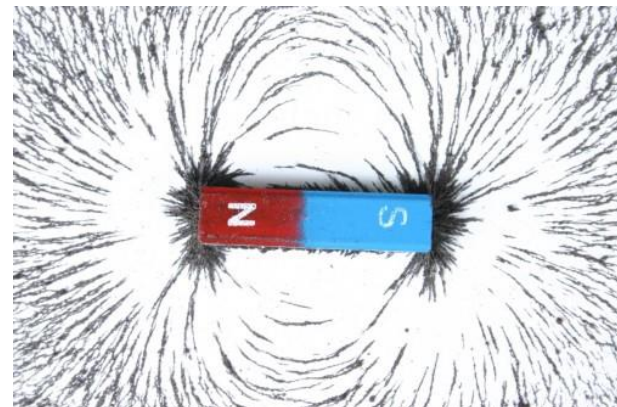


INTRODUCTION TO ELECTROMAGNETS

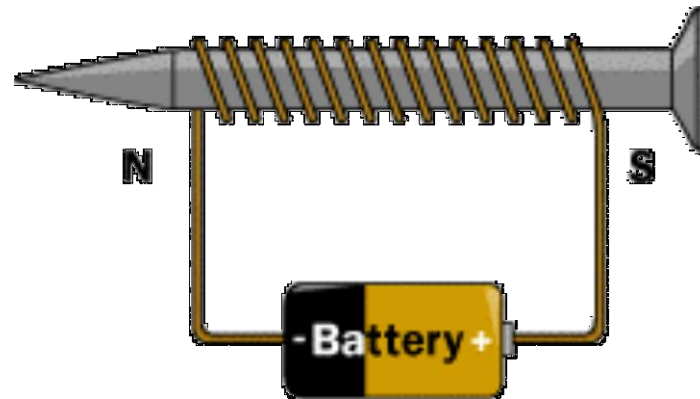
How They Work and Where to Find Them

PERMANENT VS. TEMPORARY

- ⦿ Magnets can be permanent or temporary.
- ⦿ A magnet is permanent when the material inside always produces a magnetic field.
 - Example: a bar magnet



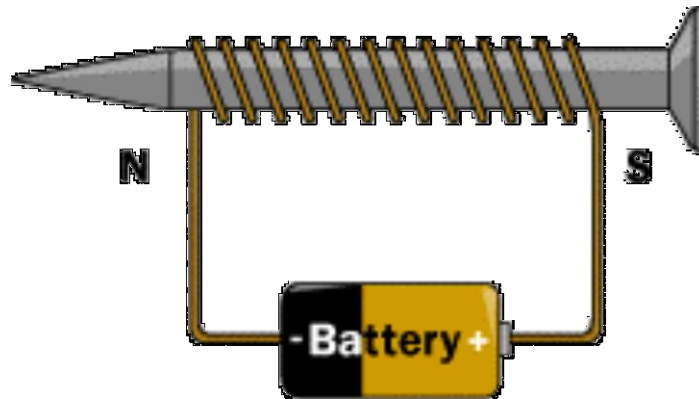
- ⦿ A magnet is temporary when the material inside only produces a magnetic field when electric current is passed through it.
 - Example: an electromagnet



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ELECTROMAGNETS

- An electromagnet is a temporary magnet created by coiling a wire around a metal core, and passing a current through the wire.



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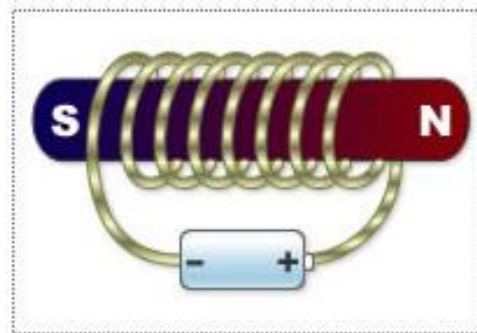
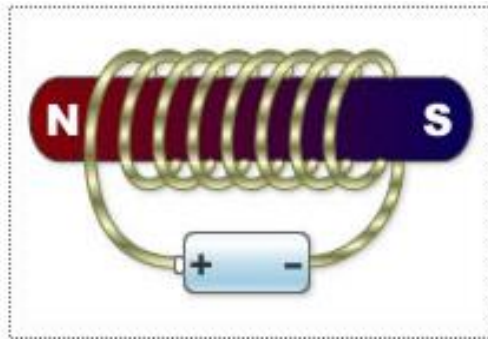
CHARACTERISTICS OF ELECTROMAGNETS

◉ Magnetic field

- The magnetic field around an electromagnet is just the same as the one around a bar magnet (permanent magnet).
- Unlike bar magnets, which are permanent magnets, the magnetism of electromagnets can be turned on and off just by closing or opening the switch.

⦿ Magnetic Poles

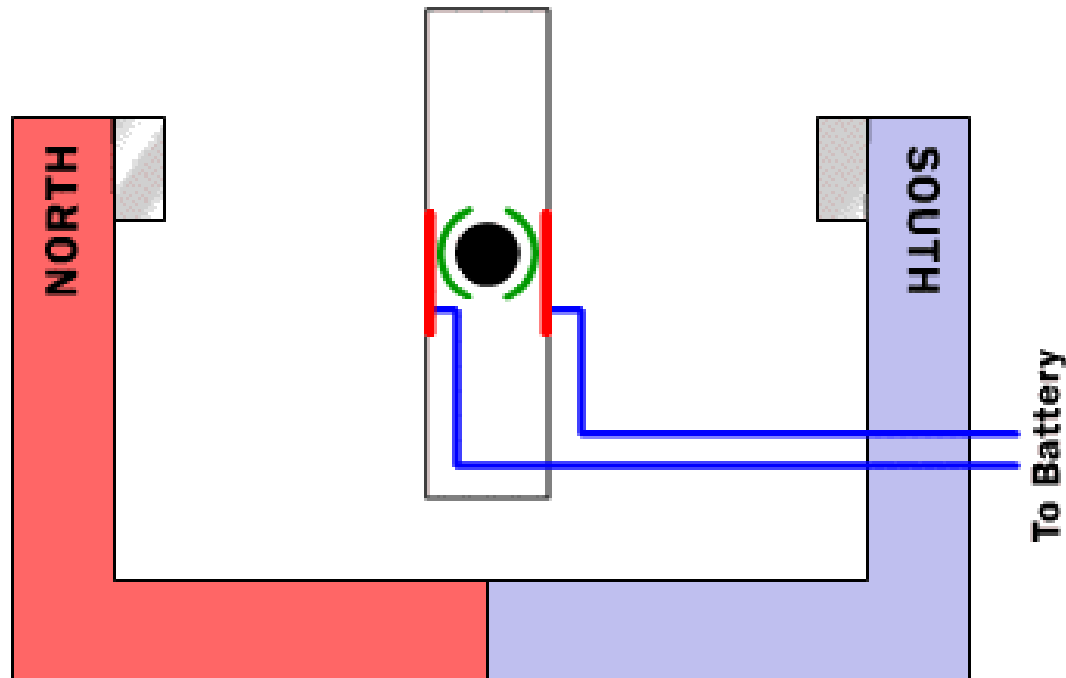
- They still have a north and a south pole.
- When the direction of the electric current is switched, poles can change places.



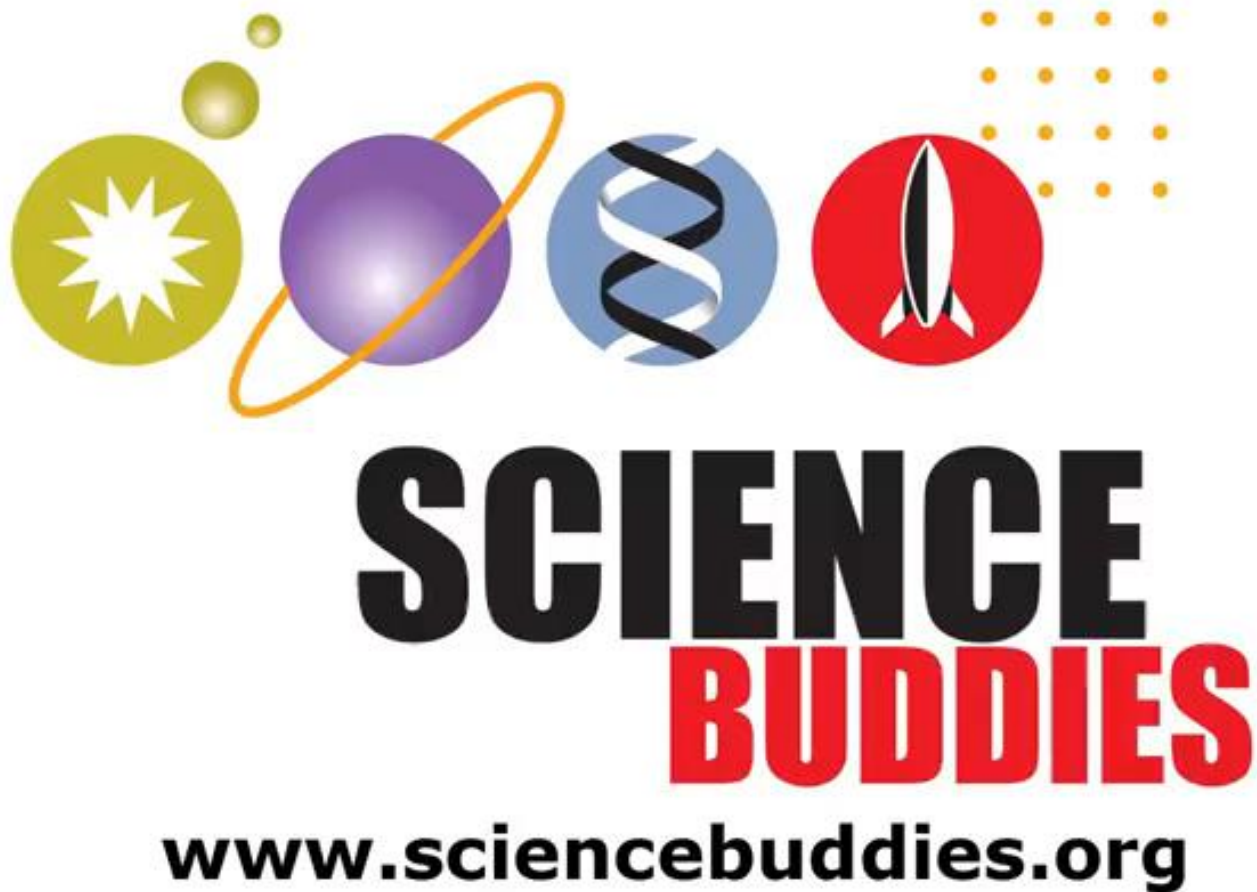
**Polarity of magnet depends
on direction of current**

◉ Magnetic Attraction

- Attracts other magnetic materials.
- When current is turned on, the magnet may be attracted to (or repelled by) other magnets.

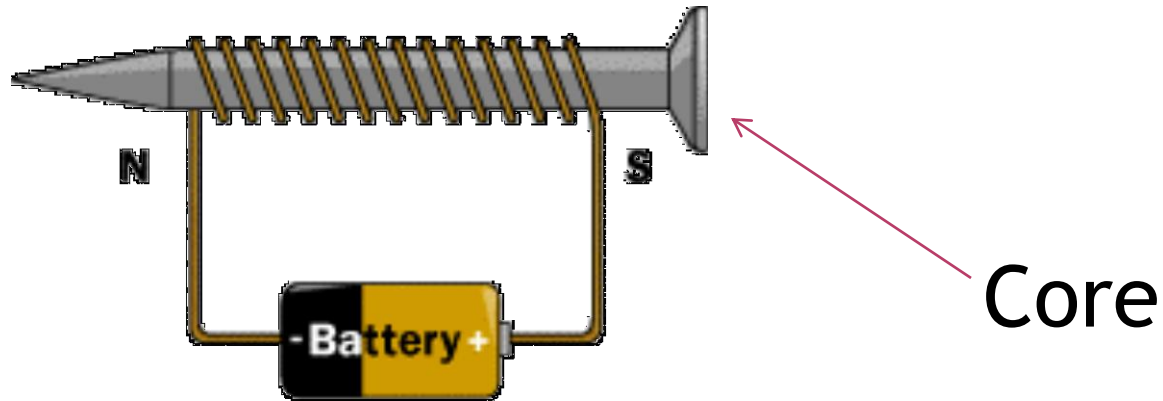


⦿ How Electromagnets Work

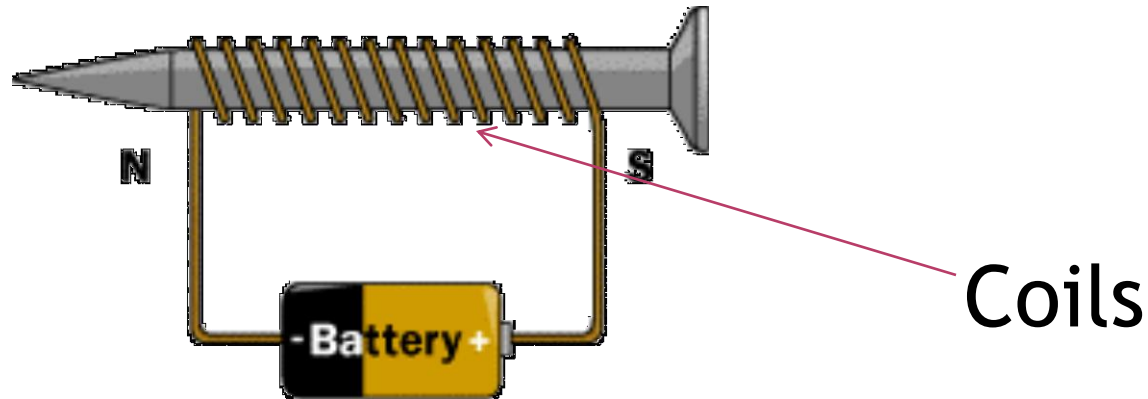


FACTORS THAT AFFECT THE STRENGTH OF ELECTROMAGNETS

- ◉ The type of core (the metal the coil is wrapped around)
 - Iron cores create the strongest electromagnets.

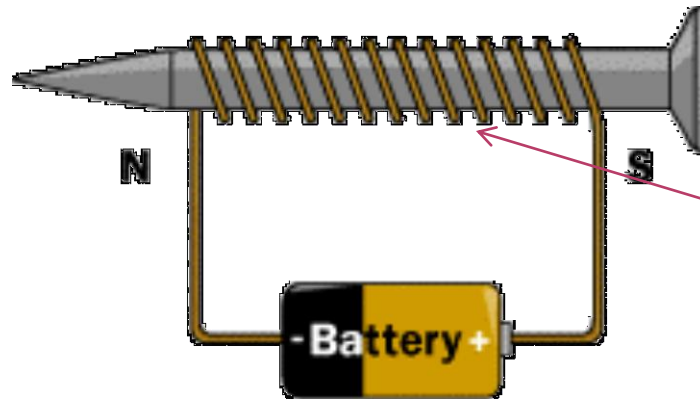


- The amount of current used
 - The more current, the stronger the electromagnet
- The number of coils used on the core
 - The more coils, the stronger the electromagnet



- The number or type of dry cell batteries

- Using more or stronger batteries will increase the strength of an electromagnet



Coils

EVERYDAY USES OF ELECTROMAGNETS

⦿ Moving scrap metal

- Turn on the current to pick up scrap
- Turn off the current to drop the scrap



EVERYDAY USES OF ELECTROMAGNETS

◎Speakers

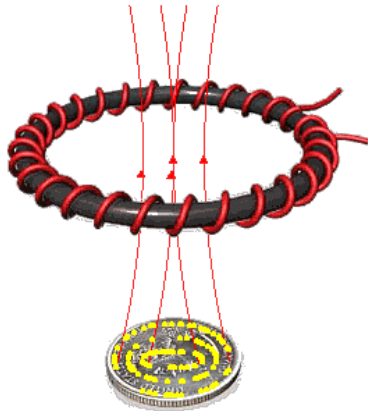
- By varying the electric current through the wires around the electromagnet, the speaker cone moves back and forth.
- The resulting vibration of the speaker cone will create sound waves, including those from voice and music.



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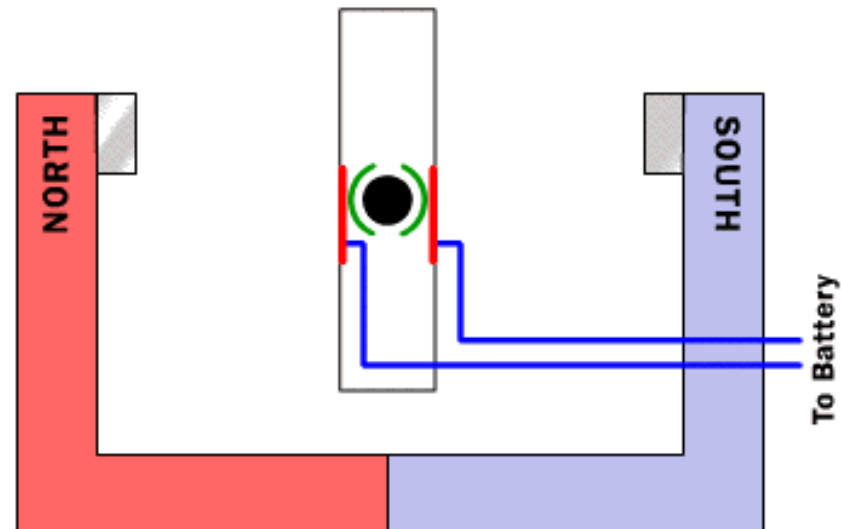
◉ Metal detectors

- Electric current passes through a coil of wire wrapped around a metal loop, creating the electromagnet. As the magnet is moved over a metal object, the object creates interference in the magnetic field. This interference is detected by the control box, which produces an audible signal.



⦿ Electric Motors

- ⦿ An electric motor is a device which converts electricity to mechanical energy.
- ⦿ An electromagnet turns inside of a permanent magnet. By changing the direction of the current, the poles will keep switching between N and S, and therefore cause the electromagnet to continually rotate.



Electric motors are used in most household appliances which convert electricity into motion.



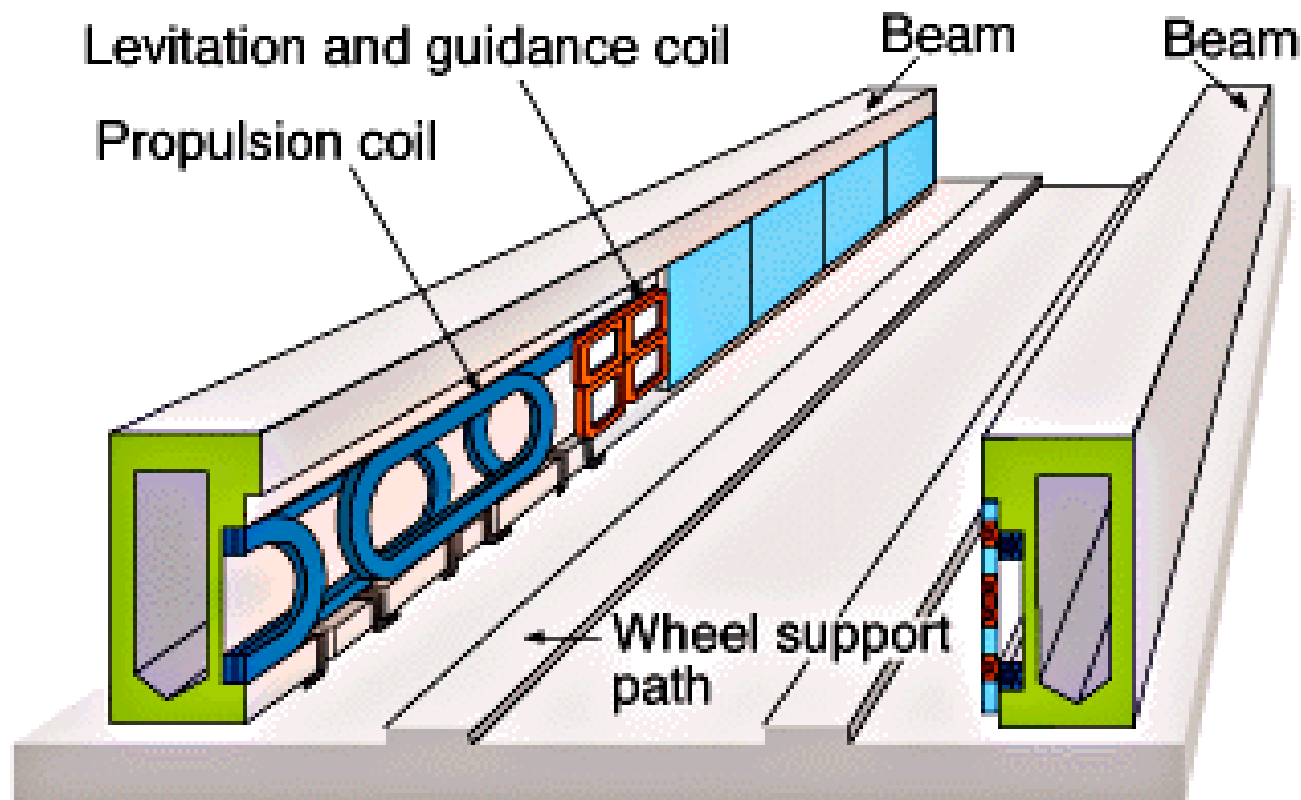
◉ Electromagnetic levitation (mag-lev)

- In electromagnetic levitation, a train or other vehicle is supported and propelled by the repulsive forces of permanent and electromagnets.



- Strong permanent magnets on the bottom of the train are repelled by the electromagnets in the track.

This supports the train, and by allowing the electromagnetic current to travel, the train is in turn pushed along.



So ... How Does This Work?





