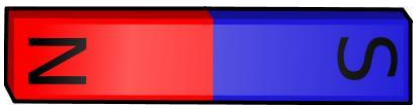
Magnetosphere- Teacher's Notes

Our Solar System's three "Goldilocks" planets, Mars, Earth and Venus are constantly being bombarded by solar winds. Radiation from the Sun contains energy and ionised particles (charged particles that are either positive or negative) that can cause death or mutation to living things.

Earth has a mobile liquid nickel iron outer core which generates a magnetic field which surrounds the planet. This can deflect most of the solar winds round the planet and sends them off into space.

Mars may at one time have had a similar magnetosphere as was suggested by data from the Mars Global Surveyor. Although its rocks have some remnant magnetism in patches, its magnetosphere is 40 times less than Earth's.

Venus has no magnetosphere. At its surface it is hot enough to melt lead. Most magnets will de-magnetise if heated.



Magnetic Spheres and Magnets

The electrons spinning round the nuclei of some metals can be lined up if they are magnetised. This creates quite strong lines of force running round the magnet that act over a short distance. Earth has magnetic poles that currently lie close to the geographic north and south poles. They can move around over time and even occasionally flip. We know this because many igneous rocks have minerals that are magnetic. When they cool, they crystalise and indicate where the magnetic poles were when they first became solid.

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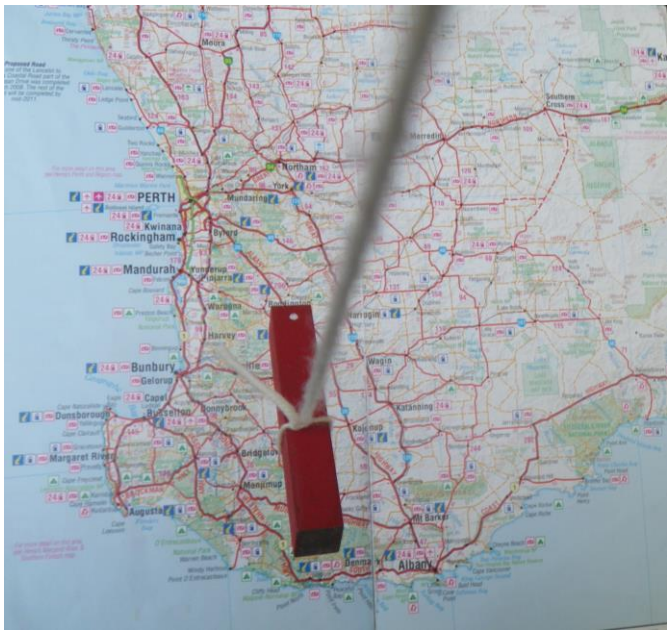
Earth's magnetic field can be demonstrated by hanging a magnet on a piece of string. It will align itself with Earth's magnetic field. This explains how a compass can be used to align a map north to south.



Magnet Hints for Teachers

1. The north end of a magnet is usually marked with "N" or a dot. If you do not know which is north, tie some string onto the magnet and let it dangle freely. It will soon align itself north to south. Your school map usually has north at the top; there are many free Apps which give compass directions or Google your location on the Internet.

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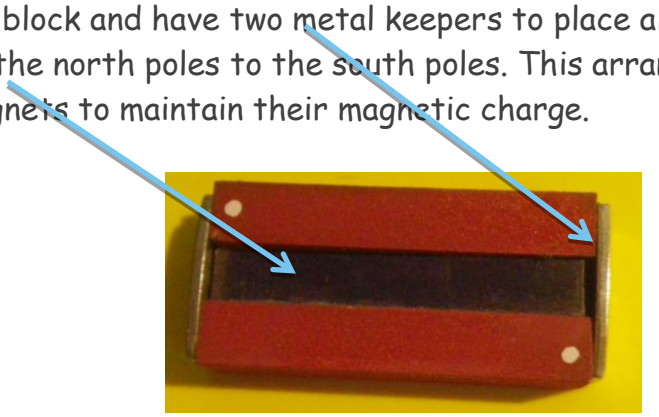
2. Magnets usually come in pairs laid top to tail on either side of a wooden block and have two metal keepers to place along the ends joining the north poles to the south poles. This arrangement allows the magnets to maintain their magnetic charge.



3. Heating and hitting magnets can cause them to loose charge.
4. If you do not protect your magnets by wrapping them in kitchen film or by keeping them under paper, you may spend many hours trying to wipe iron filings from them.
5. Not all metals are magnetic. Usually magnetic metals may contain iron, nickel and cobalt. More recently rare earth atoms such as neodymium have been used.
6. Magnetic filings can be bought in some hardware shops and at educational material providers. If the dispenser is not a shaker, students can half fill teaspoons with filings and then spread them by gently tapping the spoon.

Data and Inference

We cannot always observe what causes a change but we can ***INFER*** its presence by observing the effect it has on other things.

Can we see the force of gravity? No we cannot see the force of gravity but we can infer that it exists because falling objects fall towards the center of planets even if they are initially thrown upwards.

Magnetosphere- Teacher's Notes

Can you observe the sphere of magnetism around a magnet? No, but we can infer its presence by the effect it has on other objects.
Forces can be attractive if they pull objects together or repulsive if they push objects apart.

Magnets and Magnetosphere

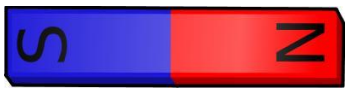
Materials per group

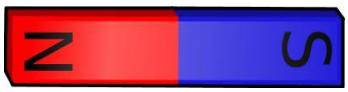
- Two bar magnets separately wrapped in cling wrap.
- A sheet of white A4 paper.
- Magnetic filings (and a teaspoon if required).
- A piece of string or wool about 30cm long.

Method

1. First find out the north poles of the magnet. Some have this marked with an "N or dot. If your magnets aren't marked, then tie the string to the magnets and let them hang loosely. And they will align north to south. Untie the string.

2. Holding a magnet in each hand about 10 cm apart, gently move the two north poles together. What did you observe and which sense did you use to make this observation? The magnets were held apart by an unseen force of repulsion. The closer they got together the stronger the force was. The sense was the sense of touch.





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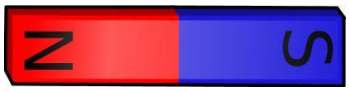
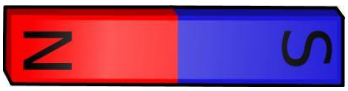
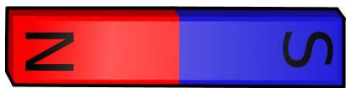
3. Again holding the magnets in each hand about 10cm apart, approach the north pole of one with the south pole of the other. What did you observe and which sense did you use to make this observation? The magnets were pulled together by an unseen force of attraction. The sense was again the sense of touch.



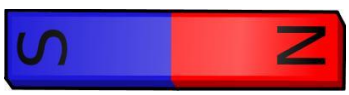


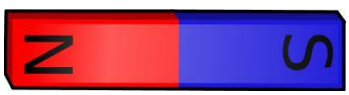
4. Place one magnet under a sheet of white A4 paper and gently sprinkle the iron filings over the paper. Draw what you observed.

What can you infer from your observations? Although we still cannot see the force field round the magnet, we can infer where it is by the alignment of the iron filings.



5. Return the filings carefully to the container. Place the two magnets as we did in step 2, only with the north poles only 3 cm apart. Put the sheet of white paper on top and sprinkle the filings on top. Draw what you observed.





Magnetosphere- Teacher's Notes

Data and Inference

Data is what you observe. Inference is working out unseen properties by analysing the data available.
For example.
Data A student runs with a bucket of water and pours it over another screaming student's head. The screaming stopped and the second student thanked them.
Inference The second student was on fire.

Using your observations (data) what can you infer from your observations? Although we still cannot see the force field or magnetic field round the magnets, we can infer where it is by the alignment of the iron filings.

If Earth is surrounded by a magnetic field, what effect will that have on incoming magnetised radiation? The rays will be repelled.