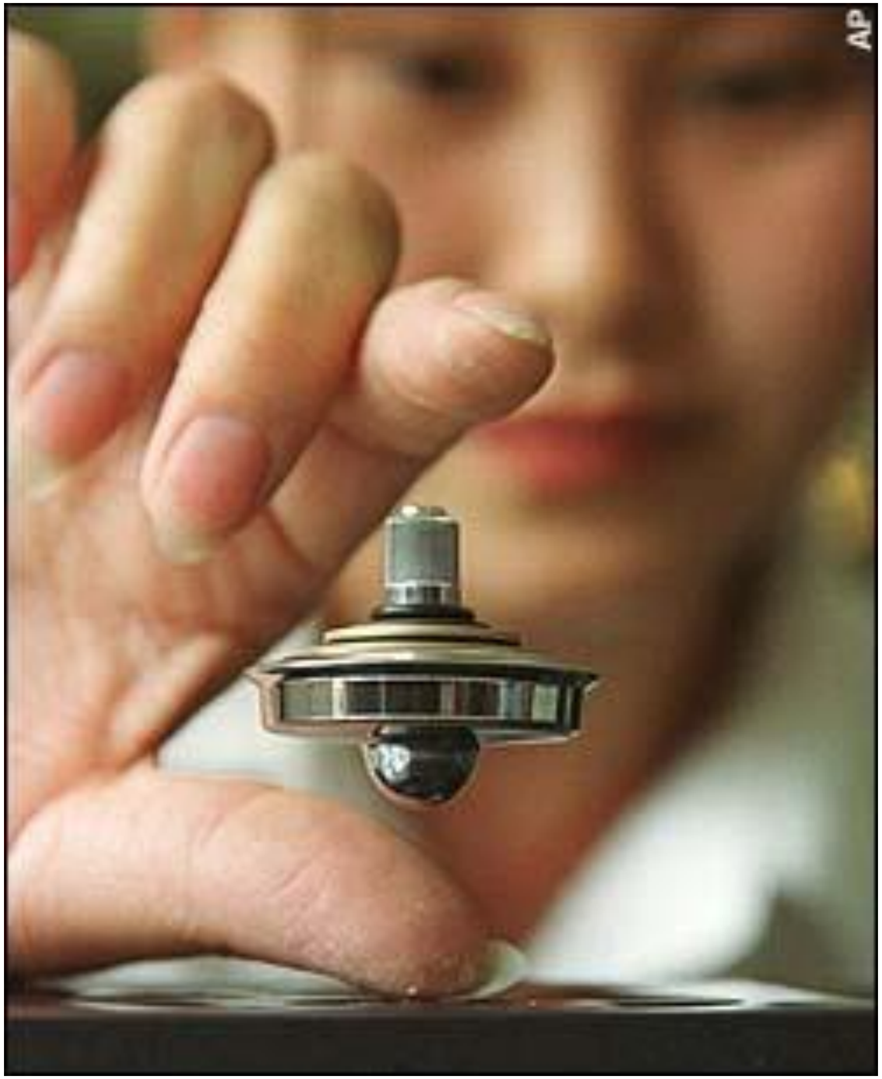
Magnetism



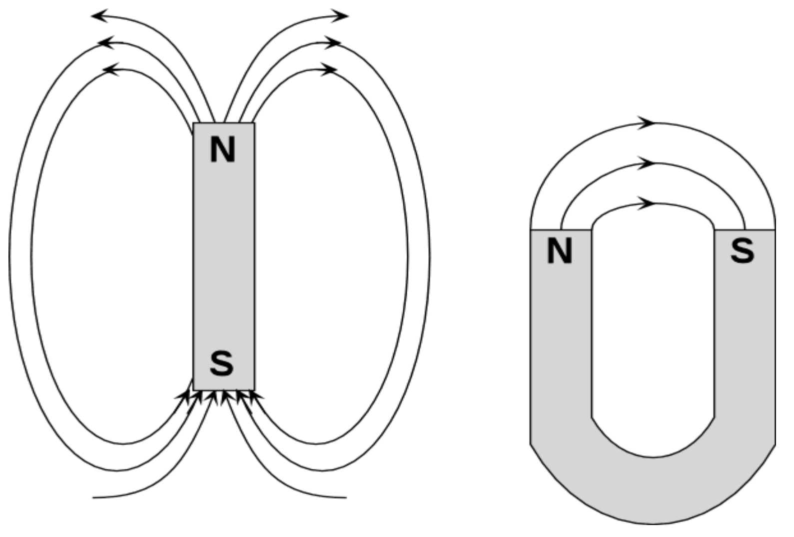
Magnetic Forces
are *fundamental forces*
observed by Physicist much like:

- Gravity
- Electrostatic forces
- Nuclear forces

In this unit we will learn how to create these magnetic forces and how this forces behave

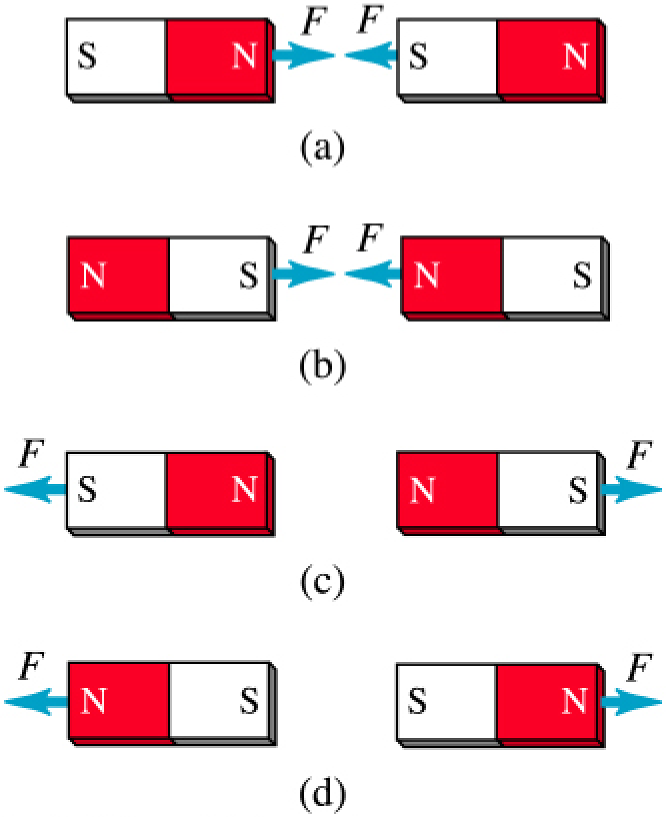
Permanent Magnets and Poles

Permanent magnets are solids (usually mineral or alloy) that react magnetically with other objects



permanent magnets usually have a stronger "magnetic field" at it "**ends**" these ends are called **poles**

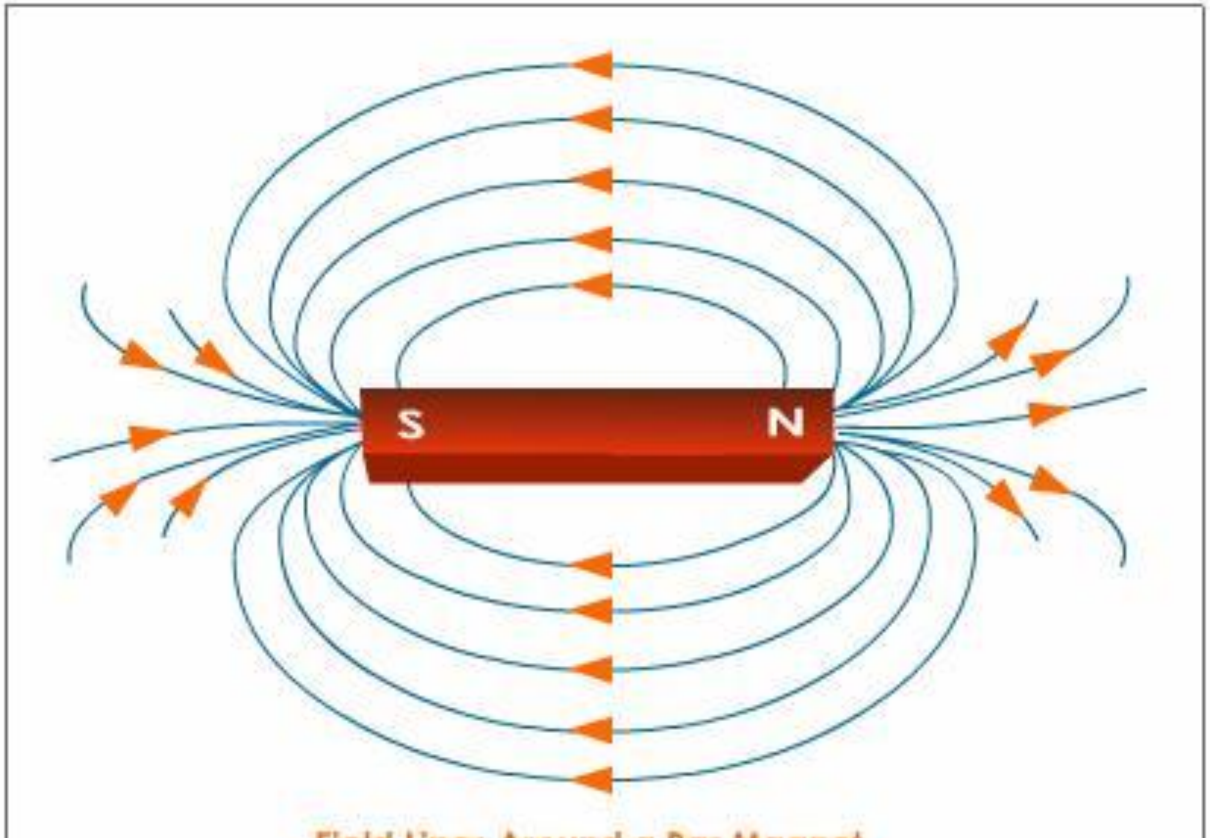
RULES for Magnetic Poles



- **opposites ATTRACT**
- **Like poles REPEL**

Magnetic Field

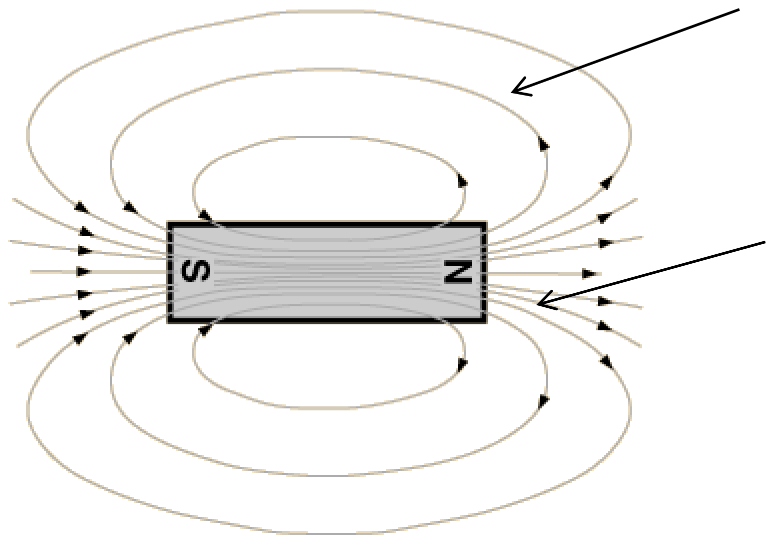
The magnetic field can be visualized using **magnetic field lines**, similar to the electric field.



Field Lines Around a Bar Magnet

The **direction** of Magnetic field lines is always:

North to South



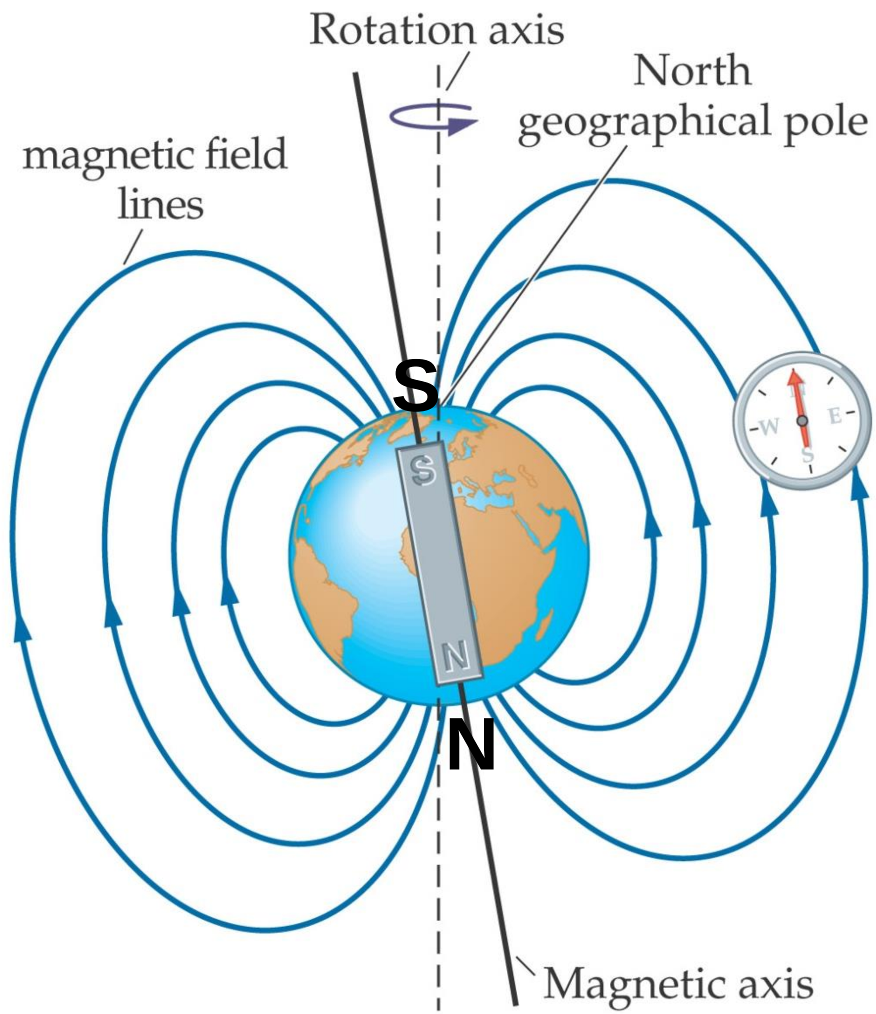
The closer the field lines are the stronger the magnetic field

The Earth has a magnetic field (caused by liquid Iron core).

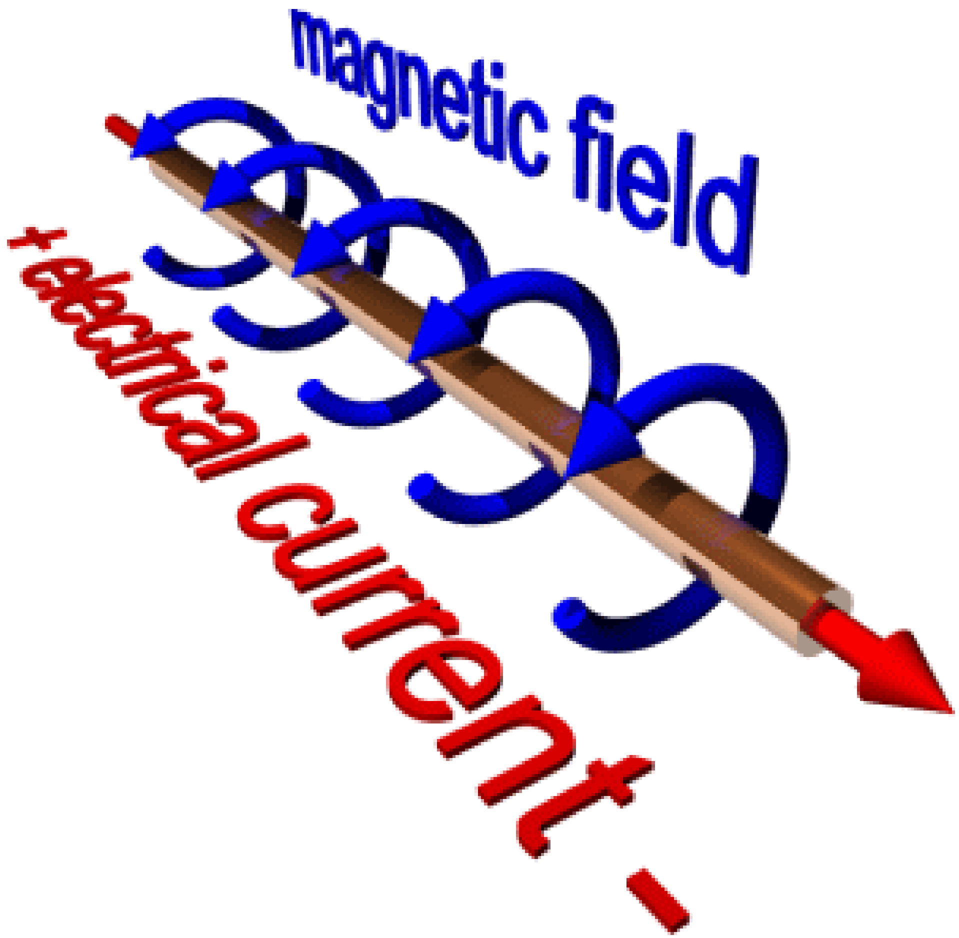
The Earth's magnetic field resembles that of a bar magnet.

Magnetic north of the earth's field is actually at *geographic* south

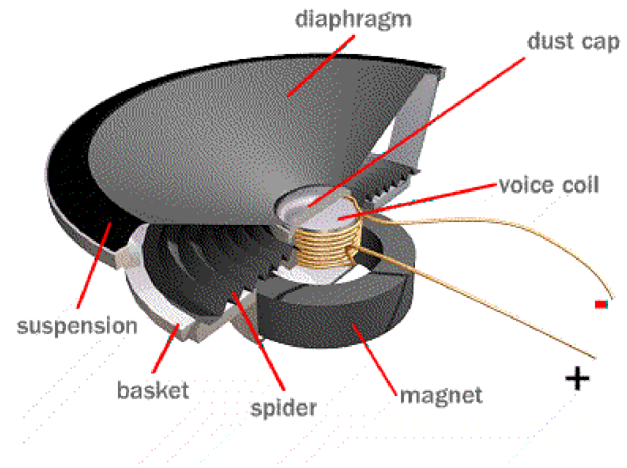
Crazy right?



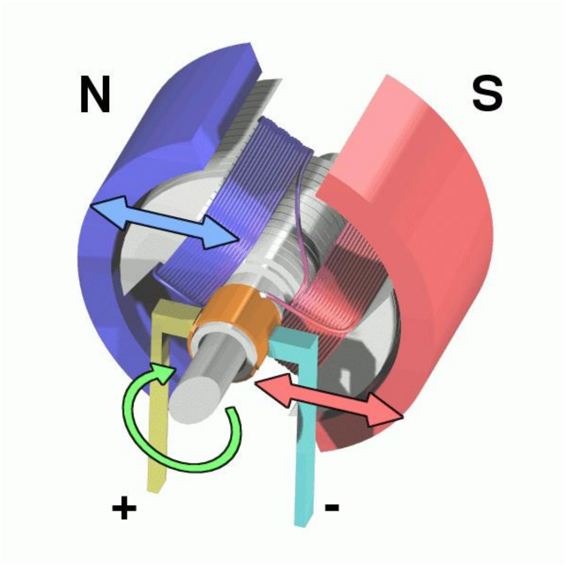
Electromagnetism



- Speakers
- Electric motors
- Solenoids
- Many of the devices we use on a daily basis involve electromagnets



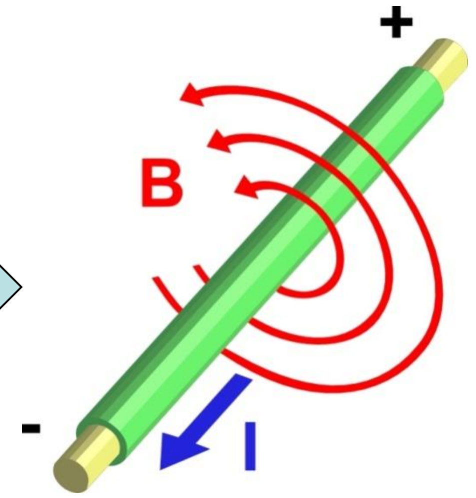
Important Fact: **if you put current through a wire it creates a magnetic field (the wire becomes magnetic!)**



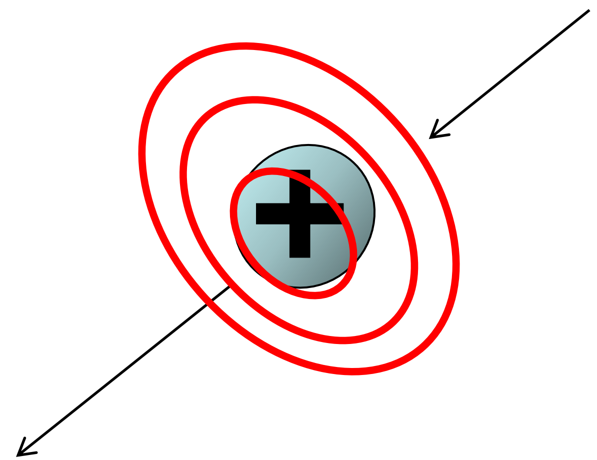
This is a fundamental and important principle in Physics that you must know and understand!

Moving Charged particles create magnetic fields!

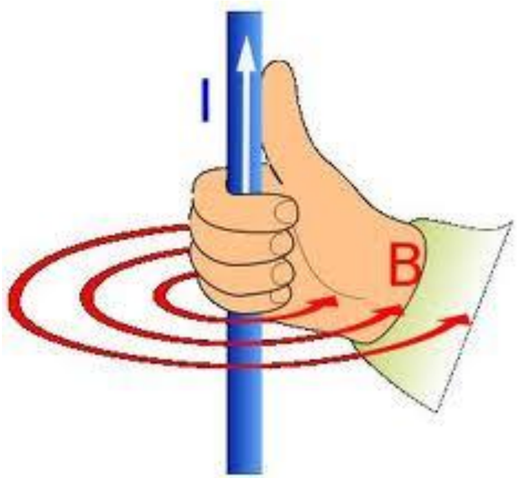
Current through a wire will create a magnetic field

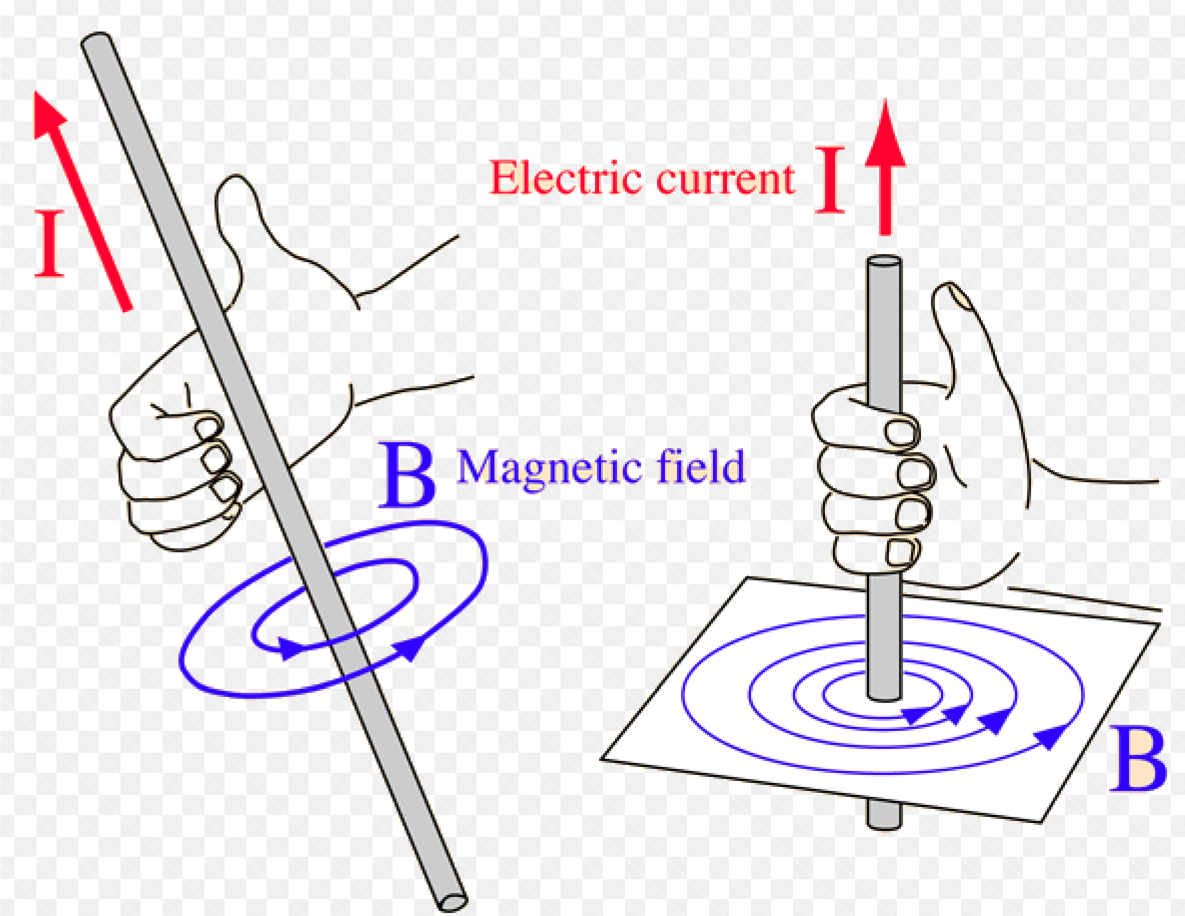


A electron/proton moving through space creates an magnetic field



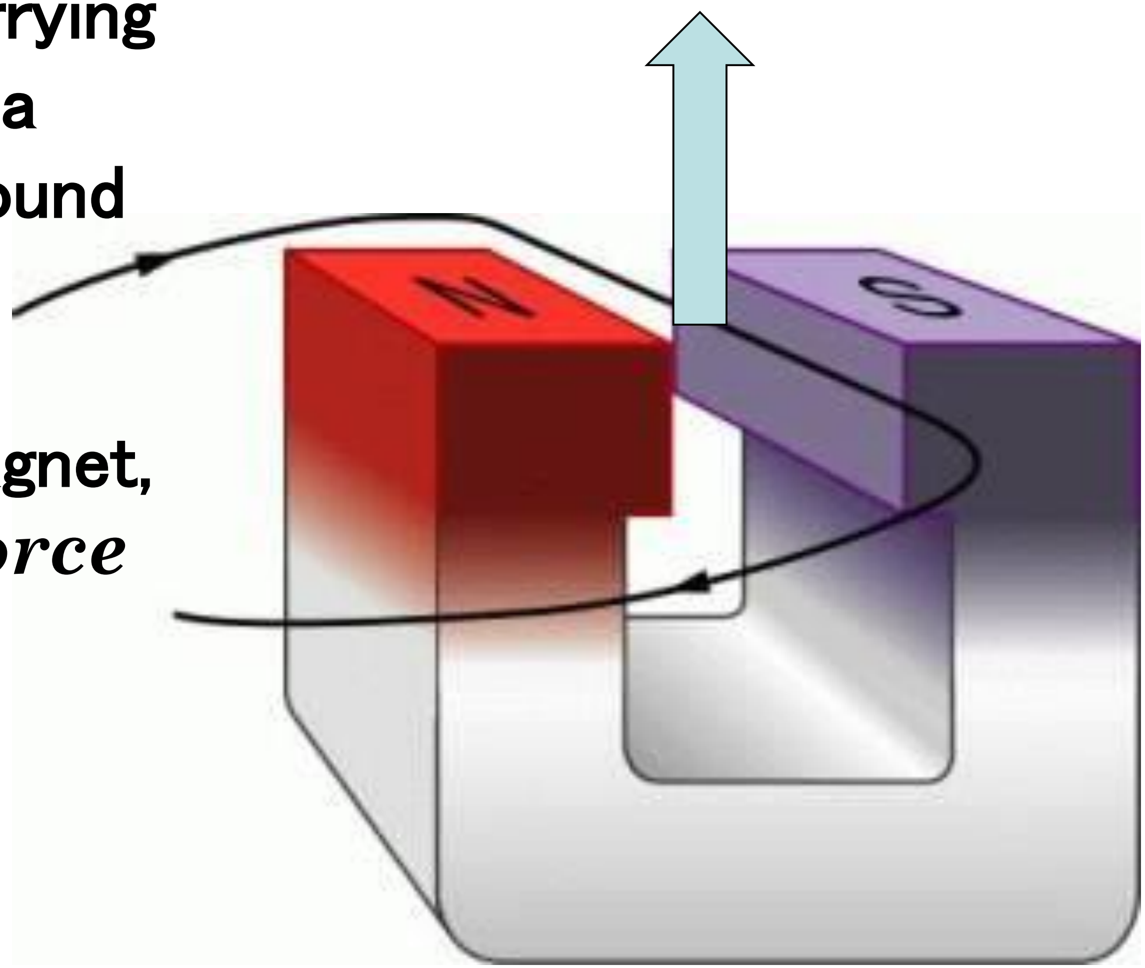
Right Hand Rule for determining the direction of a magnetic field around a conductor



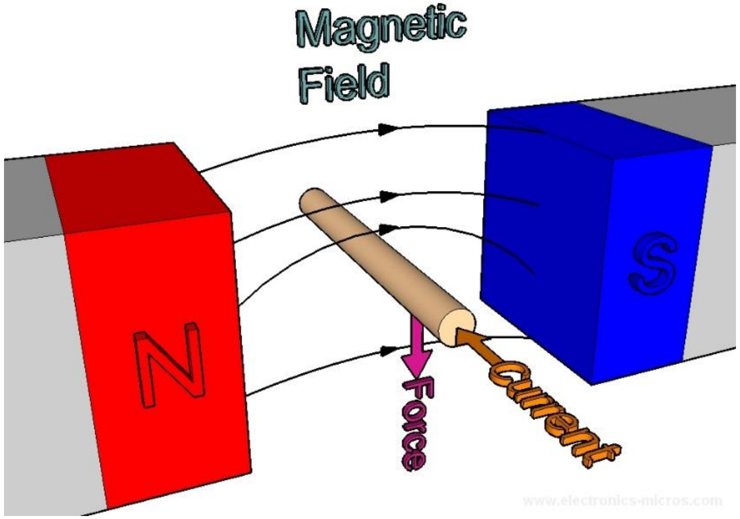


Since current carrying conductors have a magnetic field around them

They act as a magnet, and will *feel a force when they are near other magnets!*



How do we calculate the Force on the conductor? What does the force depend on?



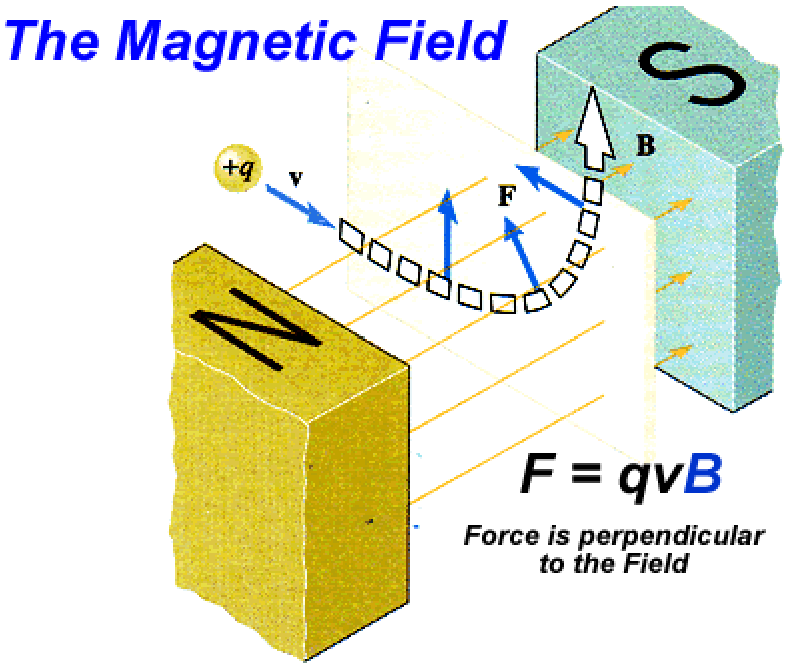
B – Magnetic Field Strength in (teslas T)
I – current in the wire (amps – A)
l – length of wire (in meters – m)

$$F = BIl$$

If the field is not at Right Angles to the wire then the perpendicular component of the field is used and the equation is:

$$F = BIlsin\theta$$

A charged particle moving through conductor also feels a **force**



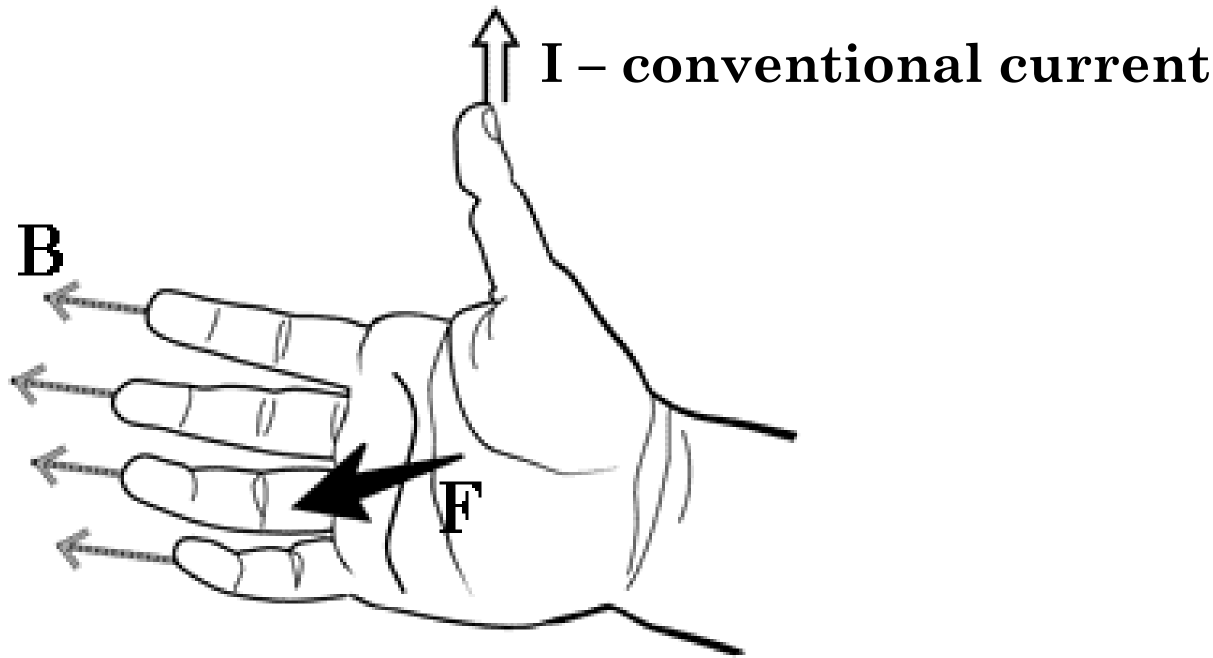
$$F = Bqv$$

Force (F – Newtons)

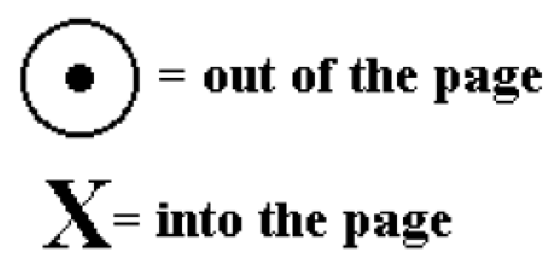
Depends on:

B – Strength of the magnetic field (teslas T)
v - Velocity of particle (m/s)
q – charge on the particle (Coulombs)

Direction of the magnetic force? Right Hand Rule



- **The Fingers = B-Field**
- **The Thumb = Conventional current**
- **The Palm = Direction of the Force**



Important!

When representing current, forces, or field lines we will be dealing with 3-dimentions:

1.Left-Right
2. Up-Down
3. Into page-Out of page

We need to establish a convention for representing the Into and Out of page directions.

We will use: