Build an Electromagnet!

Did you know you can use electricity to make a magnet? Explore the magic and power of magnetism by building your very own electromagnet.

Time

- 30 minutes class time, plus prep time

Grade

- 4-8

Next Generation Science Standards

- **4-PS3-2** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- **MS.PS2.3** - Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Utah State Science Standards

- **5.4** Students will understand features of static and current electricity.
- **5.4.2** Analyze the behavior of current electricity
- **7.1.4** Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces. Examples include electromagnets… Examples of data include the effect of the number of turns on wire on strength of electromagnet.

Materials

- 2 D batteries per group
- 1 two-D battery holder per group
- 1 long nail (approx. 3”) per group
- 30 paperclips per group
- 3-4 ft. insulated wire with alligator clips on each end per group
- 1 Lab Sheet per student

Directions

- Gather all materials ahead of time, and review teacher background information about electricity and magnetism.
- You will want to split your classroom into small groups for this activity.
- Follow the **Build an Electromagnet** directions to complete activity. Instructions follow on next page.

This activity is adapted from **Solar Dynamics Observatory**
https://sdo.gsfc.nasa.gov/assets/docs/SDOElectricityandMagnetism.pdf

Explanation

Electricity and magnetism are related. In fact, they are actually the same thing: Electromagnetism. Magnets produce a magnetic field known as a magnetic dipole. This occurs when a magnetic field exits the north pole of a magnet and enters the south pole of the magnet. Magnets are not the only things that can produce magnetic fields. A magnetic field can also be created by moving charged particles, such as elections. A straight line of moving electric charge, in a wire, creates a magnetic field which is composed of concentric circles around the wire. Electrical current is the term used to describe electrons moving through a wire. If the current is turned off and there is no longer any moving charge the magnetic field surrounding the wire will immediately vanish, unlike a magnet whose magnetic field is permanent or semi-permanent. In this lab you will make a device that uses electricity flowing through a circuit to make a magnet. This is an electromagnet – a magnet created and controlled by electricity.

When an electric current passes through a tightly coiled wire, it creates a magnetic field around the coil. To create an electromagnet, a metal rod (i.e. a nail) is placed inside of the coiled wire. When the electricity flows through the wire around the metal rod, it becomes a magnet. The magnetic field inside the coil aligns the tiny magnetic fields in the metal rod in one direction (all the north poles point the same way), making it a magnet. When the electric current is turned off, the metal rod is not a magnet. The more coils of wire with current running through them in the same direction, the stronger the magnetic field that is created. With a large number of coils, even a small amount of current can produce a noticeable magnetic field. Students will be able to see this demonstrated in this activity.

Directions

Before the Lesson - How to Prepare

- Cut the insulated wire into lengths of 3-4 ft. for each group.
- Attach an alligator clip to each end of the wire.
- Use new batteries for best results.
- Dismantle battery from holder when not using to conserve battery strength.

Directions

1. Split students into groups of 2-4. Have students tightly wrap the insulated wire around the nail 15 times.

2. Have the students clip one end of the coiled wire (using the alligator clip) to the wire protruding from one side of the battery pack. Then clip the other end if the coiled wire to the wire protruding from the other side of the battery pack.

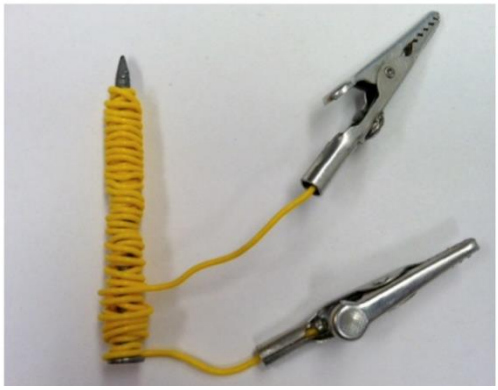
3. Insert batteries into the battery pack. (Caution: When students add the batteries the alligator clips and battery pack may get hot).

4. The nail should now be a magnet. Place the nail over the paperclips and test to see how many paperclips their electromagnet will pick up. Record the result on the Lab Sheet.

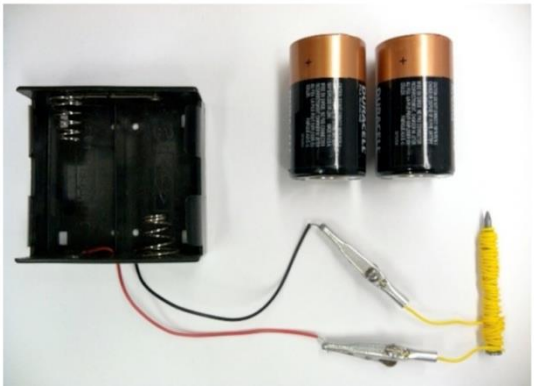
5. Repeat these steps adding more coils to the nail. Test how many paperclips can be picked up with 30 coils wrapped around the nail and 45 coils around the nail.

6. Have student complete the lab sheet as they test their electromagnets.

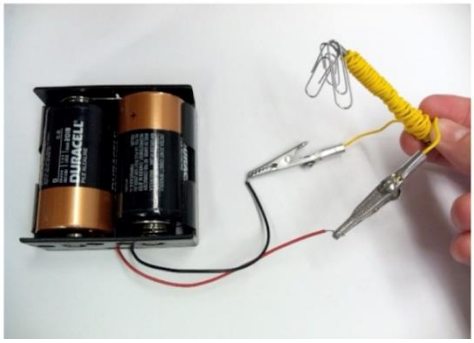
Images of Steps 1 – 3 in the construction of an electromagnet:



Step 1



Step 2



Step 3

Image credit for all 3 photos: https://sdo.gsfc.nasa.gov/assets/docs/SDOElectricityandMagnetism.pdf