



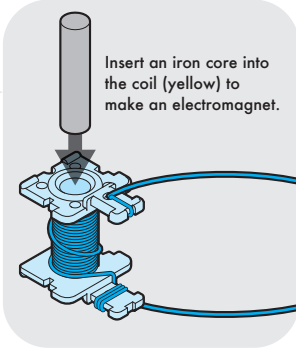
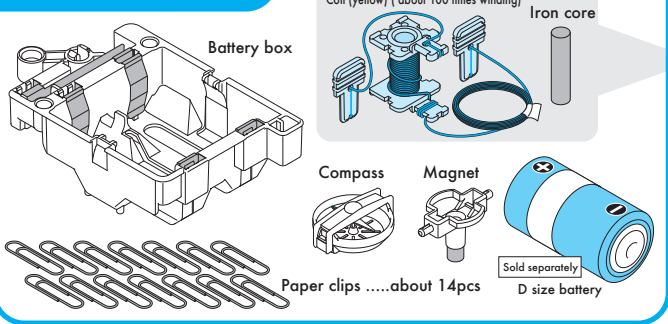
Experiment

1

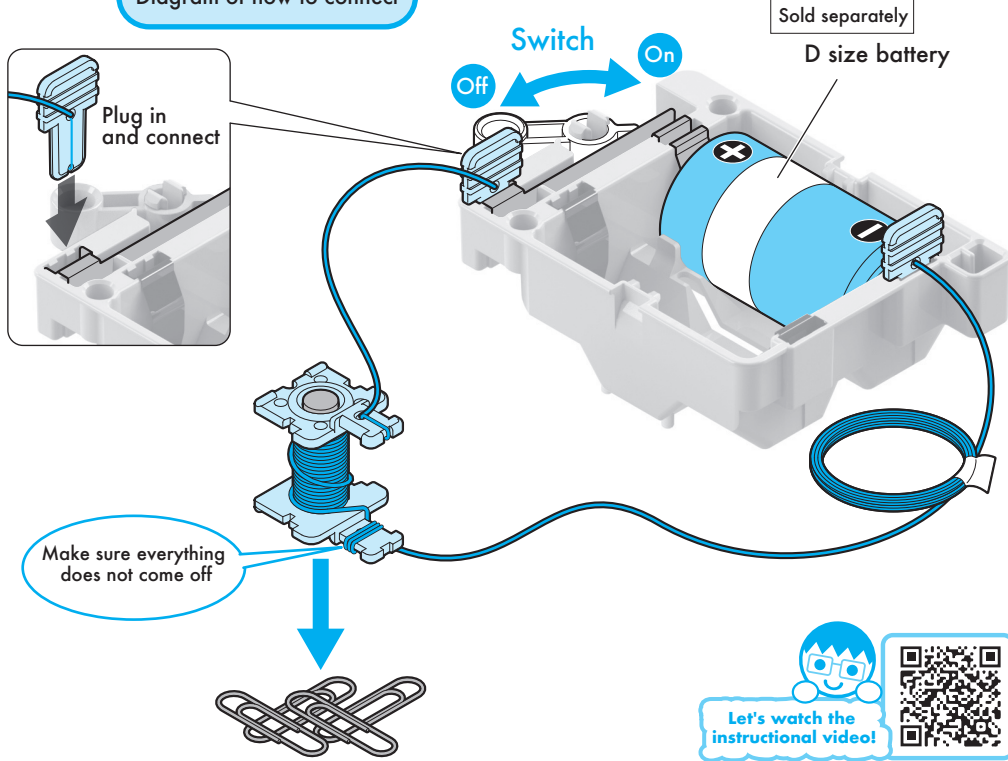
## Properties of electromagnets

Do not leave the switch on for more than 2 minutes! Stop the experiment when the coil becomes hot. After the experiment, be sure to remove the battery.

### Parts used in Experiment 1



### Diagram of how to connect



A

### Find out how to attract iron

A

Apply or stop an electric current to the electromagnet (yellow) to bring it closer to the paper clip.

What happened to the paper clip?

Apply current and bring it closer	Stop the current and bring it closer

B

### Find out if there is a pole

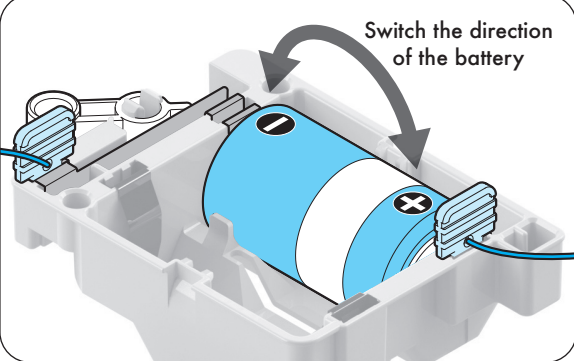
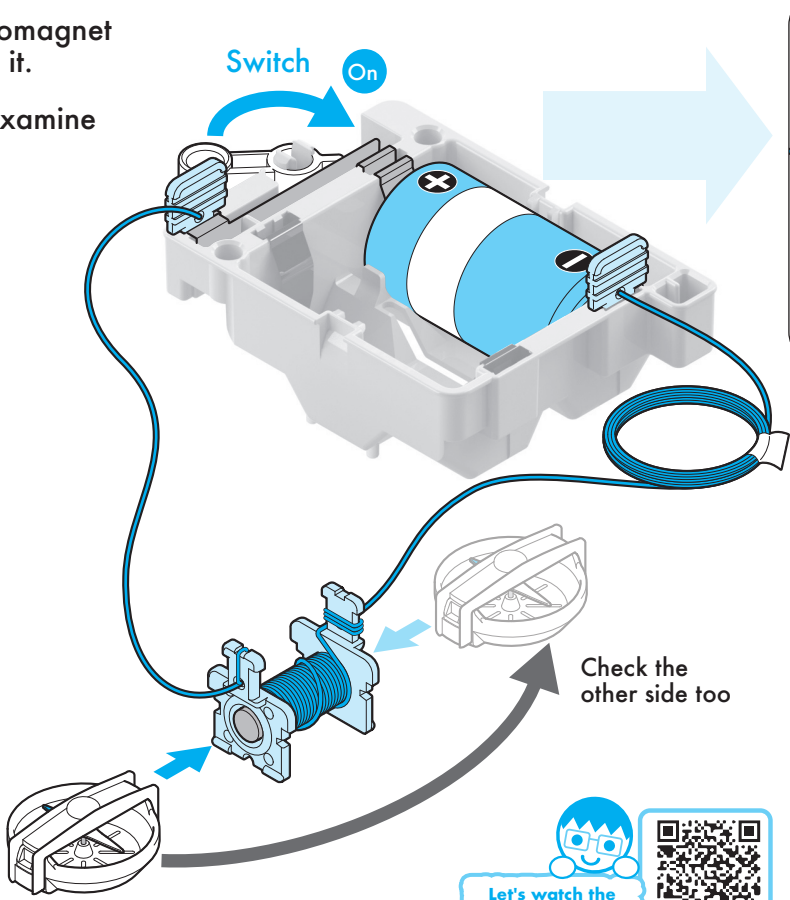
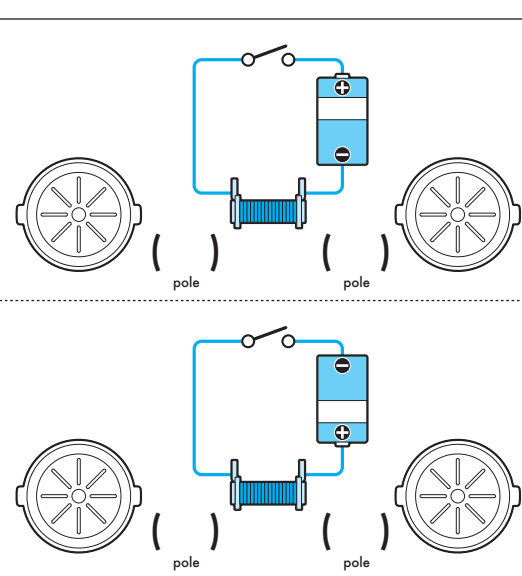
B

An electric current is applied to the electromagnet (yellow), and bring the compass closer to it.

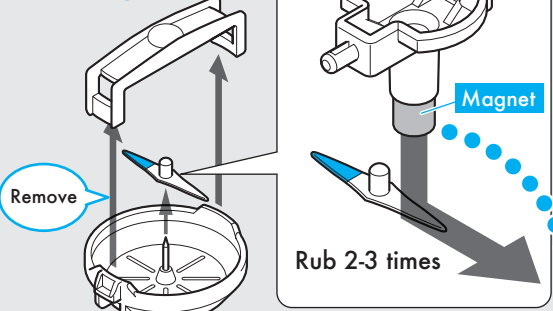
C

Switch the direction of the batteries and examine them in the same way.

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



### How to adjust the compass



### Cautions regarding magnets

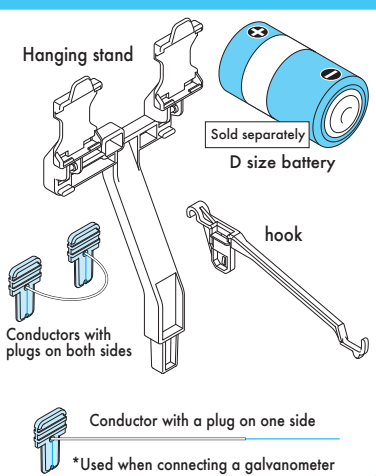
- Keep away from watches, magnetic cards, etc
- Please do not hit it against a hard surface
- Keep away from iron sand and other fine iron

Experiment

2

## Strength of electromagnets

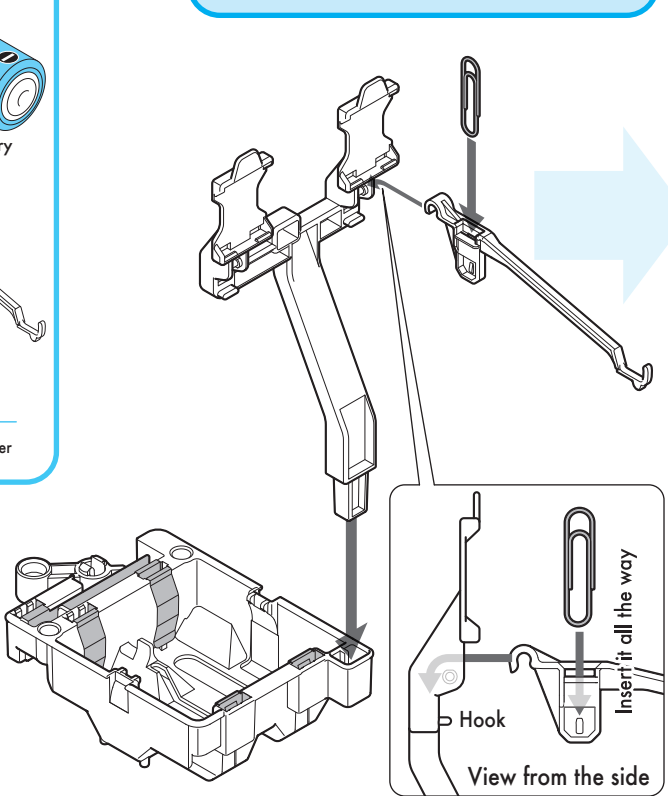
### Additional parts to be used in Experiment 2



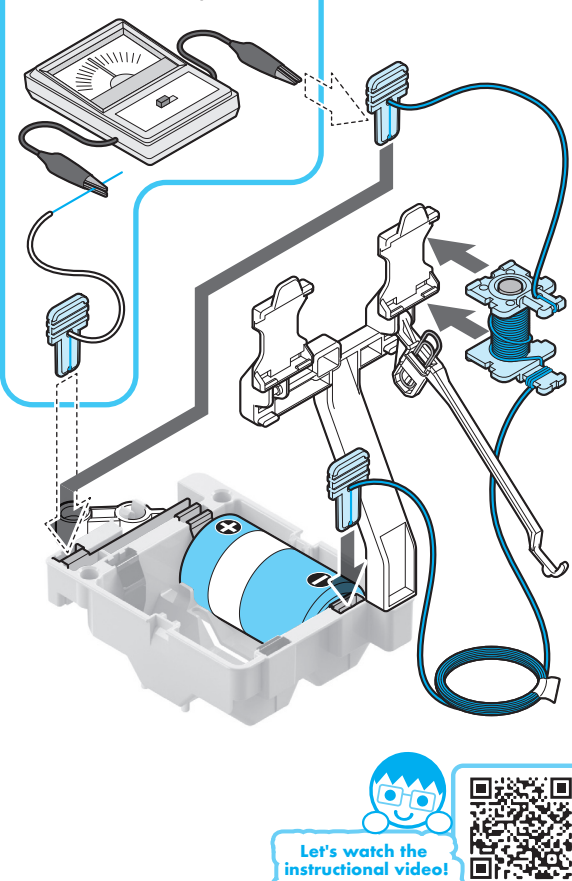
### When using a galvanometer



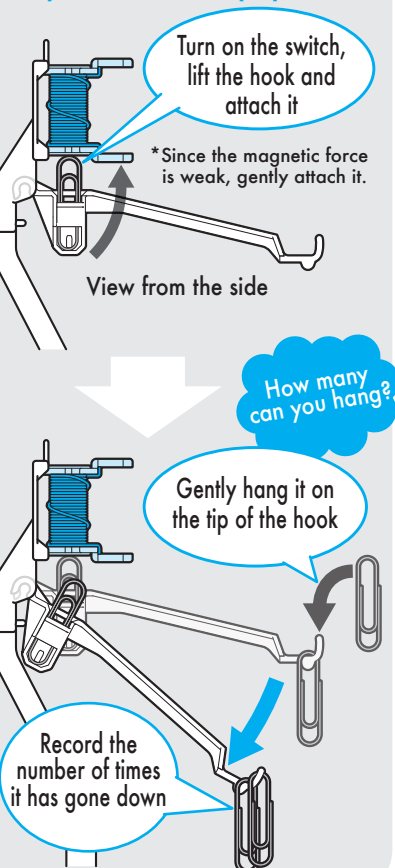
### Assembly of experimental equipment



If a galvanometer is used, connect it to this position.



### How to use the experimental equipment



C

### Investigating different magnitudes of current

D

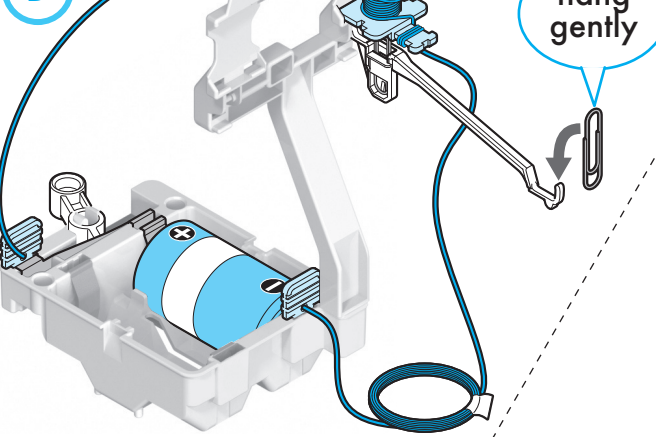
Check the number of suspended paper clips when using one battery.

E

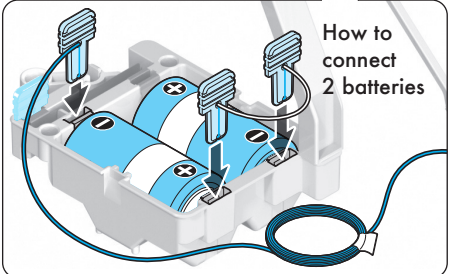
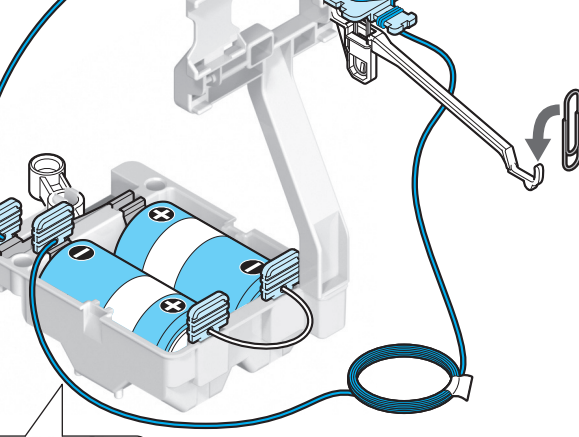
Check the number of suspended paper clips when two batteries are connected in series.

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

D



E



Continue to the back





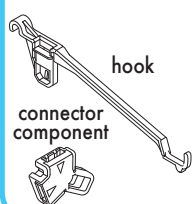


Experiment  
**2**

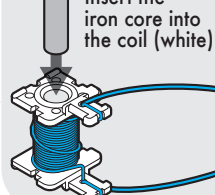
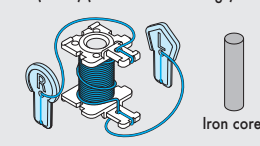
## Strength of electromagnets (continuation)

Assembly drawing of experimental equipment

Additional parts to be used in Experiment 2-D



Coil (white) (About 200 windings)

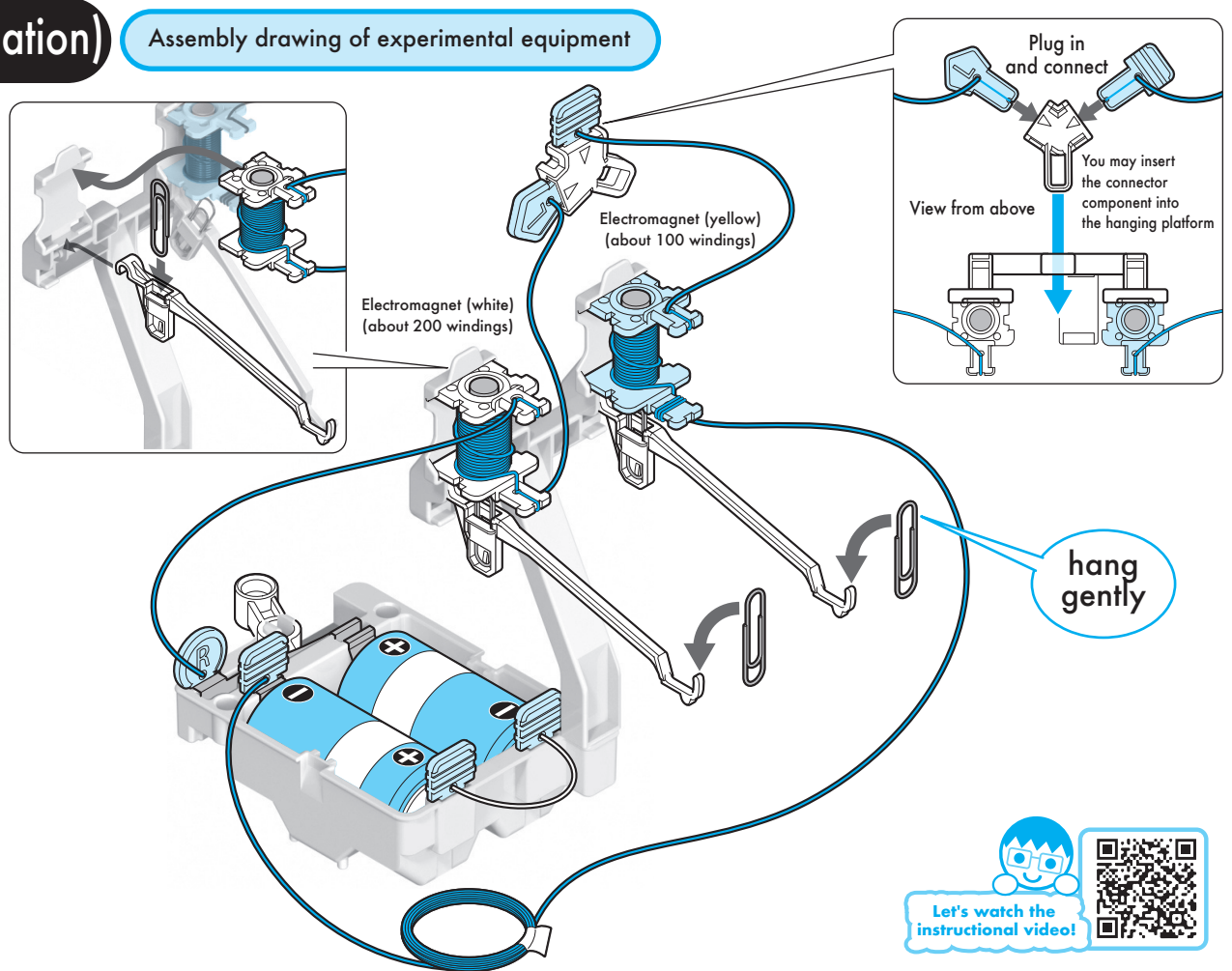


Insert the iron core into the coil (white)

**D** Investigate different numbers of coil windings

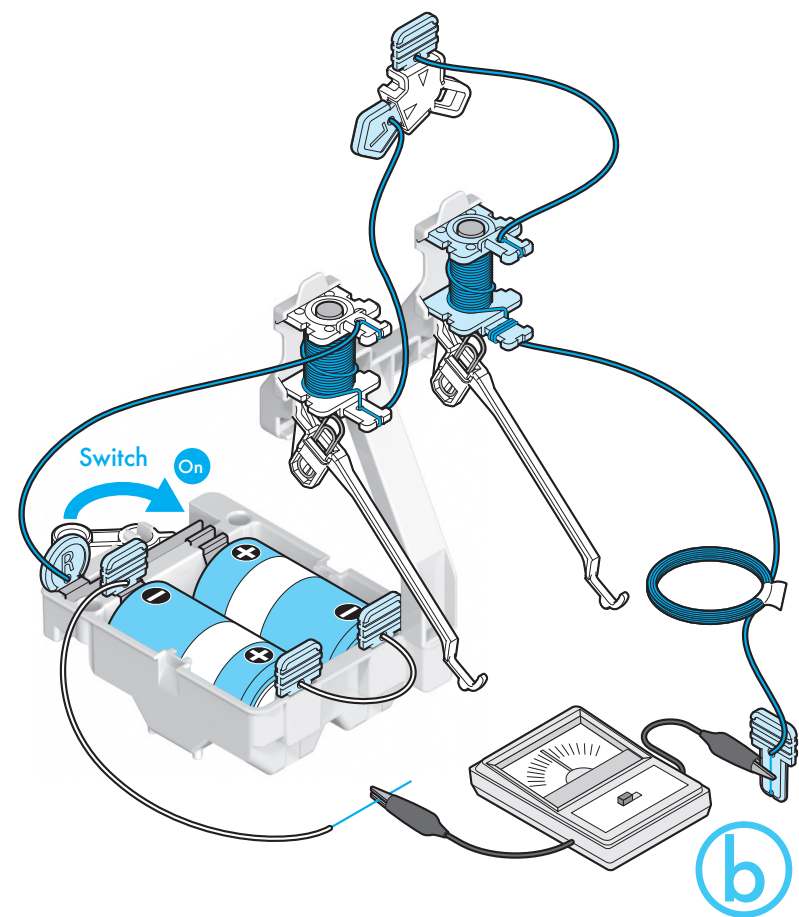
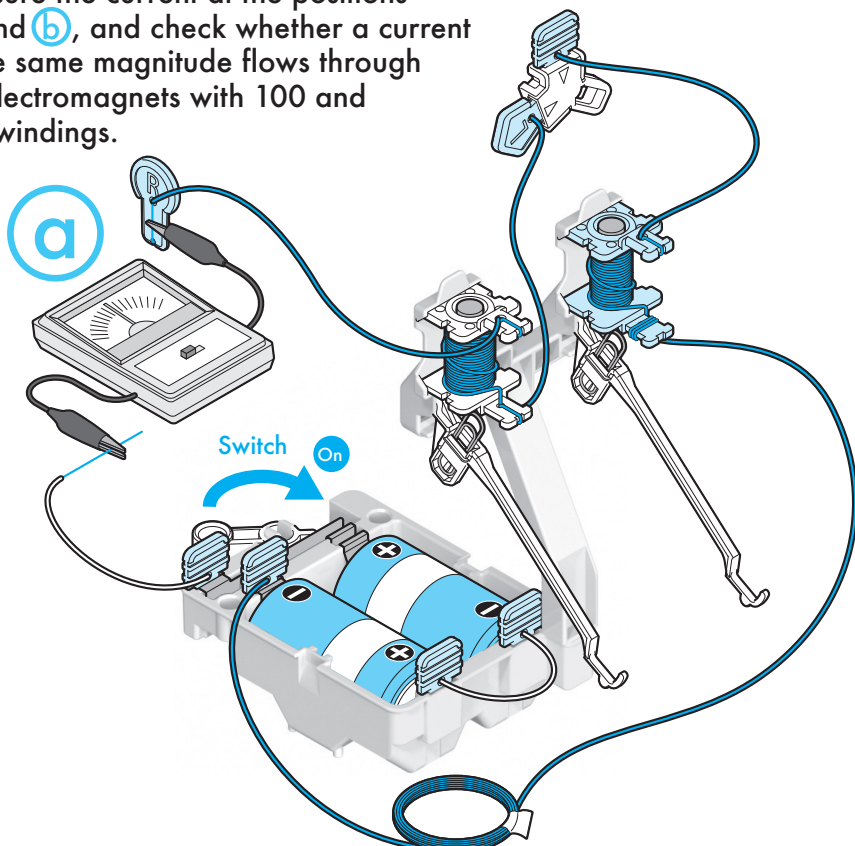
**F** Find out how many suspended paper clips you have using 100 windings and 200 windings electromagnets.

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



When using a galvanometer

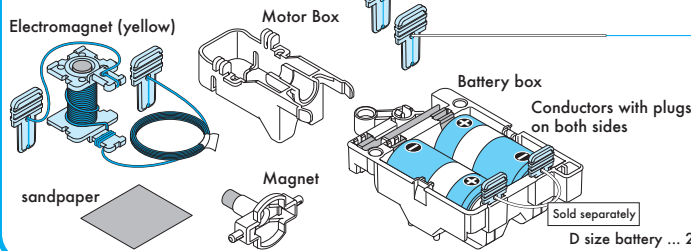
Measure the current at the positions **a** and **b**, and check whether a current of the same magnitude flows through the electromagnets with 100 and 200 windings.



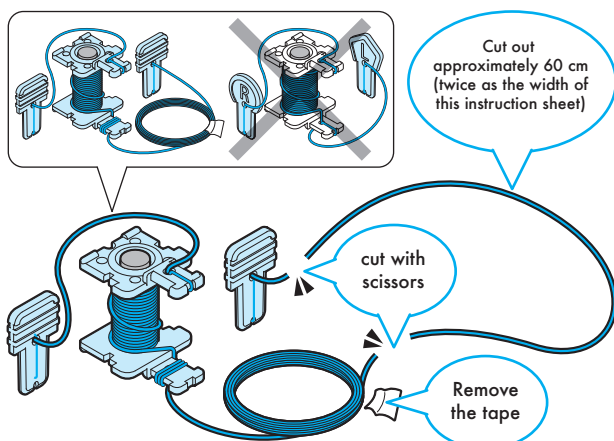
Let's try

## 1 Let's turn the coil motor!

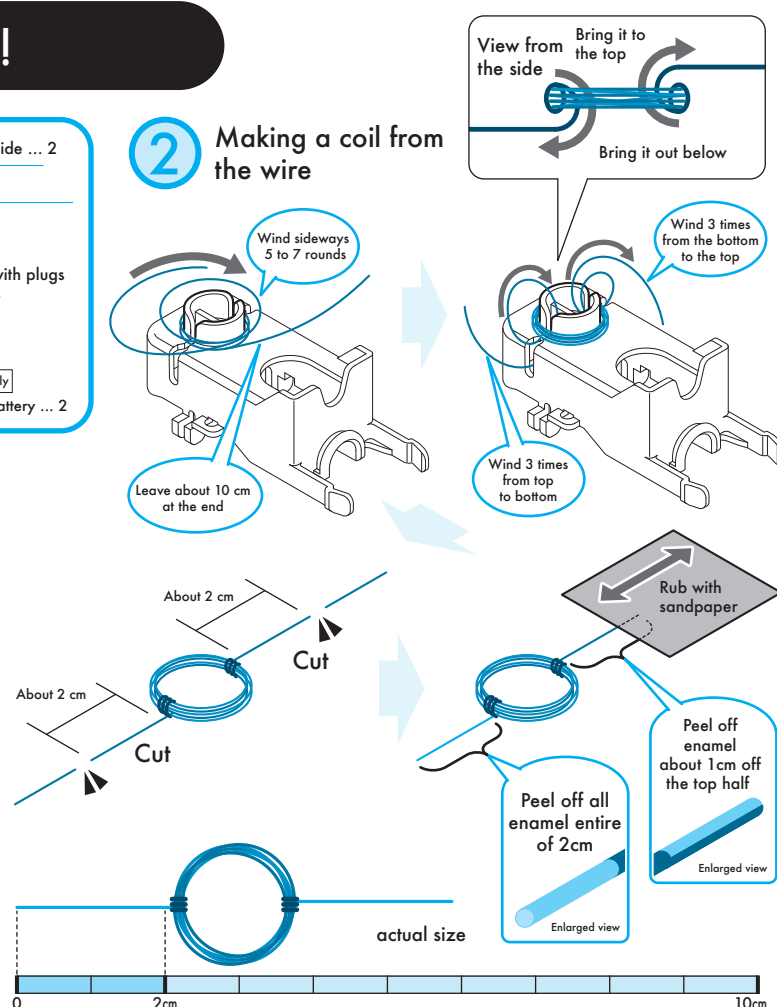
Parts used in Let's Try 1



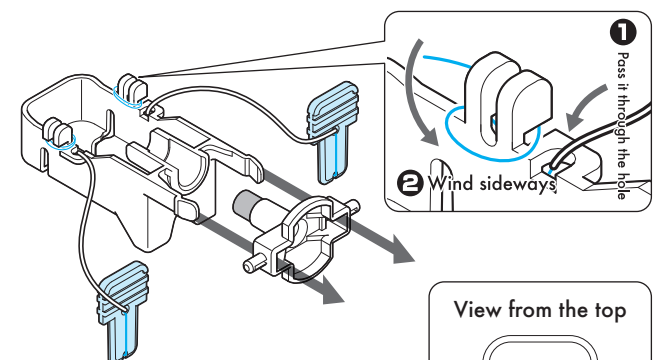
**1** Cut the wire from an electromagnet (yellow)



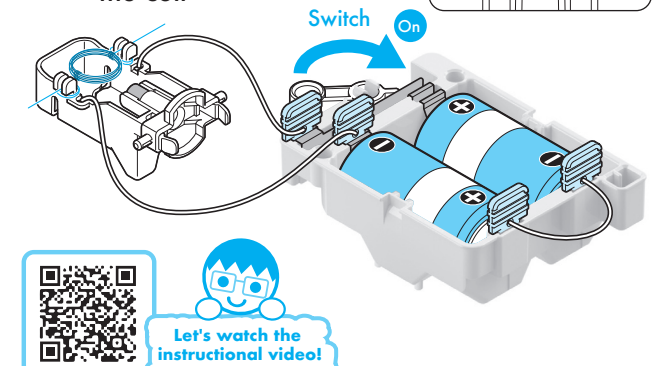
**2** Making a coil from the wire



**3** Attach the conductor with a plug on one side and the magnet to the motor box



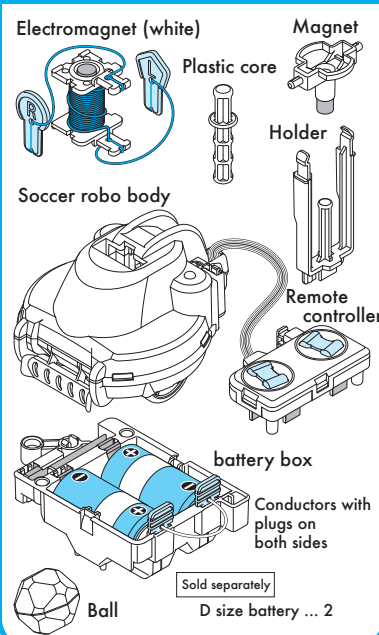
**4** Connect the conductor with a plug on one side to the battery box and turn the coil



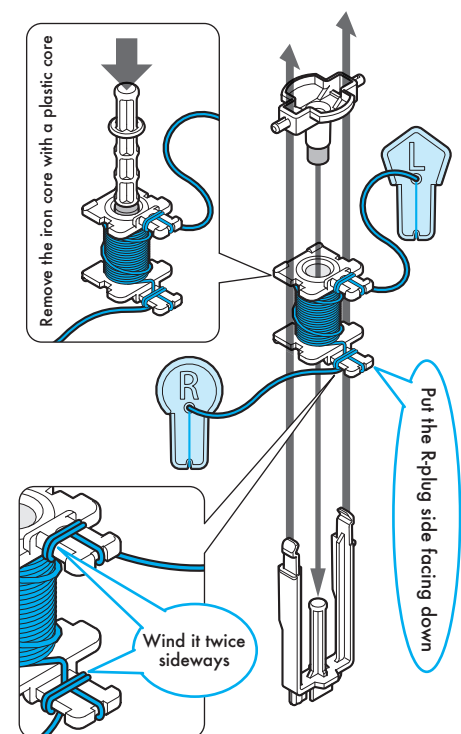
Let's try

## 2 Let's make a Soccer Robo!

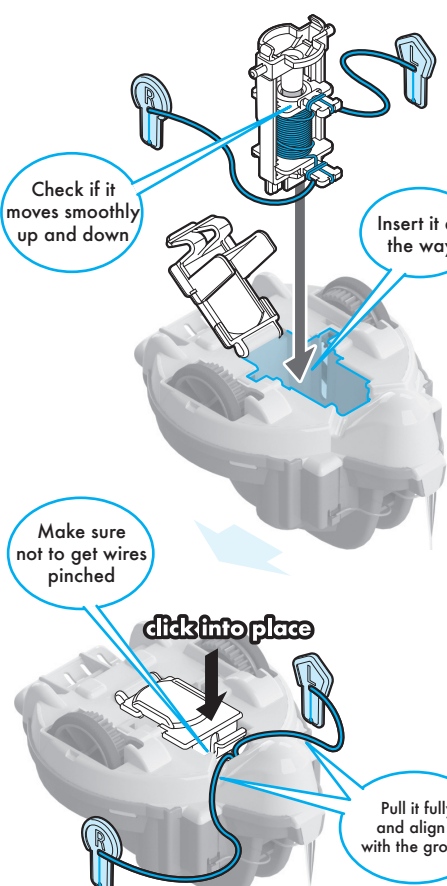
Parts used in Let's Try 2



**1** Remove the iron core of the electromagnet (white) and attach the holder and magnet



**2** Attach the parts made in 1 to the soccer robo body



**3** Attach the remote controller to the battery box and plug it in

