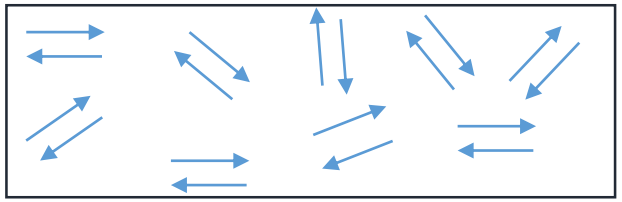
Magnetism

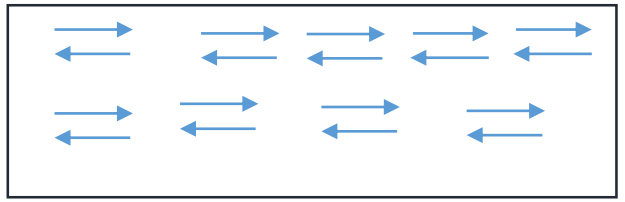
What is magnetism?

- The ability of a material to attract or repel another material within its magnetic field.
- This ability is because the material is made up of electric charges that have a magnetic field.
- The attractive force of each is very small....but combined with others...the attractive or repulsive properties are greater.

↑↓ Represent pair of electrons in valence shell (arrows are in opposite directions to indicate that they spin oppsite to each other...so they can co-exist...same charges usually repel each other)

A material that does **not** display magnetism





A material that does display magnetism

Types of materials:

- A magnet is usually of metallic origin

For example: Lodestone(an ore of iron),

- Magnets can be naturally ocurring or can be artificially made

- Some materials used to make magnets artificially are:

- Steel (Iron and Carbon),
- Alcomax/ Ticonal (mixture of nickel, cobalt aluminium and copper),
- Magnadur (Solid blocks of metallic oxide powders),
- Stalloy (Iron, Copper & Nickel),
- Mumetal (Iron & Copper)

SOFT vs HARD, WEAK vs STRONG

- Magnetically soft- materials that are easily magnetized/demagnetized

For example – Iron, Mumetal

- Magnetically hard – materials that are difficult to magnetize/demagnetize

For example – Steel, Magnadur

- Magnets can be classified as weak or strong.
- Materials that create strong magnets are called Ferromagnetic materials. For example: Iron and Steel

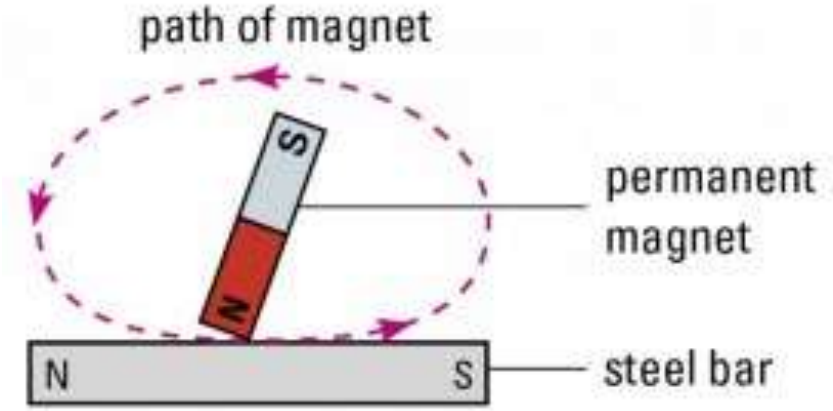
Magnetic Induction

- A magnet brought close to an unmagnetized (ferromagnetic) material such as Iron, magnetizes the Iron.
- The end of the bar becomes an opposite pole to the pole that s closest to it of the original magnet.

Magnet

Iron bar that was not
Magnetized before now
Magnetized

Or stroking the unmagnetized material with the magnet. It must be in one direction only (...not back and forth)



Magnetic poles

- Magnets have a North Pole (North seeking pole) and a South Pole (South seeking pole)
- Same poles repel, opposite poles attract each other

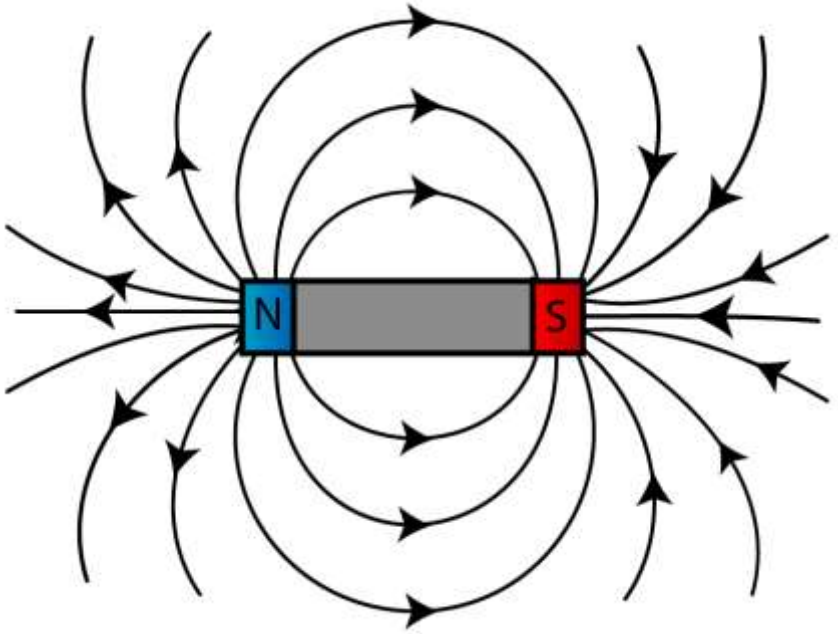
- The field around a magnet goes from the

North Pole to the Soth Pole and can

be

represented by vector lines

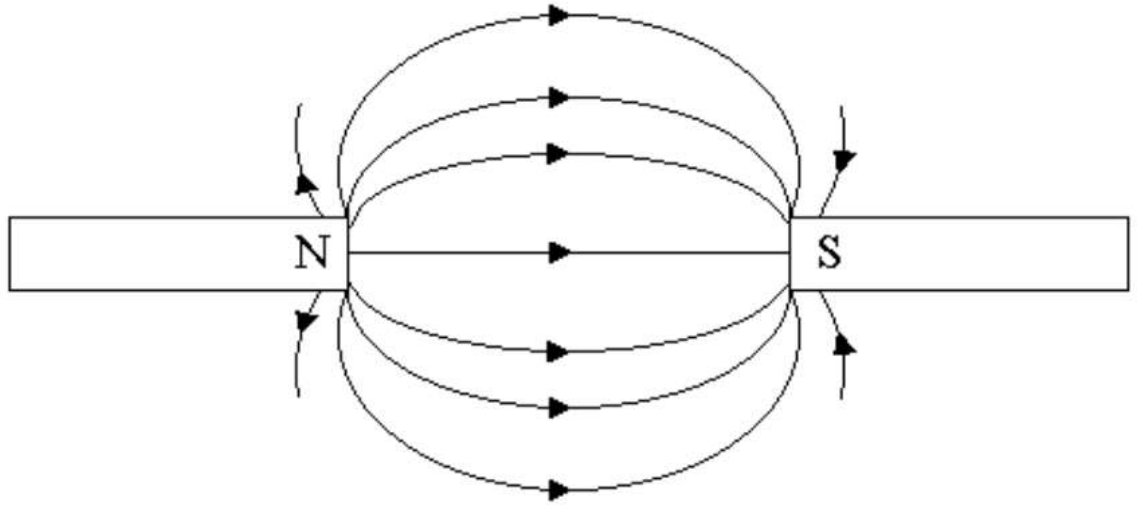
(lines with arrows)

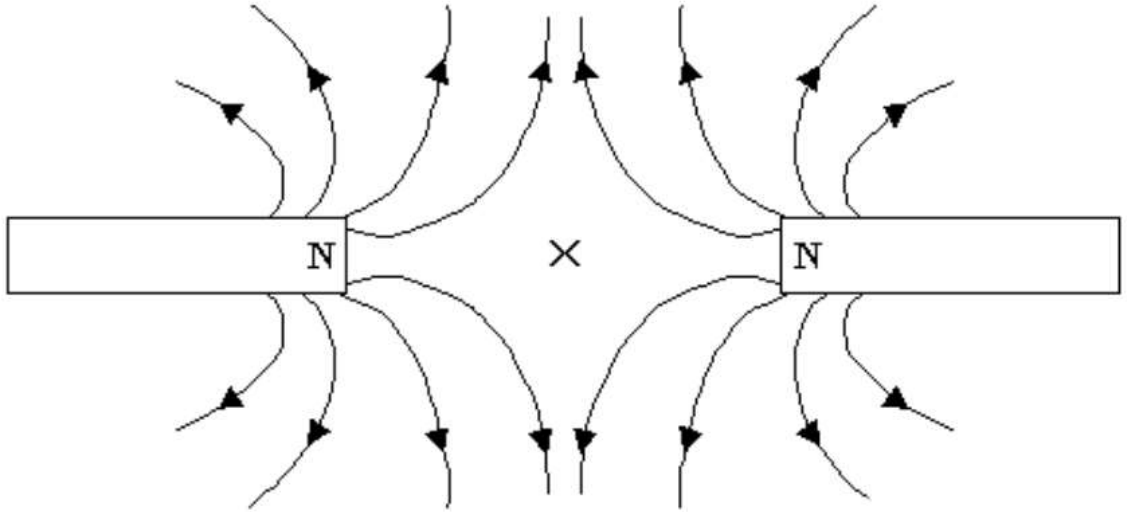


Nearby Magnets

Nearby magnets

When magnets are close together, with their fields overlapping, the fields combine to produce a field which acts in one direction at any given point.



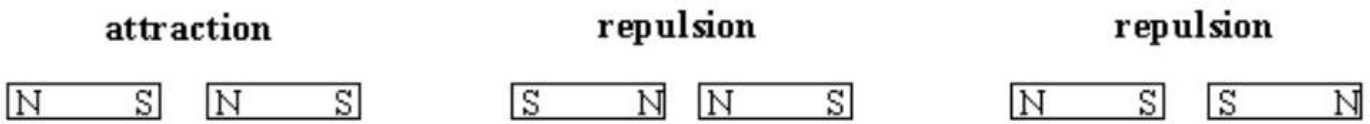


Forces between poles

Forces between poles

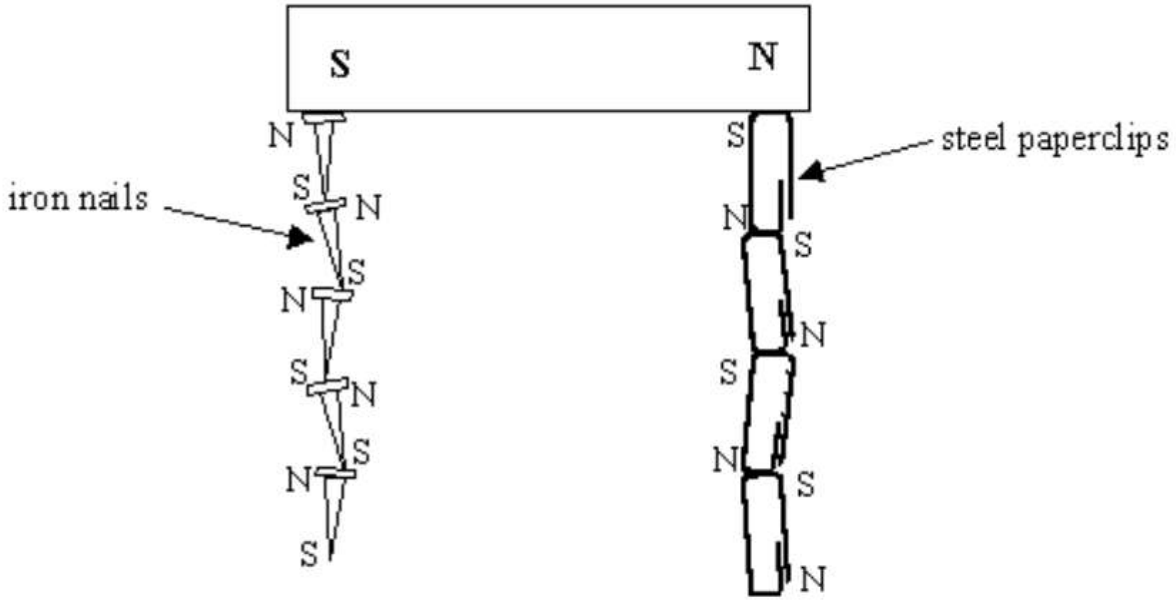
The forces between magnetic poles increase as they get closer together and:

- *like poles repel and unlike poles attract*



Inducing magnetism

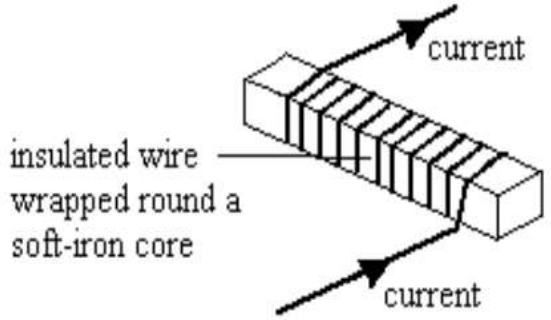
We can form a small chain of nails and paperclips as shown below:



Electromagnets

Electromagnets

An electromagnet is basically a solenoid, made of insulated wire, wrapped around a soft-iron core. When a current flows in the solenoid, the iron becomes magnetised, and when the current stops, the iron loses its magnetism.



- Soft-iron is used because it is easily magnetised and demagnetised
- The wire is insulated because we want the current to flow *around* the coil, to produce the magnetic field (if it were uninsulated, current would flow straight through the iron)

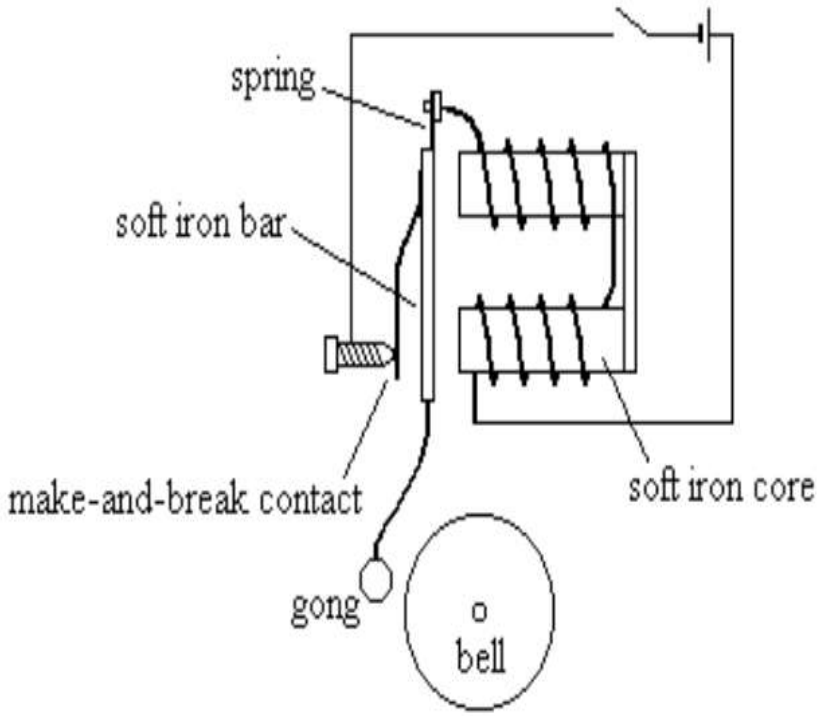
Using an iron core increases the strength of the magnetic field produced by the solenoid. We could also increase the strength by:

- increasing the current
- increasing the number of turns on the coil

Some electromagnets are in the shape of a horseshoe, which brings the poles closer together, which also makes the field stronger. Large electromagnets are used in steel works to lift items as big as, or even bigger than, cars.

Electromagnets are used in devices such as an Electric Bell

2. Electric bell



If the switch is closed, the circuit is complete, and the current through the coil magnetises the soft iron core of the electromagnet. The soft iron bar is then attracted towards the electromagnet and the gong strikes the bell. But the make-and-break contact has now been broken, so the current is turned off, and the iron core loses its magnetism, so the iron bar is no longer attracted, and springs back. But this now completes the circuit again, so the iron core is remagnetised, and again attracts the iron bar. Hence the gong will strike the bell over and over.