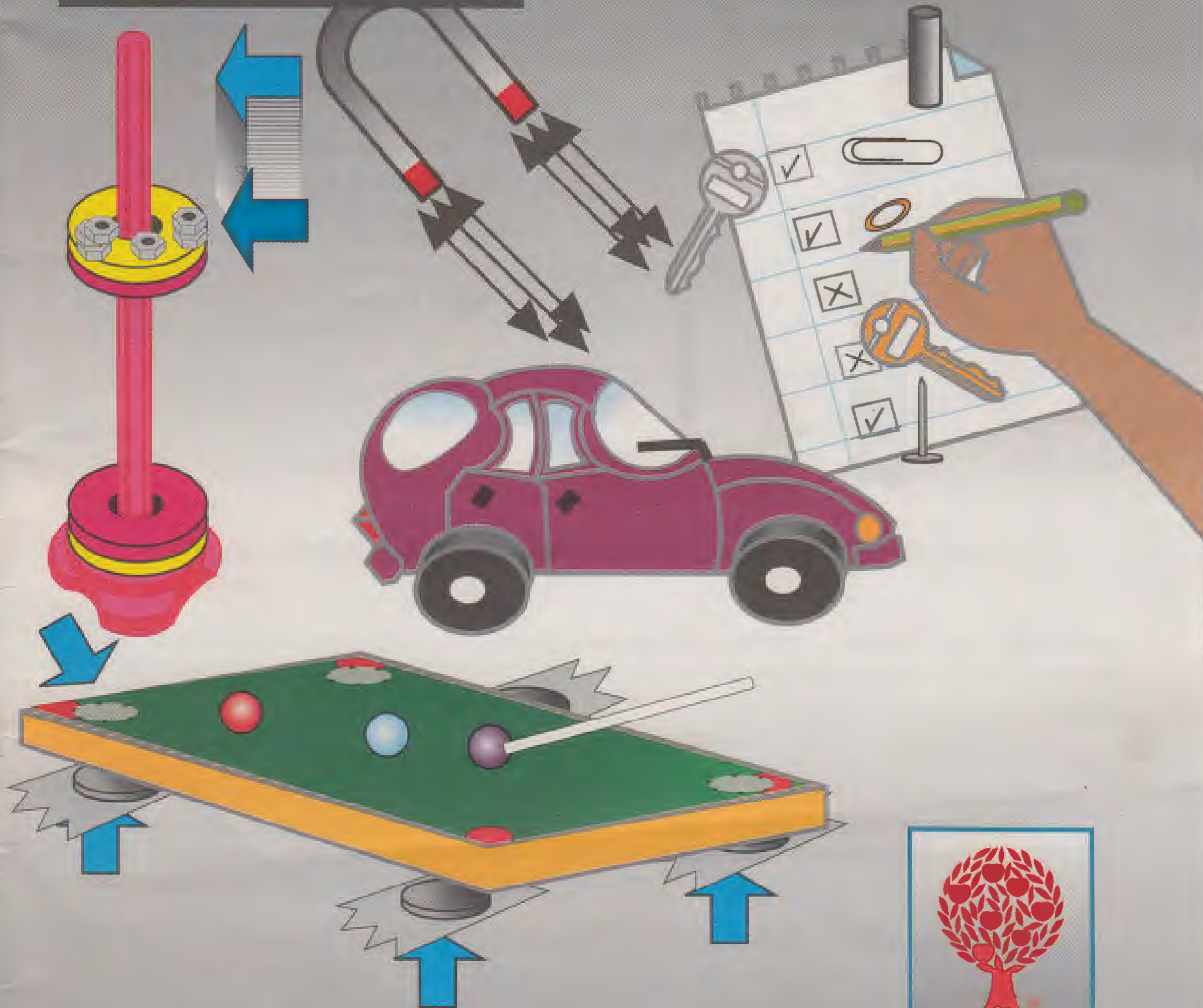
GO magnets

8+



⚠ WARNING:
Use under the direct supervision of an adult when handling parts with sharp points or edges.
Keep away from children under three years of age.

LETTER TO ADULT

This magnet kit has been designed for children from the age of 8 and up. It is primarily for playing with, and learning about magnets. While performing the activities, one learns how to conduct and follow them through, as well as learning how to draw conclusions.

The theory behind magnets is very complicated. We have attempted to explain a very small part of this theory and it appears in italic text through out the booklet. It is not essential for the child to read or understand this theory, however, if you can explain, it would be hepful for encouraging the child to learn.

In the booklet, there are several experiments/activities which require certain household objects (for example in Activity 2). The opportunity for the child to look around the house and search for each item is valuable as this helps to show that science is part of everyday life.

Most of the activities can easily be performed by children, however, we do suggest that you read this short booklet together with the child. You may feel that there are certain activities which are not suitable for your child at this stage of his/her development. When working with the child, it is important to stress that all parts of the kit not in use should remain in the box. After experimenting, the parts should be returned to the box.

Make sure that only batteries are used. Forbid the use of any other electrical source. This kit must be kept out of the reach of children below the age of three years as it contains small parts that may be a choking hazard.

We hope that both you as an adult, and the child playing with this kit will enjoy experiment and learning together.

INTRODUCTION TO MAGIC MAGNET

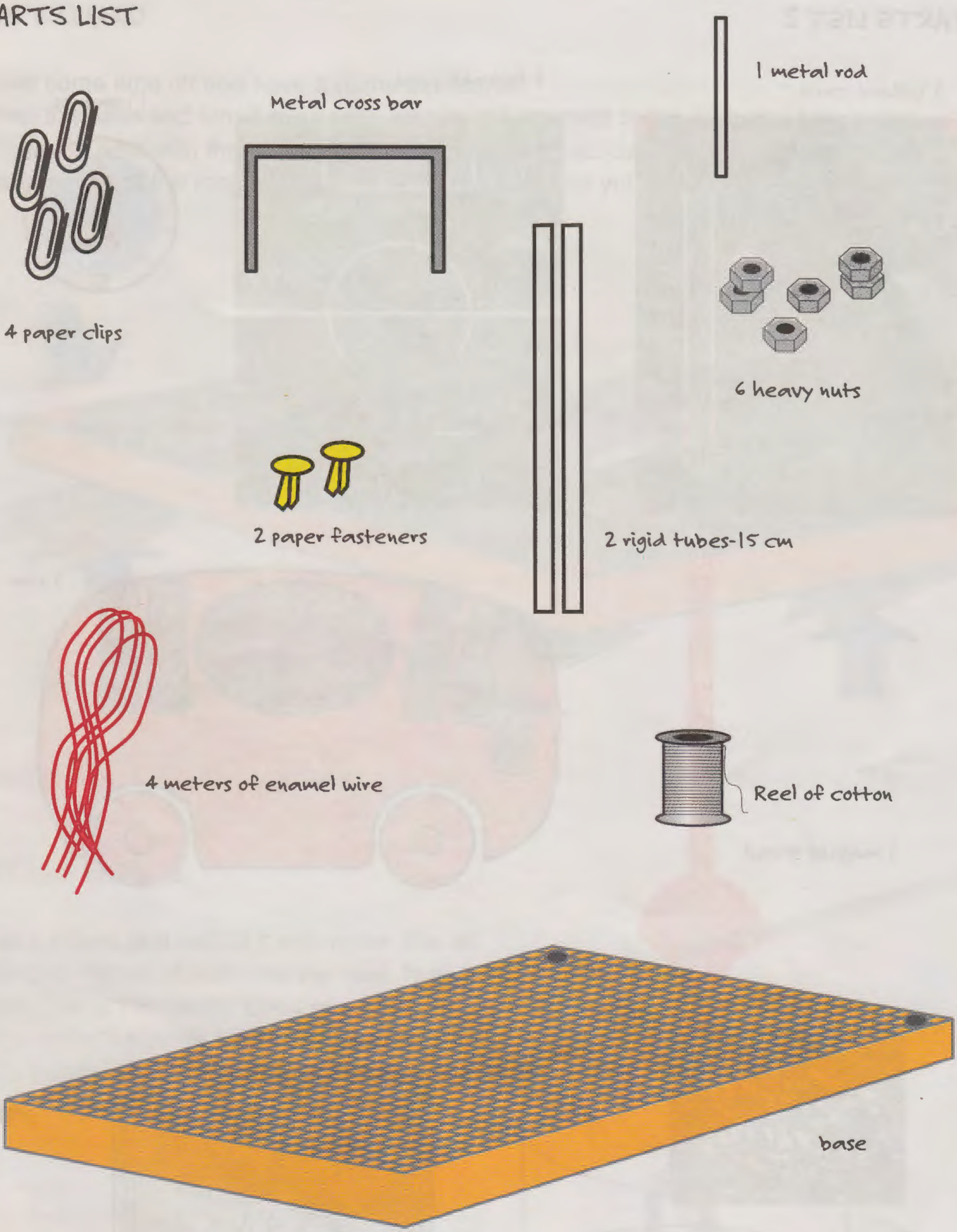
There is a story about a shepherd in ancient Crete whose name was Magnus. One day while tending the sheep, Magnus poked his metal- tipped staff into a pool of water, prodding the stones at the bottom. Suddenly, he felt the staff pull to one side. He thought most likely that an animal had caught it. He pulled on the staff and to his amazement, there was a stone stuck to the bottom. A stone had attached itself to the staff, without any explanation. The bottom part of Magnus's staff was metallic. We know that his staff being made of metal, was magnetic, but at that time in ancient Crete, such scientific facts were not known by everyone. Now, this stone is called magnetite. It is possible that the ancient Greeks also discovered the same stone - magnetite - at round about the same time - more than 2,000 years ago, in 500 BC. About 800 years ago, in the twelfth century, Chinese sailors hung a piece of stone on to a pole off the edges of their boats, so that it hung undisturbed. They found that it always pointed North and South, so that they managed to work out in which direction to travel. Even if there was a fog, or if it was dark and had no way of seeing the stars or sun which they used for navigation, they could distinguish in which direction to travel. Yes, you have probably guessed -this was the first compass. Compasses are still used today for navigation in ships and aeroplanes. Later on in this booklet, you will find out how to make your own compass.

The scientist who was probably the first to turn magnetism into an applied science was Sir William Gilbert, an Englishman who lived between 1544 - 1603. He worked as a proper scientist should, by experimenting, making notes of what he did, thinking carefully and methodically, questioning his findings, and coming to conclusions. We hope that you too will follow his footsteps and in your own way, will experiment, note, question and learn, with a little help from this kit about magnetism, as well as other scientific facts.

1. EXAMINE YOUR MAGNETS

Take a close look at the magnets in your kit.
- Horseshoe magnet.
- Two oblong magnets with a hole in middle, be very careful as if these fall, they may shatter.
- One bar magnet in a plastic case.
- Four round flat magnets, these also may shatter if they fall.
- Two ball magnets.
- Two disc magnets.

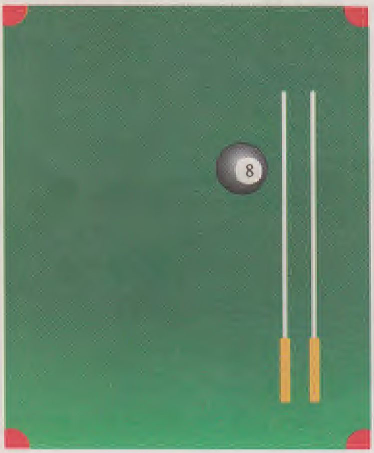
PARTS LIST



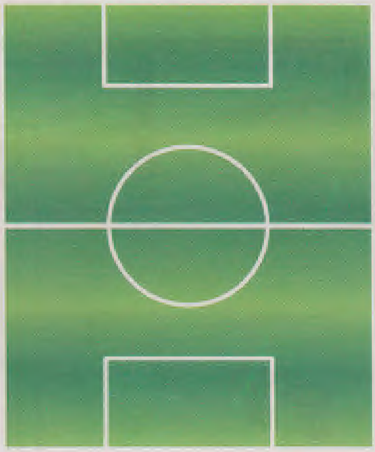
1 metal rod
Metal cross bar
4 paper clips
6 heavy nuts
2 paper fasteners
2 rigid tubes-15 cm
4 meters of enamel wire
Reel of cotton
base

PARTS LIST 2

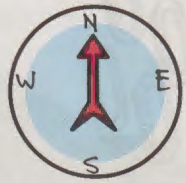
1 billiard card



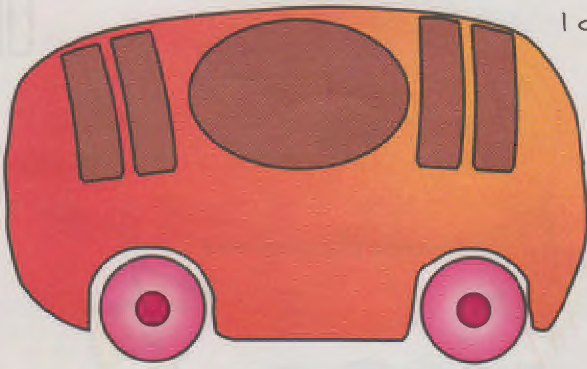
1 football card



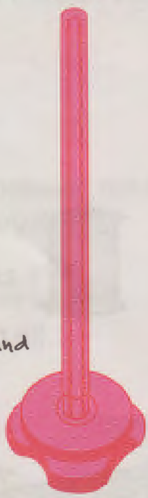
1 compass

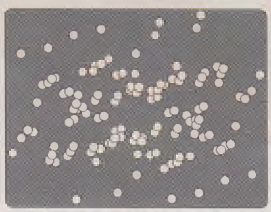


1 car



1 magnet stand

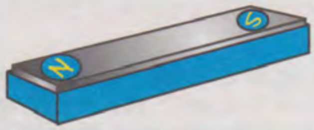




1 pcs of sand paper

1 Frame with iron powder

horseshoe magnet



One bar magnet in a plastic case

two disc magnets

two oblong magnets

four round flat magnets

two ball magnets

As you can see, magnets come in all shapes and sizes.
Some of the magnets in your kit are marked "N" and "S", this shows the North and South poles of their magnet.

Look around the house and see if you can find any another magnets, in the kitchen, in the bathroom, amongst your toys or in any other room you think will be lucky to find a magnet.

If you find any that are not being used, add them to your kit, so that you can experiment with them together with the magnets in the kit.

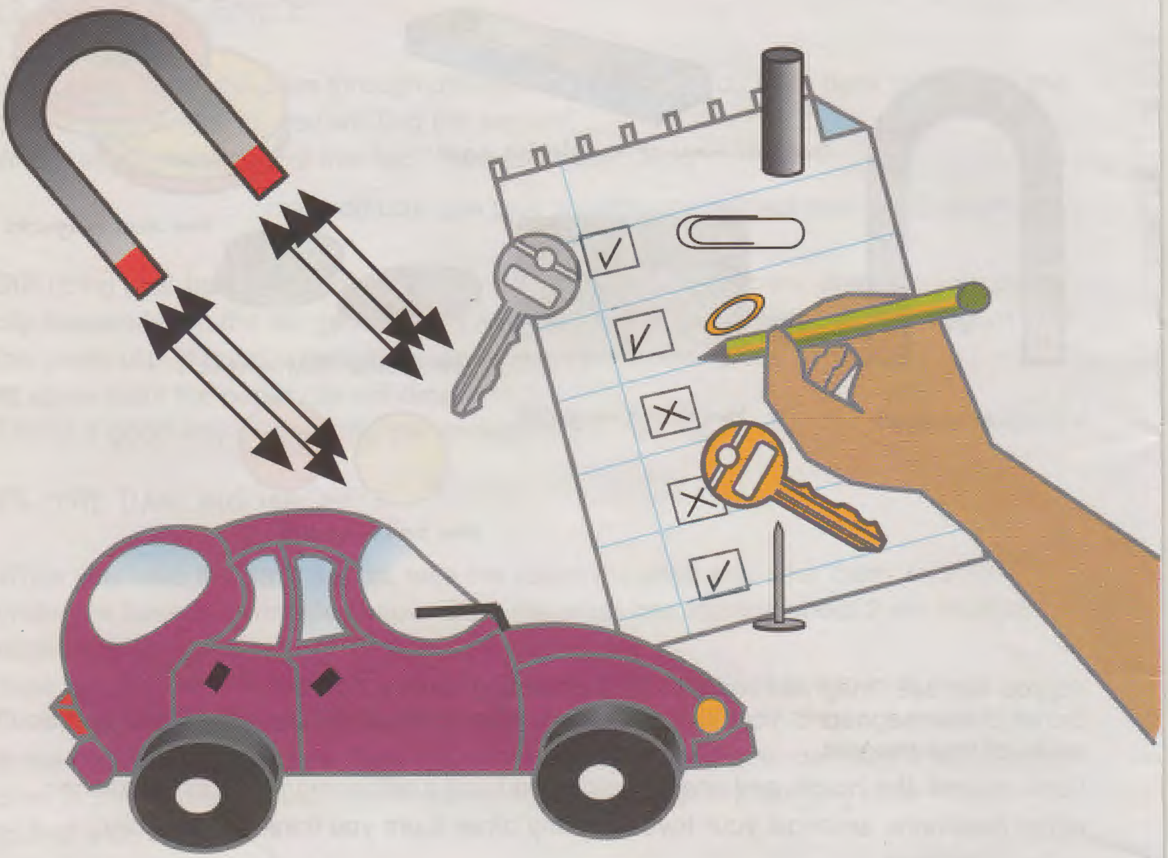
2. WHAT MATERIALS DO MAGNETS ATTRACT?

What do all the magnets have in common? Lets see if you come up with the answer. Is it the colour? Is it the material they are made of?

Magnets always have two different poles: North and South. These may be at the ends of the magnets or at the top and bottom of the magnets.

Do they stick to anything? What do they not stick to? Well you probably have found out that magnets stick to metal, but do they stick to all metals? See if you can make a list of metal objects that magnets attract or stick on to.

The refrigerator door - A spoon - A coin
A key - A nail - Magnet - Coke can
Wood - Plastic - Glass - Door Handle



From this you will see that not all metal objects are attracted by a magnet. Some items you chose are made of stainless steel, aluminium, brass, copper, silver and gold: none of these metals are attracted by a magnet. But don't be fooled, you may find an object that looks as if it is made of copper, but in fact it is only plated with a very thin layer of copper. You may find the same with gold and silver as these are also used frequented as plating,

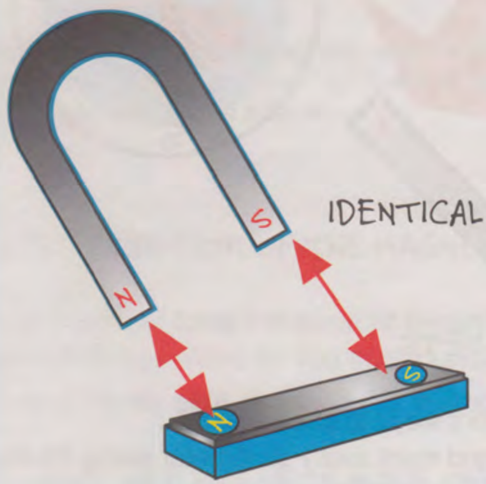
In the previous activity, you found that some things are attracted to magnets and some are not. Why is this?

This is difficult, ask your teacher if you have problems understanding this. Iron, like all elements, is made up of millions of atoms. Atoms are minute particles (they cannot be seen by the eye) that are specific for each element. Every element has its own specific atom number. The properties of elements are determined by this structure. In iron, atoms tend to exchange electrons between themselves. This exchange alters the internal structure of the atoms, causing changes in internal electrical charges. These changes can be altered by outside influences and this is called the MAGNETIC FORCE.

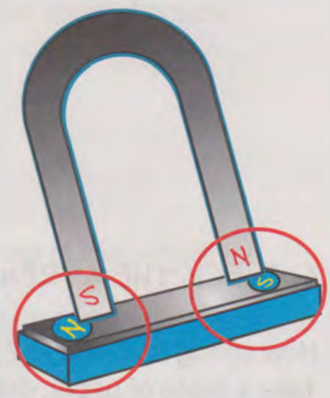
Now all this is very complicated. However, one thing is important to understand. There are thousands of different types of metals and all these are compounds of different elements and chemicals. Due to this, some compounds are influenced by magnets, while others are not.

3. OPPOSITE POLES ATTRACT - IDENTICAL POLES REPEL.

Look at the horseshoe magnet and the bar magnet and you will see they have (N) for north and (S) for south marked on them. Stand the horseshoe magnet on the table so that it looks like a big "C". Take the bar magnet and gently hold it so that the (S) is opposite the (N) on the horseshoe magnet. What happened? Did they stick together?
Now take the magnets and hold the (N) of one magnet opposite the (N) on the other, what happened? From this experimente you have learned the basic principle of magnets: OPPOSITE POLES ATTRACT - IDENTICAL POLES REPEL.



IDENTICAL POLES REPEL

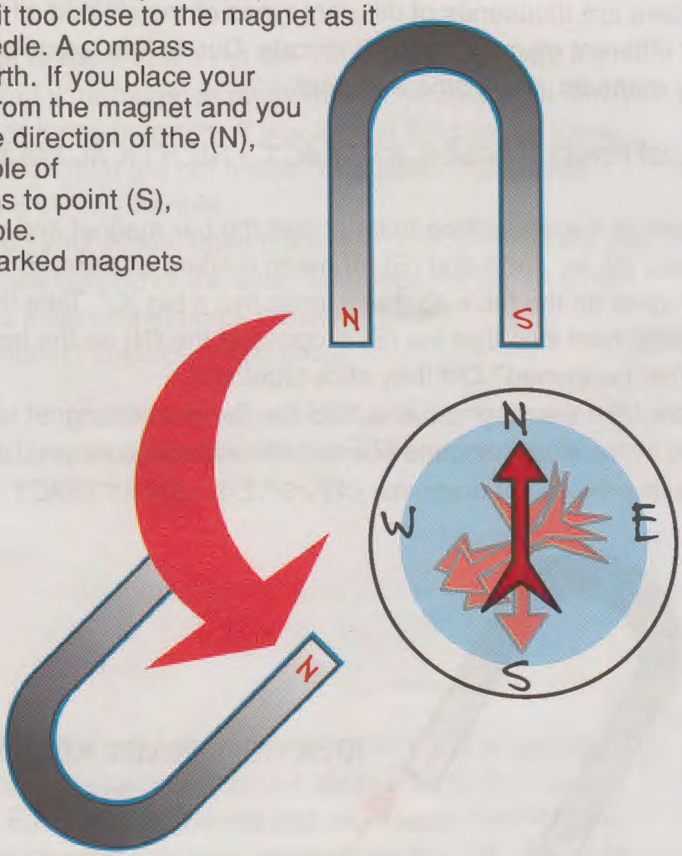


OPPOSITE POLES ATTRACT

4. FIND THE POLES OF YOUR MAGNETS

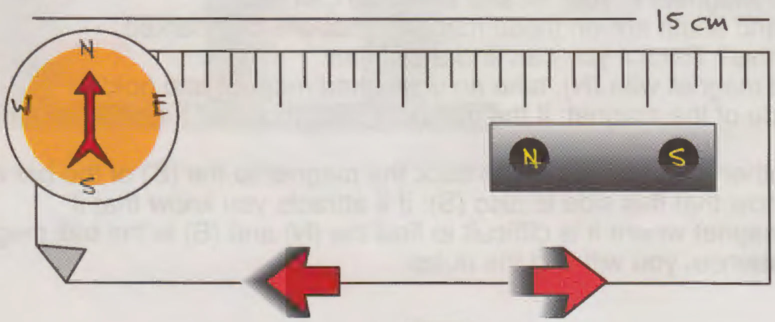
Lets check all the magnets in your kit and see if we can find where the north and south are on those magnets that are not marked.
How can you do this? Think if you can find a solution.
Take one marked magnet with (N), take an unmarked magnet and hold it next to the (N) side of the magnet; if the magnets stick together then the unmarked magnet is (S)
Take one of the other magnets and try to stick the magnet to the (S) of the bar magnet. If it repels, you know that this side is also (S): if it attracts you know that it is (N). The only magnet where it is difficult to find the (N) and (S) is the ball magnet, but with a little patience, you will find the poles.

5. Another way to find the poles is to use your compass, but be very careful not to hold it too close to the magnet as it may damage the magnetic needle. A compass needle always points to the north. If you place your magnet 10 centimeters away from the magnet and you see that the needle turns in the direction of the (N), then you have found the (S) pole of your magnet. If the needle turns to point (S), then you have found the (N) pole.
The best way to test your unmarked magnets is to stand them on their sides.



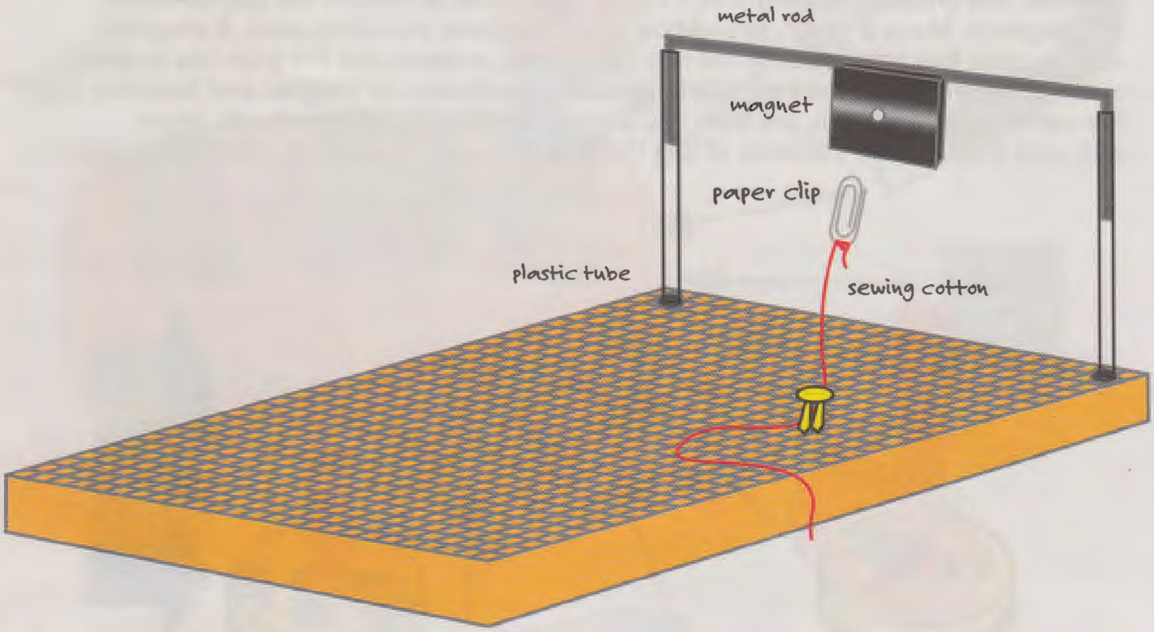
6. CHECK THE STRENGTH OF YOUR MAGNETS

How strong is a magnet? There are many different ways to check this.
Take a piece of paper, draw a line 15 cm long, and mark every centimeter along the line. Draw a circle at one end of the line and place your compass in it. Now take each of your magnets and starting at the other end of the line, push them slowly along the line; watch carefully when the needle on the compass starts to move. This will give you an indication of how far the magnetic field reaches.



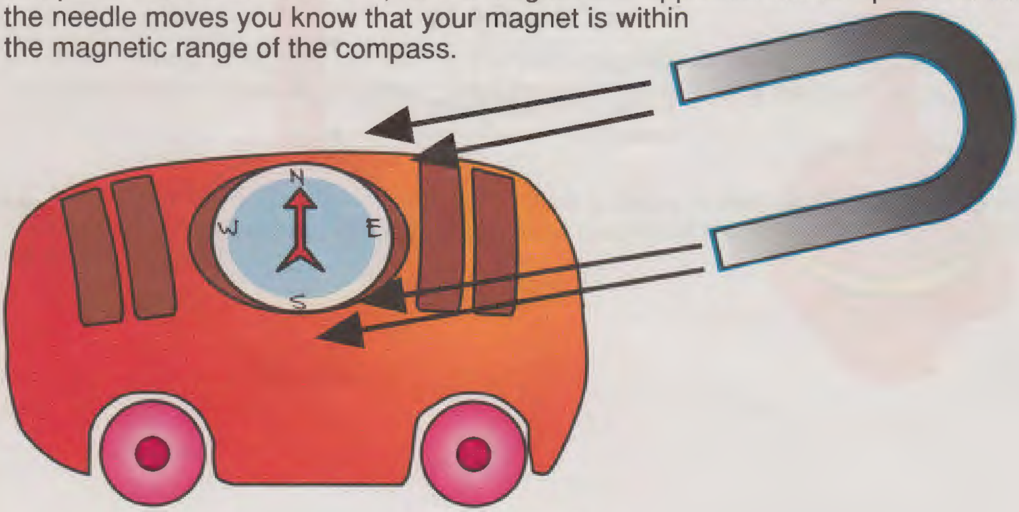
7. INDIAN ROPE TRICK

Another way to check the strength of the magnetic force is to set up your magnet experiment bar. Tie a piece of thread to a paper clip and let it hang from the cross bar. With one hand hold the thread till it is about 5 centimeters from the base. Place the magnet you want to test under the clip and gently pull on the thread till the paper clip stands very straight: that is when the magnet has attracted the paper clip.



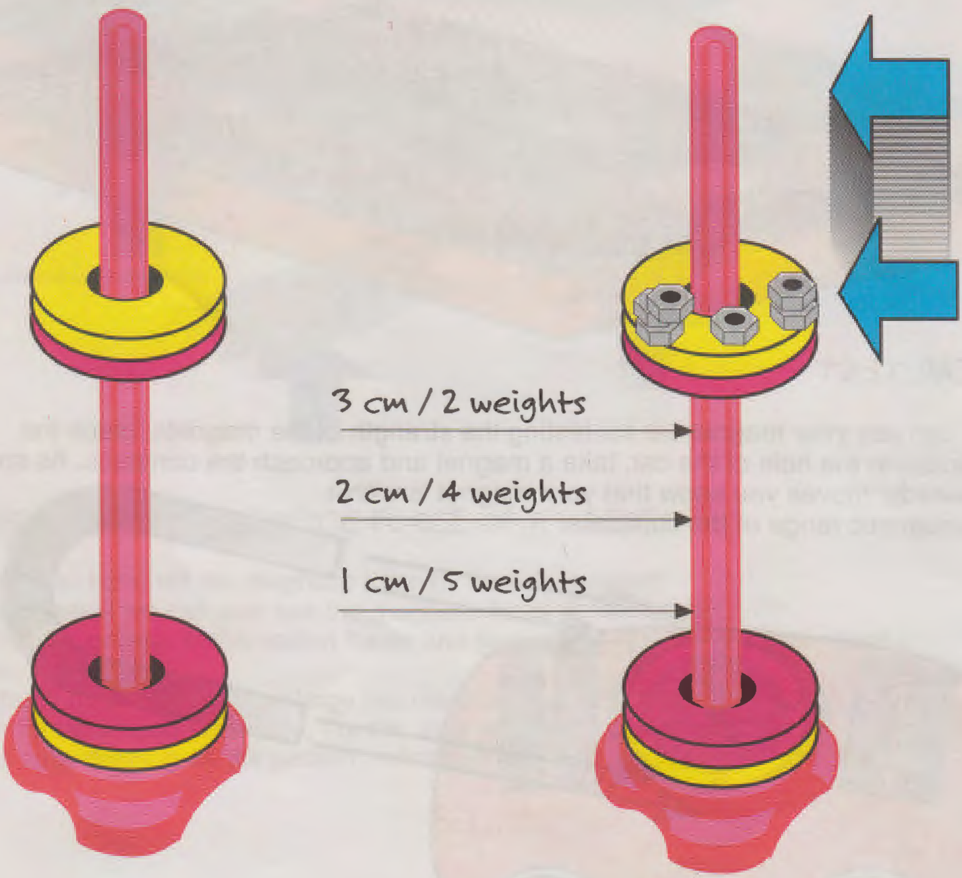
8. CAR TEST

You can use your magnet car for testing the strength of the magnets, place the compass in the hole of the car, take a magnet and approach the compass. As soon as the needle moves you know that your magnet is within the magnetic range of the compass.

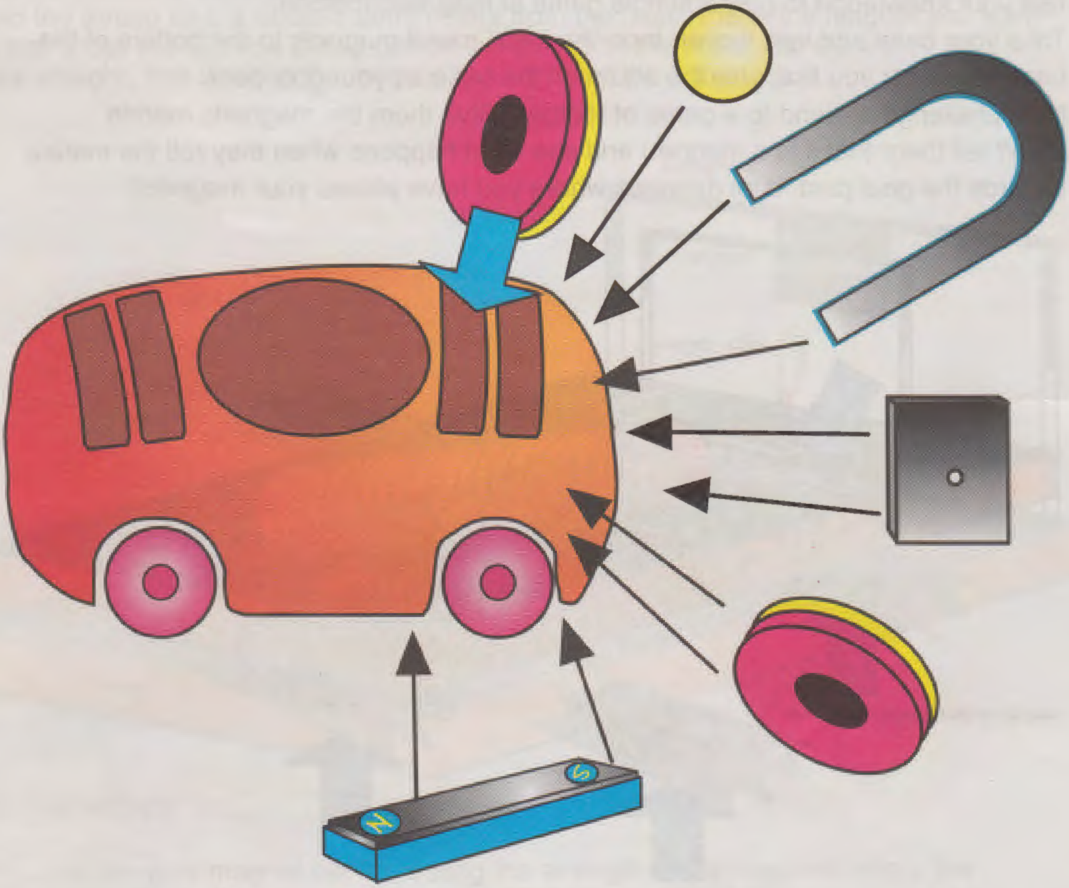


9. IDENTICAL POLES REPEL-WILL THE MAGNETS TOUCH EACH OTHER?

Take your magnet stand and place one of the Disc magnets on it , than take the other disc magnet and also put it on the stand in such a way that the magnets repel each other. By now you know how to do this. The second magnet remains in the air. Take a washer from your kit, drop it onto the top magnet and see how far the magnet goes down, Keep adding washers till the magnets meet. Note that the closer the magnets become, the greater the weight that has to be applied to reduce the gap between the magnets. Make a graph to see how many washers you have used. A magnetic railway uses this principle: the rail is a very strong magnet and the train has a strong electromagnet. When the train starts to move, it activates its magnet and because it has the same pole as the rail, the train lifts slightly off the rail and the wheels move with very little friction: because of this these trains can travel at over 300kms an hour.



10. Take the magnet car and place one disc magnet into the front slot: now with another magnet make the car go forward or backwords. Try the different magnets to see which pushes or pulls the car best.

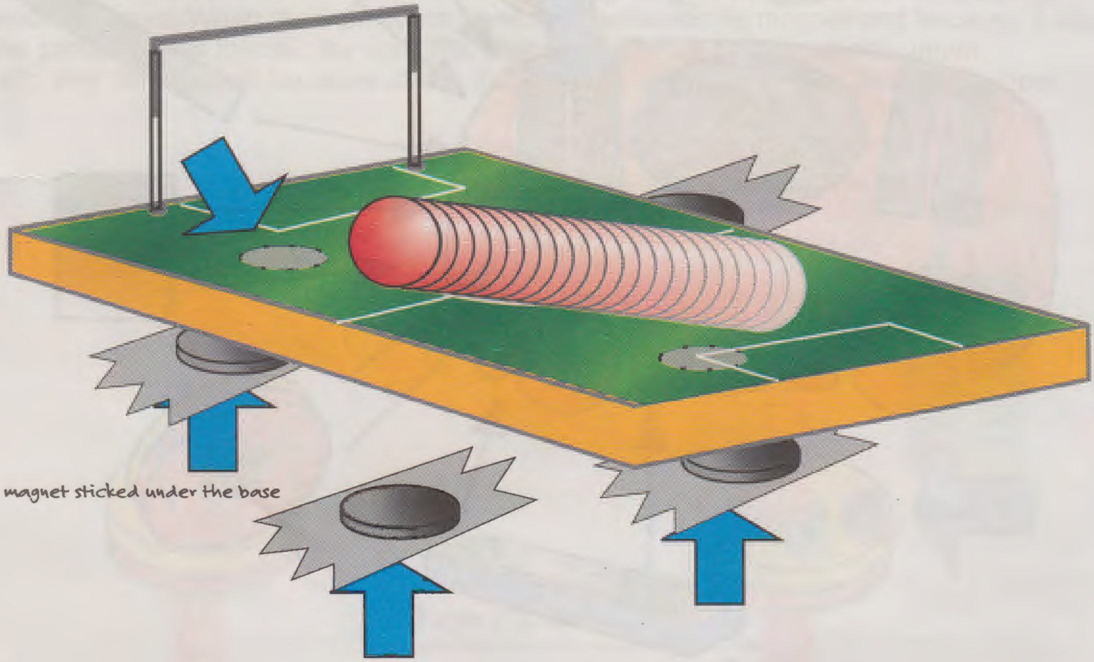


11. Ask a friend to try and put two of the disc magnets in the first two slots in a way that the same colours face each other. Than you can tell him why he can't do this.

12. While you have your friend with you place a disc magnet on the table, find a glass marble and put the marble into the hole. Now give your friend the magnetic marble and tell him to do the same.

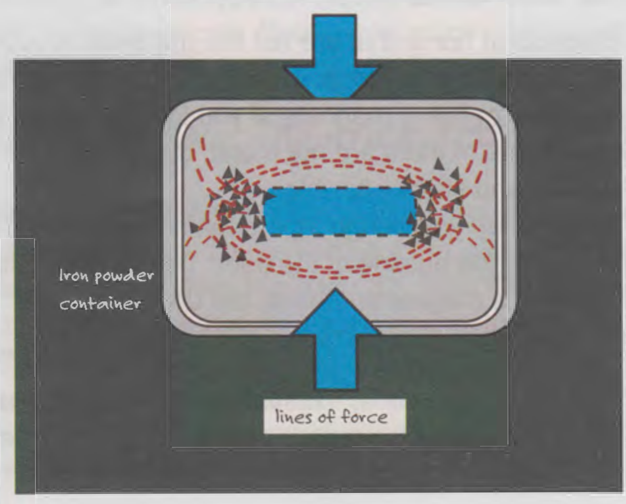
13. PLAY MAGNETICOOTBALL

Now that you have seen a little of what magnets can do,
use your knowledge to play a simple game of magnetic football.
Take your base and turn it over: tape the small round magnets to the bottom of the base wherever you like. Use the stand on the base as your goal post.
Now challenge a friend to a game of football. Give them the magnetic marble (don't tell them that it is a magnet) and see what happens when they roll the marble towards the goal post. It all depends where you have placed your magnets!



14. DISCOVER THE MAGNETIC FORCE OF A MAGNET

Now that you have felt the magnetic force by holding magnets apart, lets see if we can also see the magnetic force of the magnet.
Take the iron powder in the sealed frame and shake it so that the powder is evenly spread.
Place the frame on top of your large bar magnet and see how the powder forms around each pole. Try this also with the disc magnet.
Make a copy drawing of the pattern: what conclusion do you come to?



Take one of the small magnets and move it around on the top of the iron powder frame. And you can "draw " pictures in the powder by moving the magnet around. See if you can make a face.

15. DISTRIBUTION OF THE MAGNETIC FORCE

Is the magnetic force the same all through the magnet or are there places where the strength is less. What do you think? (ANSWER UPSIDE DOWN)

The middle of the magnet is much weaker than the N / S ends.

16. WHAT ARE MAGNETS MADE OF?

Can any material be used to make a magnet? What would be your guess? Look at the magnets in your kit: you will notice that they are all black or dark gray (not counting the plastic covers to prevent them from breaking).

The magnets in your kit are called ceramic magnets. They are made from a material that has a large amount of iron powder mixed with ceramic powder and is heated to a high temperature under pressure. The strongest magnets are made of special steel: the harder the steel the stronger the magnet. The milder or softer the steel, the weaker the magnet. Magnets made of very mild steel loose their magnetic power quickly and are not permanent magnets.

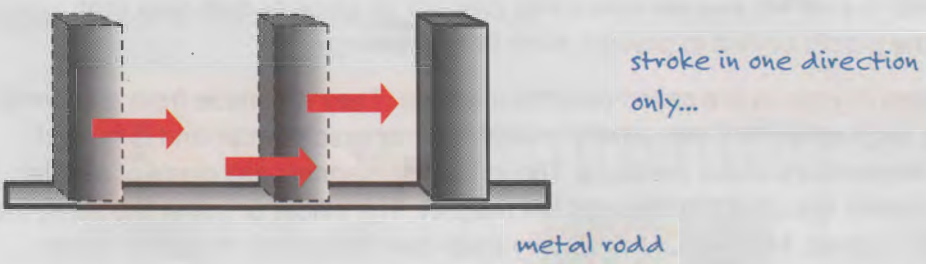
17. MAGNETS AT HOME

Can you think of any magnets at home that are not like the ones in your kit?
Here is a clue! Look at the door of your fridge: in many homes, people stick notes on the fridge door with decorative or funny magnets. If you look at the back of these magnets, you will see that some of them are not metal, but plastic. The plastic magnets are brown coloured and slightly flexible.
If you don't have any magnets on your fridge, open the fridge door and you will see a rubber type material all around the outside of the door. Take a paper clip or a nail and see if it sticks to it! This is a magnet that holds the door closed.
Can you magnetize plastic or rubber? (ANSWER UPSIDE DOWN)

No, you can't: the plastic and rubber magnets are made by mixing iron powder into the plastic and only then can you magnetize them.

18. MAKE A MAGNET ADULT SUPERSION

You can make a simple magnet by taking a paper clip or the iron rod in your kit and rubbing it along the length of the large bar magnet, but always rub in the same direction, from North to South. Each time lift the rod and rub it again from N to S. Do this about 30 times and then check if you have magnetized the rod. Check the strength of your rod magnet and then check again after a few hours to see if it has lost its magnetic force. You can remagnetize it the same way as before. Now heat the rod slightly with a candle: be careful not to burn your fingers. Check the strength of your rod magnet again, you will find that the heat has destroyed the magnetic force.

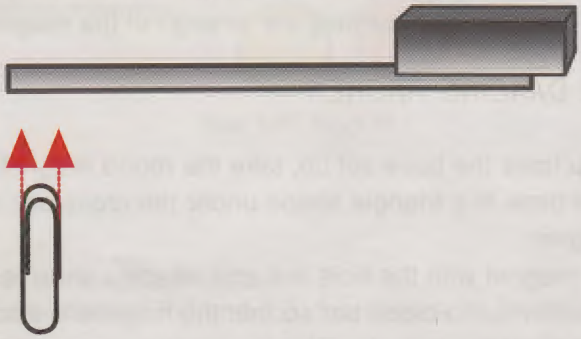


19. MAKE A STRONGER MAGNET. ADULT SUPERVISION

You can make a much better magnet by taking a large sewing needle and magnetizing it in the same way as you did with the rod. Check if the needle remains magnetized for longer: it should, because a needle is made of steel with which you can make a permanent magnet.

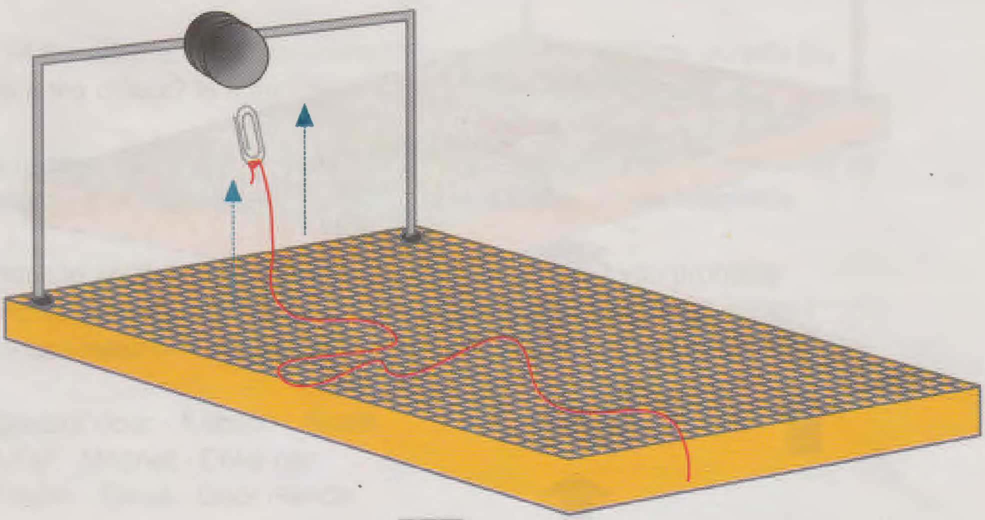
20. TRANSFER MAGNETIC FORCE

How you can transfer magnetic force?
Try this: Take an iron rod and stick it to one of the strongest parts of the bar magnet. Now, with the iron rod still attached to the bar magnet try to pick up a pin or a paper clip with it.



21. INCREASE MAGNET POWER

Set up the indian rope trick again as in activity 7 stick two round magnets on the crossbar. Now bring the paper clip close to the magnets ad see how large is the distance between the magnets and the paper clip.
Add the third magnet as the distance of the paper clip increased.
Does that show that the magnet became stronger?



22. MAGNETIC FORCE

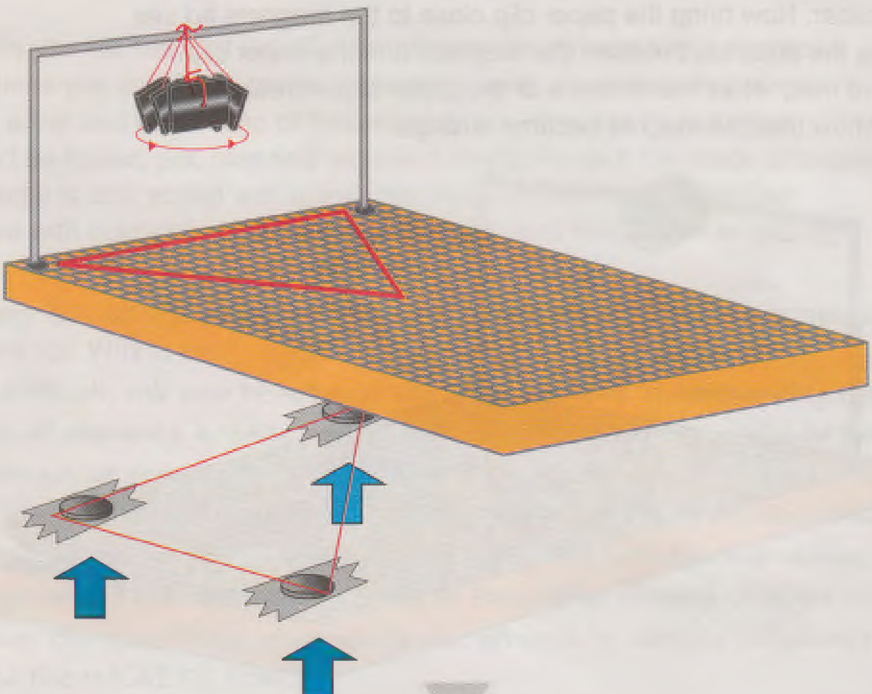
Does magnetic force pass through different materials? If you think back to some of the previous experiments, you will find the answer.
Which experiments prove this fact? (ANSWER UPSIDE DOWN)

The football game and the electromagnetic field with iron powder.

Still using your base and cross bar as in the previous experiment, and with your paper clip suspended in the air, gently insert a small piece of paper between the magnet and the paper clip. If the clip remains suspended, try a thicker piece of paper.
At some point the paper clip will drop.
This is a good way of checking the strengh of the magnet.

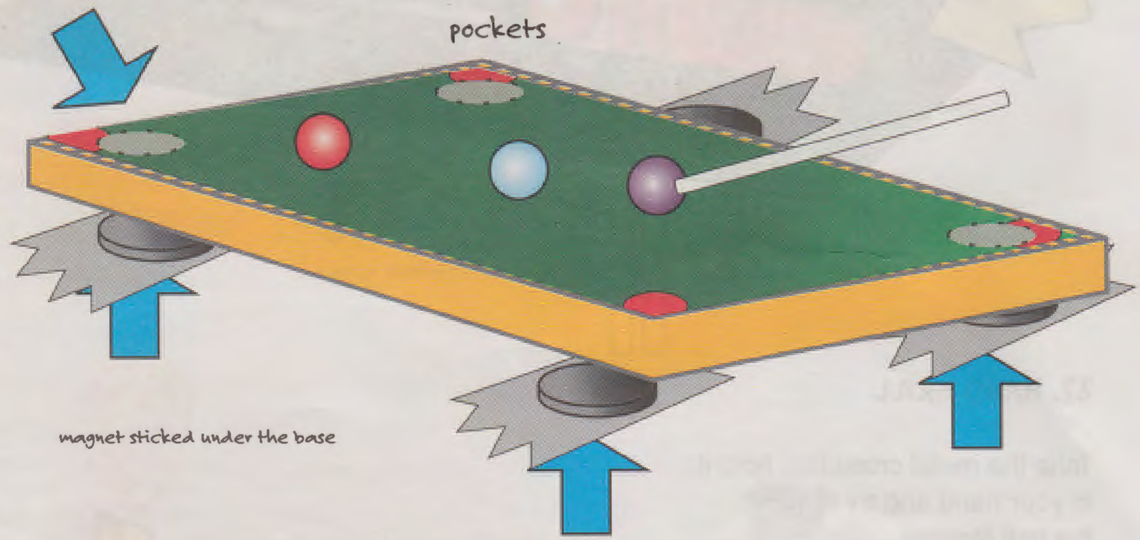
23. THE DANCING MAGNET

While you have the base set up, take the round magnets and stick them with tape under the base in a triangle shape under the cross bar, leaving about 2 cm between each magnet.
Take the magnet with the hole in it and attach a short length of cotton to it.
Tie the cotton to the cross bar so that the magnet is about 2 cm above the base and in the middle of the triangle. Give it a small push and it will start dancing: if there is no draft in the room it will continue to dance for a long time. Try hanging other magnets to find which is best.



24. BILLIARD

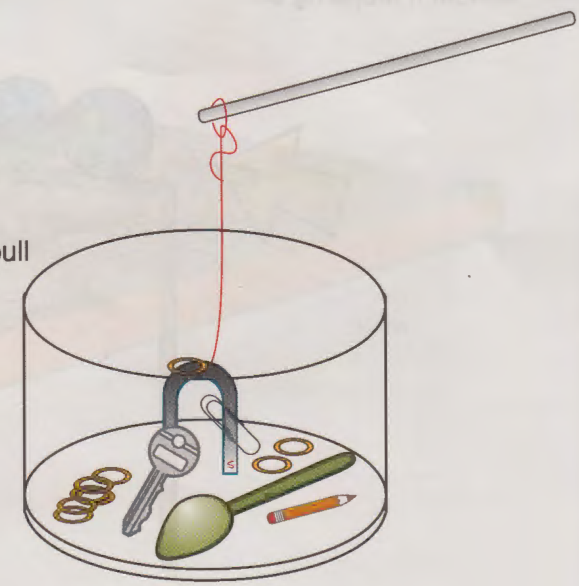
Take some time off and have a game of billiards.
Take the base and turn it over; tape your round magnets to the corners of the base. Place the card with the billiard table on top of the base. Using the two plastic tubes as cues knock the magnetic balls into the "pockets" on your billiard table.



25. GO FISHING

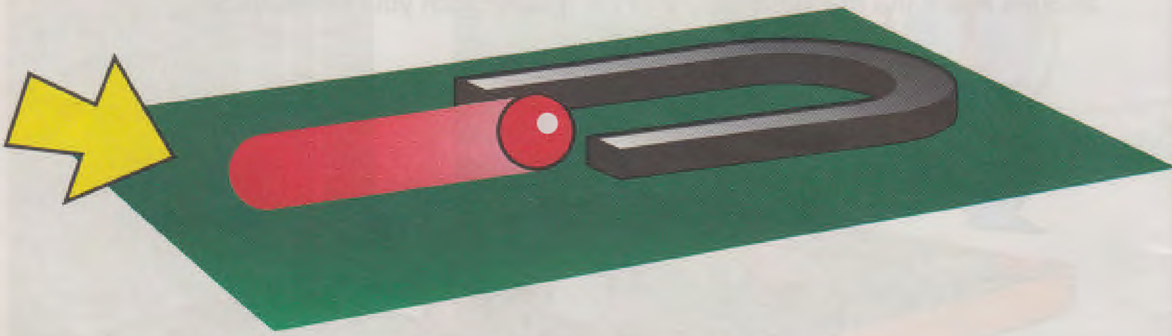
Take a bowl and half fill it with water. Put all sorts of metals objects into the bowl. Now take one of the plastic tubes or a stick and tie one of the magnets onto it with thread.
Go fishing and see how many "fish" you can pull out in a given time, say 30 seconds.

Try this with a friend.



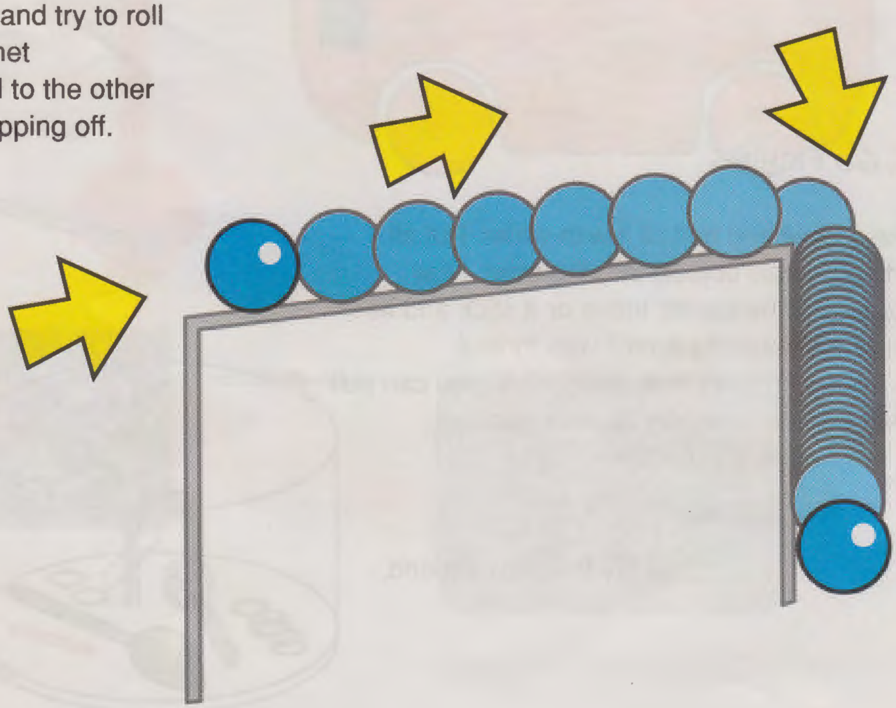
26. PLAY GOLF

Take your horseshoe magnet and lay it on the table.
Now take the magnetic ball and roll it so that the ball goes through the arms of the magnet all the way to the back. This needs practice!.



27. HAND SKILL

Take the metal cross bar, hold it in your hand and try to roll the ball magnet from one end to the other without it dropping off.



28. UNDERSTANDING YOUR COMPASS.

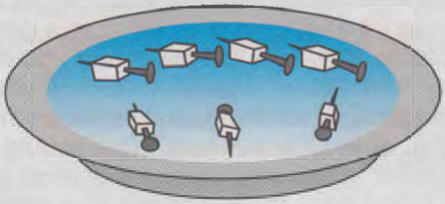
Lets go back to our shepherd who found the first magnet and the Chinese who used a magnet as a compass. What is a compass used for? Take your compass outside, hold it in you hand and you will see that the needle points to the North. Now to prove that, look where the E (East) points to: is this the direction where the sun rises every morning? and the W (West), is this where the sun sets? This should prove that your compass is O.K. Look for a map at home and you will see that most maps have a sign pointing to the north. Place the map on the table and put your compass on the map; turn the map around until the North of the map is in the same direction as the North on your compass. Find the town where you live on the map and choose a place you want to go to just by using the compass. Lets say it is due north.
Go outside, hold your compass in your hand and see where north is. Look for a house or a tree
which is in line with the North and walk over to that spot. Keep going North until you get to where you wanted to go.
Years ago sailors used the stars as pointers to sail in the right direction.
No trees or houses on the sea!

The earth is like a big bar magnet, one end the North Pole and the other end, the South Pole. Any magnet suspended between these poles will line up with the lines of the magnetic force. Your compass, being a magnet, will always align itself so that it points to the North or the South. However, there is one small difference. A compass points to the Magnetic North Pole, which is a distance from the true North Pole. All navigators have to keep this in mind, therefore they have to make a correction in their calculation when navigating.

magnetic field
surrounding the earth

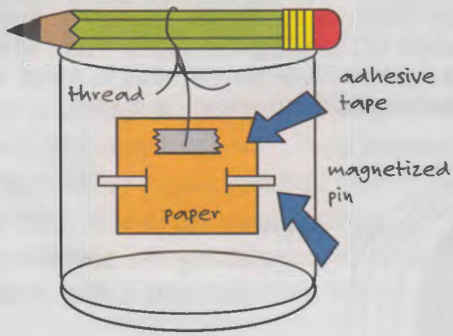
29. MAKE YOUR OWN COMPASS.

If you did not have a compass. you could make one.
Take a pin or a small needle, magnetize it as you did before by rubbing it on a magnet, but make sure that the point is rubbed towards the North.
Find a piece of styrofoam from some old packaging and break off a very small piece.
Stick the pin through the middle of the styrofoam.
Now take a small dish and fill it with water: float the needle on the water and you will see that the point will turn around to the north.



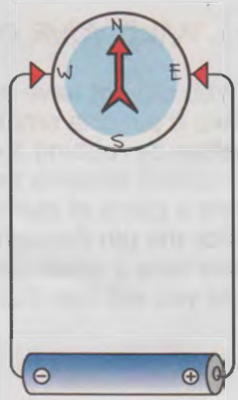
30. MAKE A BETTER COMPASS.

Find a beaker or a glass, and a pencil. Magnetize a pin or a needle as you did in the previous experiment and thread it through a small piece of paper.
Take a length of cotton thread and attach one end to the paper with the pin, with adhesive tape. Attach the other end to the pencil and place the pencil on the top of the glass so that the pin hangs in the middle of the glass. You now have a perfect compass: check it against the compass in your kit.



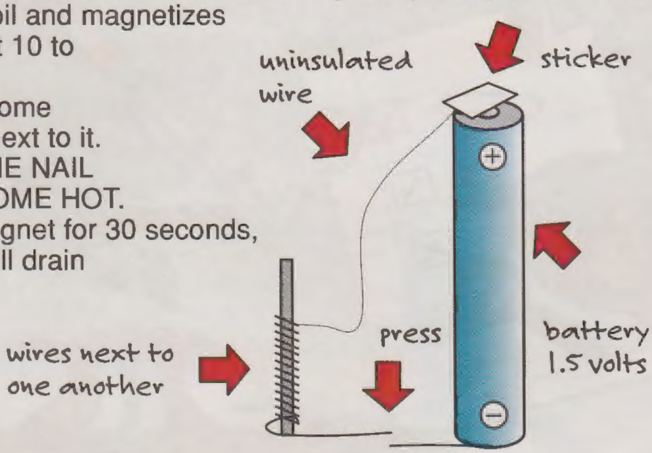
31. ELECTROMAGNETS ADULT SUPERVISION

In 1820,a Danish scientist, Hans Christian Oersted, noted that a magnet is influenced by electricity flowing through a wire. You can do the same experiment. Take a wire and pass it under your compass in a straight line and touch the ends of the wire to a battery. The compass needle changes direction! This shows that when electricity flows through a wire it creates a magnetic field. If you wrap the wire around a nail and then connect the wire to a battery, you create a magnetic field that magnetizes the nail.
The use of electricity together with magnets is very common today. Some familiar examples are electric motors, generators and loud speakers.
Beware the battery may get hot



32. MAKE A SIMPLE ELECTROMAGNET. ADULT SUPERVISION

The principle of electromagnetism is used in thousands of different ways, electric motors, electromagnetic switches, in cranes to lift large metal objects, to sort metals, in trains and there are many other uses. You can now make a very simple electromagnet. You will need a 1.5 volt D cell, and a metal rod or a nail.
Take 1.50 metres of the copper wire in your kit and start wrapping it around the nail or rod: make sure that you wrap the wire so that each coil lies next to the other, not on top of one another. Leave about 10 cms of wire at the beginning and 10 cms at the end. Take the sand paper and gently rub the insulation off the ends of the wire.
Tape one end of the wire from the coil on the to the top of the battery. Take a short piece of wire and tape to the bottom the battery. Make sure that both ends are **NOT** insulated. Now touch the short wire from the bottom of the battery to the free end of the wire coming from the coil on the nail. By completing the circuit, current flows through the coil and magnetizes the nail. This will take about 10 to 15 seconds.
Check that the nail has become a magnet by placing a pin next to it.
BE VERY CAREFUL AS THE NAIL AND BATTERY WILL BECOME HOT.
Only connect the electromagnet for 30 seconds, as it will become hot and will drain the battery very quickly.



33. HOW LONG DOES AN ELECTROMAGNET STAY MAGNETIZED?
ADULT SUPERVISION

Once you have disconnected the battery the nail will remain a magnet for a short time. Check how long the nail remains a magnet and then remagnetize it as you did before.

34.. MAKE A USEFUL TOOL. ADULT SUPERVISION

Find a steel screwdriver, wind the wire around the steel part of the screwdriver and magnetize it as you did before. As it is made of steel it will remain magnetized much longer and you can use it to pick up screws and hold them in place when you want to fix something in a difficult corner.

35. DISCOVER THE MAGNETIC FORCE OF YOUR ELECTROMAGNET.
ADULT SUPERVISION

In activity 9 you discovered the magnetic field of a magnet. Now set up the same experiment, only this time with an electromagnet. The iron powder will again form a magnetic field showing the magnetic force of your electromagnet.