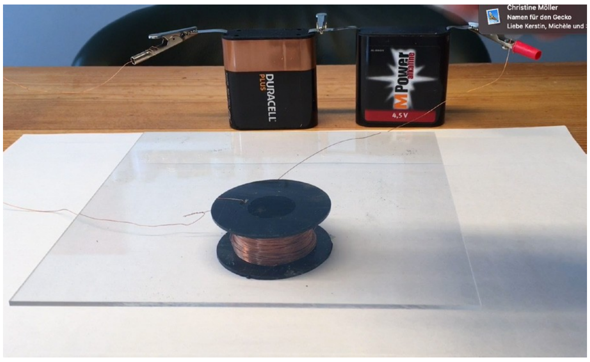
Electromagnetism

Electricity and magnetism are two aspects of the same phenomenon: electromagnetism. A moving electric charge (in other words, an electric current) generates a magnetic field. Every electromagnet consists of a coil, which is nothing more than a tightly wound wire. Many electromagnets also have an iron core to make the magnetic field stronger. The more times the wire is wound around the coil, the stronger the magnetic field produced by the same current.

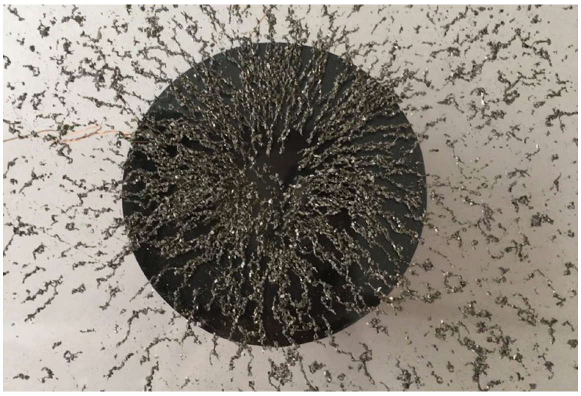
Demonstration: Using electric current to create a magnetic field



What you'll need

- a large sheet of paper on which to conduct the experiment
- a sheet of stiff card or plexiglass
- two batteries connected in series
- a coil of copper wire
- iron filings
- crocodile clips (optional)
- a small piece of iron (e.g. a screw) to place inside the coil (iron core)

Instructions

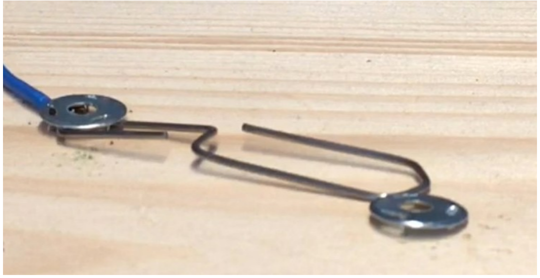


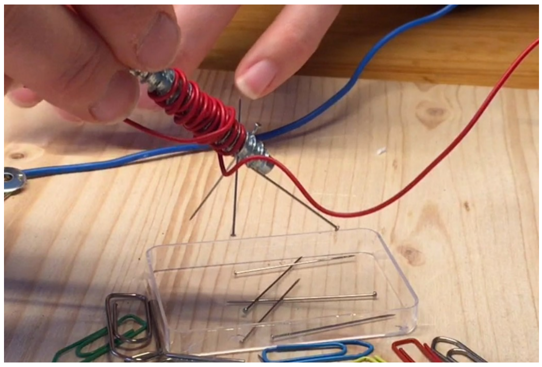
1. Position the coil so that you can easily access the two ends of the wire and connect them to the battery. I used crocodile clips to attach them to the battery contacts, but you could also use wooden clothes pegs or electrical tape.
2. Connect the two batteries in series (+ - + -).
3. Place the plexiglass or card over the coil.
4. When the electrical circuit is closed, slowly scatter the iron filings on top.

What happens?

The iron filings arrange themselves along the magnetic field lines. If you look closely, you can make out a pattern.

Turn a screw into an electromagnet





What you'll need

- a long iron screw or nail
- two pieces of insulated copper wire measuring 15 and 30 cm
- two three-pronged thumb tacks
- a metal paperclip
- a small wooden board
- pins or paperclips
- a 4.5 V battery

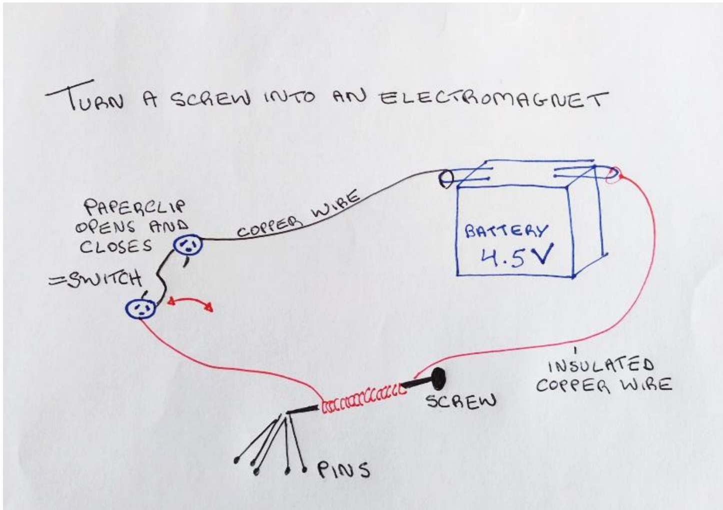
Instructions

Switch

1. Bend open the paperclip.
2. Push the two three-pronged thumb tacks into the wooden board, connecting them with the open paperclip in such a way that it can move back and forth.

Electromagnet

1. Wind the longer wire around the screw between 10 and 20 times.
2. Connect one end to the switch, and the other end to the battery.
3. Close the switch.



What happens?

When the switch is closed, electricity from the battery flows through the closed switch and coil, and back to the battery. The current generates a magnetic field in the coil, turning the screw into an electromagnet.
The screw now attracts pins or paperclips. The more loops it has, the stronger its magnetic field.

If the electric current is broken, the magnetic field turning the iron core (the screw) into a magnet disappears. The screw loses most of its magnetic force, and the metallic items it attracted before fall back down again. Sometimes, a few of the small magnets in the iron core stay aligned in the same direction, allowing it to retain a small amount of magnetism.

Would you like to know more?

A coil is an object with conductive wire wound around it. Each loop acts as a circular conductor. Together, these loops generate a powerful total magnetic field, as each individual loop is surrounded by a magnetic field of its own. In other words, the more loops, the stronger the magnetic field. Electromagnetic coils often have an iron core which makes the resulting magnetic field even stronger.