

Magnetism

Magnetism plays an important role in Electrical and Electronic Engineering because without it components such as:

relays—solenoids—inductors—chokes—coils—loudspeakers—motors—generators—transformers—electricity meters—bank cards—old-fashioned video tape—maglev trains

... would not work if magnetism did not exist.

elevator button

strip

VHS tapes Disney

History of Magnetism

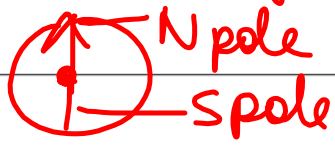
Supposedly a Greek shepherd boy in the province of Magnesia stubbed his toe on a rock—and for fun tied a string around it and found that it always pointed to the North—a cute story!

Naturally occurring magnets take the form of magnetic ore, with the two main types being Magnetite also called "iron oxide", Fe₃O₄ and Lodestone, so called "leading stone" or north stone.

If these two natural magnets are suspended from a piece of string, they will take up a position in-line with the Earth's magnetic field always pointing "north".

Permanent magnets are usually made out of steel, an alloy of iron and other metals and carbon. (homogeneous mix)

Compasses are magnets



What makes magnetism?

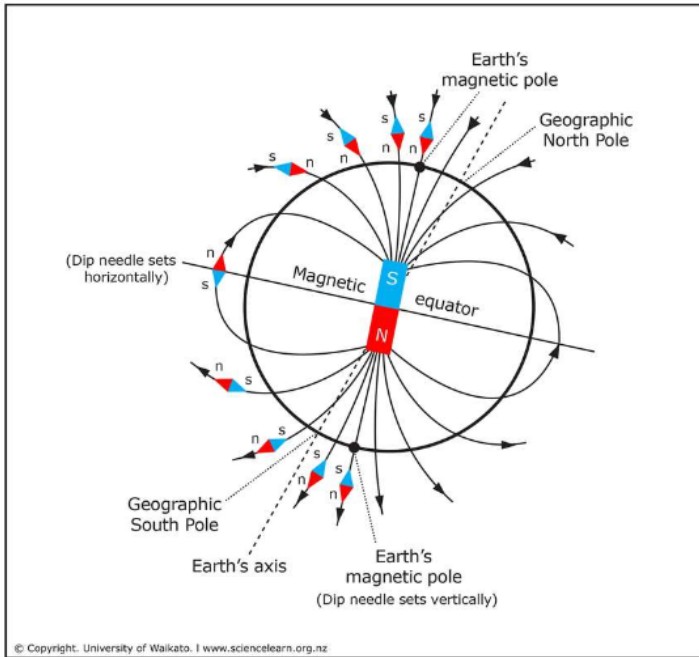
• moving charges

What is the Earth made of?

• molten iron (✓ other stuff) = moving

Why is the Earth a big bar magnet?

• its mag field takes the shape of a bar mag. butterfly / hot dog / yoga



- axis = rotates
- out of N into S = arrows pt. " "
- geog N ≠ mag N pole
- equator is where it splits N & S
- shape is "butterfly"
- traditionally Red = N blue = S

The Earth's magnetic field protects us from:

- massive amts of solar radiation

The Aurora Borealis is caused by:

- trapping of solar radiation = exciting the atmosphere

Domain Theory

Only 3 metals have the ability to be attracted by a magnet:

- iron
- nickel
- cobalt

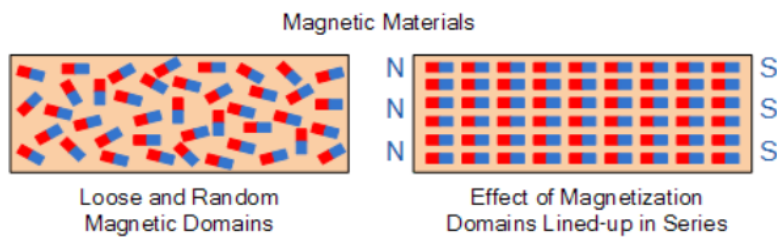
ferromagnetism

Fe Ni Co

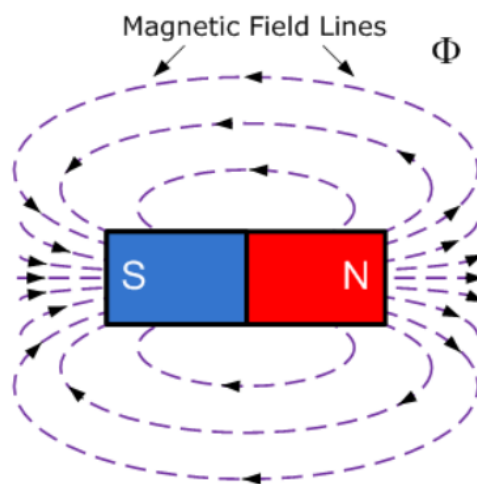
Fe Co Ni

These metals have domains (clusters of atoms with spinning electrons) that can be aligned when the metal is placed in a magnetic field.

Any other metals will not be attracted to a magnet because _____



Magnetic Field Lines—indicate the _____

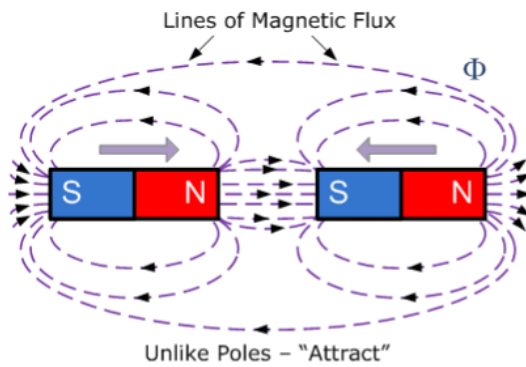


"Yoga" Magnets

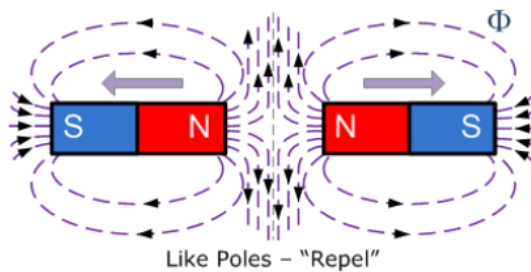
- Lines of force **NEVER** cross.
- Lines of force are CONTINUOUS.
- Lines of force always form individual CLOSED LOOPS around the magnet.
- Lines of force have a definite DIRECTION **from North to South**—watch arrow heads!!
- Lines of force that are close together indicate a **STRONG** magnetic field—the poles
- Lines of force that are farther apart indicate a **WEAK** magnetic field.

poles

UNLIKE POLES = N & S!
attract



LIKE POLES N & N or S & S
repel

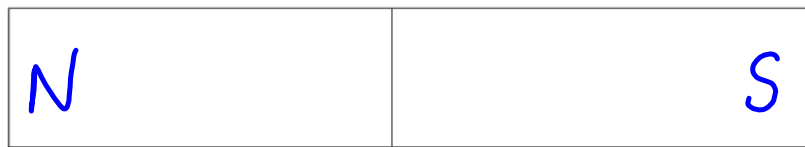


If you take a normal bar magnet and break it into two pieces you end up with:

2 bar magnets

Sketch what happens when you cut a magnet in half:

Magnet before being cut in half—show the poles and indicate the domains



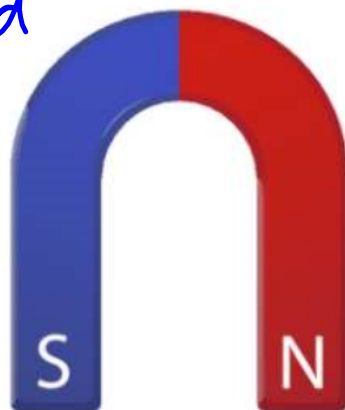
Magnet after being cut in half—show the poles and indicate the domains



Why a horseshoe magnet? What's the point?

Sketch the field lines:

U-shaped



pole stronger

*major attraction
major pick up.*

pole stronger