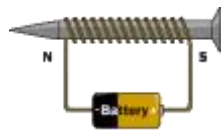


### Electromagnets

An electromagnet is a type of magnet whose magnetic field is produced by the flow of electric current. The magnetic field disappears when the current is turned off. If you have ever played with a really powerful magnet, you have probably noticed one problem. You have to be pretty strong to separate the magnets again! Today, we have many uses for powerful magnets, but they wouldn't be any good to us if we were not able to make them release the objects that they attract. In 1820, a Danish physicist, Hans Christian Oersted, discovered that there was a relationship between electricity and magnetism. Thanks to Oersted and a few others, by using electricity, we can now make huge magnets. We can also cause them to release their objects. Electricity and magnetism are closely related. The movement of electrons causes both, and every electric current has its own magnetic field. This magnetic force in electricity can be used to make powerful electromagnets that can be turned on and off with the flick of a switch. But how do you make an electromagnet?

Making an electromagnet: By simply wrapping wire that has an electrical current running through it around a nail, you can make an electromagnet. When the electric current moves through a wire, it makes a magnetic field. If you coil the wire around and around, it will make the magnetic force stronger, but it will still be pretty weak. Putting a piece of iron or steel inside the coil makes the magnet strong enough to attract objects. The strength of an electromagnet can be increased by increasing the number of loops of wire around the iron core and by increasing the current or voltage. You can make a temporary magnet by stroking a piece of iron or steel (such as a needle) along a permanent magnet. There is another way that uses electricity to make a temporary magnet, called an electromagnet. In class today, we are going to make a simple electromagnet using a nail, copper wire and a battery (see diagram below). We will be able to pick up paper clips and other objects with our electromagnets. In the picture at the top of this page, in our class project, the nail will be in place where the green tube is and where the red arrows are, that will be the copper wire.



### Uses of an electromagnet:

Electromagnets are very widely used as components of other electrical devices, such as television, cell phones, doorbell, radio, microwave, motors, generators, relays, loudspeakers, hard disks, and magnetic separation equipment. They are also employed as industrial lifting electromagnets for picking up and moving heavy iron objects like scrap iron.



*Pictured above: A huge electromagnet used at a scrap yard. Iron attaches to the electromagnet and is lifted onto a truck. The electricity to the electromagnet is turned off in order to get the magnet to release the iron scraps into the truck.*

**Optional Reading** for Students interested in learning more about electromagnets --may enjoy learning about electromagnetic aircraft launch systems (EMALS). Check out the article written on December 24, 2010 at <https://www.youtube.com/watch?v=o4ZqfEJTGzw>

This is a fascinating article about Navy Uses Electromagnets to Launch Fighter Jets. There is a video at this website that shows an amazing gun created using magnets for the Navy. <https://www.youtube.com/watch?v=o4ZqfEJTGzw>

### **Hans Christian Oersted**

In 1820, Hans Christian Oersted (1777-1851) proved electric current can affect a compass needle. However, Oersted could not explain why. His observations brought scientists one more step closer to seeing the relationship between magnetism and electricity.

### **Michael Faraday (1791-1867)**

Invented the electric motor. Electromagnetic induction is the production of voltage across a conductor moving through a magnetic field. Faraday discovered induction which is at the basis of electromagnetic technology.

### **James Clerk Maxwell (1831-1879)**

Discovered electromagnetic theory. His work in producing a unified model of electromagnetism is one of the greatest advances in physics.

**Heinrich Rudolf Hertz** (1857 -1894) was a German physicist who clarified and expanded the electromagnetic theory of light that had been put forth by Maxwell. He was the first to satisfactorily demonstrate the existence of electromagnetic waves by building an apparatus to produce and detect radio waves.



*Hans Christian Oersted*



*Michael Faraday*



*James Clerk Maxwell*



*Heinrich Rudolf Hertz*

*Answers: 1) electric current 2) it disappears 3) Hans Christian Oersted 4) switch 5) wire, voltage 6) yes 7) varies 8) no 9) electric motor 10) James Clerk Maxwell 11) Heinrich Rudolf Hertz*