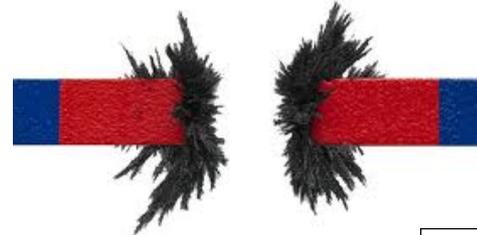# Physics 30 – Magnetic Forces and Fields

Agenda:

- Describe magnetic interactions in terms of forces and fields
- Describe how the discoveries of Oersted and Faraday form the foundation of the theory relating electricity to magnetism

Demos:

- Iron Shavings in Petri Dishes
- Gyroscopic Magnets
- Vector and Solenoid Props

Demos:

WEAR YOUR SAFETY GLASSES

Demo #1: Two Bar Magnets
- Create a rule for the forces that you feel.

Demo #2: Iron Filings
- How do the Iron Filings orient in regards to the orientation of the bar magnet?

Demo #3: Gyroscopic Magnets
- How does the gyroscopic magnet orient itself in relation to a fixed magnetic field?
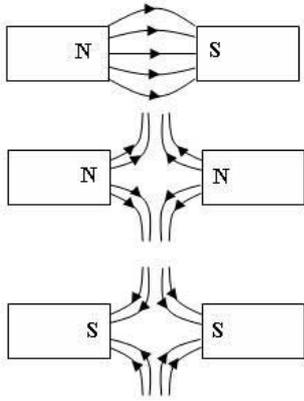
Demo #4: Verify your Findings
- http://phet.colorado.edu/en/simulation/magnets-and-electromagnets

Magnetic Field Lines

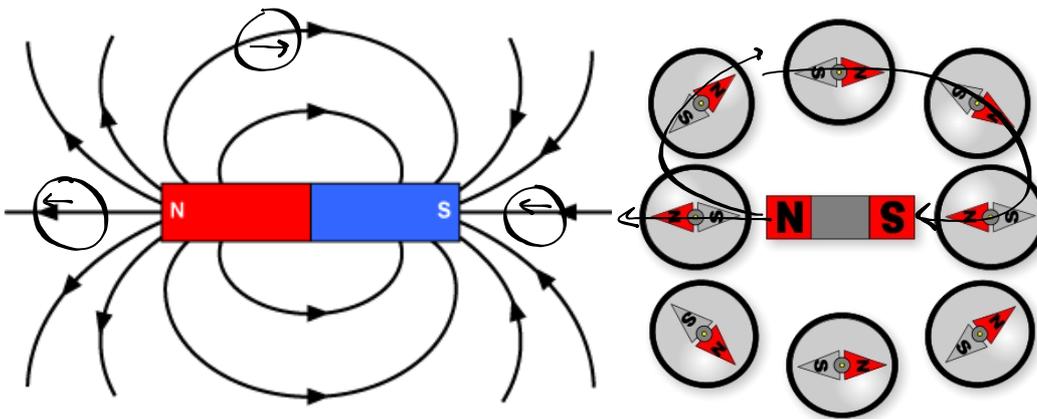http://phet.colorado.edu/en/simulation/magnets-and-electromagnets

Law of Magnetism

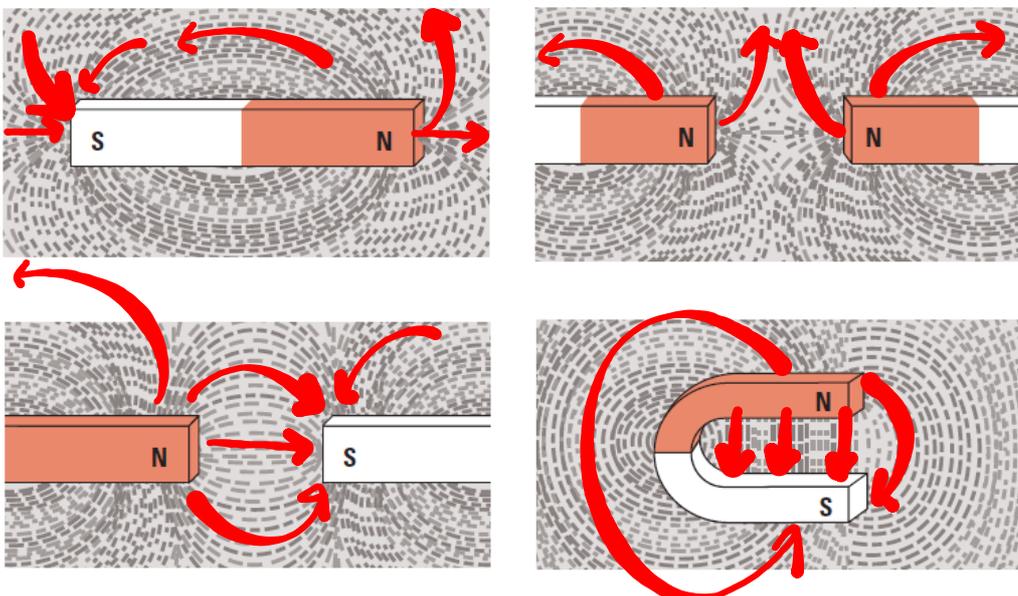Like magnetic poles repel and unlike poles attract each other.
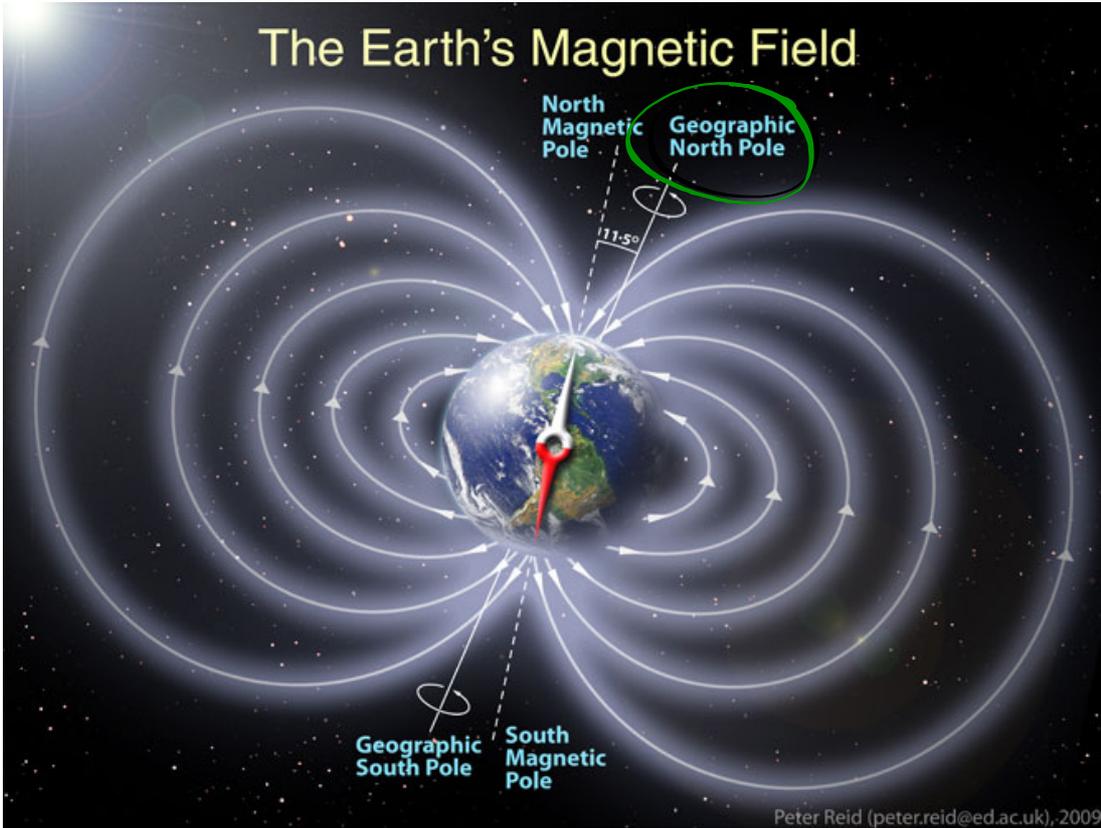

Dealing with Magnetic Fields

- Field lines point away from North Pole and into South Pole
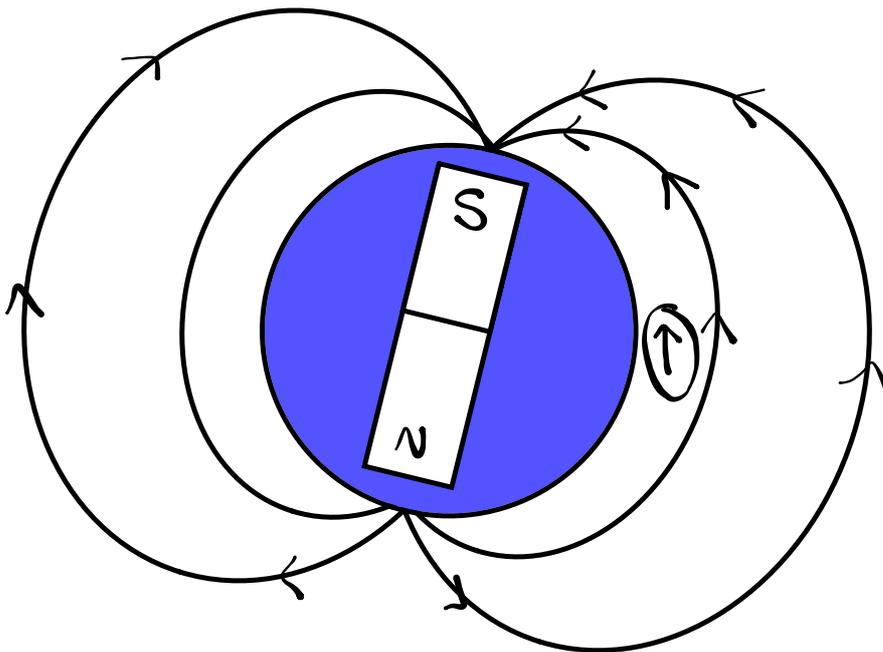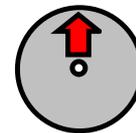- Field lines point in the same direction that a North on a compass would point.
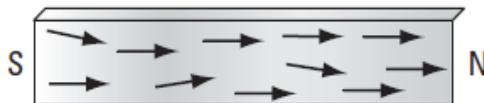

Draw the Field Lines

Earth's Magnetic Field Lines

The Earth's Magnetic Field

North Magnetic Pole
Geographic North Pole
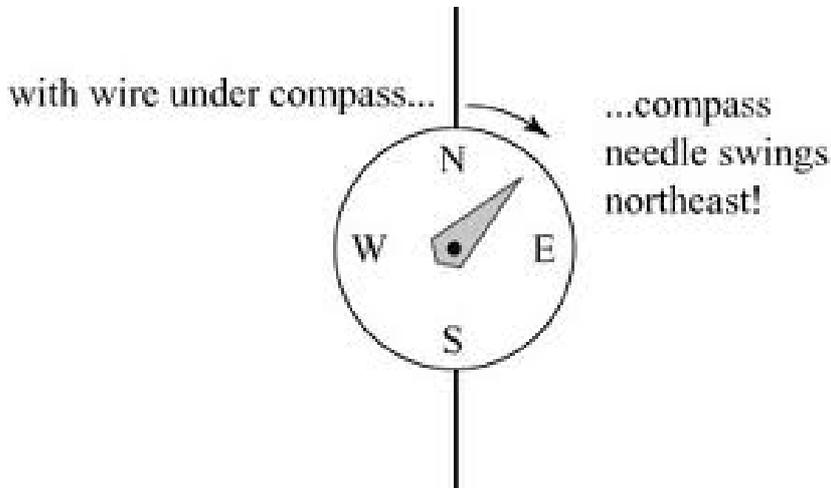11·5°
Geographic South Pole
South Magnetic Pole
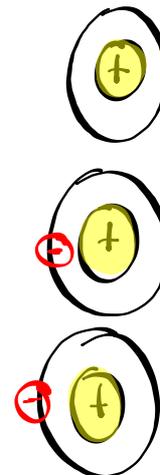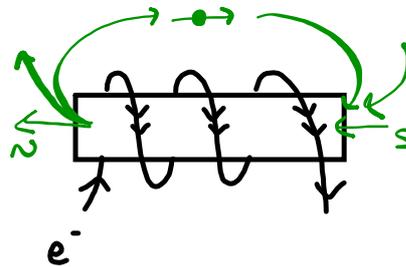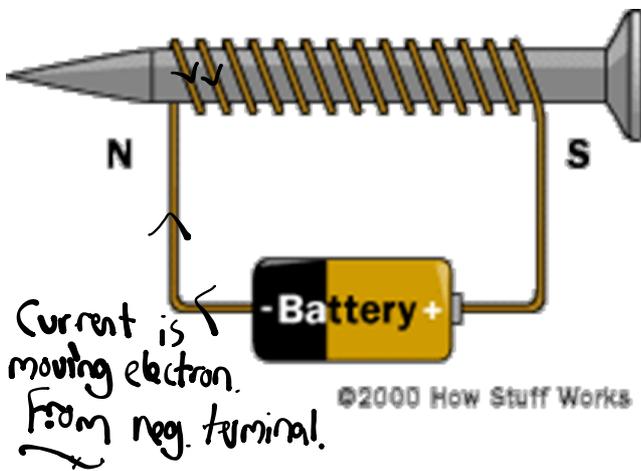
Peter Reid (peter.reid@ed.ac.uk), 2009

Which End is Magnetic North?

Domain Theory and Magnetism

Oersted and Faraday

with wire under compass...

...compass needle swings northeast!

N

W ● E

S

Electromagnets

N   S

-Battery +

©2000 How Stuff Works
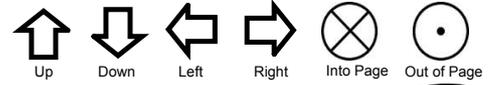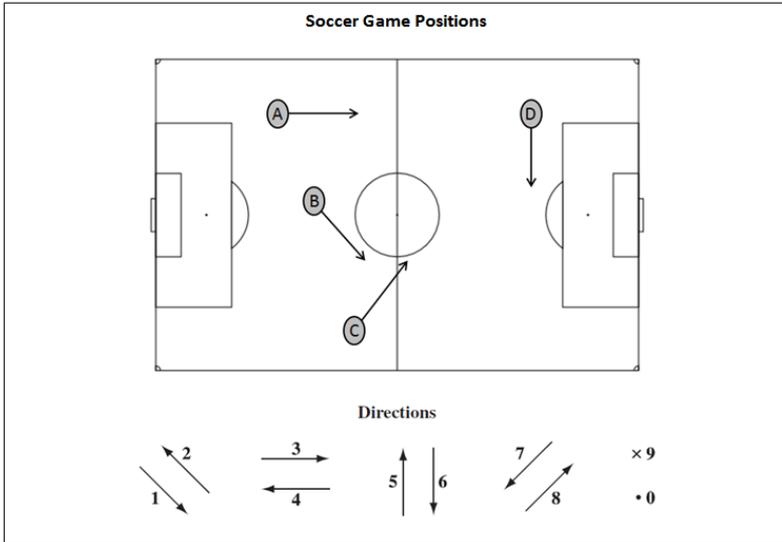
Current is moving electron. From neg. terminal.

e⁻

Increase strength by:
- Increasing the current through the wire
- Increasing the number of loops in the coil
- Increasing the size of the loops in the coil
- Changing the core of the coil

Vector Directions

Use the following information to answer Q15:

Soccer Game Positions

Directions

Q15: The directions of soccer players can be described using the numbers given above.

Direction of Travel: _____   _____   _____   _____
Player: Player A   Player B   Player C   Player D

*(Record your **four digit** answer in the Numerical Response boxes below)*
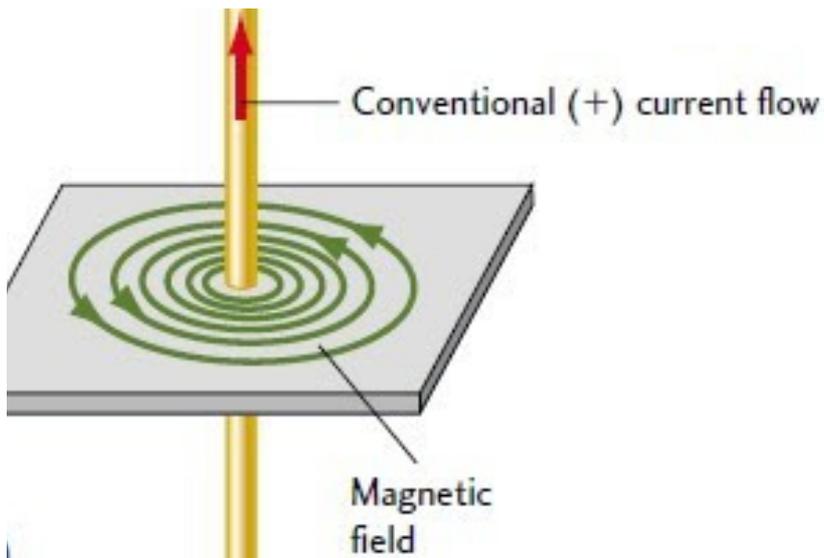

First Hand Rule

(a)

direction of
magnetic field lines

e⁻

direction
of electron flow

left
hand

conductor

magnetic
field lines
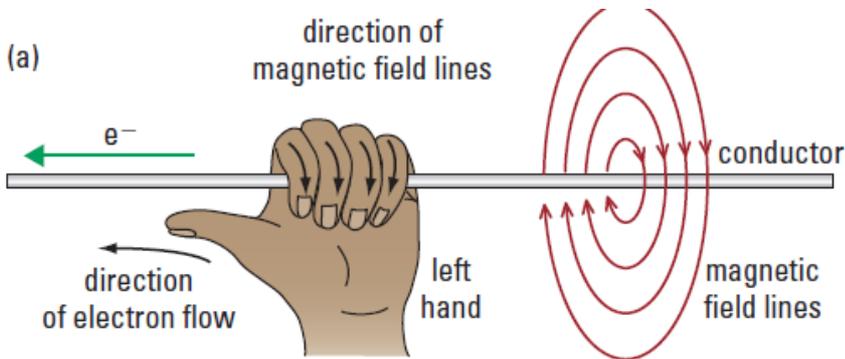
Left: Neg. charges

Thumb: Direction of current

Fingers: Circ. Mag. Field

Worth Mentioning – "Conventional Current"

Conventional (+) current flow

Magnetic
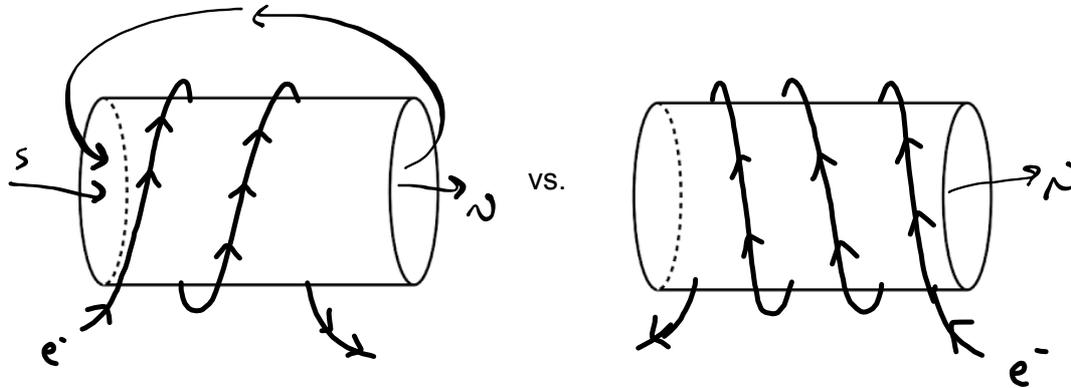field

Second Hand Rule
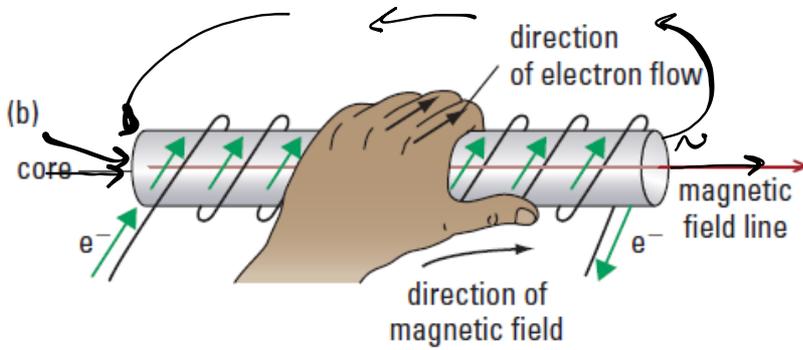
Left: Mov of e⁻

Thumb: Straight Mag Field $(\vec{B})$

Fingers: Curved current

Worth Mentioning – Wrap Direction

vs.

Our Equations

- Symbol of $\vec{B}$
- Measured in Tesla (T)

Electricity and Magnetism

$$\left|\vec{F}_e\right| = \frac{kq_1q_2}{r^2} \qquad \Delta V = \frac{\Delta E}{q}$$

$$\left|\vec{E}\right| = \frac{kq}{r^2} \qquad I = \frac{q}{t}$$

$$\vec{E} = \frac{\vec{F}_e}{q} \qquad \left|\vec{F}_m\right| = Il_\perp \left|\vec{B}\right|$$

$$\left|\vec{E}\right| = \frac{\Delta V}{\Delta d} \qquad \left|\vec{F}_m\right| = qv_\perp \left|\vec{B}\right|$$