

# Experimenting with Electromagnets

By Doaa George, based on the workshop investigation by Simone Matic

## Introduction

Sometimes magnets seem like magic! But did you know that it is easy to construct an electromagnet by passing an electric current through a coil surrounding a metal core? The strength of the electromagnet can be changed. In this experiment, you will investigate how the strength is affected by changing the number of turns in the coil and the provided voltage.

## Risk analysis

- Electromagnets can become hot, make sure you wait until they cool down before touching them.
- Also make sure you disassemble them after finishing the experiment.

## Questions

Aim: To find out whether the strength of the electromagnet is affected by the number of turns in the coil and/or the voltage provided.

Fill in the blanks with what you think will happen. These statements can form the basis of your hypothesis.

Increasing the number of coils will \_\_\_\_\_ the strength of the electromagnet.

Increasing the voltage will \_\_\_\_\_ the strength of the electromagnet.

## Plan

You are given a procedure and a number of hints to construct your own electromagnet and to make the measurements required.

Think about what variables should be kept constant to get fair results.

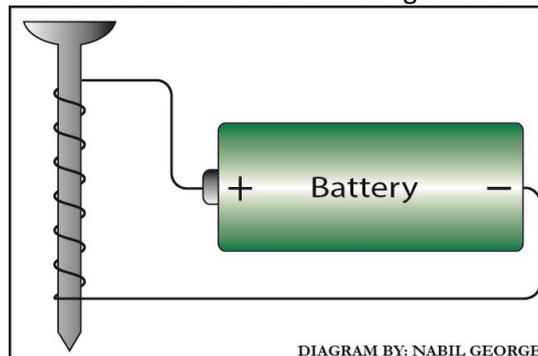
## Materials

- Insulated copper wire (about ½ metre)
- A small battery
- An iron nail
- Some pins, paper clips or other small metal objects
- Scissors
- Sticky tape

## Conduct

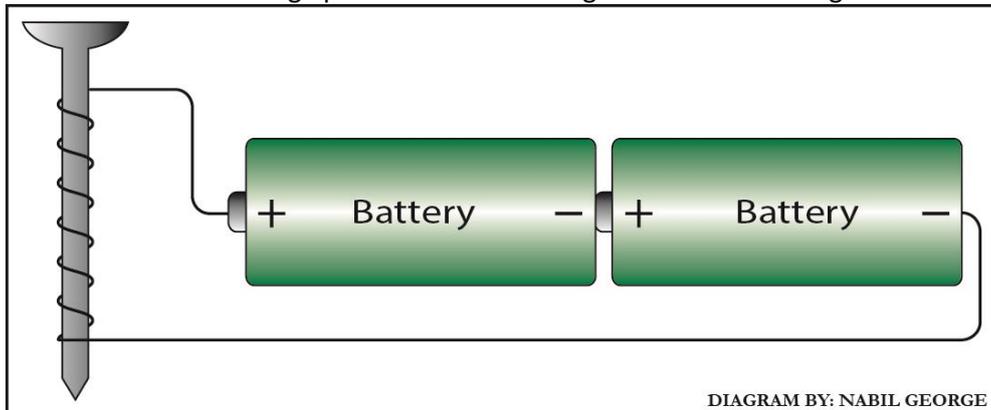
### Procedure

Experiment 1: Effect of number of turns in a coil on the strength of the electromagnet.



1. Using scissors, carefully strip off approximately 2cm of insulation from both ends of the copper wire.
2. Wrap the insulated copper wire 20 times evenly spaced around the iron nail, leaving an equal length of about 15cm at each end.
3. Attach an end of the copper wire to each end of the battery and secure it with tape. Now you have constructed your electromagnet.
4. Bring a number of pins and paper clips close to your electromagnet and watch what happens to them.
5. Un-tape the copper wire ends from the battery and leave it to cool.
6. Uncoil the copper wire from the nail and recoil it, adding 10 more coils.
7. Repeat steps 3 and 4 for the new setup.
8. Repeat steps 5 to 7 one more time adding 10 extra coils.

Experiment 2: Effect of the voltage provided on the strength of the electromagnet.



1. From the last setup done in experiment 1, un-tape the copper wire ends from the battery and leave it to cool.
2. Connect another battery in series (positive end of one battery to the negative end of the other).
3. Attach the ends of the copper wire to the free ends of the 2 batteries connected in series.
4. Bring a number of pins and paper clips close to your electromagnet and watch what happens to them.

Experiment 1:

Tabulate your results as follows:

Number of coils	Number of paper clips picked up

Experiment 2:

Number of batteries connected	Number of paper clips picked up

**Analysis:**

Graph your results here:

**Discussion-Problem solving and reasoning**

Did your results agree with your hypothesis? If not, what do you think might have gone wrong in the experiment?

For each experiment answer the following questions

What factor is kept constant here (controlled variables)?

What are the dependent and independent variables?

**Conclusion**

What did you learn from this experiment?