick to the cap of the pin holder.

Tightening a screw:

When you use a screwdriver to tighten or loosen a screw, you might have seen that the screw sticks to the screwdriver easily. **Why does the screw stick to the screwdriver?**

A screwdriver has a small piece of magnet attached to its end and screws are made up of magnetic material. Therefore, a screw can be tightened or loosened easily using a screwdriver.

Magnetic Poles



- Take a white sheet of paper and fix it on a wooden drawing board.
- In the middle of the white sheet, draw a straight line.
- Place a magnetic compass needle on the drawing board and turn the board in clockwise or anticlockwise direction to align the needle with the line drawn on drawing board.

At this point, the drawing board is said to be in magnetic meridian.

- Place a bar magnet instead of the magnetic needle such that its axis coincides with the line on the paper.
- Mark the outline of the magnet.
- Place the compass needle near one end of the bar magnet.

  As the action of the earth's field is ineffective along the magnetic meridian, the compass needle will not show any deflection because of the earth's magnetic field. The compass needle is only attracted by the nearest pole of the magnet at this position.

- Mark the two ends of the needle by two dots as shown in the figure.
- Now, change the position of the compass needle and repeat the whole process for the new position of the needle. Take two such marks by placing the compass at two different places.
- Join the two marks by straight lines.
- You will see that the straight lines meet near the end of the magnet.
- It is this point of intersection that indicates the exact position of the magnetic pole of the bar magnet.

Try to find out the exact position of the other pole of the magnet.

The length between the two poles is called the effective length of the magnet. It is observed that the effective length of a magnet is 0.84 times the length of the real magnet.

So, have you found the answer to the question – **why a magnetic compass always aligns itself along the North-South direction**?

So far you have learned that *opposite poles of magnets attract each other whereas like poles of magnets repel each other.*

The answer to the question lies in this property of a magnet.

A magnetic compass works on this principle because the earth is considered as a huge bar magnet with its North and South poles aligned along the geographical South and North Poles respectively. Hence, the North pole of the magnetized needle in a magnetic compass is attracted towards earth's geographic North Pole and the South pole of the magnetized needle is attracted towards earth's geographic South Pole. Hence, the magnetized needle of a magnetic compass always aligns itself along the North-South direction.

Some interesting facts:

- Did you know that the only repulsive force that you have studied about is the magnetic force?
- Repulsion is considered the sure way for testing magnets. Do you know why?

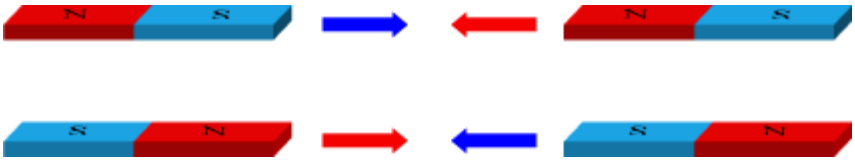
Magic trick

Pooja goes to a village fair. There, she sees a magic trick in which a frog is made to hover magically over a table defying earth's gravity. Pooja observes that the magician had slipped a magnet below the table and this made the frog rise in the air. **What made the frog rise in the air in the presence of the magnet?**

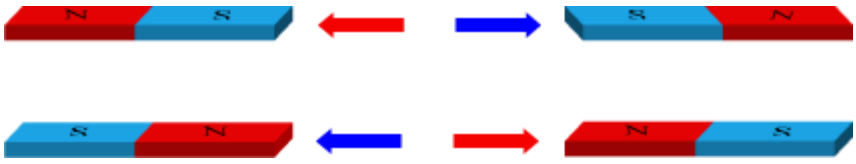
The frog behaves like a magnet. Hence, it is repelled by the permanent magnet placed below the table.

Like poles repel each other and unlike poles attract each other

- When north pole of one magnet is brought near to south pole of another magnet, we will observe that the poles will attract each other. Thus, we can say unlike poles of magnets attract each other.



- When two north poles or two south poles of magnets are brought close to each other, we will observe that the poles will repel each other. Hence, we can say like poles of magnets repel each other.



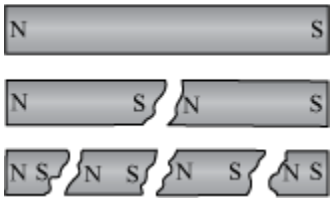
Repulsion is the sure test for a magnet

A magnet can either attract or repel another magnet, depending upon the type of poles. However, a magnet will always attract an un-magnetised magnetic material. Hence, attraction can take place for both but repulsion will take place only with a magnet. Hence, repulsion is a surer way of differentiating between an un-magnetised magnetic material and a magnet.

Magnetic poles always occur in pairs

Niraj has a bar magnet. He breaks it into two pieces. He then brings the broken ends of the pieces close to each other. To his surprise, the broken ends attract each other. Again he brings the broken end of one piece to the smooth end of the other piece. This time he observes that the pieces repel each other. **Can you explain why this happens?**

This is because **magnetic poles always occur in pair** i.e., you cannot separate a single pole of a magnet by breaking it into pieces. **When you break a bar magnet, each piece of the broken magnet behaves similar to a separate bar magnet.** Therefore, every piece will have one North Pole and one South Pole in it.



emagnetization and Uses of Magnet

Take a bar magnet and heat it strongly. Now, place an iron nail near this magnet. You will observe that the magnet does not attract the iron nail. **Why does this happen?**

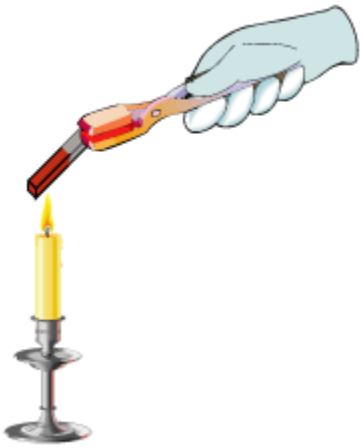
A magnet may lose its magnetic property if it is not handled carefully. Some common ways in which a magnet loses its magnetic property are discussed below.

a) When dropped from a height

A piece of magnet may lose its magnetic property if it is dropped from a height, such as the top of a building.

b) When hammered

A magnet may lose its magnetic property if it is hammered repeatedly.



c) When heated

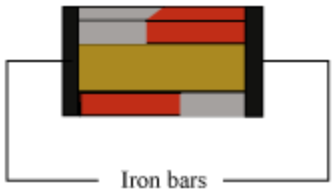
A magnet loses its magnetic property after being strongly heated and becomes an ordinary piece of metal.

Can you figure out some other ways by which a magnet may lose its magnetic property?

Magnets and electronic gadgets

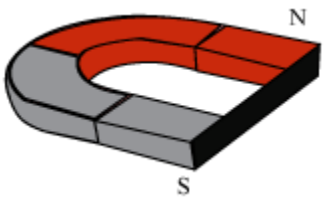
Placing a magnet near electronic gadgets such as TV, music system, wristwatch, cassettes, mobile phones, etc., may cause internal damage in them. Therefore, a magnet must be kept away from these gadgets.

Keeping magnets safe



- To ensure the working of bar magnets, they must be kept in pairs with a piece of wood in such a way that their unlike poles lie on the same side. The open ends of the bar magnets are covered with two pieces of iron bars that are placed across their ends.

Try to arrange four bar magnets in the way described above.



A horseshoe magnet can be kept safe by placing an iron bar across its poles, as shown in the figure.

You have a horseshoe magnet and a bar magnet. **How will you ensure the safety of these magnets?**

Uses of Magnet

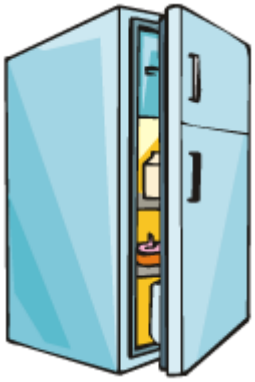
Magnets have very wide range of uses:

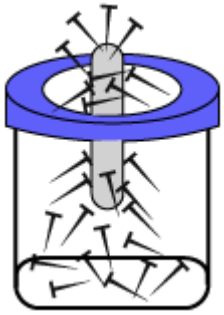
- **Magnetic compass**

  With the help of a magnetic compass, you can know the directions at a particular place. The red end of t needle indicates the North direction. Rotate the compass in such a way that its red end directly points to letter ‘N’ of the compass. Now, observe all the four alphabets marked on the compass. These letters indi the four directions at that particular place in the same order.

- **Magnets in daily life**

  You are familiar with the fact that magnets have a variety of applications in our daily lives. Magnets are used in refrigerator doors as pin holders, in screwdrivers, etc.





- **Magnet in junkyard**

  In the junkyard, you will see that a large magnet is attached at the bottom of the arm of a crane. The arm moves over a heap of junk and the magnet collects objects made of iron. The magnet used in a junkyard crane is not a natural or a **permanent magnet**. It is a **temporary magnet**,which is called an **electromagnet**.

- **Magnet in electrical appliances**

  Magnets are also used in many electrical appliances such as electric bells, telephone, telegraph, radio, loudspeaker, fans, electrical motors, electric generator, etc.

- **Magnet for security**

  While going to some important places like temples, buildings, airport etc. you will see equipments for insepection of people entering these places. These equipments uses

magnets and are known as **Metal detectors.** These metal detectors are also used in food-processing industry to detect any unwanted iron/steel objects mixed unknowingly in food stuff.