Preview of Period 15:
Magnetic Forces and Electromagnets

15.1 Properties of Magnets

When are magnets attracted to other materials? What happens when a magnet is broken?

15.2 Magnetic Domains and Info Storage

How is information stored on magnetic media?

15.3 Magnetic Forces and Magnetic Fields

What makes one magnet "float" above another magnet?

What are magnetic fields?

15.3 Magnetic Forces and Moving Charges

What is an electromagnet?

How does current in a wire interact with another magnet?

Magnetic Force and the Four Fundamental Forces

Fundamental Forces

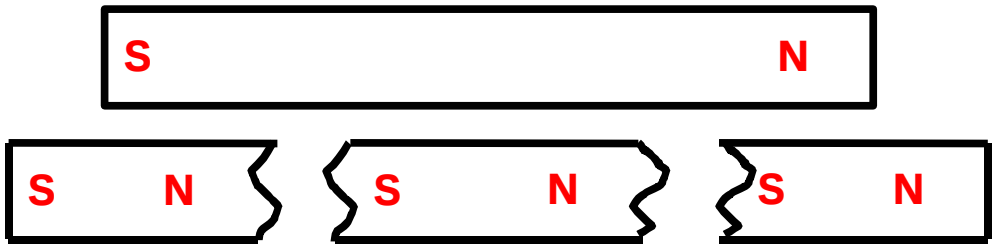
- **Gravitational**
- **Electromagnetic = Electrical + Magnetic**
- **Weak Nuclear**
- **Strong Nuclear**

- **Charges moving within some types of materials produce magnetic forces.**
- **These magnetic forces are in addition to the electrical forces between moving charges.**
- **Magnetic energy results from the forces between magnets.**

Act. 15.1: Properties of Magnets

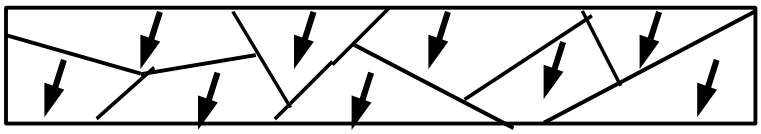
Magnets attract or repel other magnets.

- All permanent magnets have a north and a south pole.
- Like magnetic poles (two north poles or two south poles) repel each other.
- Unlike magnetic poles (a north and a south pole) attract each other.
- Magnets can attract materials with magnetic properties.
- Permanent magnets broken into pieces create smaller magnets, each with a north and a south pole

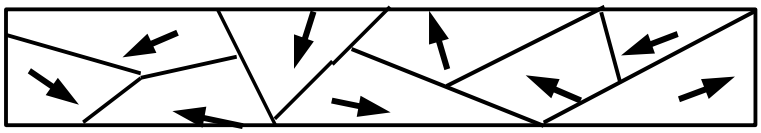


Act. 15.2 Magnetic Domains and Information Storage

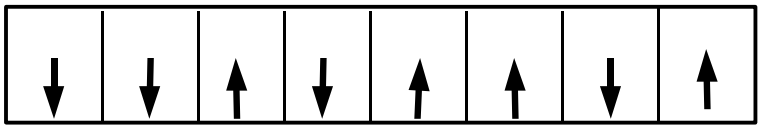
Magnetic Domains



Magnetized material has aligned magnetic domains



Material with randomly aligned domains is not magnetized



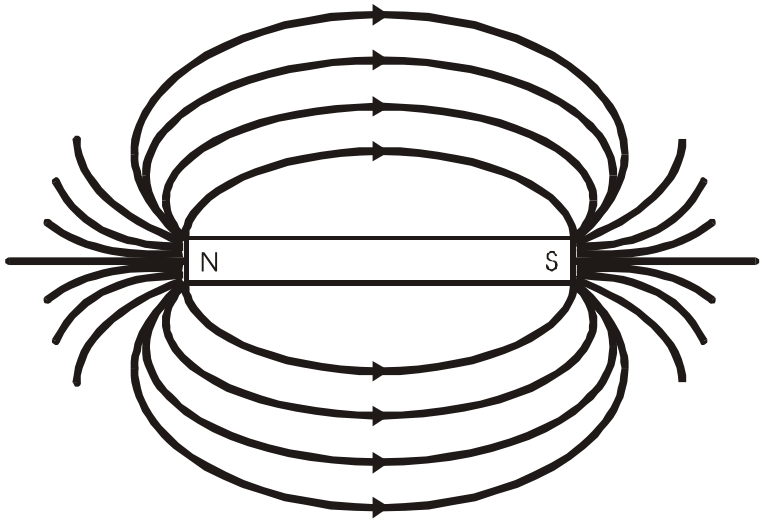
The black magnetic strip on a credit card contains magnetized material with domains aligned in two directions.

Act.15.3: Magnetic Forces and Fields

- Magnets set up a condition in their surrounding space known as a **magnetic field.**

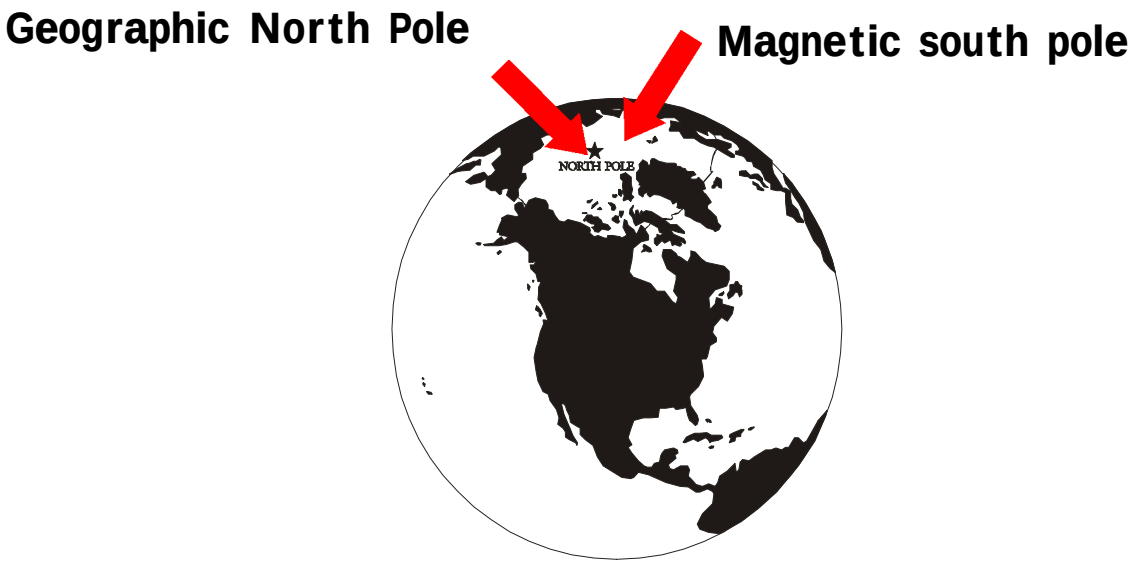
- When objects sensitive to magnetic forces are placed in a magnetic field, the objects experience a **magnetic force.**

The Magnetic Field Surrounding a Bar Magnet



Act.15.3: Magnetic Forces and Fields

The Earth's Magnetic Field

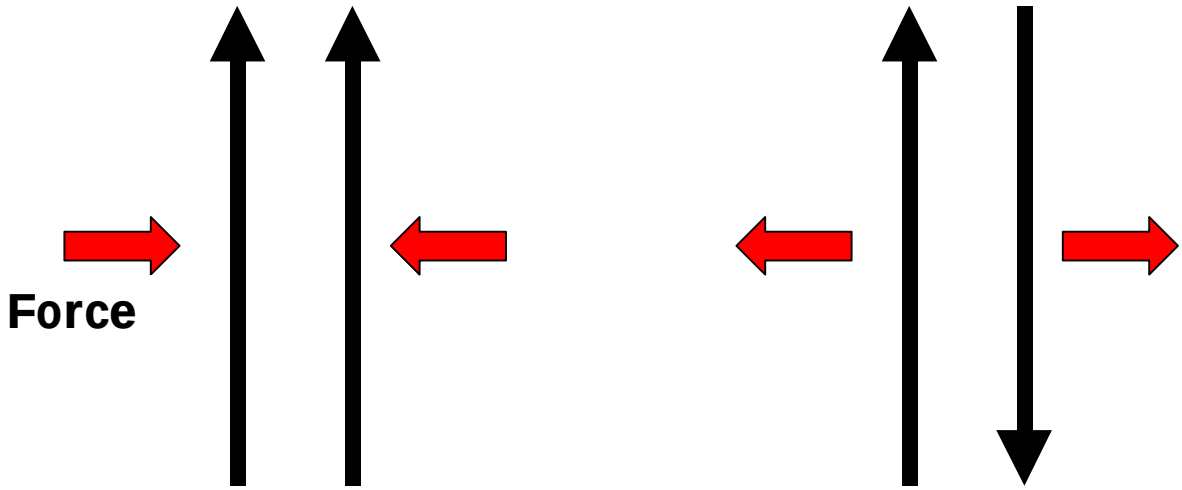


Why does the north end of a permanent magnet point toward the geographic North Pole?

- **The geographic North Pole is located very near the Earth's magnetic south pole**
- **The geographic South Pole is located very near the Earth's magnetic north pole.**

Act. 15.3 Magnetic Fields and Current

- A magnetic field is created by moving charges (electric current).
- If two wires carry current, the magnetic fields surrounding each wire exert magnetic forces on each other.
- Each wire creates a magnetic field near the other wire. The moving charges in the second wire experience a force.
- If current flows in the same direction, the magnetic fields point in opposite directions, and the wires are attracted to each other.
- When currents flow in the opposite directions, the magnetic fields repel.



Current carrying wires

Act.15.4: Electromagnets and Solenoids

Electromagnets

- When current flows through a wire, a magnetic field is created around the wire.

- Electromagnets use the magnetic field around a current carrying wire to attract or repel the magnetic field from another electromagnet or a permanent magnet.

Solenoids

A solenoid is an electromagnet whose current carrying wire is wrapped in a coil.

How can you increase the strength of a solenoid?

- Place a metal rod or core inside the coil of wire.

- Increase the current flowing through the wire.

- Increase the number of turns of wire in the coil.

Period 15 Summary

15.1: All permanent magnets have a north and a south pole. Two north poles or two south poles repel each other. A north and a south pole attract each other.

15.2: Magnetic material consists of tiny magnetic domains. When the domains are aligned in the same direction, the material displays magnetic properties.

Magnetic domains are used to store and transfer information on magnetic media such as credit cards or computer drives.

15.3: The attraction and repulsion between magnets is due to magnetic forces.

Magnets are surrounded by magnetic force fields.

15.4: The magnetic fields surrounding moving charges can be intensified by:

- wrapping the wire into a coil (a solenoid)
- increasing the current flowing through the solenoid and
- placing a rod made of iron or other easily magnetized material inside the solenoid

Period 15 Review Questions

R.1 **Name three ways you could increase the magnetic field of a coil of wire.**

R.2 **How does a changing magnetic field affect a nearby wire?**

R.3 **If north magnetic poles attract south magnetic poles, why does the north end of a compass needle point to the Earth's North Pole?**

R.4 **What are magnetic domains? How do they create magnetic properties in materials?**

R.5 **What practical uses do magnetic domains have in modern technology?**