

Themed: 08-01

History, basics, Domains, creation/destruction of magnets, field lines & poles, earth, Santa, solar wind, right hand rule

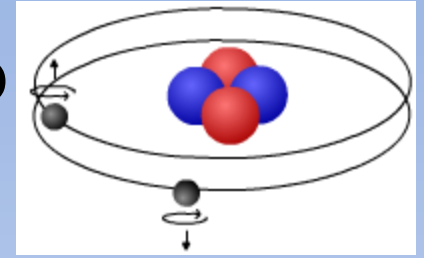
History of Magnetism

(don't memorize these dates!)

- Greeks find lodestone in Magnesia
- 13th century: Mariners use compasses
- 1820: Oersted discovers current makes magnetic field
- 1837: Morse uses magnets to invent telegraph
- 1855: Faraday (famed for cages) found magnetic fields could make currents too
- 1885: Tesla makes AC generator and AC motor

19th century life was doomed by Tesla's genius. In a single generation we'd have electricity in-home, drive cars, have phones, radios: In my opinion, the biggest lifestyle change in the history of man...thanks to magnets!

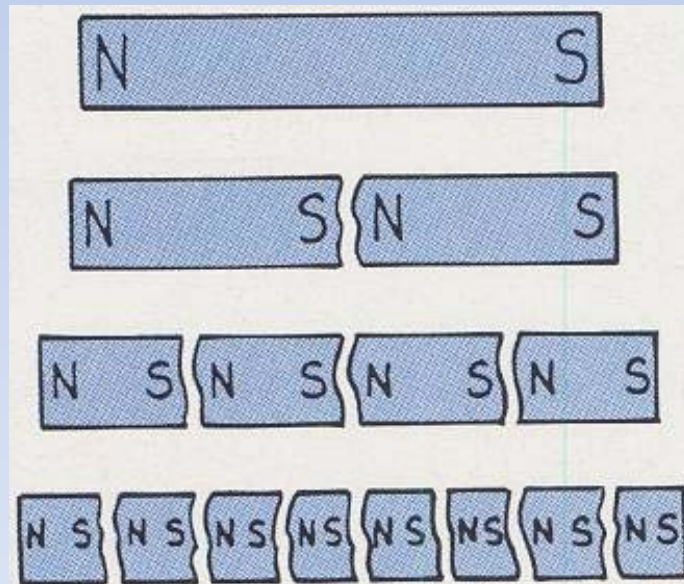
Basics - What is magnetism?



- Definition: Force field from motion of electrical charges
- Magnetic materials have unpaired spinning electrons...that's the motion!
- The N and S poles are along the spinning axis
- Magnetized materials have more electrons spinning the same way harmoniously
- Three elements are Ferromagnetic (strongly magnetizable): Fe, Co, Ni

Basics - Magnets are dipoles

- Unlike charges, can't have + or - alone
- Cut a magnet in two, get a pair of N and S poles



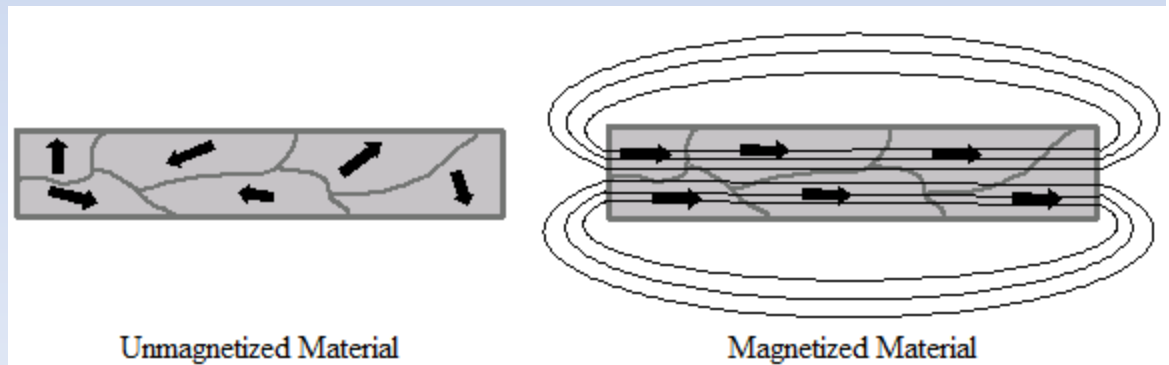
Break a magnet in half and you have two magnets. Break these in half and you have four magnets, each with a north and a south pole. Keep breaking the pieces further and further and you find the same results. Magnetic poles exist in pairs.

Basics - Opposites attract, like repel

- North pole seeks south and vice versa
- N avoids N and S avoids S

Domain theory

- An un-magnetized Ferromagnetic rock consists of thousands of tiny magnets aligned randomly
- These tiny magnets are domains
- Since they're random, their magnetic fields cancel
- Line up these domains in the same direction and you have magnetized the rock

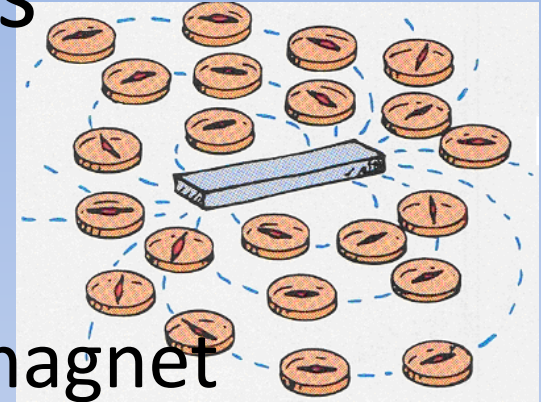


Creating/Destroying a Magnet

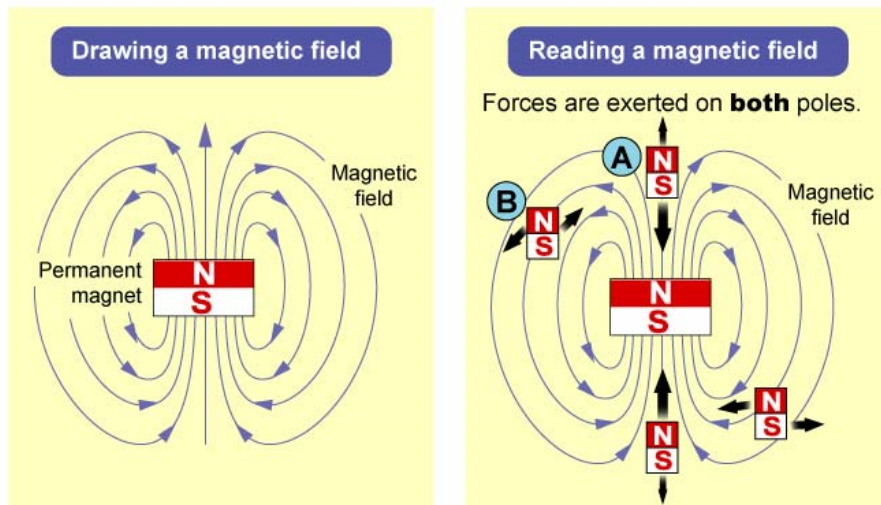
- Permanent magnet: Expose ferromagnetic material (Fe, Co, Ni) to magnetic field
 - strong or long
- Electromagnet: coil current-carrying wire around ferromagnetic core
- Destroy one by randomizing domains
 - Heating very hot (beyond Curie temperature)
 - Exposing it to opposite magnetic field
 - Hard hit (drop it hard, hit with hammer, etc.)
 - Jostling it randomizes domains

Magnetic field lines

- Lines of force
- Compasses line up along them
- They go from N \rightarrow S outside the magnet (just like we do up north!)
- Magnetic Field Strength: a) Strongest by



Magnetic Field Lines

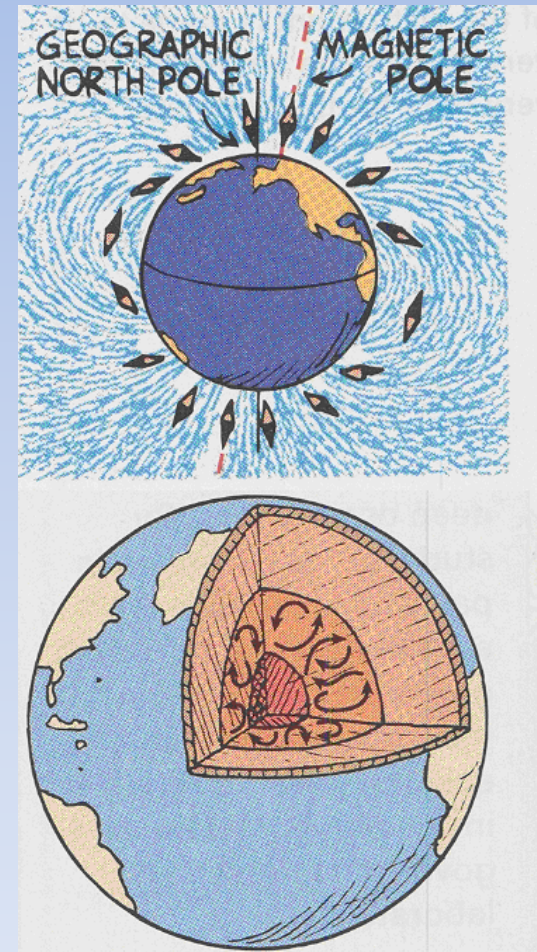


poles (N and S)

b) Where field lines are most crowded together

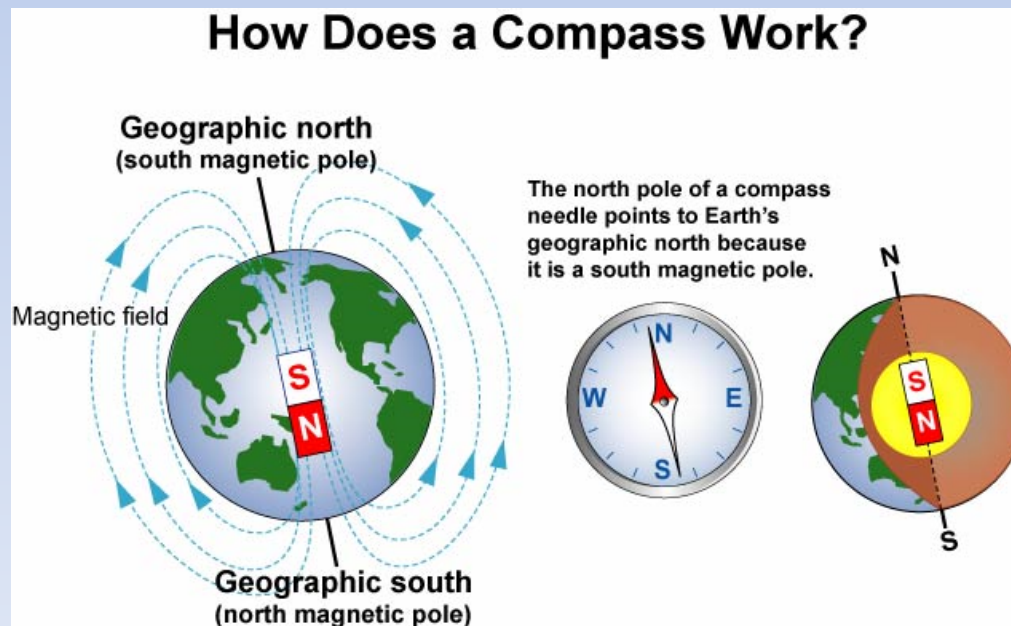
Earth: A huge electromagnet

- Magnetism exists when charges are in motion
- Scientists *think* our magnetic field comes from charges swirling in our molten core



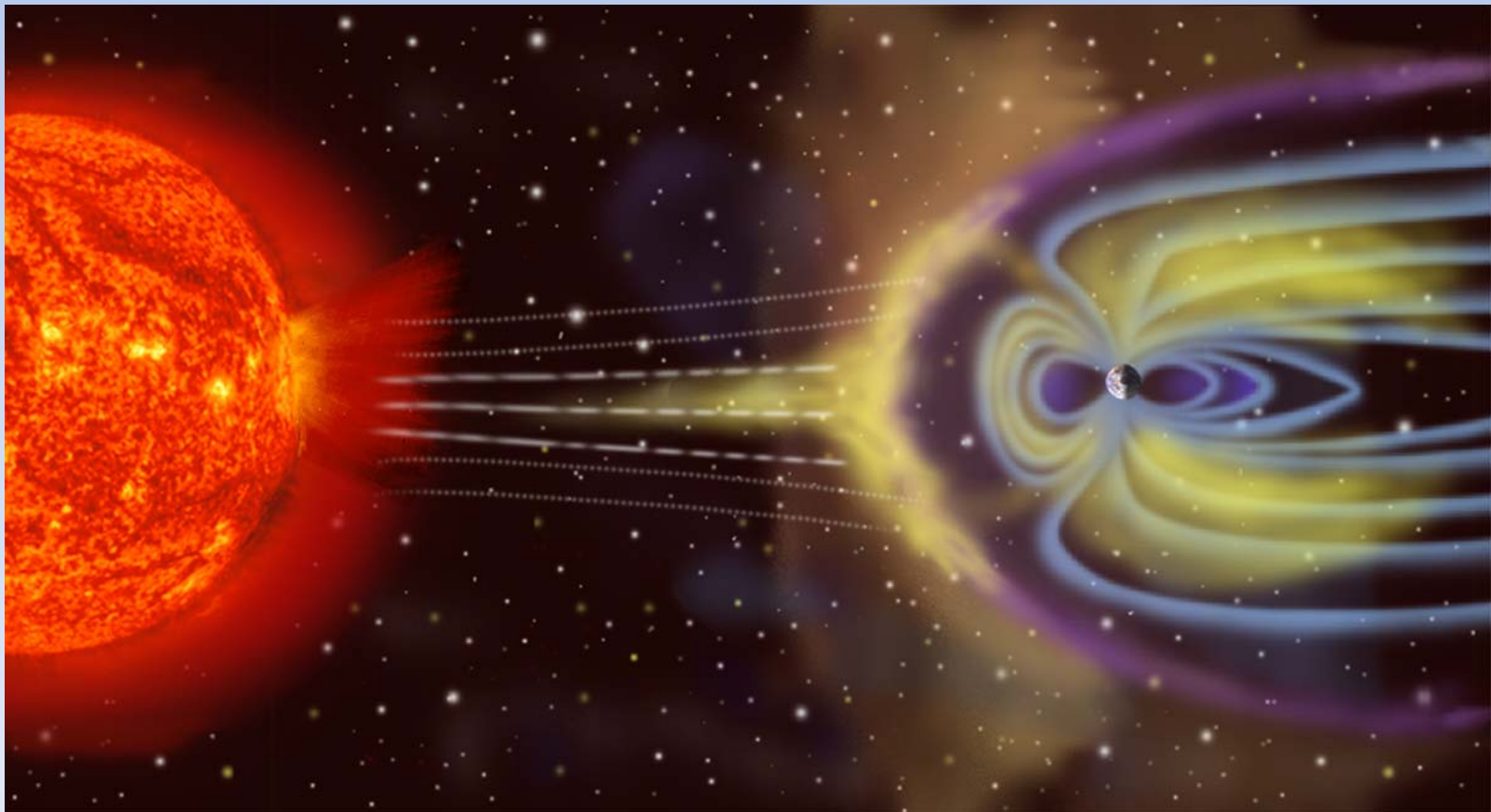
Compasses & Santa

- Compasses line up in our magnetic field
- Not attracted to just a pole..the whole mag. Field
- Santa lives at the SOUTH magnetic pole



Our solar wind screen

- Earth's magnetic field shields us from solar wind
- Mars lost its magnetic field and solar wind blew away its atmosphere



Direction of B – “easy” right hand rule

- If you have a current, you have motion of charges, charges in motion make magnetic fields
- B is always perpendicular to I, so how can you tell direction of I and B?

The easy right hand rule

- Relates I and B produced BY moving charges
- Align CONVENTIONAL current (I) with your thumb, direction of B is curl of fingers
- NOTE: If I is moving in a coil, align curled fingers with I and thumb points in direction of B

