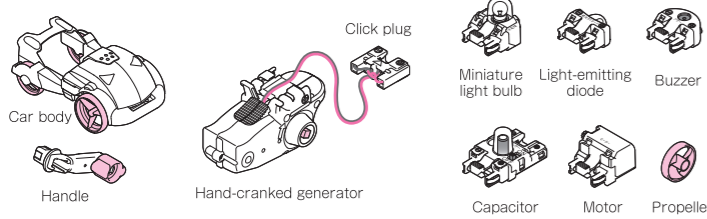


Caution

- Please read the instructions carefully before experimenting.
- Do not use a power supply for this material.
- Do not use this material for any purpose other than experiments.
- Do not store too much electricity in the capacitor. If too much electricity builds up, it may break, so please stop storing electricity after the power storage notification light comes on.
- Do not use a generator other than the one included in the set.
- Do not use the generator for products or parts other than the set.
- Do not look directly into the light of the light-emitting diode.
- Do not hold the buzzer close to your ear.
- Do not turn the hand-powered generator too fast when shining a miniature light bulb or light-emitting diode. It may cause the bulb to blow out.
- Please do not turn the hand-cranked generator too fast, stop it abruptly, or forcibly turn it. This can cause the gears to become damaged.
- Do not disassemble or modify the hand-powered generator.
- Do not drop or otherwise subject the hand-powered generator or capacitor to strong shocks.
- Do not turn the hand-cranked generator too fast when reversing the flow of electricity to the light-emitting diode and buzzer.
- Please run the capacitor car or power generator in a safe and wide area where no vehicles can pass by.

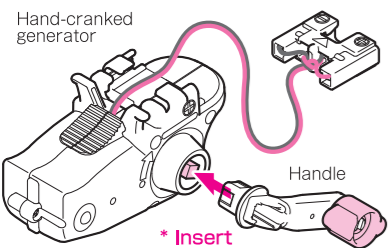
Let's get ready for the experiment.

*Make sure you have everything you need before you start.



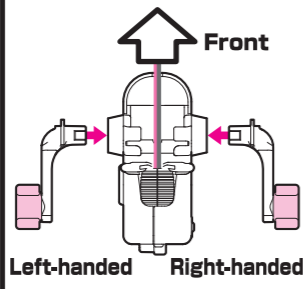
Preparing the hand-powered generator

○ Attach the handle to the hand-powered generator.



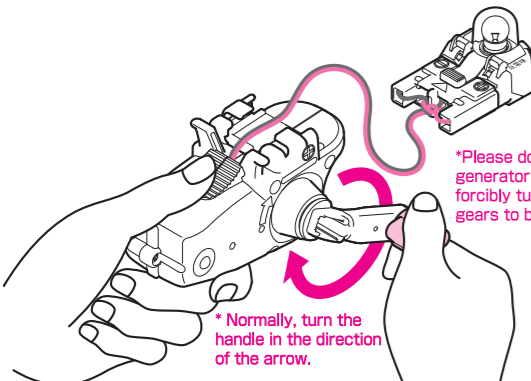
View from the top

○ Attach the handle to your dominant hand.



How to hold and use the hand-powered generator

- When you turn the handle of a hand-powered generator, you can make electricity.
- When the direction of the handle changes, the current direction also changes, so decide which way to turn the handle.



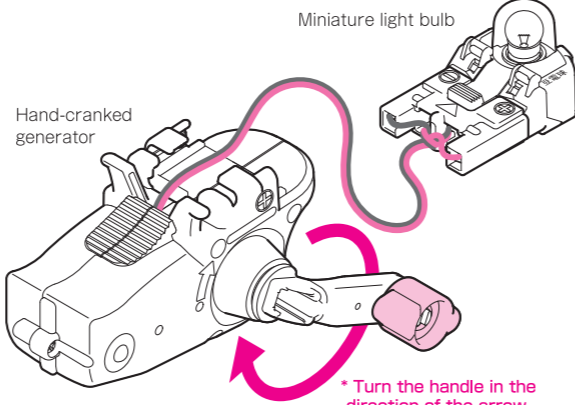
*Please do not turn the hand-cranked generator too fast, stop it abruptly, or forcibly turn it. This can cause the gears to become damaged.

*Normally, turn the handle in the direction of the arrow.

Do not use this outside of experiments.

Power generation experiment

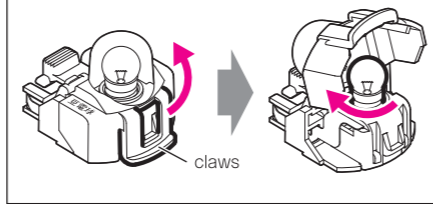
- 1 Attach a miniature light bulb to the hand-cranked generator and slowly turn the handle.
- 2 Turn the handle quickly and examine if there is a difference in the brightness of the miniature light bulb.
- 3 Find out what happens to the miniature light bulb when you turn the handle in the opposite direction.



* Turn the handle in the direction of the arrow

When the miniature light bulb does not light up

Pull the claws to open the cover and turn the bulb inside to the right to tighten it securely.



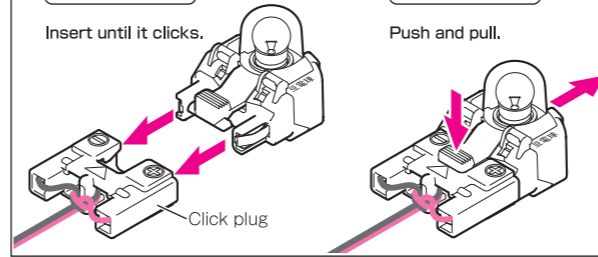
How to use click plug

How to attach:

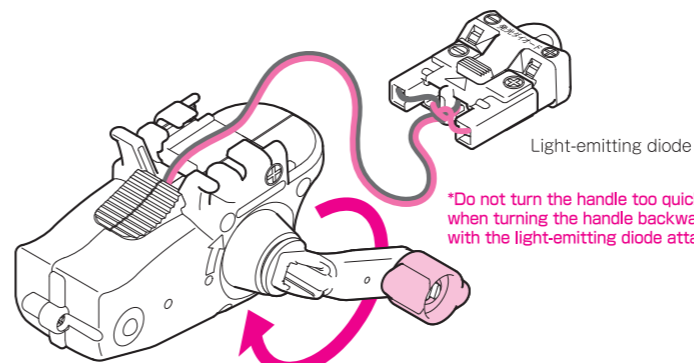
Insert until it clicks.

How to remove:

Push and pull.



- 4 Replace the light bulb with a light-emitting diode and try turning the handle in the same way. Compare the difference as compared to turning the handle when the light bulb is attached (if it is difficult to see the difference, switch the diode and light bulb several times). If you turn the handle quickly, examine if there is a difference in the brightness of the light-emitting diode.
- 5 Find out if the light-emitting diode shines differently when the handle is turned quickly.
- 6 Find out what happens to the light-emitting diode when you turn the handle in the opposite direction.

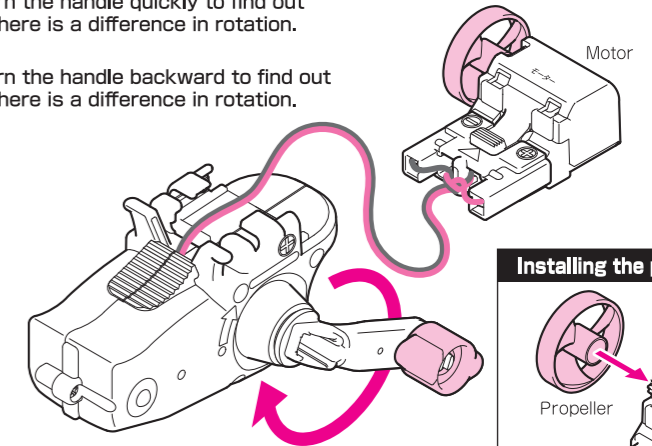


*Do not turn the handle too quickly when turning the handle backward with the light-emitting diode attached.

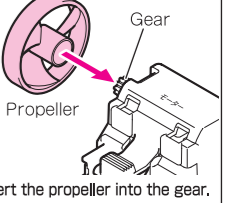
*Do not turn the hand-powered generator too quickly. It may cause the miniature bulb or light-emitting diode to burn out.

Do not look at the light from light emitting diode from the front. It may hurt your eyes.

- 7 Switch to a motor and try turning the handle in the same way. Compare the difference as compared to turning the handle when the light bulb is attached.
- 8 Turn the handle quickly to find out if there is a difference in rotation.
- 9 Turn the handle backward to find out if there is a difference in rotation.

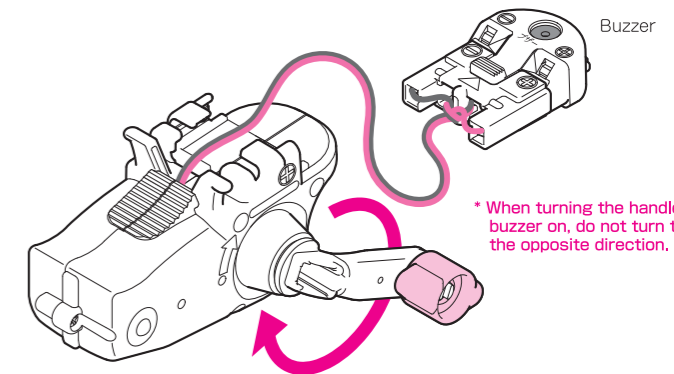


Installing the propeller



Insert the propeller into the gear.

- 10 Replace it with a buzzer and turn the handle in the same way.
- 11 Turn the handle quickly and see if there is a difference in sound.
- 12 Find out what happens to the buzzer when you turn the handle backward.



* When turning the handle with the buzzer on, do not turn the handle in the opposite direction.

Keep away the buzzer from your ears.

☆ Let's summarize the results of Experiment 1 in the table below.

	Miniature light bulb	Light-emitting diode	Motor	Buzzer
Response to turning				
When turning slowly				
When turning quickly				
When turning in the opposite direction				

☆ Write down what you have learnt about electricity generation in the brackets ().

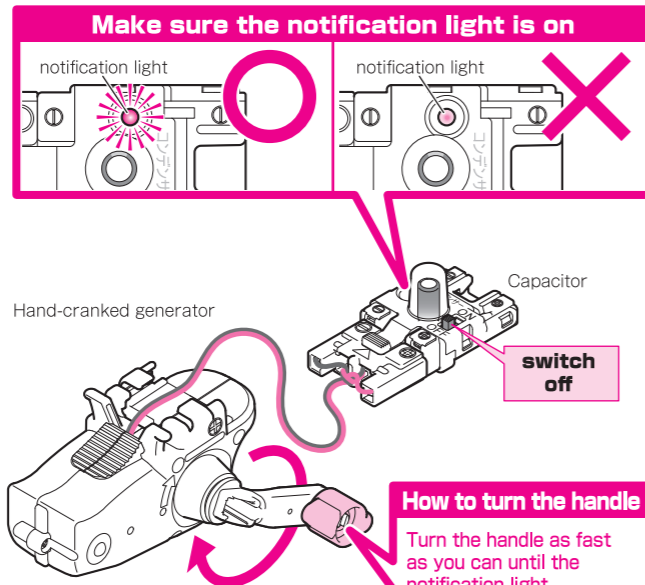
- If you generate electricity slowly, you generate () electricity, and if you generate electricity quickly, you generate () electricity.
- If we generate electricity in the opposite direction, the flow of electricity will be ().

☆ Let's summarize what we have learned about power generation.

Electricity storage experiment

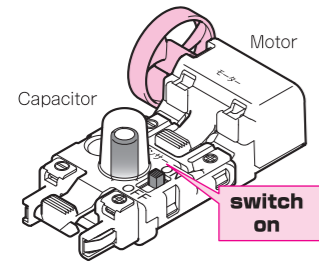
Store electricity in the capacitor

1 Attach the capacitor to the hand-powered generator, turn the switch to OFF and turn the handle until the notification light comes on.



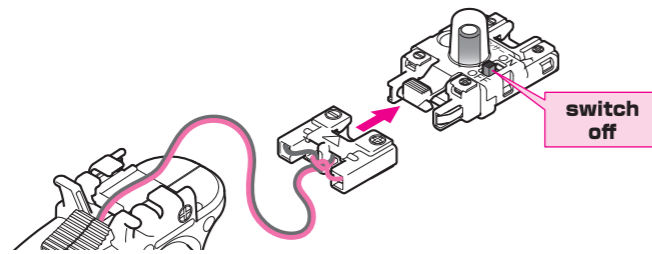
Ensure that there is no leftover electricity before storing electricity

Connect the motor to the capacitor, turn the switch to ON (on), and let it rotate until it stops.



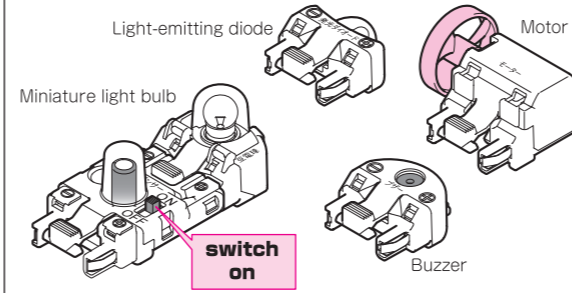
*If there is still electricity in the capacitor, the experiment will not be accurate.

2 When the notification light is on, remove the capacitor from the hand-cranked generator.



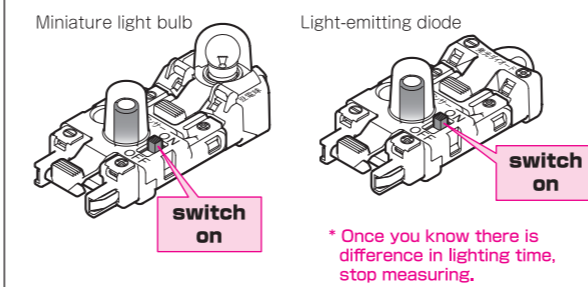
Application of stored electricity

3 Find out what happens when you attach the miniature light bulb to the capacitor, and turn on the switch. In the same way, find out what happens when you attach the light-emitting diode, motor, and buzzer.



Compare miniature light bulb and light-emitting diode

4 Store electricity using method described in 1. Compare the time taken for the miniature light bulb/ light-emitting diode to light up.



* Once you know there is difference in lighting time, stop measuring.

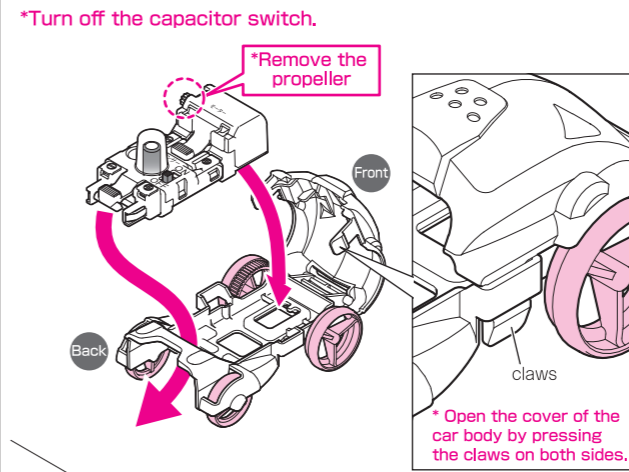
Do not look at the light from light emitting diode from the front. It may hurt your eyes.

Try making devices that make use of electricity!

Let's get this car moving

Capacitor car

Attach the motor to the capacitor, and then attach to the car body.

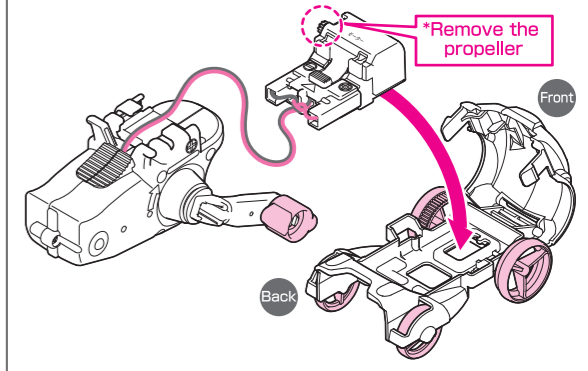


Tighten the car's cover, turn on the capacitor switch, and get it to move.

To make it move again, insert the plug from the back to store electricity.

Power-generating car

Attach the motor to a hand-cranked generator and attach it to the car body.



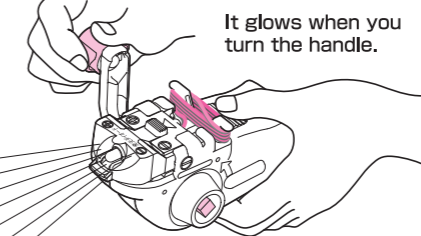
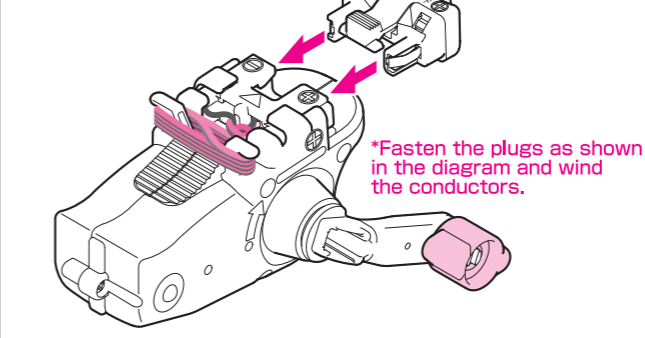
Let's change the direction of the handle to make it move back and forth.

When operating the capacitor car or power-generating car, do it in a wide and safe area without traffic.

Let's make a light generator

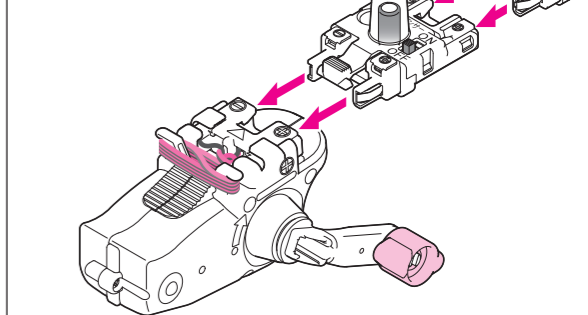
Light generator

Attach the light-emitting diode to the hand-cranked generator.



Light generator using stored electricity

When the capacitor is attached between the hand-cranked generator and light-emitting diode, it can be used as a light generator.



1 Turn the capacitor switch off and turn the handle to store the electricity.
2 After storing the electricity, it glows when the switch is turned on (ON).

☆ Let's summarize the results of Experiment 2 in the table below.

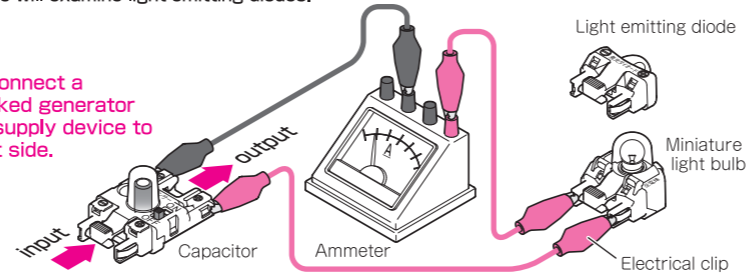
	Time taken to light up
Miniature light bulb	
Light-emitting diode	

Let's try Let's connect an ammeter to check the strength of the electric current.

Use a miniature light bulb and an ammeter to test the strength of the current in a capacitor that stores electricity. Similarly, we will examine light-emitting diodes.

Current strength
Amps
Amps

* Do not connect a hand-cranked generator or power supply device to the output side.



☆ Let's summarize the use of electricity by miniature light bulbs and light-emitting diodes.

☆ Write down the changes caused by the electricity in the brackets ().

- When the miniature light bulb/light-emitting diode were attached, the electricity causes ().
- When the motor is attached, the electricity causes ().
- When the buzzer is attached, the electricity causes a ().