

Student Worksheet for Ep. 17:

Electromagnetic Crane

Overview: Most of the electricity you use comes from moving magnets around coils of wire. Electrical power plants either spin HUGE coils of wire around very powerful magnets or they spin very powerful magnets around HUGE coils of wire. The electricity to power your computer, your lights, your air conditioning, your radio or whatever, comes from spinning magnets or wires!



What to Learn: A science teacher doing a demonstration for his students noticed that as he moved a magnet, he caused one of his instruments to register the flow of electricity. He experimented a bit further with this and noticed that a moving magnetic field can actually create electrical current, thus tying the magnetism and the electricity together. Before that, they were seen as two completely different phenomena! Now we know that you can't have an electric field without a magnetic field. You also cannot have a moving magnetic field without causing electricity in objects that electrons can move in (like wires). Moving electrons create a magnetic field and moving magnetic fields can create electric currents.

Lab Time: An electromagnet is a magnet you can turn on and off using electricity. By hooking up a coil of wire up to a battery, you will create an electromagnet. When you disconnect it, it turns back into a coil of wire. Since moving electrons cause a magnetic field, when connecting the two ends of your wire up to the battery, you caused the electrons in the wire to move through the wire in one direction. Since many electrons are moving in one direction, you get a magnetic field!

The nail helps to focus the field and strengthen it. In fact, if you could see the atoms inside the nail, you would be able to see them turn to align themselves with the magnetic field created by the electrons moving through the wire. You can test the nail by itself (with the wire removed) after you've done the experiment, because you may have caused it to become a permanent magnet.

Materials:

- Nail and wood skewer
- Magnet wire (Radio Shack Part #278-1345)
- D cell battery
- Sandpaper or nail file
- 2 rubber bands
- Foam block
- 2 fat popsicle sticks
- Paperclips
- Drill
- Hot glue or tape

Experiment:

1. Wrap your wire 20 times around the nail. Be sure to always wrap in the same direction. If you start wrapping clockwise, for example, be sure to keep wrapping clockwise.
2. Clip the ends off, leaving 4" tails for both wires.
3. Take your wire and remove about an inch of insulation from both ends using sandpaper.
4. Wrap your rubber band around the battery lengthwise, and double it up (wrap it twice around).
5. Now, connect one end of your wire to one end of the battery.
6. Connect the other wire to the other end of the battery.
7. How many paperclips can you pick up?
8. Continue to make the crane as shown in the video.