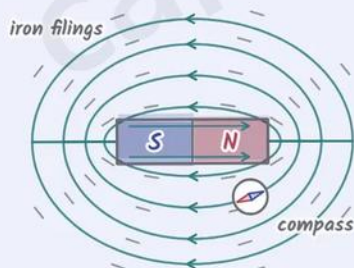


the bar magnet, the electrostatic analogy and the Earth's own field

Facts about magnets

- every magnet has two poles, north and south, whatever its size or shape
- like poles repel, unlike poles attract
- a freely suspended magnet settles along the geographic N-S direction
- magnetic lines form closed loops: N to S outside, S to N inside the magnet
- unlike an electric dipole, whose field lines start and end on charge



outside the magnet the lines run N to S

lines leave N, run round outside to S and close through the magnet; filings lie along them and the compass needle follows

Cut a magnet: no lone pole

- cut a magnet into pieces: each piece is its own weaker magnet, both poles again
- an isolated magnetic monopole has never been found



a bar



two magnets



four magnets

every piece has its own N and S

a bar, cut in two, cut in four: every piece shows its own S and N

The bar magnet as a dipole

pole strength

$\pm q_m$, at the N and S poles

magnetic dipole moment

$m = q_m(2l)$, from S to N

magnetic length

$2l = \frac{S}{B} \times \text{geometric length}$

magnetic flux density

$B = \frac{\Phi}{A}$, unit tesla (Wb m^{-2})

SI unit of pole strength is A m; of dipole moment, A m^2 . a bar magnet is the magnetic counterpart of an electric dipole, with q_m in the role of q