# Electricity 2 - Electro-Magnetism

Chocolate and peanut butter, peanut butter and jelly, jelly and toast, toasts and weddings, weddings and chocolate, are all classic pairings. In physics there is one pair that is really two sides of the same coin, electricity and magnetism.

For many, many, many years electricity and magnetism were considered separate things until a man named James Clerk Maxwell figured out they are really the same thing.

## Electricity & Magnetism

Electric currents create magnetic fields, and magnetic fields create electric currents.

Magnetic fields come from one of two things, electro-magnets and permanent magnets

Electro-magnets are made anytime a charge is moving. In this way, ANY conductor can be made magnetic simply by passing a current through it. This happens because electrons are very loud mouthed particles. Whenever they do something, they want everyone else to know. An electrons 'shout' is a magnetic field. The magnetic field then applies a force on other charged particles.

Permanent magnets are special materials where their internal structure aligns in such a way that they always produce a magnetic field. Common magnets are made of iron, nickel, or cobalt, but modern high strength magnets are made out of neodymium and other rare-earth metals.

Because a magnetic field creates an electric field, and an electric field creates a magnetic field, something amazing can happen. When a magnetic field and an electric field get locked into a loop, it is called an electro-magnetic wave or LIGHT!!! Every bit of light is a small packet of electricity and magnetism that keep feeding each other so that they are pure energy!

**Notes continued on next page.**

# Activity 1 - Electro-Magnet

You will take non-magnetic materials, a nail, copper wire, and a battery, and make an electro-magnet out of them.

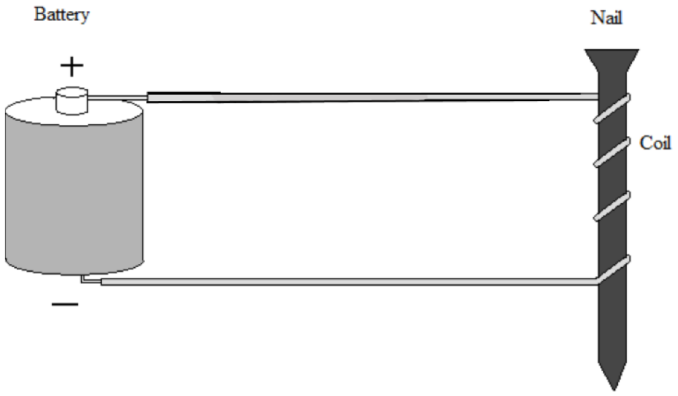
You will need two boxes to complete this activity:

- Electricity 2 - Electro-magnet/DC Motor
- Powersupply/Multimeter

## Step 1 - 10 Turns

Construct an electro-magnet by wrapping the wire around the nail 10 times.

**Warning:** When you connect wires to the battery the wires will get HOT. Do not leave it connected any longer than needed to record your data.




Once you have wired up your nail, see how many paper clips it can pick up and how it interacts with the compass.

***Draw a diagram for your electromagnet into your notebook****

***Record how many paper clips your electromagnet could pick up****

***Record any other observations you may have made, such as how the electromagnet interacted with the compass, or why you think the ends of the wire may have gotten hot****

## Step 2 - Many-Many Turns

Wrap the wire around your nail as many times as you can leaving just enough for the wire to still connect to the battery.

***Record the number of wraps you were able to get in your lab notebook****

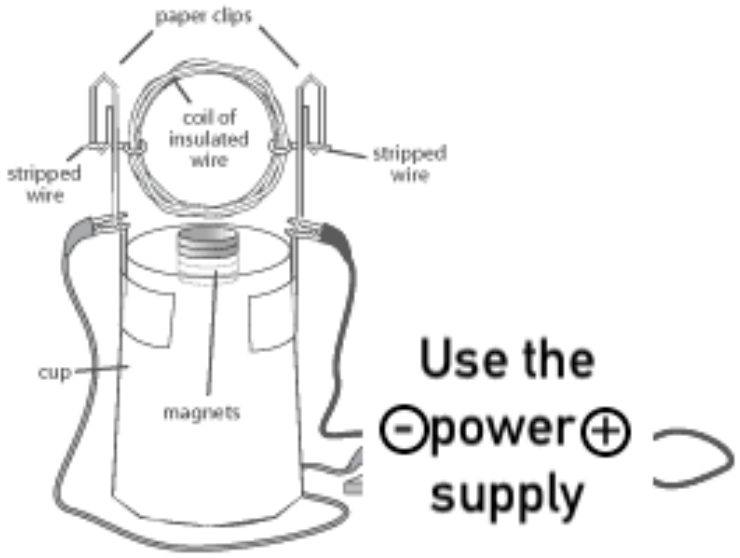
***Record how many paper clips your electromagnet could pick up****

***Record any other observations you may have made, such as how the electromagnet interacted with the compass****

***What do you think effects the strength of your electro-magnet?****

# Activity 2 - DC Motor

## Step 1 - Construct a DC Motor




Electric Motor

**Instructions**

- Use the rubber bands to hold the two paper clips to the side of the cup so that you can suspend the coil between them.
- You then need to make sure that the coil has half of one side, and only half of one side, covered with marker. If you have more than one half of one side, ask me to help you.
- Attach the magnets so that half are on one side and half on the other side of the bottom of the cup. You will have to ask me for the magnets.
- Set the power supply to 6V and connect it to the paper clips. **IF THE RED LIGHT ON THE POWER SUPPLY COMES ON IMMEDIATELY TURN OF THE POWER SUPPLY AND DOUBLE CHECK YOUR CONNECTIONS!!!**
- Give it a gentle spin and you should be off! If it does not work, try and adjust things, and double check that you did everything.

****Sketch what your motor looked like in your lab notebook****

****Briefly describe the instructions (so you could make another at home if you wanted)****

****Record any observations****

- **Does it spin only one way or both ways?**
- **How might you reverse its direction?**
- **How might you make it spin faster**