



# High Touch High Tech®

Science Experiences That Come To You

## Electromagnet

### Supplies:

- Insulated Copper Wire (~24 - 36 inches)
- Iron nail
- Wire cutters
- Metal paper clips
- D Battery

### Instructions:

1. With adult supervision and assistance, use your wire cutters to remove 1" of the plastic insulation from both ends of your copper wire.
2. Using your iron nail and copper wire, leaving approximately 5" of wire slack at the top, start wrapping the wire around the nail so that the nail is covered from top to bottom. Leave 5" of wire slack at the bottom.
3. Attach the exposed ends of your wire to the battery.
  - a. Connect one side to the positive (+) side and the other side to the negative (-) side.
  - b. **SAFETY NOTE:** Do not leave the wire attached to both battery terminals too long or the battery power will be drained, and the wire will get hot.
4. Move the nail near the paper clips. What happens?
  - a. How many paper clips can you catch?
  - b. Can you get the paper clips to link together into a chain?
5. **STEM Challenge:** Take a longer length of wire, complete the same steps listed above. Is the magnetic force stronger with the longer wire? If yes, why?
  - a. How many paper clips can you catch?
  - b. Can you get the paper clips to link together into a chain?
  - c. Are you able to catch and link more than you did with the shorter wire?
    - i. The number of turns and the current in the battery change the amount of magnetic force in an electromagnet.
6. When complete, disconnect one side of the wire from the battery.



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## The Science Behind It:

What do you think electricity and magnetism have in common? Electricity is the flow of electrons down a path. Magnetism, in general, is created naturally by the movement of electrons within the atoms of certain elements. Whereas with electromagnetism, electricity goes around and around in a circle creating a magnetic field.

So, electricity and magnetism are friends.

- **Magnetism:** The attraction or repulsion of an object when it is placed in a magnetic field.
- **Magnetic Field:** A field of force with electric charges that are in motion. Most magnets have magnetic fields as a result of the spinning motion of the electrons orbiting the atoms of which they are composed. Large objects, such as the earth, other planets, and stars, also produce magnetic fields.
- **Electromagnetism:** When a magnetic field is created by an electric current moving through a coil.

As you could see, without electricity there was NO magnetism. The energy from the electricity moved the electrons around and around the coil on the electromagnet creating a magnetic field. This magnetic field attracted the paperclips to the electromagnet, allowing them to “stick”

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