Chapter 21 - Magnetism

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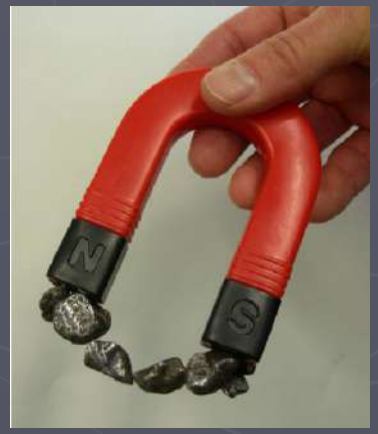
Warm-Up Jan. 15

1. What 2 magnetic poles would attract one another?
2. What is a solenoid?
3. What do magnetized magnetic domains look like?

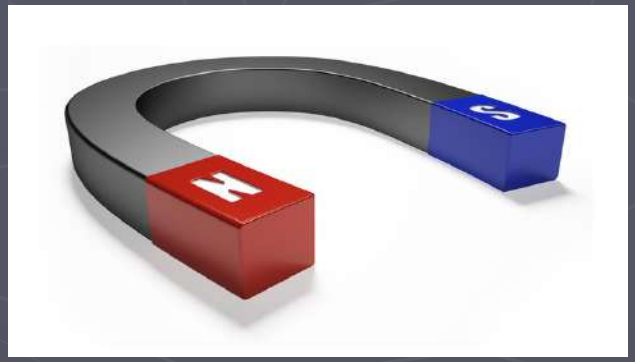
Section 21.1 – Magnets and Magnetic Fields

- Magnetic force is the force a magnet exerts on another magnet, on iron or a similar metal, or on moving charges.
- Magnetic forces, like electric forces, act over a distance.
- Magnetic forces, like electric forces, vary with distance.

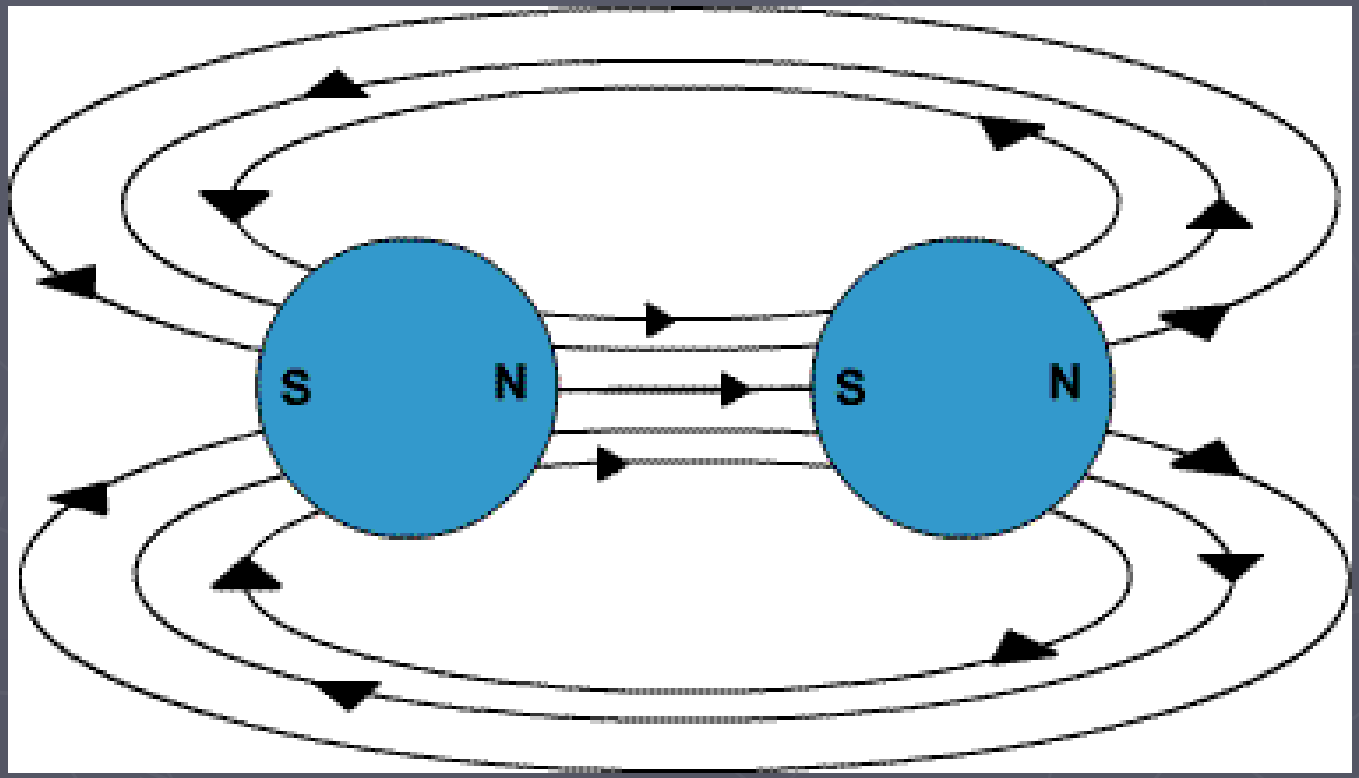


Magnetic Poles

- All magnets have two magnetic poles, regions where the magnet's force is strongest.
- One end of a magnet is its north pole; the other end is its south pole.
- Like magnetic poles repel one another, and opposite magnetic poles attract one another.

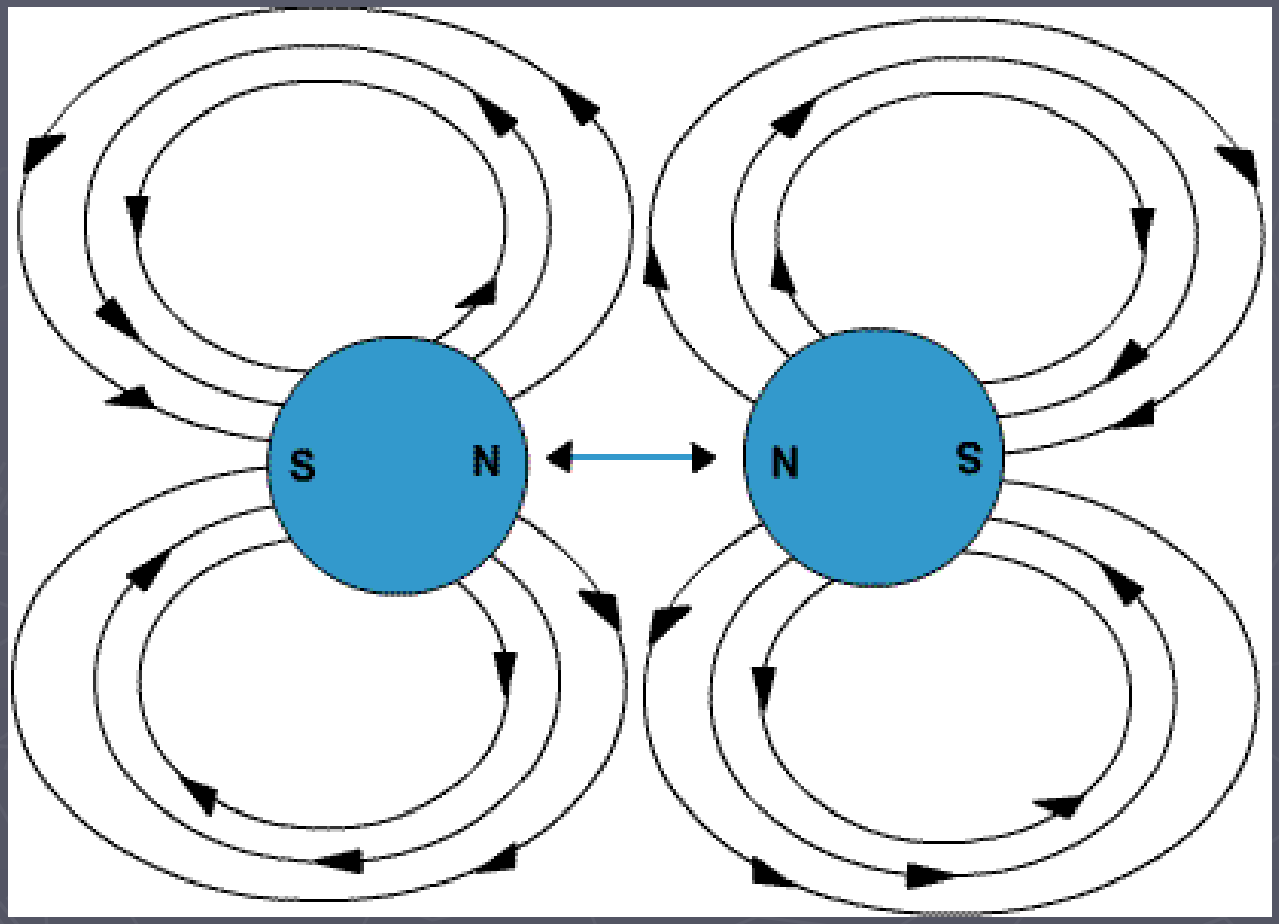


Attraction



Force attracts N to S

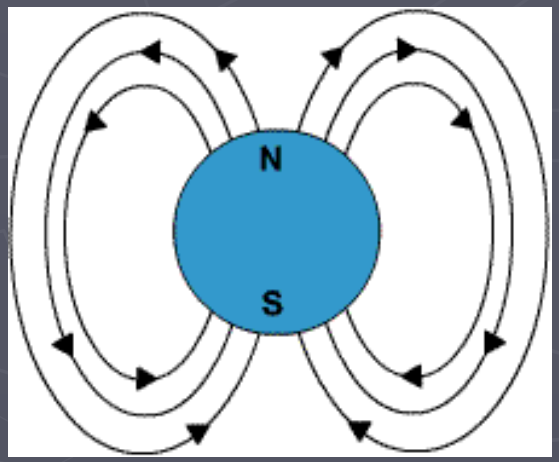
Repulsion



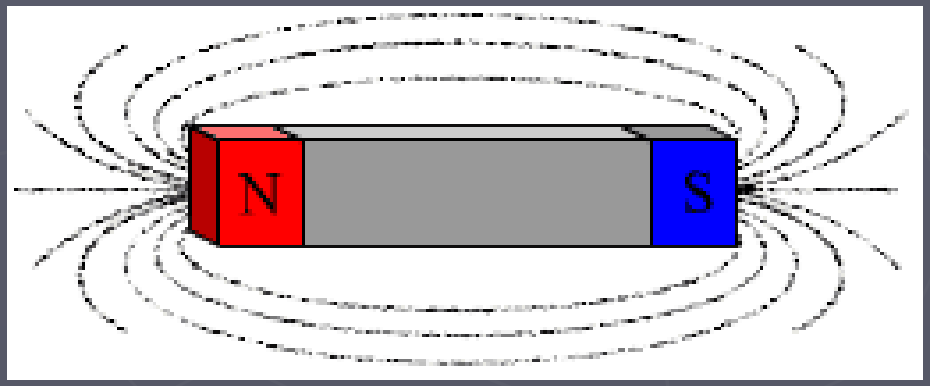
Force pushes magnetic objects apart

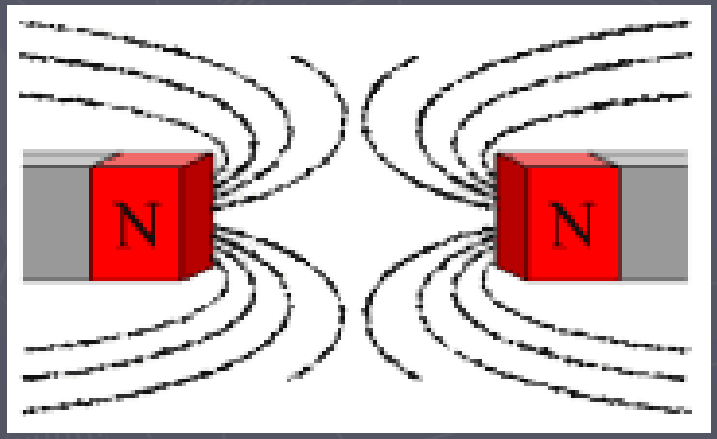
Magnetic Fields

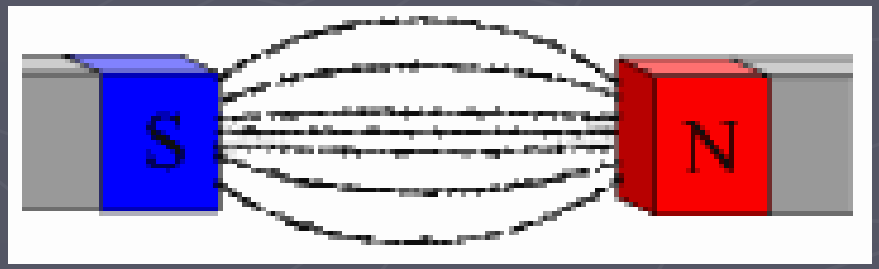
- A magnetic field surrounds a magnet and can exert magnetic forces.
- A magnetic field, which is strongest near a magnet's poles, will either attract or repel another magnet that enters the field.
- The magnetic field lines always travel from the north pole to the south pole of a magnet.



Iron Filings

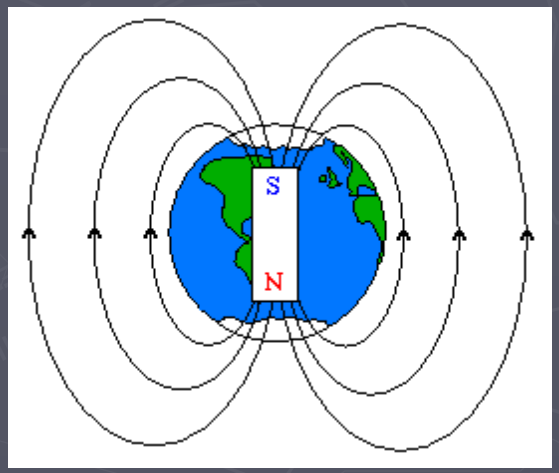


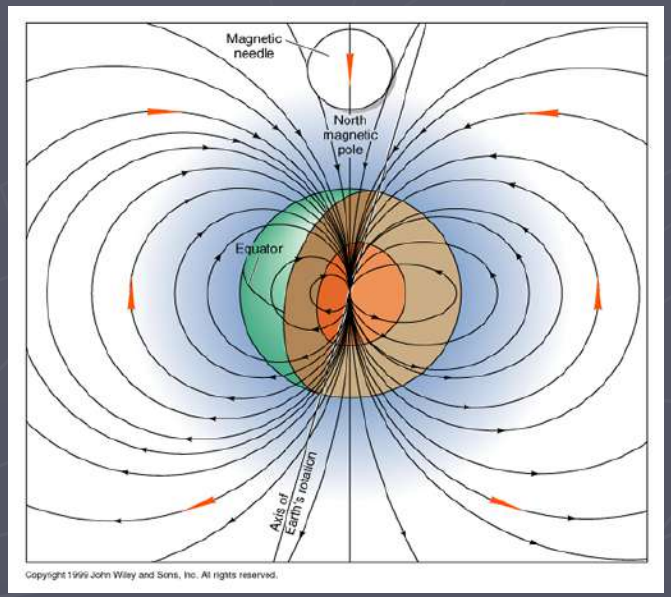




Earth's Magnetic Field

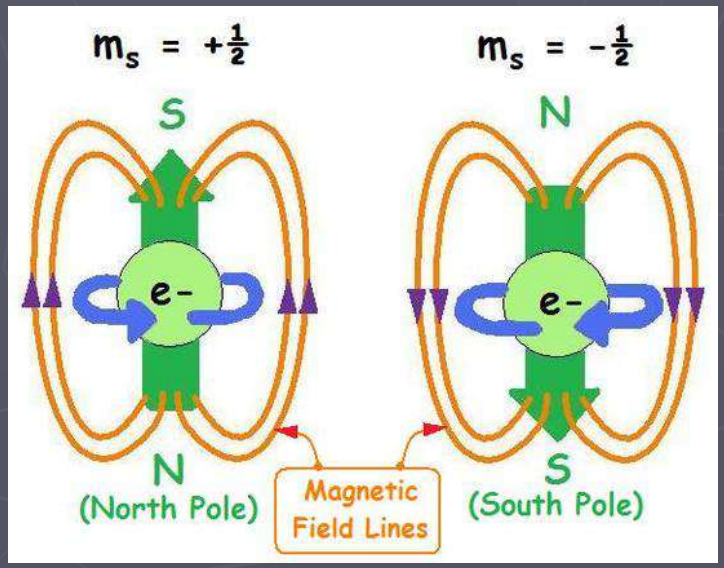
- Earth is like a giant magnet surrounded by a magnetic field.
- The area surrounding Earth that is influenced by this field is the magnetosphere.





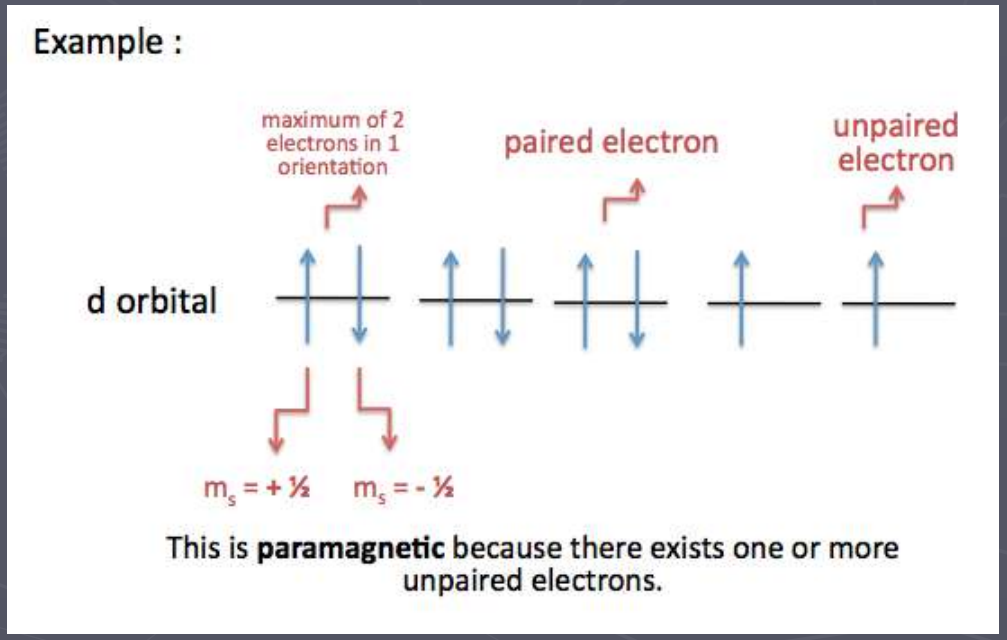
Magnetic Materials

- Within an atom, electrons move around the nucleus.
- This movement, along with a property called spin, causes electrons to act like tiny magnets.



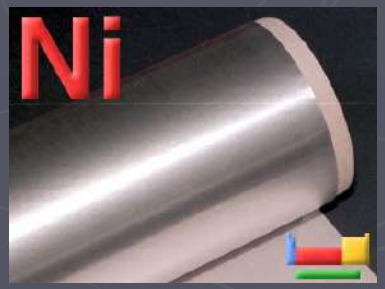
Paired Electrons

- In many materials, each electron is paired with another having an opposite spin, so magnetic effects cancel each other out.
- Many other materials have one or more unpaired electrons, but the magnetic fields usually don't combine because the arrangement of atoms is not right.



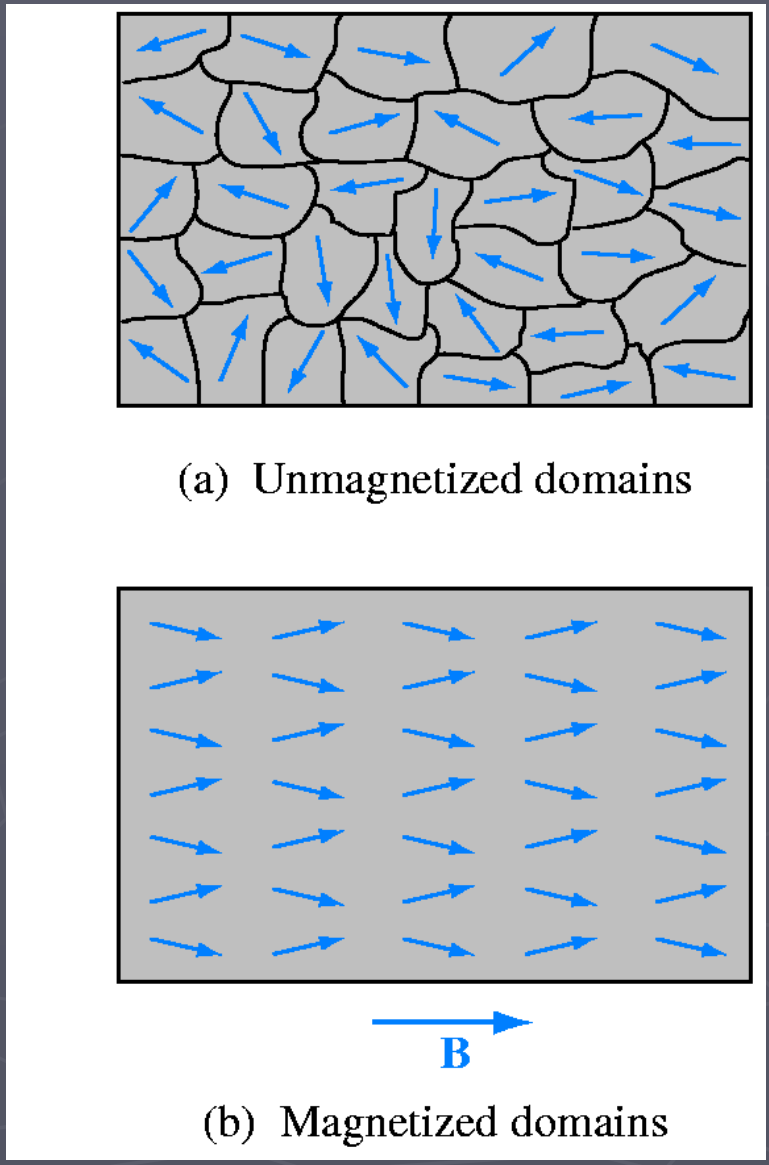
Magnetic Domains

- In a few materials, such as iron, nickel, and cobalt, the unpaired electrons make a strong magnetic field.
- Then the fields combine to form magnetic domains.
- A magnetic domain is a region that has a very large number of atoms with aligned magnetic fields.



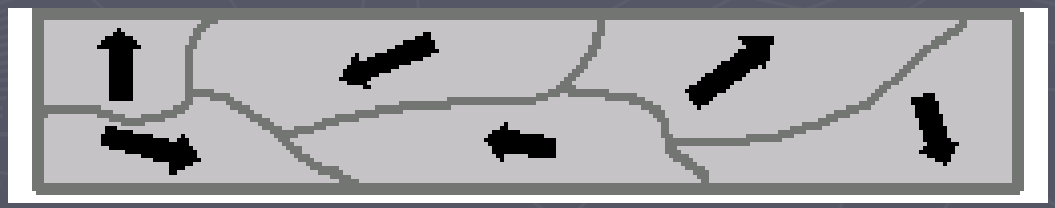
Magnetic Domains

- A ferromagnetic material can be magnetized because it contains magnetic domains.
- When a material is magnetized, most of its magnetic domains are aligned.



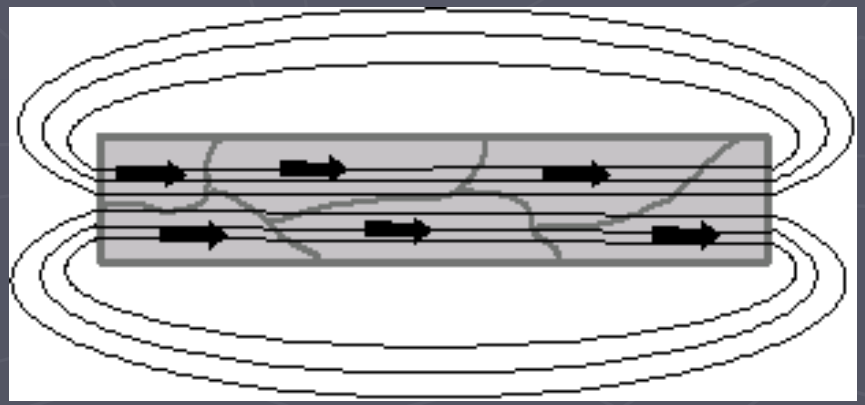
Nonmagnetized Materials

- If the domains of a ferromagnetic material are aligned randomly, the magnetization of the domains is cancelled, and it is not a magnet.



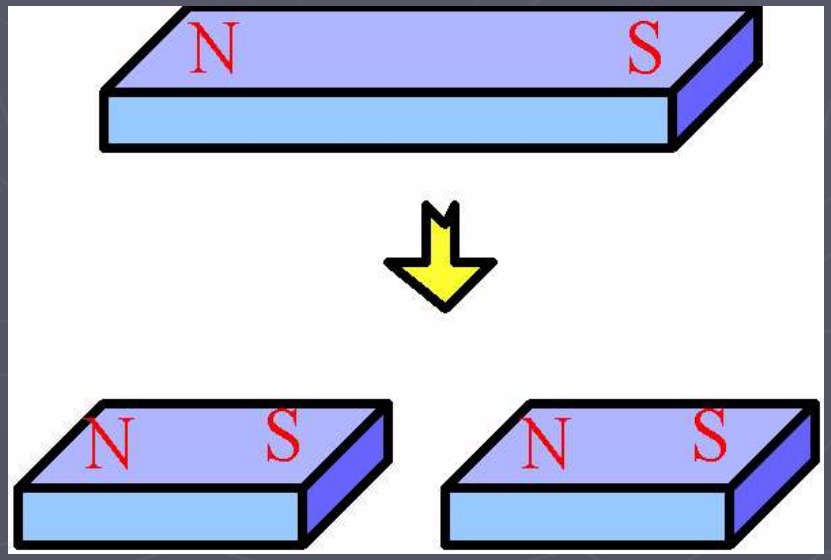
Magnetized Materials

- If a ferromagnetic material is placed in a magnetic field, then the electron domain can align which produces a magnet.
- Permanent magnets are materials whose domains will stay aligned for a long time.



Cutting Magnets

- No matter how many times you cut a magnet, each piece will always have a north and a south pole.



Section 21.1 Assessment

- Describe the interaction of magnetic poles.
- What two things can happen to a magnet entering a magnetic field?
- What makes a material magnetic?
- Describe what happens to the fields of two bar magnets when you bring their north poles together.

Section 21.1 Assessment

- What happens if you suspend a bar magnet so that it can swing freely?
- How are electrons responsible for magnetism?

Warm-Up Jan. 16

1. What is the Earth's magnetic field called?
2. What is the direction of magnetic field lines?
3. What is a magnetic domain?

Section 21.2 - Electromagnetism

- Electricity and magnetism are different aspects of a single force known as the electromagnetic force.
- The electric force results from charged particles.
- The magnetic force usually results from the movement of electrons in an atom.
- Both aspects of the electromagnetic force are caused by electric charges.

Magnetic Fields

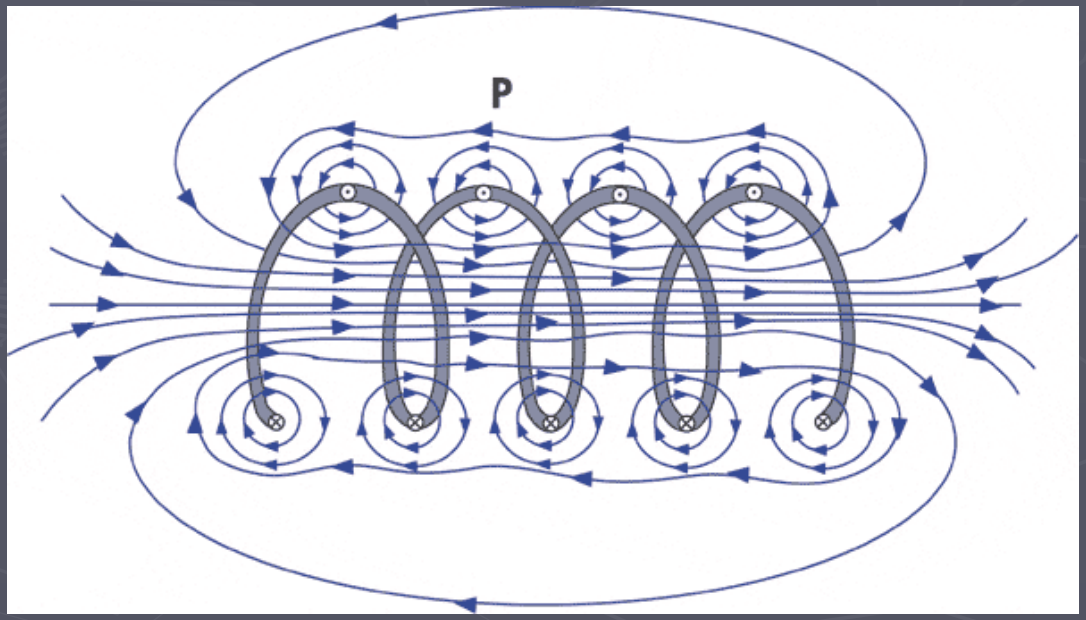
- Moving electric charges create a magnetic field.
- The magnetic field lines form circles around a straight wire carrying a current.

Moving Charges

- A charge moving in a magnetic field will be deflected in a direction perpendicular to both the magnetic field and to the velocity of the charge.
- If the current is parallel to the magnetic field, the force is zero and there is no deflection.

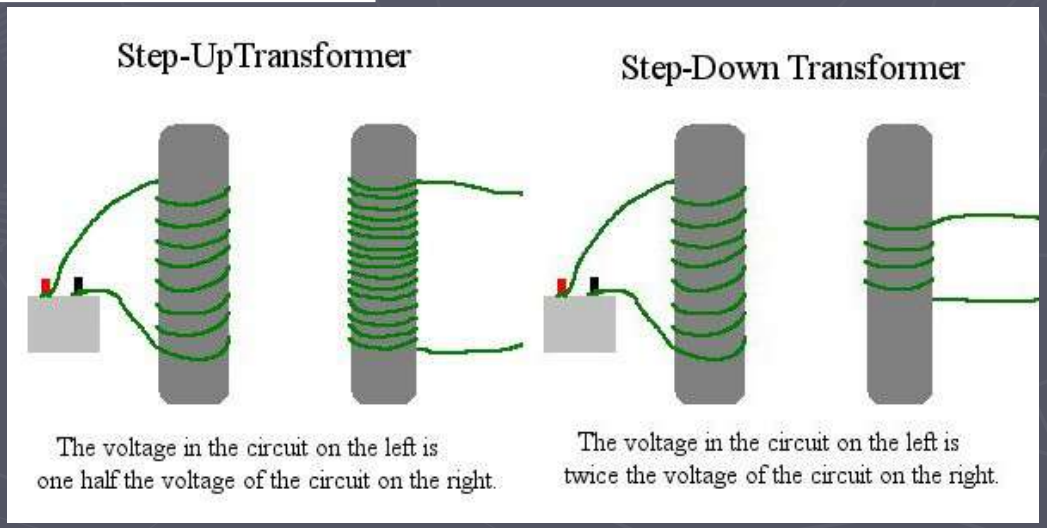
Solenoids

- The magnetic fields of loops combine so that a coiled wire acts like a bar magnet.
- A coil of current-carrying wire that produces a magnetic field is called a solenoid.



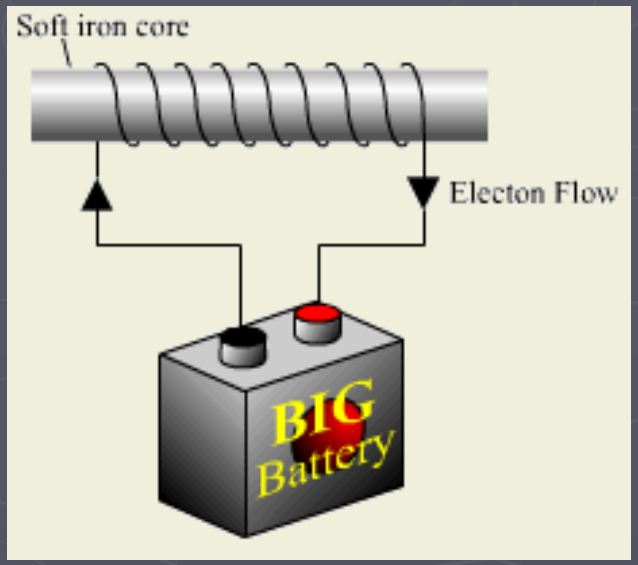
Strength of Solenoids

- If you place a ferromagnetic material, such as an iron rod, inside the coil of a solenoid, the strength of the magnetic field increases.
- The magnetic field also increases as the number of loops increase.



Electromagnets

- An electromagnet is a solenoid with a ferromagnetic core.
- Changing the current in an electromagnet controls the strength and direction of its magnetic field.



Section 21.2 Assessment

- Besides a magnet, what can create a magnetic field?
- How is the magnetic field of an electromagnet controlled?
- How does a ferromagnetic rod inside a solenoid affect the strength of an electromagnet?

Section 21.2 Assessment

- What is the effect of a magnetic field on a stationary electric charge? On a moving electric charge?
- Why is it a good idea to have the coil of a solenoid wound closely with many turns of wire?