ScienceCube

Electromagnets

Explain the various conditions that affect the strength of an electromagnet.

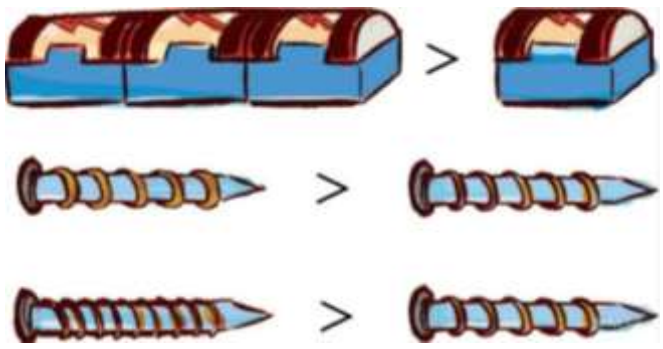
Fundamental Concept

1. Electromagnets

An electromagnet is created by wrapping a wire (enameled wire) around an object and running a current through it, causing the object to exhibit magnetic properties..

2. Strength of Electromagnets

The strength of an electromagnet increases with thicker enameled wire, more turns of the wire, and higher current flow. The strength can be confirmed by the number of paper clips the electromagnet can pick up or the deflection angle of a compass needle.



3. Uses of Electromagnets

A. Speaker

As sound is converted into an electrical signal that flows through the electromagnet in the speaker, the changing signal alters the strength and polarity of the electromagnet, causing the speaker cone to vibrate..

B. Electromagnetic Crane

Used in scrapyards or factories to lift heavy metal objects, the electromagnet lifts objects when current flows through it.

Experiment

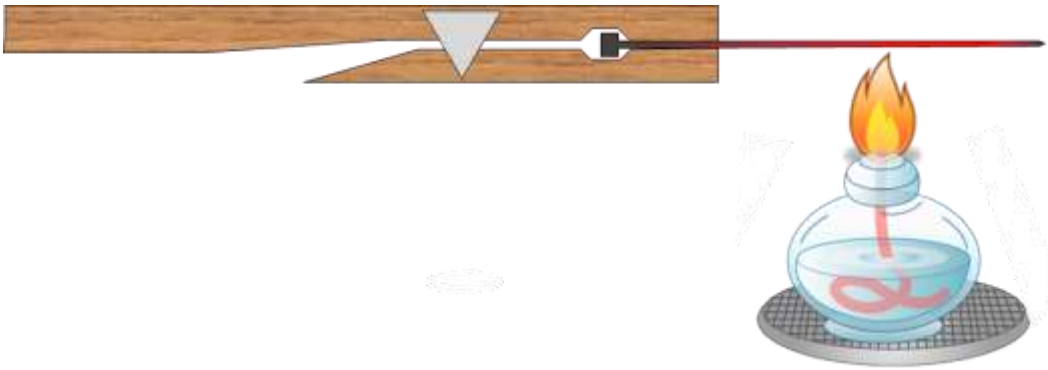
Materials Needed

Interface, Science# program, Magnetic field sensor, Nichrome wire, Nails (2), Alcohol lamp, Test tube holder, Lighter, 1.5V batteries (3), Battery holders (3), Alligator clip wires (2), Switch, Paper

Experimental Setup

[Number of Turns of Enameled Wire and Electromagnet Strength]

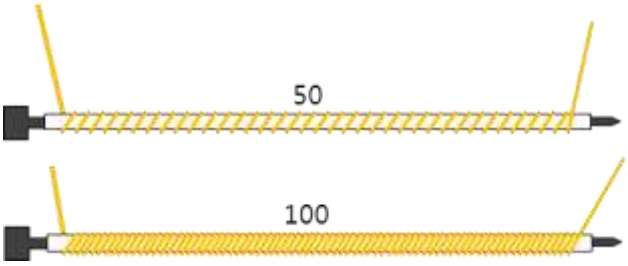
1. Heat the nails with a flame and cool them slowly.



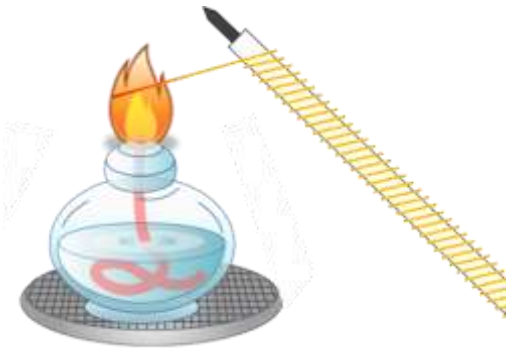
2. Wrap the cooled nails with paper.

3. Wrap the enameled wire around the nail 50 times and 100 times to create coils.

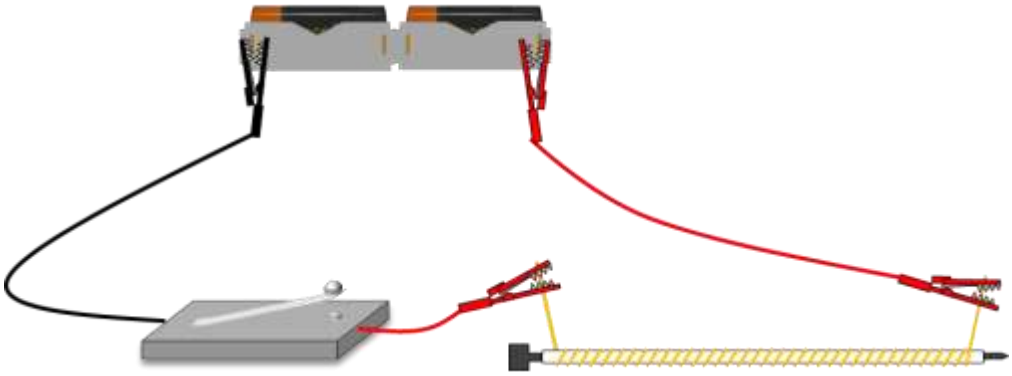
   ※ Ensure the length of the enameled wire wrapped section is the same for each coil.



4. Burn or strip the ends of the enameled wire with a knife.



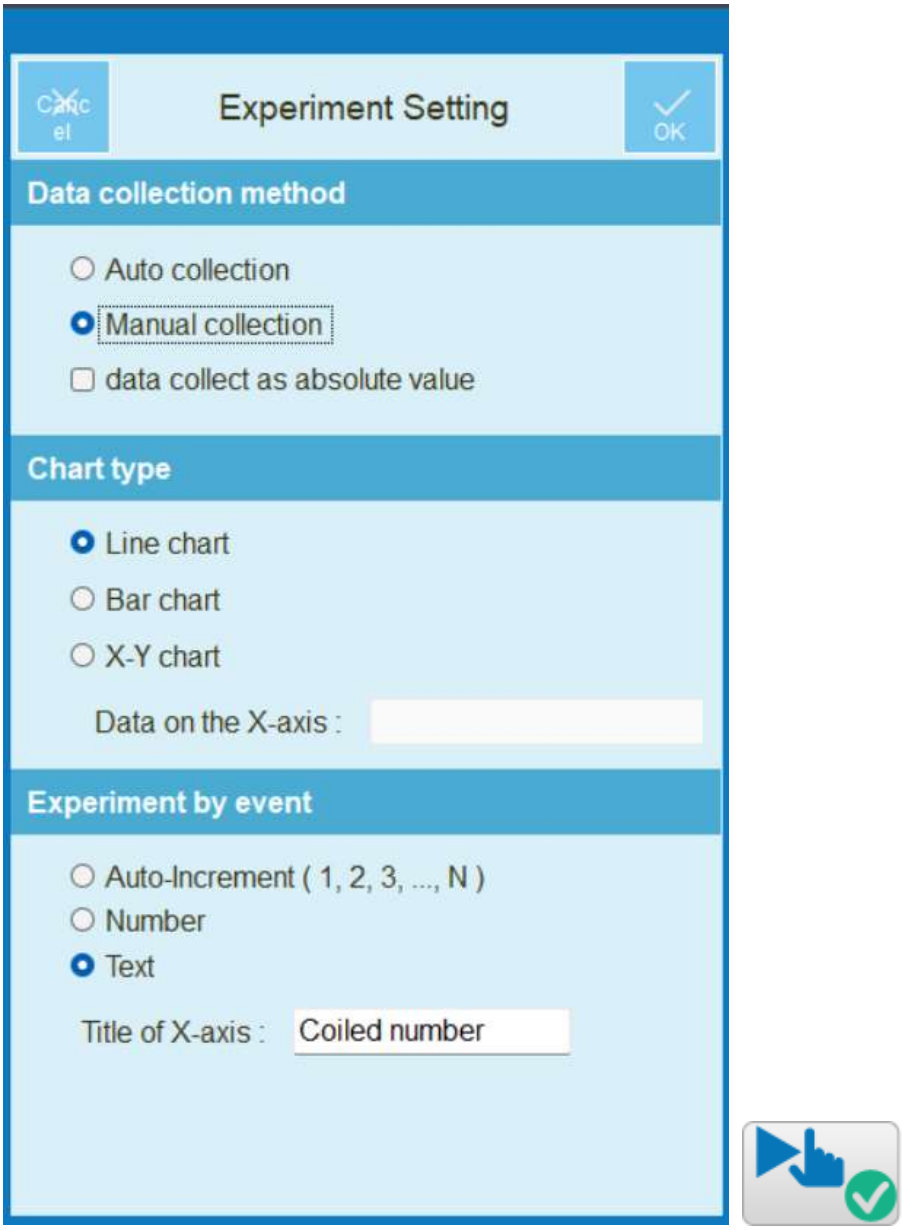
5. Connect two batteries in series and connect the electromagnet to a switch using alligator clip wires.



6. Position the magnetic field sensor at the end of the nail.

Interface Setup

1. Run the Science# program.
2. Connect the magnetic field sensor to the interface.
3. Press to set up the experimental environment as shown or press for automatic setup.



Data Collection

1. Press  to start data collection.
2. For the 50-turn electromagnet, press at the point with the highest magnetic field value.
3. Enter '50' when prompted.
4. For the 100-turn electromagnet, press at the point with the highest magnetic field value.
5. Enter '100' when prompted.

[Number of Batteries and Electromagnet Strength]

6. For the 100-turn electromagnet, measure the strength of the electromagnet by increasing the number of batteries from 1 to 2 to 3.

[Finding the Poles of the Electromagnet]

7. Measure the ends of the electromagnet to observe changes in the polarity and determine the poles of the electromagnet.

Data Analysis

Recording Data

1. Record the strength of the electromagnet measured with the magnetic field sensor based on the number of turns of enameled wire..

Number of Turns	50	100
Magnetic Field Strength (G)		

2. Record the strength of the electromagnet measured with the magnetic field sensor by changing the number of batteries..

Number of Batteries	1	2	3
Voltage (V)			
Magnetic Field Strength (G)			

3. Determine the polarity and record the magnetic field signs and poles for each end of the nail.

Measurement Position	Nail Tip	Nail Head
Magnetic Field Sign (+/-)		
Polarity (S/N)		

Data Application

1. List the factors that affect the strength of an electromagnet.

2. Explain the reason for wrapping the coil around the nail.

3. Explain why the coil is wrapped in only one direction.

4. List tools used in daily life that utilize the properties of electromagnets..