

Inquiry Question

Did you know that your ear buds likely contain tiny electromagnets? What is an electromagnet? Why are some stronger than others? Can you build one?

Name: _____

Date: _____

Electricity can create magnetic fields. In fact, it is now known that moving charges (like current in a wire or electrons in an atom) are responsible for all magnets. How can we utilize this concept to build a good electromagnet?



General Instructions

Using a nail and a long piece of insulated wire, build an electromagnet and test its strength. Then modify your electromagnet to make it as strong as possible and discuss your design choices.

Materials you'll need:

- Your course notes
- The internet
- 1 3 inch long nail (iron, zinc, or steel, NOT aluminum)
- two to three feet (0.5 to 1m) of insulated copper wire (22 gauge works well)
- smaller nails or paper clips to pick up with your magnet
- D-cell 1.5V batteries
- rubber band
- tape
- small compass (if possible)

Procedure:

1. Wrap your wire neatly around your nail 20 times.
2. Connect the ends of the wire to your battery with a rubber band as shown.



Ideas and Hints

- a rubber band can be used to hold the wires onto the battery.
- wrap your wire as neatly as possible.
- disconnect from the battery in between tests to keep your battery from dying.
- if you have a compass try and determine which end of the nail is North. Reverse your battery. Does the North end change?

Project submission:

- Upload your completed work to the Physics project drop box if you chose to submit online.
- You can either submit photos/video of your project (along with an explanation and/or steps of construction) or, if you can drop-in to the school, you can present it to your teacher in-person.
- Be sure to carefully organize any data collected so that any other student or teacher could reproduce your experiment and achieve the same results.

Project Timing:

- In its most basic form, this project will take the average student 2 hours. Locating all of the materials needed may vary.

Inquiry Questions and Experimental Design:

1. Test the strength of your electromagnet by seeing how many paper clips (or small nails) it can pick up. Record your results for the 20 turn electromagnet in a table.
2. Disconnect one end of the wire from your battery and repeat. What happens? Record results in your table.
3. Increase the number of turns to 40 and repeat. Record your results in your table.
4. Decrease the number of turns to 10 and repeat. Record your results in your table.
5. Add a second battery to the first battery so that they are connected end to end. The positive terminal of the first battery should connect to the negative terminal of the second battery. Keep the wire winding to 20 turns (around your nail). How many nails can you pick up? Compare this to the results of step 3 above.
6. Try a thicker or thinner nail. Record results.
7. Compare the strength of the pointy end of the nail to the flat end. Record results.
8. Try spacing your windings out. Record results.
9. Create the most powerful electromagnet that you can. Describe exactly how you built it. Take a photo of it picking up as many paper clips (or small nails as possible).