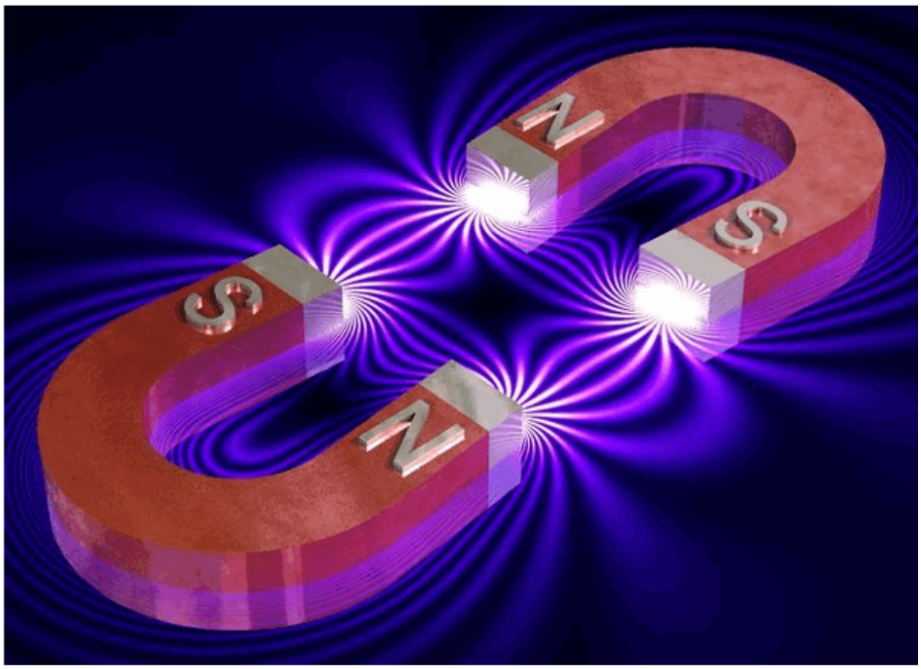
Homework: Review worksheet on magnets.

We just studied electricity. As we will learn in this unit, electricity and magnetism are related.



By the end of class today, you will:

✓ **Define what a magnet is**

✓ **Define what a domain is, and how it defines if something is a magnet or not**

✓ **Determine what kinds of things magnets attract and what things they don't attract**

✓ **Observe the magnetic fields of various magnets and pairs of magnets**

✓ **Create a temporary magnet**

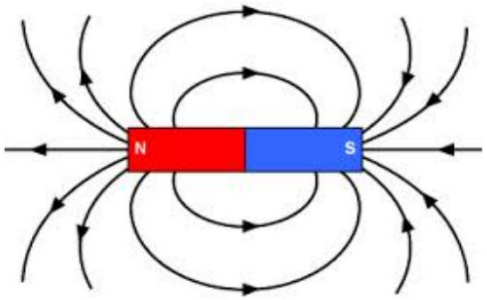
What Will A Magnet Attract?

Magnets attract objects that contain the following elements: iron, nickel, or cobalt. These are called magnetic materials.

Some examples of magnetic materials: nails, paper clips, hairpins, keys, scissors.

Magnetic Fields

There is an "invisible" force around a magnet. The area around the magnet where the magnetic force or magnetism can be felt is called the magnetic field.

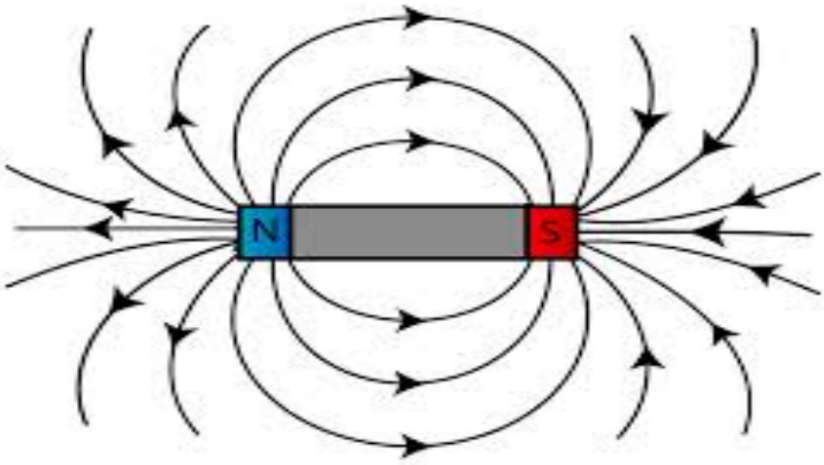


You can see the magnetic field of different magnets by putting iron filings around the magnet and seeing where they "stick".

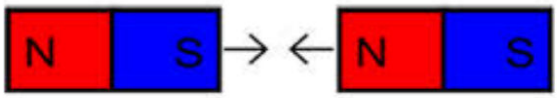
North and South Poles

Magnets have 2 poles (north & south). The lines showing the magnetic field are bunched together and concentrated at the poles.

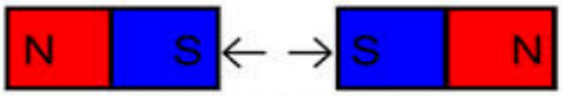
This causes a magnet to be strongest at the poles and weakest in the middle.



Opposite poles attract, but the same (like) poles repel.

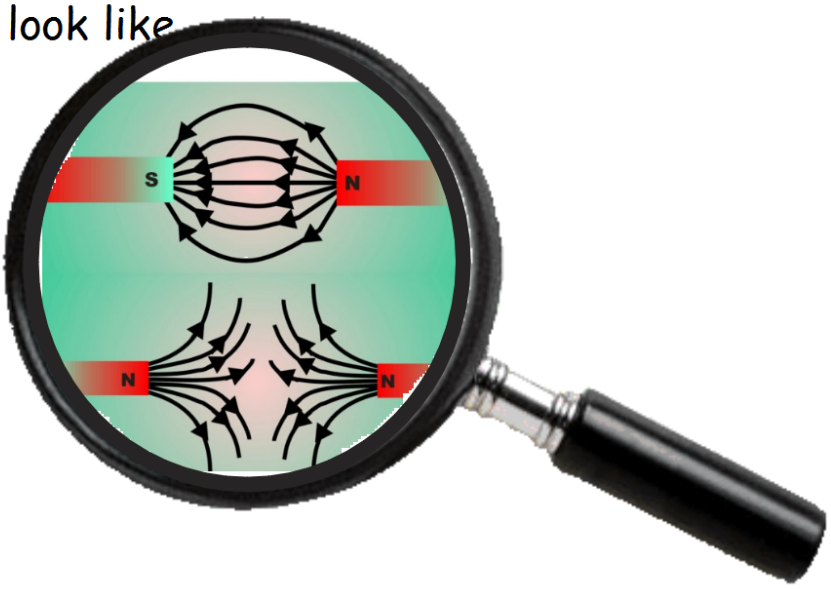


Opposite poles **attract**



Same poles **repel**

We are going to use pairs of magnets to look at the field lines of pairs of magnets. One time, you should have "like" poles (the same poles" facing one another). The next time, you should have the opposite poles facing each other. Put about 3 cm of space between then each time. Notice what the field lines look like.



So what makes a substance a magnet?

Substance made of iron, nickel or cobalt can become magnets when the atoms all line up in the same direction.

Materials contain regions called domains, where all the atoms in that region are facing the same direction. When all or most of the domains are facing the same direction the substance becomes magnetized.

Each atom is a tiny magnet.

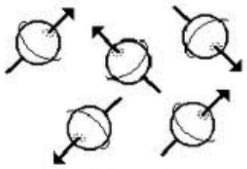
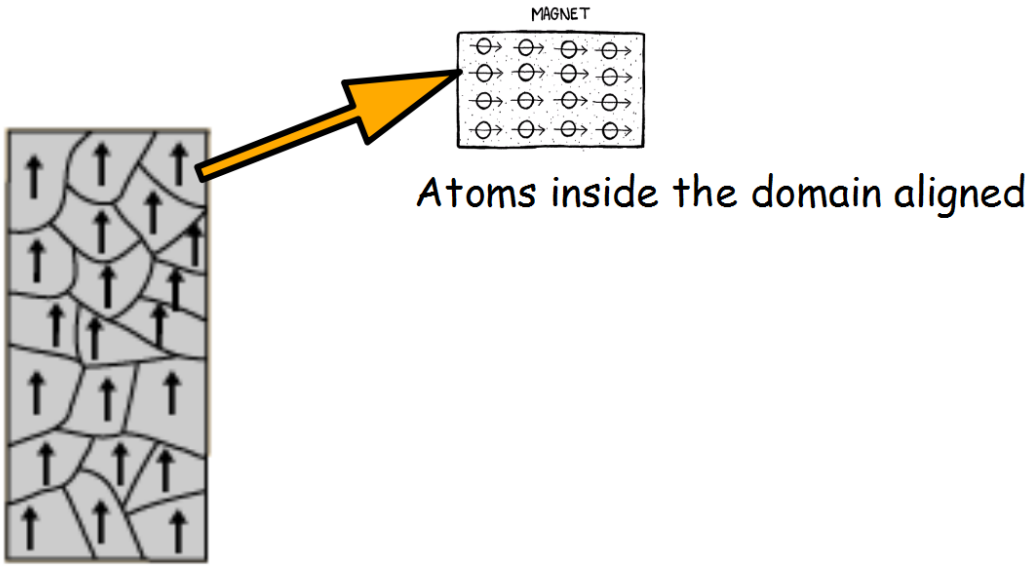


Figure 1
Randomly oriented
nuclear magnetic moments

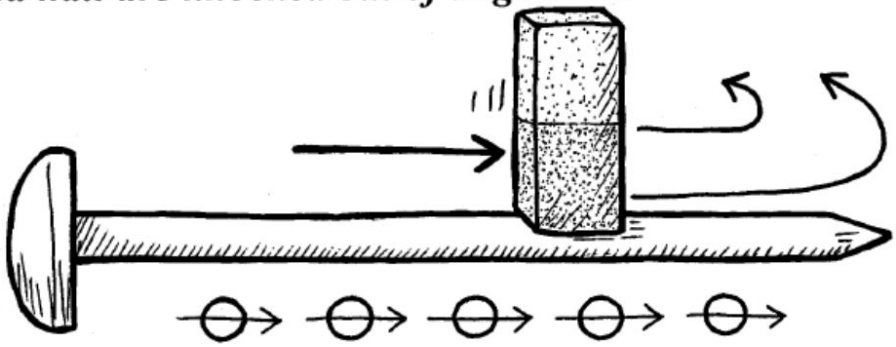
In a substance that is a magnet, the domains are arranged like students standing in straight rows, with all their noses pointing in the same direction.

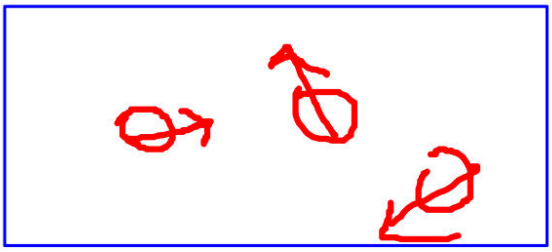


In an ordinary object, that is not a magnet, the domains are arranged like groups of students standing around the locker area, all facing different directions.

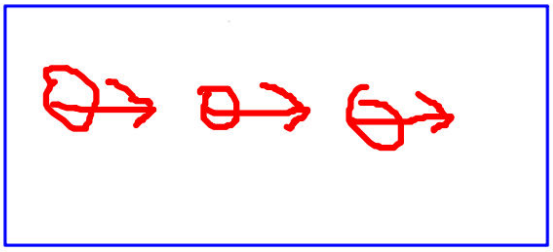
The domains are NOT aligned

Factfile: An iron nail can be made into a temporary magnet by rubbing it with a permanent magnet. The rubbing causes the atoms to line up in rows, creating a temporary magnet. Dropping the nail will make the nail lose its magnetism. The atoms in the dropped nail are knocked out of alignment.





Draw the domains before the magnet was used.



Draw the domains after the magnet was used.

a magnet that loses its magnetic force easily

temporary magnet

the groups of particles in a substance that determine if it is a magnet

domain

a magnet that does not lose its force easily

permanent magnet

the part(s) of a magnet where the magnetic force is the strongest

poles

to push away

repel

all pointing in the same direction

aligned

to pull toward one another

attract

is not attracted to magnets

non-magnetic

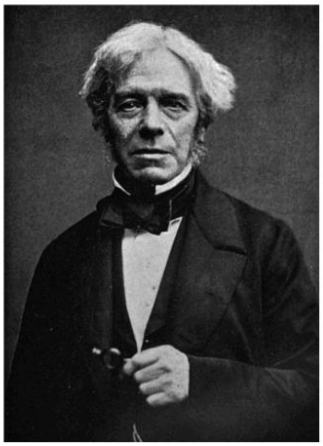
the area around a magnet where the force is felt

magnetic field

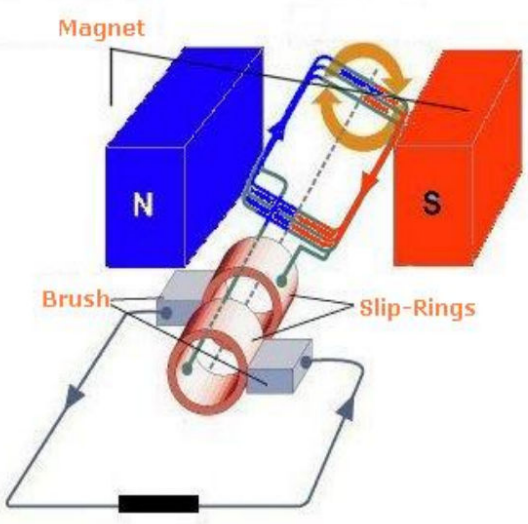
We have discovered that the two forces of electricity and magnetism are two aspects of the same thing. You cannot have one force without the other.

The interaction between the electricity and magnetism is called electromagnetism.

In the early 1800's, a scientist named Michael Faraday figured out that magnetism and electricity were closely related, and wondered if he could use magnets to create electricity.

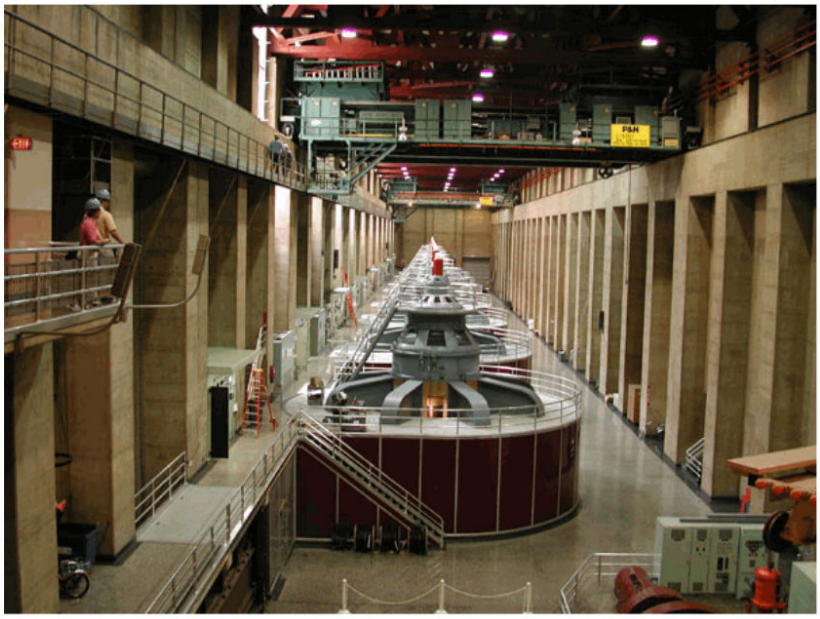


If you move wire loops in a magnetic field or move magnets around loops of wire, you cause electric current to flow. This is known as a generator.



phet simulator

spinning generator



Generators at the Hoover Dam electrical power plant.

Electric power plants use generators to produce the electricity that is brought to our homes, and lets us use all of our electrical appliances.

Generators can be turned by running water, steam that is created by burning coal, burning oil, or heat from nuclear reactions.

generator run buy water

Power plants use generators, but lots of other people and places use generators too. In fact, you might know someone with one!

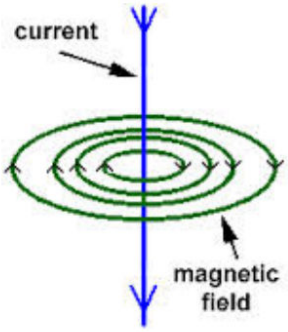
Why might someone, or some place, own their own generator?

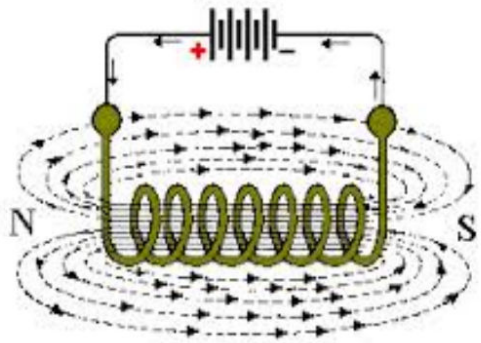
A generator is a device that converts mechanical energy (kinetic) into electrical energy.

Just like, we can use magnetism to create electricity, we can also use electricity to create magnets. In fact, some of the most powerful magnets in the world are created by electricity.

Maglev

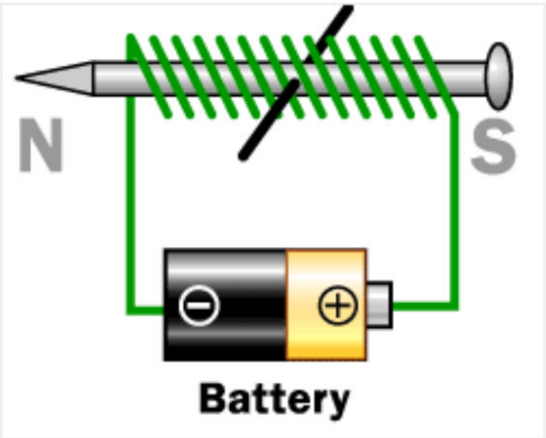
A scientist named Hans Christian Oersted discovered that a circular magnetic field exists around a wire.

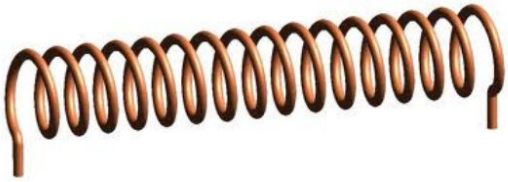




Compass near coil of wire

Electromagnets are created by using an electrical energy source (such as a battery) an iron core (or rod, such as a nail), and some wire. The wire is wrapped around the iron core in coils.

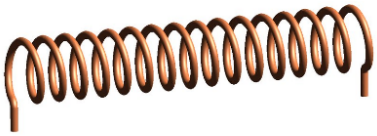




Solenoid

Today, we will create electromagnets and explore what factors make a difference in how strong it is.

Problem question: **Does the number of coils affect the strength of an electromagnet?**



Hypothesis:

If we increase the number of coils then the strength of the electromagnet will increase.

Independent Variable:

Number of coils

Dependent Variable:

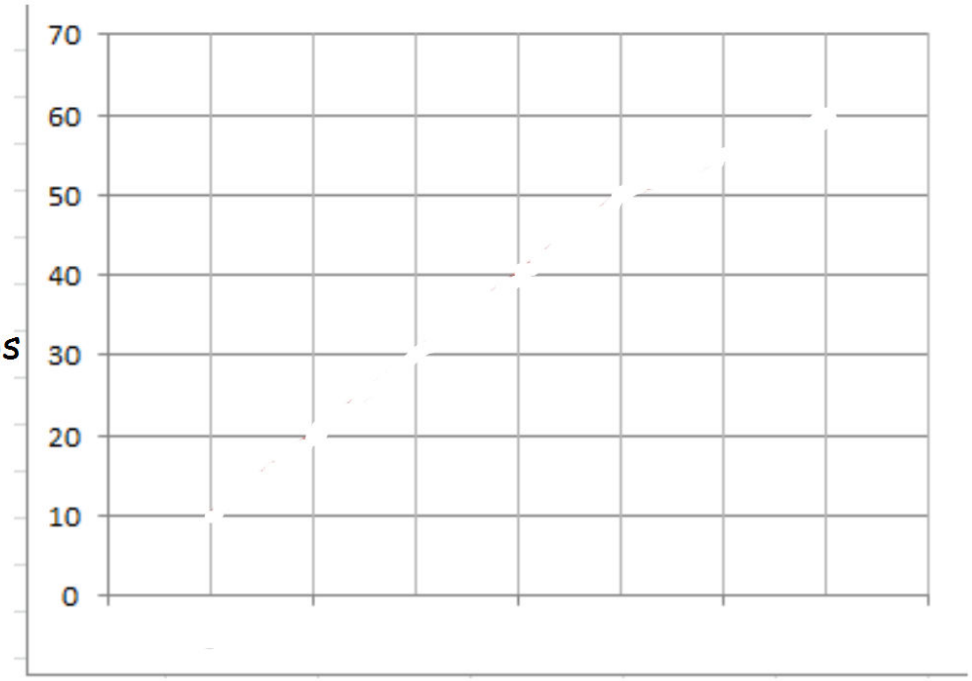
Stength of the electromagnet. We will determine this with the number of paper clips picked up.

Constants:

Same type of battery, wires, nail and paper clips

We need a data table to record our results. What type of data can we collect to show if the coils affect the strength of the electromagnet?

# of coils	# of paper clips
5	6
20	25
35	45



of
paper clips

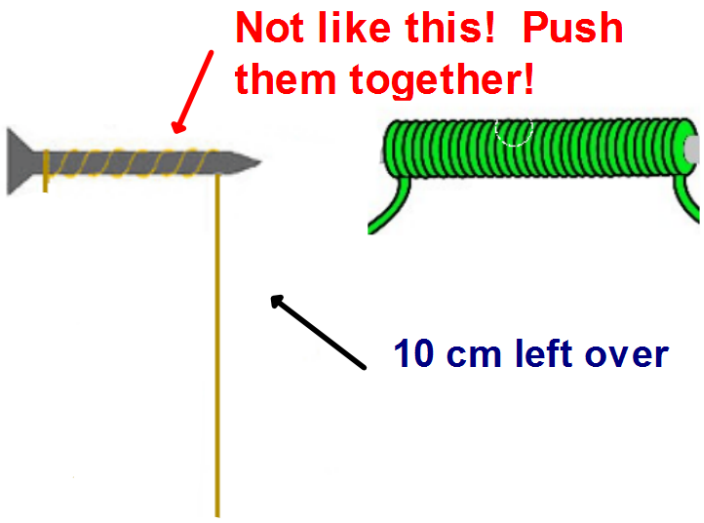
DV

IV

# of coils

First, take your insulated wire and your nail from the bin. Measure off 10 cm from the end of the wire, and then start coiling the wire around the nail. Make 5 loops. Push the loops closely together.

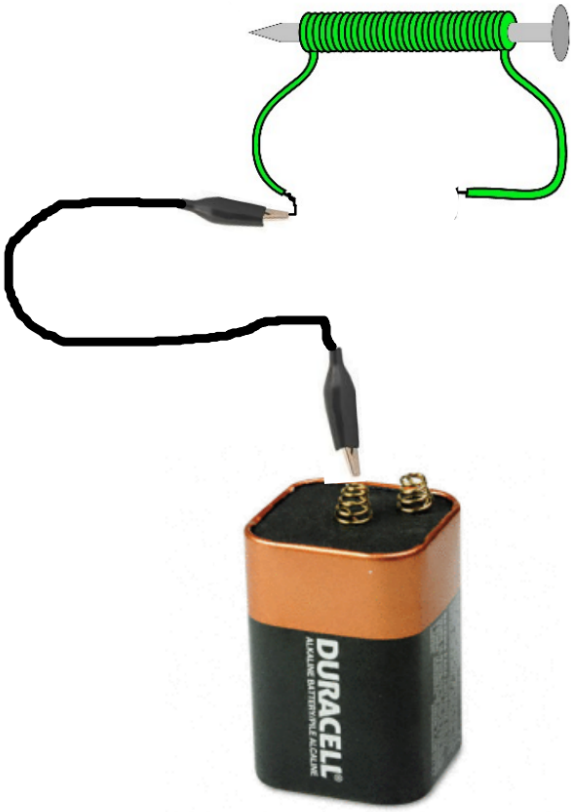
What have you just made, when you coiled the wire around the nail?



Dump your beaker of paper clips on the desk in front of you.

They do not need to be very spread out, but you also don't want a tall pile of them.

1. Attach an alligator clip from the one end of your solenoid to the negative termimal of the battery.



2. When I say "go", attach a second alligator clip from the other end of your solenoid to the positive termimal of the battery. I will give you 15 seconds to see how many paper clips you can pick up with your electromagnet.

3. When I say "stop", move your electomagnet to an area where there are no paper clips, and have one team member unclip the alligator clips from the positive terminal.

Count the number of paper clips you were able to pick up.

4. Add 15 more loops to your solenoid so you have 20 loops total.

Repeat the same procedure as before and record your data in the Data Table.

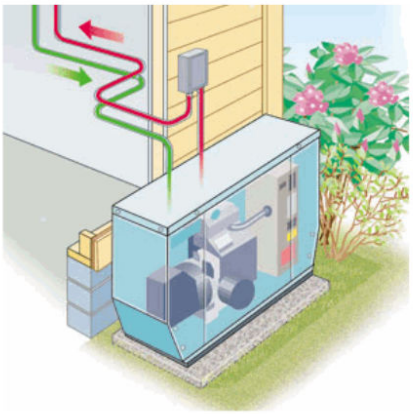
5. Add 15 more loops to your solenoid so you have 35 loops total.

Repeat the same procedure as before and record your data in the Data Table.

Electromagnets are temporary magnets that lose their magnetism when the electric current is removed. Both motors and generators have electromagnets.

Generators are NOT the same as electric motors.

A generator converts kinetic energy into electrical energy.



An electric motor converts electrical energy into kinetic energy.

Examples of motors: blenders & washing machines