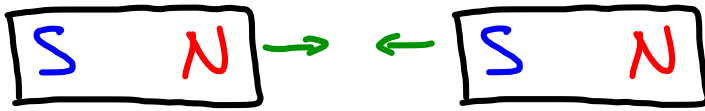


ELECTROMAGNETISM

Outline

- what is magnetism
- relationship between electricity and magnetism
- right hand rules
- motor principle (how do electric motors work)

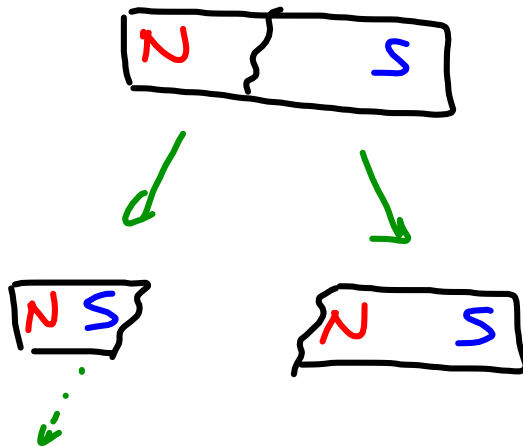
Magnetism



Opposite Poles Attract.



Like Poles Repel



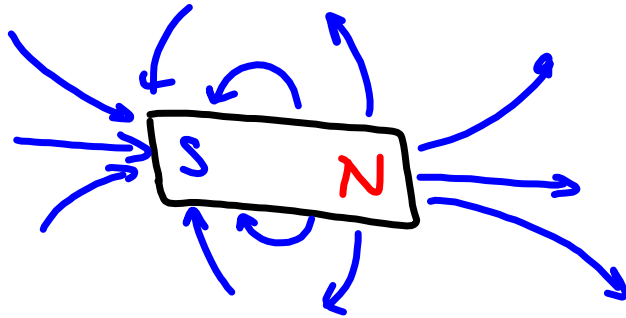
N e S

magnets must always have a N and a S pole (magnetic monopoles do not exist)

Magnetic Field Lines

Magnetic field lines always go from North to South (point in the direction a north pole of a magnetic would be directed).

Examples

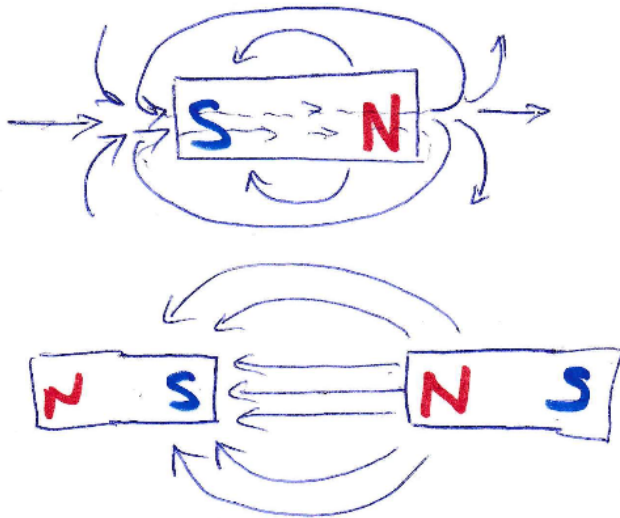


The magnetic field gets weaker the further away you are from the magnet.

Magnetic Fields

The symbol used for magnetic field strength is \vec{B} .

Magnetic field strength is measured in Tesla's.



Magnet Type

Strength

Earth

$50 \mu\text{T}$ (0.000050T)

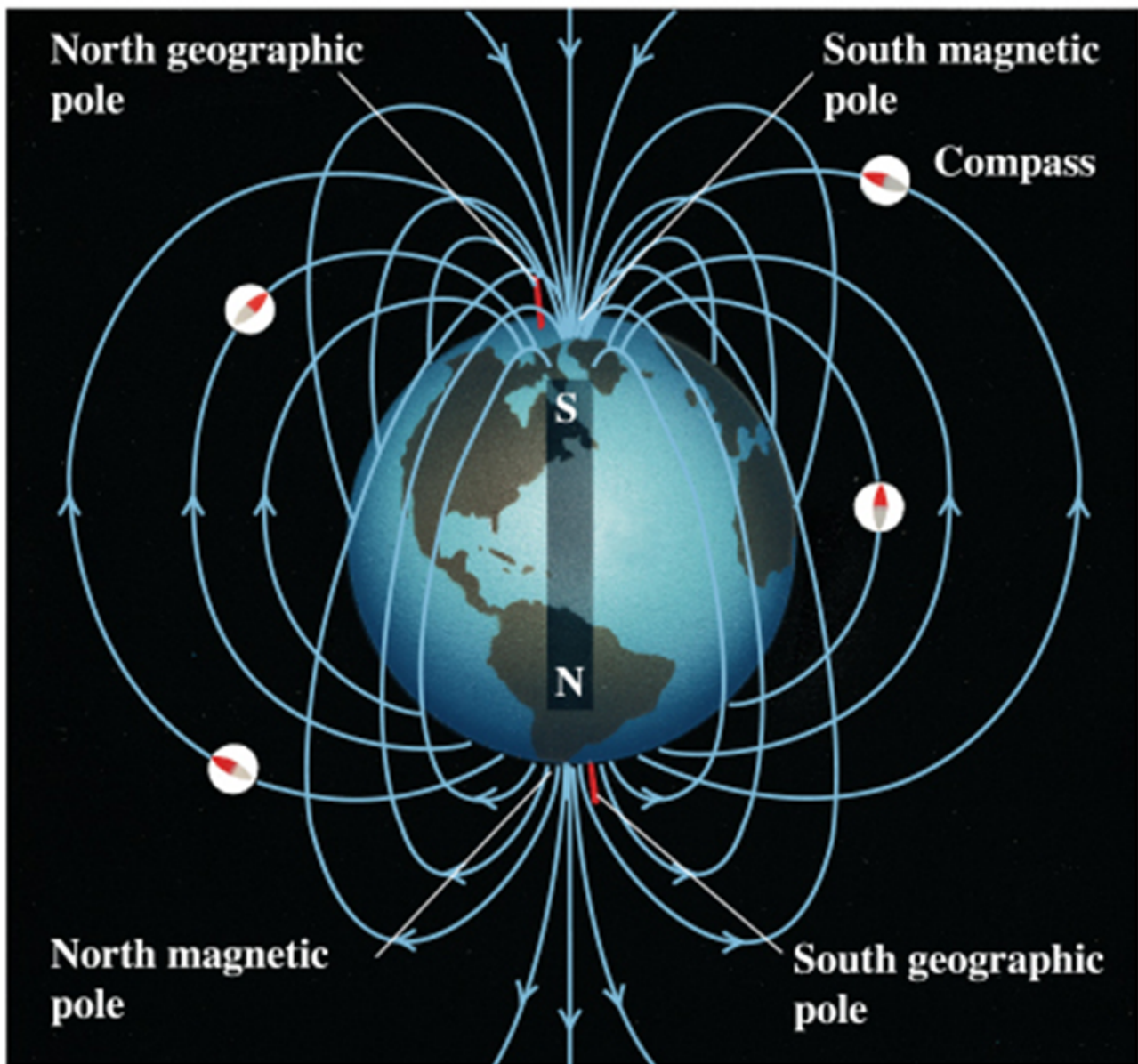
Fridge Magnet

$1-10 \text{ mT}$ ($0.001-0.010\text{T}$)

MRI machine

$1.5-3.0\text{T}$

The Earth's Magnetic Field



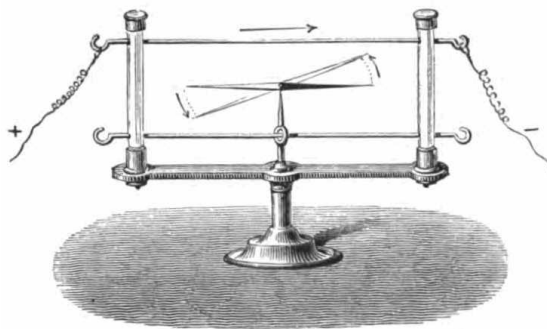
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Electromagnetism

Principle of Electromagnetism
(sometimes called Oersted's Principle)



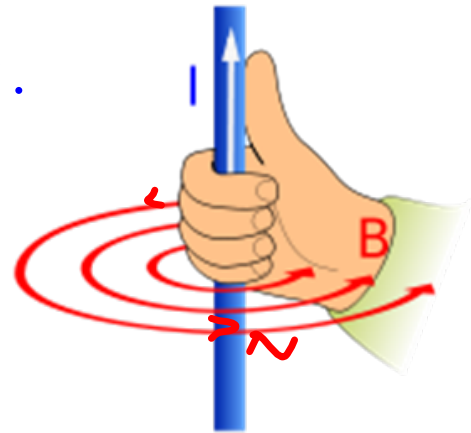
- A flow of electric charge will create (induce) a magnetic field
- The opposite is also true – a moving magnetic field will create (induce) an electric current



Right Hand Rule for a straight conductor

Magnetic field wraps around the conductor.

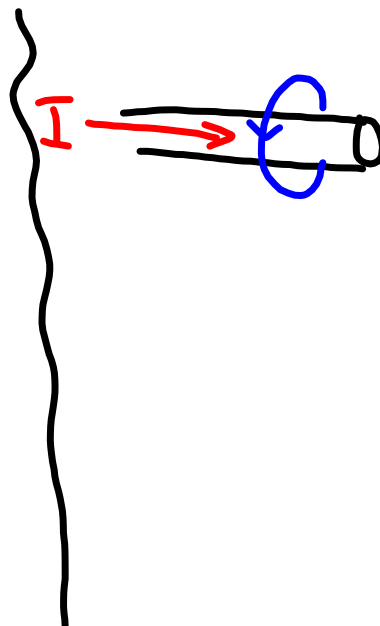
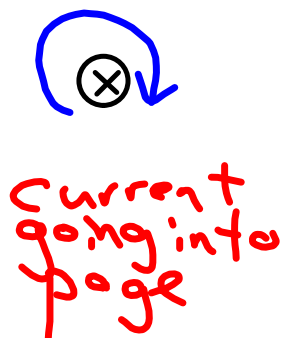
Rapidly decreases in intensity as distance from the conductor increases.



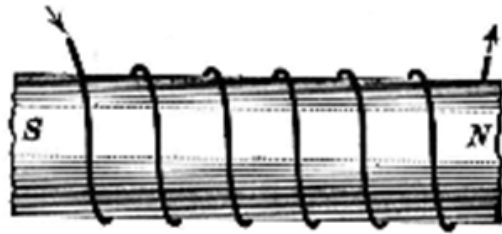
Right-Hand Rule for a Straight Conductor

Thumbs point in the direction of current flow (from + to -).
Fingers curl around the conductor in the direction of the magnetic field lines.

Conventions on drawing current flow



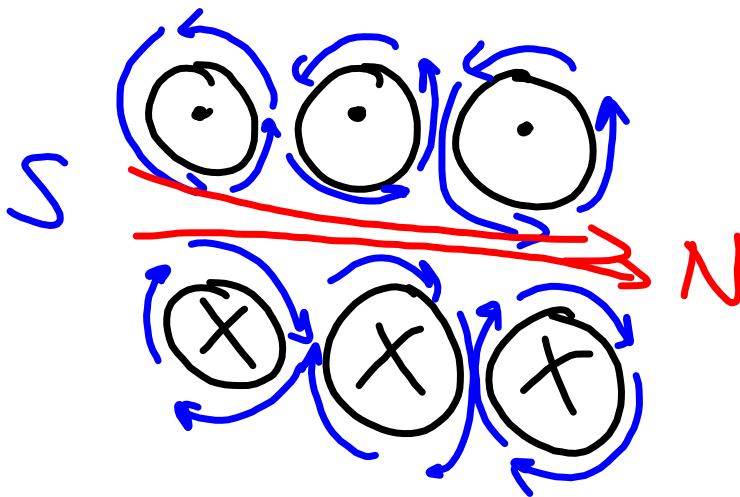
Electromagnets (increasing or concentrating the magnetic field)



To increase the magnetic field in a region of space, wire can be wound into a coil called a solenoid or helix.

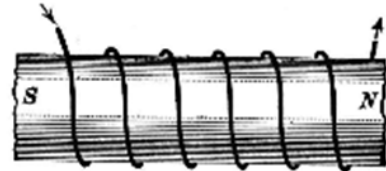
With more current travelling in a smaller space, there is more magnetic fields concentrated in this space.

To further intensify this field, a core material, such as iron, can be inserted into the centre of the coil.



Electromagnets (cont'd)

The direction of the current flow through **and** the magnetic field around an electromagnet are also linked by a right-hand rule



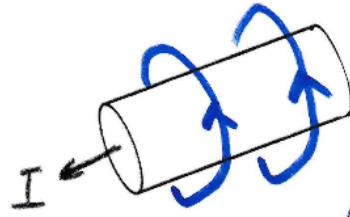
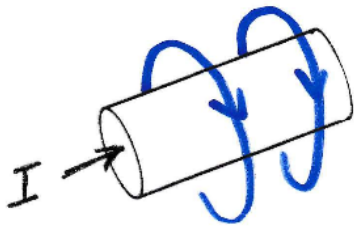
Right-Hand Rule for a Solenoid

Fingers curl around the solenoid in the direction of current flow (from + to -).

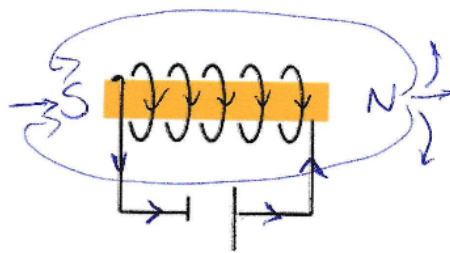
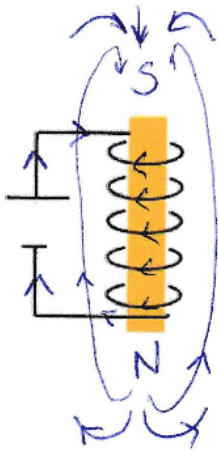
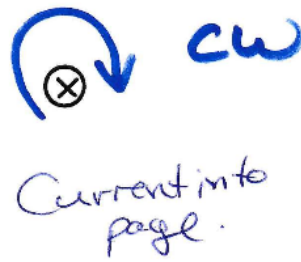
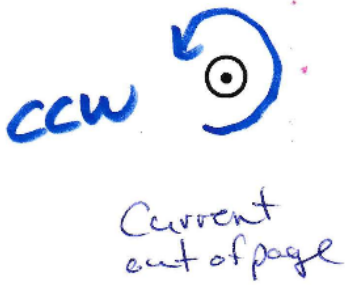
Thumb points toward the North pole of the electromagnet, in the direction of the magnetic field lines.

Check your understanding

B -magnetic field:
(Tesla).



$$B = \frac{\mu_0 I}{2\pi r}$$



Motor Principle

See page 490 in text



A current carrying conductor experiences a force when it is placed in an external magnetic field.

In other words...

if you put a wire with a current flowing through it near a

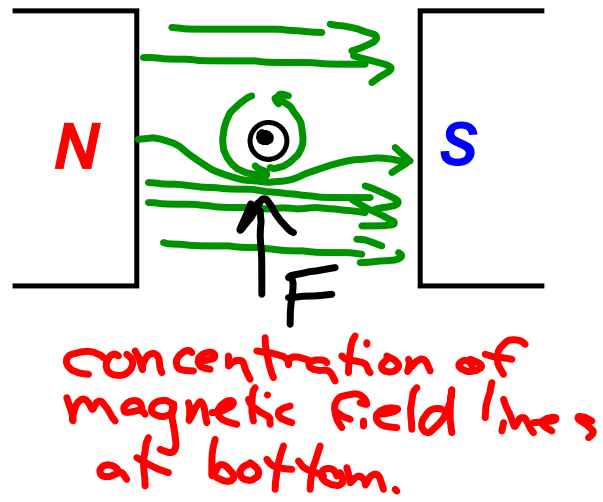
magnet, you can make the wire move either up or down in the magnet field

depending on the direction of the magnetic

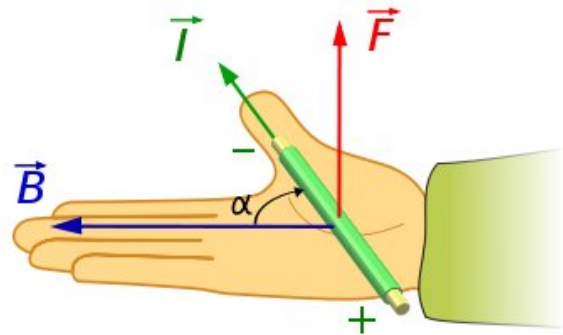
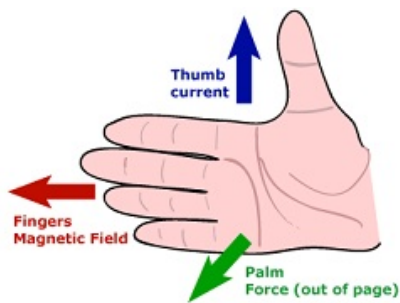
field and the direction of the current flow.

This is the basic principle that all electric motors and generators are based on.

Motor Principle



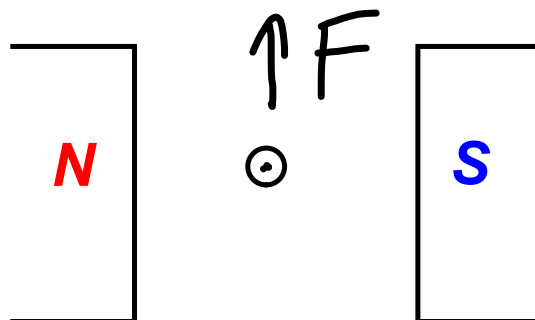
Right Hand Rule for the Motor Principle



Right-Hand Rule for the Motor Principle

Thumb points in the direction of current flow (from + to -).
 Fingers point in the direction of the magnetic field.
 The palm of your hand will point in the direction of the force on the wire.

Example: What is the direction of the force on the current carrying conductor?



Right Hand Rule for Motor Principle.

