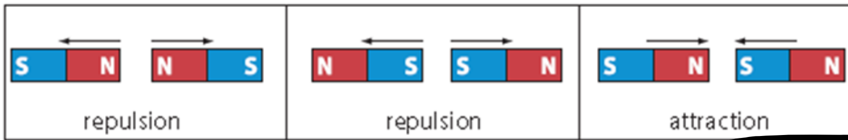
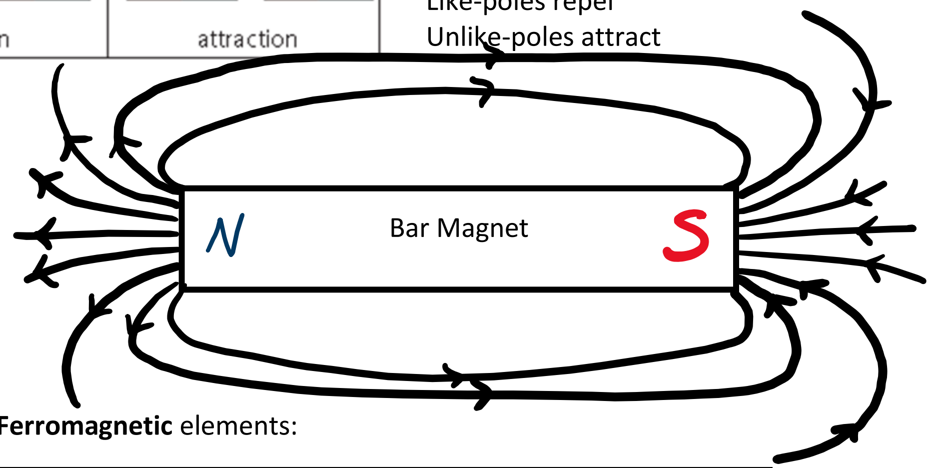
Lesson 7.1 – Magnetism and Fields

Unit 7: Magnetism

Permanent Magnets:



North-seeking end
South-seeking end
Like-poles repel
Unlike-poles attract



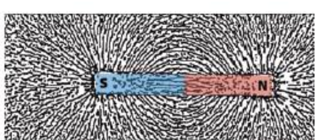
Field Line Rules:

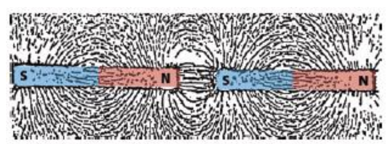
1. Field lines flow from N to S
2. Lines never cross
3. Closer lines = stronger field

Strongly magnetic elements are called Ferromagnetic elements:

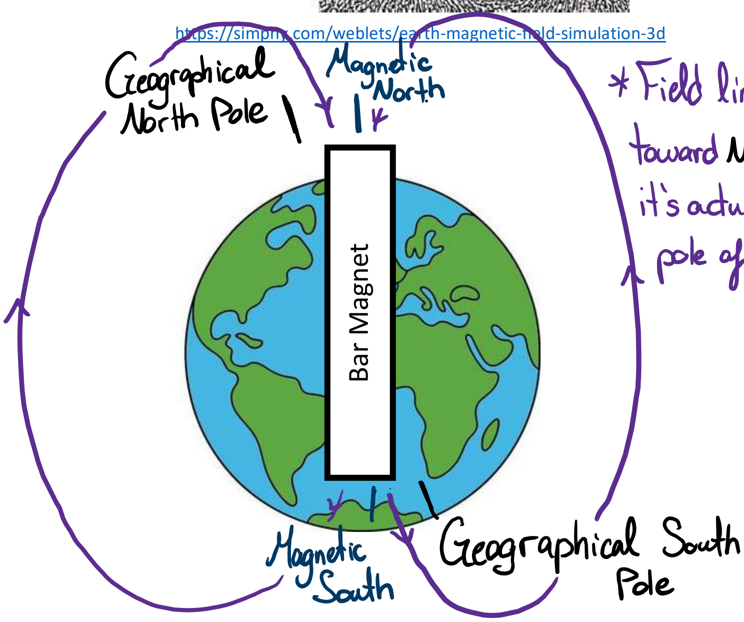
Well Known:	**Less Known:**
Iron, Nickel, Cobalt	*neodymium* and *gadolinium*

Sprinkling iron fillings around a bar magnetic shows the magnetic field of a magnet.

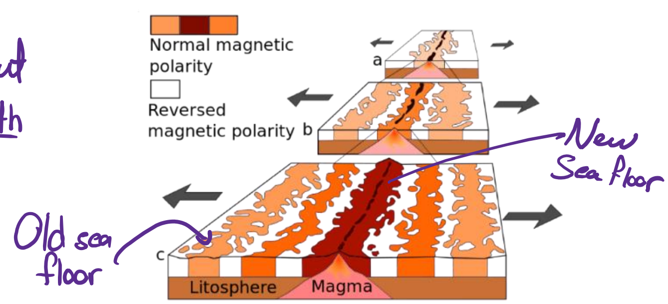




https://simphy.com/weblets/earth-magnetic-field-simulation-3d



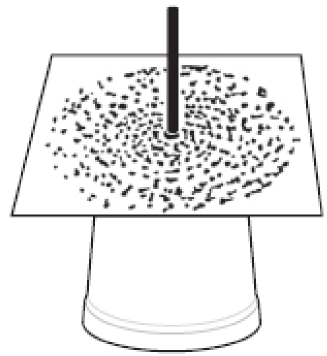
* Field lines point toward North poles, but it's actually the south pole of a magnet.



* Earth's magnetic polarity undergoes
* reversals.
Last flip ~ 780,000 yr ago.

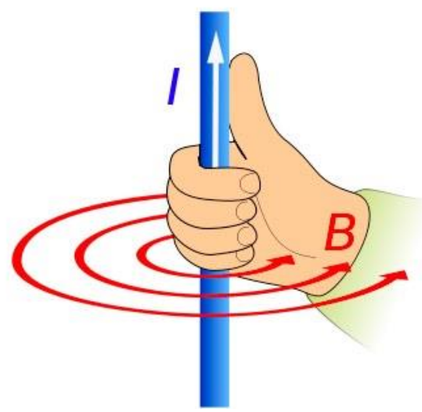
Electromagnetism:

Electric current produces magnetic fields. ***(Show demo)***



- Hans Christian Oersted noticed that compasses would deflect near flowing current in a wire
- Andre Ampere used iron filings and high current flowing through a conductor to visualize magnetic field lines
- Magnetic as long as current flows

First Right-Hand Rule: Ampère’s Rule

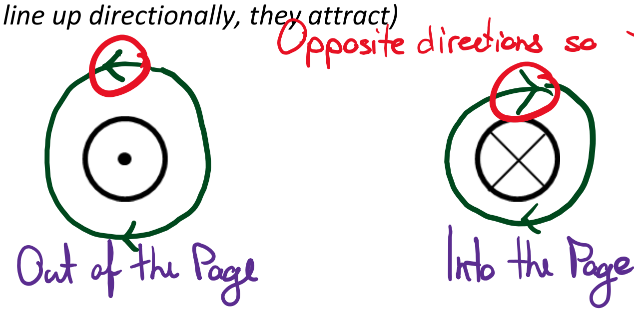


- ❖ Grab a wire with your right hand so the thumb points in the direction of conventional current (from + to -)
- ❖ Your fingers (slightly open) point in the direction of the magnetic field

Notation Check: Somethings current is drawn into or out of the page.

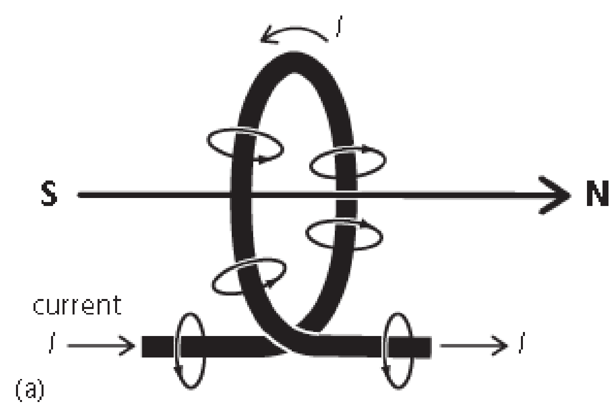
Draw magnetic field lines of force around the currents below. Would these conductors attract or repel each other? (Hint: if they line up directionally, they attract)

Opposite directions so they will repel



A loop of wire: Apply Ampère’s Rule

- ❖ Apply Ampère’s Rule
- ❖ Magnetic field lines exit at N and enter at S
- ❖ **Trick:** grab the loop/coil and curl fingers in direction of conventional current
- ❖ Thumb points N (through the loop)

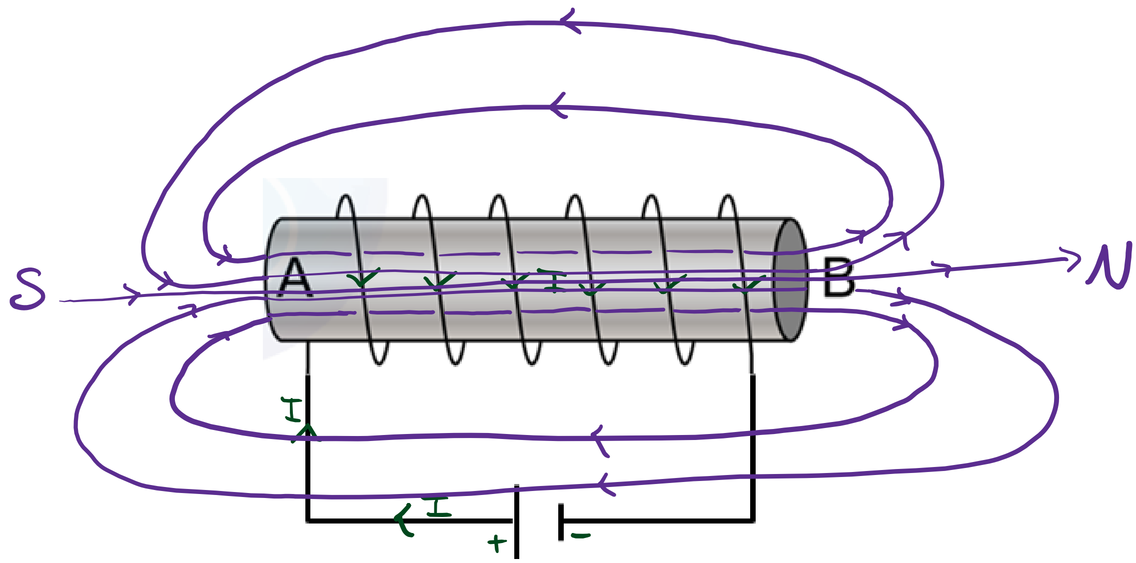


Solenoids:

A long coil of wire that produces a magnetic field when an electric current flows through it.

Outside the Coil	Inside the Coil	Summary
• magnetic field lines look like a bar magnet's	• B points in direction of North • Parallel force lines = uniform B field	• B lines leave out from north and into South

Draw the magnetic field lines and determine if the North pole is at A or B

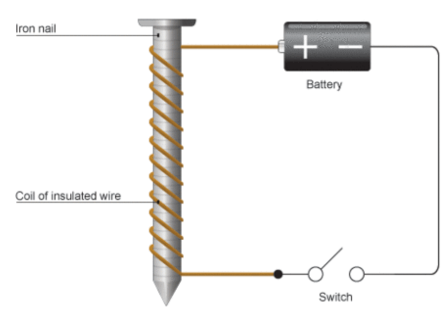


Electromagnet:

Created by placing an iron core inside a solenoid

Magnetizes the iron, creating a greater combined magnetic field

https://youtu.be/1TKSfAkWWN0?si=lqWTUfIlaJ4LNakT



Calculating the magnetic field in a solenoid:

$$\vec{B} = \mu_0 \left(\frac{N}{\ell}\right) I$$

OR

$$\vec{B} = \mu_0 n I$$

$\vec{B}$ = magnetic field intensity (Teslas - T)

μ_0 = permeability of free space
$= 4\pi \times 10^{-7}$ Tm/A

ℓ = length of the solenoid (m)

N = # of loops

I = Current (Amperes - A)

n = # of loops per metre $= \frac{N}{\ell}$

Example 1: A 10 cm long solenoid has a total of 400 loops of wire and carries 2.0 A of current. Find the magnetic field inside the solenoid.

$$\vec{B} = \mu_0 \frac{N}{\ell} I$$

$$= (4\pi \times 10^{-7}) \left(\frac{400}{0.1}\right)(2)$$

$$\boxed{\vec{B} = 1.01 \times 10^{-2}\,T}$$

Assignment: *Sandner-Gore:* Pg. 222 # 1-7 | Pg. 227 # 1-3