

TAP 411-1: Magnetic field shapes seen as flux patterns

You will need:

- ✓ bar magnet
- ✓ pair of slab magnets mounted on a yoke
- ✓ small button magnet
- ✓ collection of shaped permanent magnets
- ✓ long wire
- ✓ power supply, 0–12 V, (a Westminster Very Low Voltage power supply is designed for this work)
- ✓ 240-turn coil
- ✓ C-core
- ✓ 1100-turn coil
- ✓ long coil
- ✓ slinky spring, metal
- ✓ gimbaled bar magnet
- ✓ iron filings
- ✓ plotting compasses
- ✓ multimeter

Exploring fields

1. First remind yourself of the pattern around a permanent bar magnet. Place the bar magnet under a piece of paper. Scatter iron filings on top. Tap the paper gently to obtain what will probably be the familiar 'butterfly pattern'.
2. Use the gimbaled magnet to explore the flux around the other permanent magnets. Try to record your results by sketching the flux lines in three dimensions.
3. Connect the long straight wire to the dc supply. Place a plotting compass a few centimetres away from the wire. To explore the field around the single long straight wire: vary the current, move the compass around the wire and change its distance from the wire.
4. A slinky spring can be used as an air-cored electromagnet of varying turns per metre length if it is connected to the dc supply. Explore the field using the gimbaled bar magnet and the plotting compasses. Vary the number of turns per metre length and the current through the slinky.

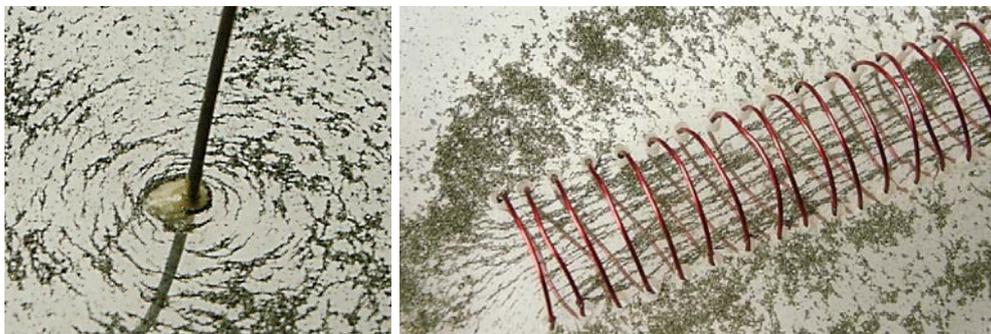
What you have seen

1. Field lines do not cross.
2. North poles are places where large amounts of field (flux) leave an object, south poles where large amounts enter the object.

Practical advice

This is a simple activity. The point really is to revise the idea of magnetic field lines, seen as flux paths in electromagnetic machines. Clearly any selection of permanent magnets and electromagnets can be explored and any method can be used to explore them. The idea of field lines not crossing but forming closed loops is the one to emphasise.

It is often difficult to get sufficient current through a single wire to explore the field thoroughly. Many low voltage power supplies will produce a strong 100 Hz ripple at high currents which may mask changes. We suggest a high current rheostat in series with the supply and a high current smoothing unit on the supply.



Alternative approaches

There are modern computer programs that help visualise field lines. Alternatively the whole thing could be done quickly by demonstration. The iron filings can be done on an OHP and fixed using hair spray. Chains of paperclips can show the field of a large horseshoe magnet.

External reference

This activity is taken from Advancing Physics chapter 15, 40E