

To teachers We have prepared worksheets to accompany the experiments in the instructions, which you can copy and use in your teaching.



How Electric Current Works

Soccer Robo 2 Worksheet

Name	Year	Class
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Experiment 1 Properties of Electromagnets

A Find out how to attract iron

- A** To apply or stop the current to the electromagnet (yellow), bring it closer to the paper clip.

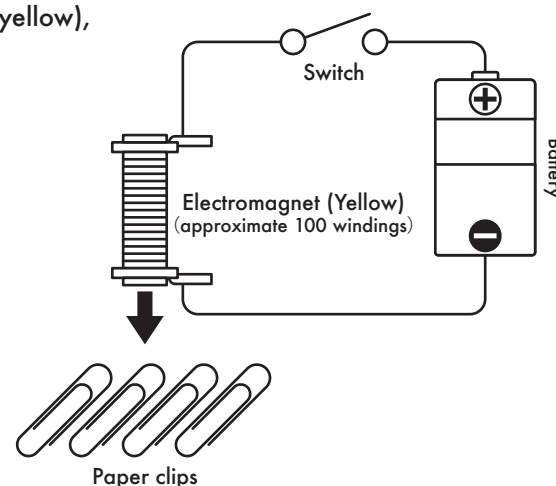
☆ What happened to the paper clip?

Apply current and bring it closer

< Example >
It was attached to the iron core.

Stop current and bring it closer

< Example >
It did not attach to the iron core.



B Find out if there is a pole

- B** An electric current is applied to the electromagnet (yellow) and the compass needle is brought closer to it.

- C** Change the direction of the battery and examine them in the same way.

☆ Write down the direction of the compass's needle and write N or S in brackets (). in the figure on the right.

☆ Let's summarize the relationship between the orientation of the battery and the pole of the electromagnet.

< Example >
When the direction of current flow is reversed, the N and S poles of the electromagnet reversed as well.

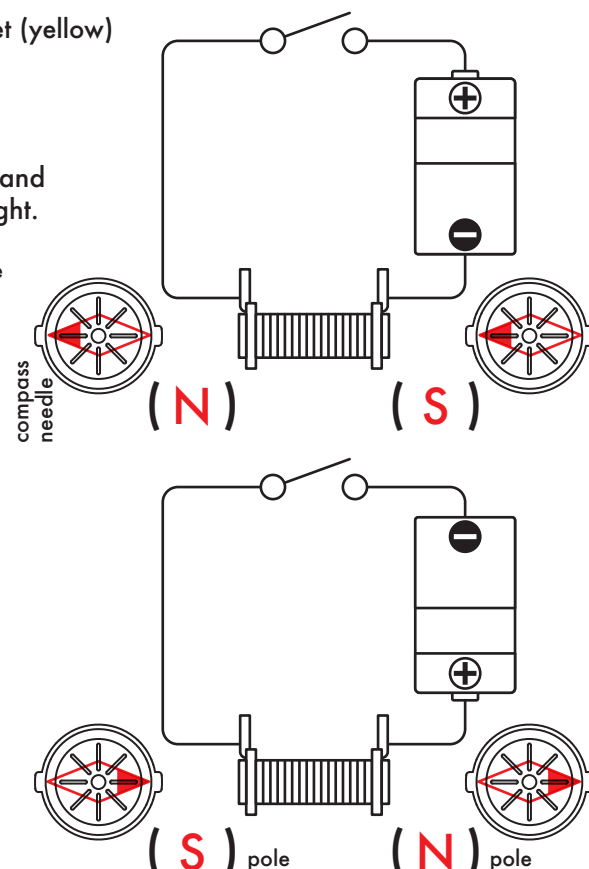
☆ Let's compare magnet and electromagnet.

Similarities

< Example >
Attracts iron. It has a N-pole and a S-pole.

Differences

< Example >
An electromagnet will attract iron only as long as an electric current flows. It can change its N-pole and S-pole.



☆ Before proceed to Experiment 2, let's all think about how to make a strong magnet.

< Example >

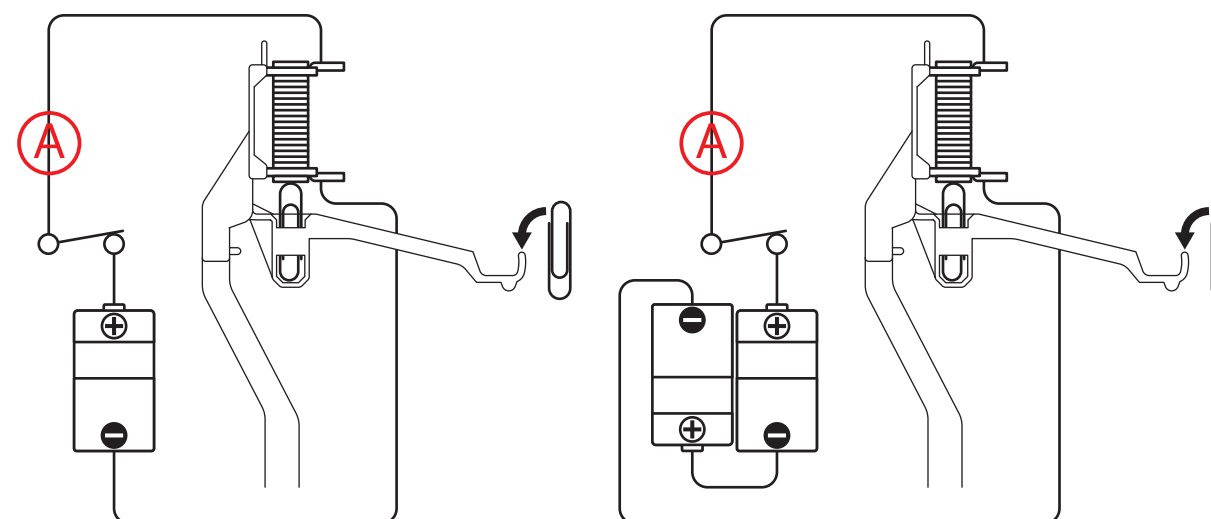
Increase the number of batteries. Increase the number of coil windings.

Experiment 2 Strength of electromagnets

C Examine by changing the magnitude of the current

- D** Find out how many suspended paper clips you have using 1 battery.

- E** Find out how many suspended paper clips you have using 2 batteries connected in series.



☆ When using a galvanometer in Experiment 2-C, try drawing the schematic symbols in the figure above.

Galvanometer schematic symbol



Changeable conditions	The magnitude of the current	1 battery	2 batteries
	When measured with a galvanometer	Enter the actual current value measured ampere	Enter the actual current value measured ampere
Unchangeable condition	Number of coil windings	100 windings	
Experiment 2-C results (number of paper clips)	1st time	Enter the actual number of pieces that you can hang	Enter the actual number of pieces that you can hang
	2nd time	Enter the actual number of pieces that you can hang	Enter the actual number of pieces that you can hang
	3rd time	Enter the actual number of pieces that you can hang	Enter the actual number of pieces that you can hang

Experiment

2 Strength of electromagnets (continuation)

D

Investigate different numbers of coil windings

F

Find out how many suspended paper clips you have using 100 windings and 200 windings electromagnets.

Electromagnet (white)
(approximate 200 windings)

Electromagnet (yellow)
(approximate 100 windings)

☆ When using a galvanometer in Experiment 2-D, try drawing the schematic symbols in the figure above.

Unchangeable condition	The magnitude of the current	2 batteries	
	When measured with a galvanometer	Enter the actual current value measured ampere	
Changeable conditions	Number of coil windings	200 windings	100 windings
Experiment 2-D results (number of paper clips)	1st time	Enter the actual number of pieces that you can hang	Enter the actual number of pieces that you can hang
	2nd time	Enter the actual number of pieces that you can hang	Enter the actual number of pieces that you can hang
	3rd time	Enter the actual number of pieces that you can hang	Enter the actual number of pieces that you can hang

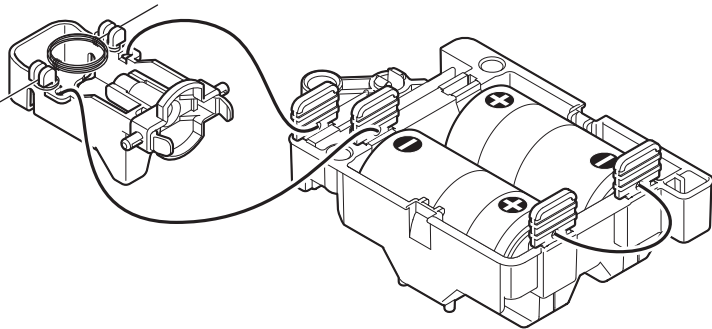
☆ From the results of Experiment 2, let's summarize the strength of the electromagnet.

< Example >

The greater the current flowing or the greater the number of coils, the stronger the electromagnet's force.

Let's try

1 Let's turn the coil motor!



☆ Write down what areas/things that you need to pay attention to before the coil motor runs well.

< Example >

When making the coil loop, I took care to balance the weights of the left and right sides of the coil.

Enamel was carefully peeled off all the way to the base.

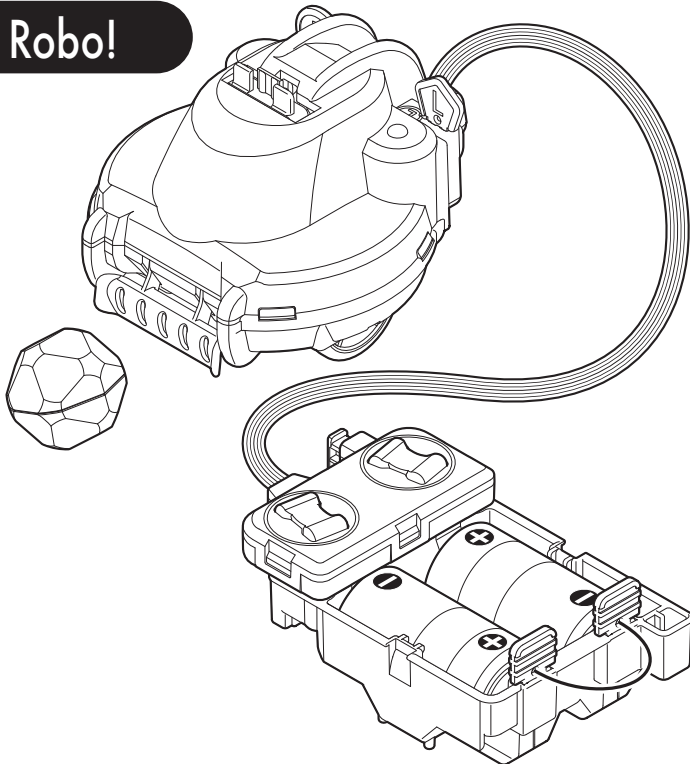
Let's try

2 Let's make a Soccer Robo!

☆ Let's write down your thoughts when the soccer robo move.

< Example >

I could kick the ball whenever I wanted, making it fun to play with. Even in narrow spaces, I could dodge objects and move around.It was interesting to see the headboard moving in a bobbing motion at the same time as the kick.



☆ Let's think about what kind of machines and tools that use the function of electromagnets.

< Example >

Electromagnetic cranes, Linear motor cars, Electric fans, clocks, etc.