

Electromagnets

MATERIALS:

- D-cell batteries and holder
- 6 V battery
- Magnetic Field Sensor
- Paper clips
- Magnet wire
- Iron core

What are Electromagnets? There are three types of magnets: permanent magnets, temporary magnets, and electromagnets. An electromagnet is a coil of wire around a metal core. It is “turned on” when current is flowing through the wire. Make an electromagnet and determine which factors impact the strength.



STEPS:

1. Wrap ten coils of wire around the iron core.
2. Energize the electromagnet by powering the coil with the D-cell battery. Record the number of paper clips you can pick up. Next use the magnetic field sensor to measure the magnetic field in Milliteslas (mT).
3. Continue to add coils and take measurements to complete the chart.
4. Graph the data for both the paper clips and the probe.
5. Describe the relationship between coils around the iron core and the strength of the magnetic field. Is it linear or nonlinear?
6. Is the number of paper clips a reliable measure of magnetic field strength?

TABLE 1

COILS	PAPER CLIPS	MAGNETIC FIELD STRENGTH (mT)
10		
20		
30		
40		
50		
60		
70		

Compare your results with others

1. Does it matter if the coils are messy?
2. Which area of the wire wrapped core has the strongest magnetic field?

A long, magnetic filament burst from the Sun

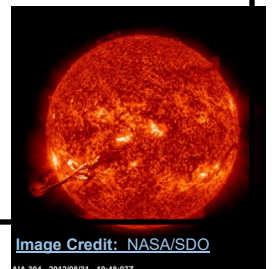


Image Credit: NASA/SDO

POWER SOURCES

1. Choose the data entry from TABLE 1 on the previous page for the largest number of paperclips. Record it in TABLE 2
2. What do you think will happen when you change the power source? Try multiple D-cell batteries in series and in parallel. Try a 6V later battery or a 9 V battery. Which do you think will have the strongest magnetic field?
3. Test several power sources and add the data to TABLE 2.
4. Describe the relationship between the power source and the magnetic field strength. Is voltage or current more of a factor?

TABLE 2

Power Source	Paper Clips	Magnetic Field (mT)
One D-cell Battery		
Two D-cell batteries in series		
Two D-cell batteries in parallel		
Three D-cell batteries in series		
Three D-cell batteries in parallel		

IRON CORE

1. Wrap 30 wire coils around one rod and connect to one D-cell battery. How many paper clips can you pick up? Record in the data table.
2. Power with two D-cell batteries and record.
3. Wrap 30 wire coils around two rods and connect to one D-cell battery. How many paperclips can you pick up? Record in the data table.
4. Power with two D-cell batteries and record.
5. Wrap 30 wire coils around three rods and connect to one D-cell battery. How many paperclips can you pick up? Record in the data table.
6. Power with two D-cell batteries and record.

TABLE 3

Rods	Power Source	Paper Clips
1		
1		
2		
2		
3		
3		

OBSERVATIONS AND CONCLUSIONS

How can the strength of an electromagnets magnetic field be maximized?

Electromagnets can be turned off or on and the strength of the magnetic field can be varied. How do you think these characteristics can make electromagnets useful ?