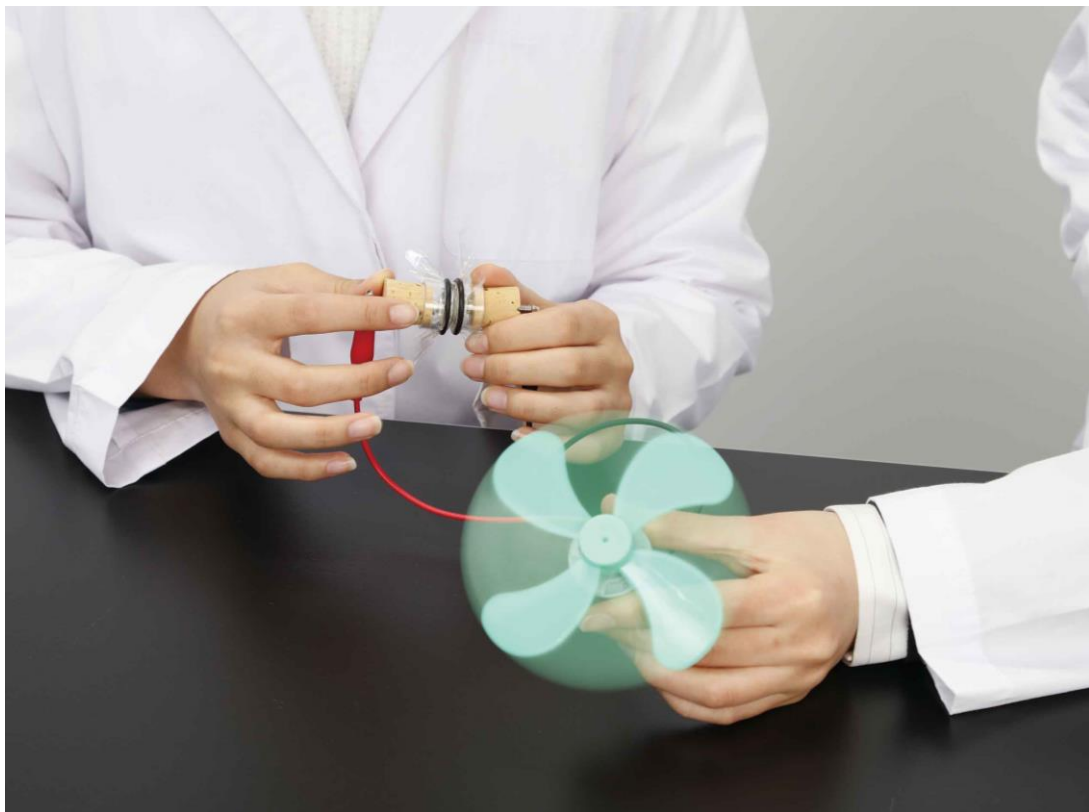


Miniature Daniell Cell

Basic Daniell cell set DH-B Cat.No. B10-2014-W0

and

Full Daniell cell set DH-F Cat.No. B10-2014-X0



Cautions

- Wear safety glasses and safety gloves when you do experiments with this product.
- Do not conduct experiments with this product without your teacher.
- Instruct the experiment procedure before beginning the experiment.
- Be careful about chemicals, not to get them in your face to your hands or clothes. If that happens clean the affected area with water as soon as possible.
- Wash hands and face as soon as possible when chemicals attach to hands and face.
- Read and follow Safety Data Sheet (SDS) of Copper sulfate and Zinc sulfate for student's safety before conducting experiments.

Introduction

Purpose of the Product

The purpose of this product is to conduct chemical battery experiments with minimum chemicals. Positive electrode cell and negative electrode cell are made separately and by their contact with each other electromotive force is created by the chemical reaction thus becoming electric battery. The waste fluid is minimized after the experiment and waste treatment time can be saved.

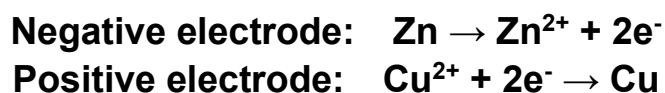
Information about Daniell Cell

Before Daniell cell was invented, Voltaic cell was common. However, Voltaic cell had short life because hydrogen as an inhibitor occurs between Zinc and Copper. Daniell cell was invented to make a longer life than Voltaic cell. In 1836, J. F. Daniell invented the chemical cell which is called after him Daniell Cell. The cell has the following structure:



Chemical reaction equation is shown $\text{Zn} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{ZnSO}_4$. Theoretical electromotive force is 1.07V when the concentration of each electrolytic solution is the same. Therefore, the reaction is same as a reaction between Zinc metal and Copper sulfate solution which produces Copper metal on the surface of Zinc metal. Daniell cell uses a porous plate (biscuit firing) as a separator between Zinc metal within Zinc sulfate solution and Copper metal within Copper sulfate solution. This is a big difference between Voltaic cell and Daniell cell. The separator inhibits Zinc metal and Copper ion from direct contact; therefore its chemical reaction is controlled. When both electrodes are connected with each other by lead wire, electron starts to move from one electrode to another electrode, and the chemical reaction starts. Therefore, Zinc ionization and dissolution occur in its own solution, precipitation reaction of Copper in its own solution. Finally, Daniell cell is completed.

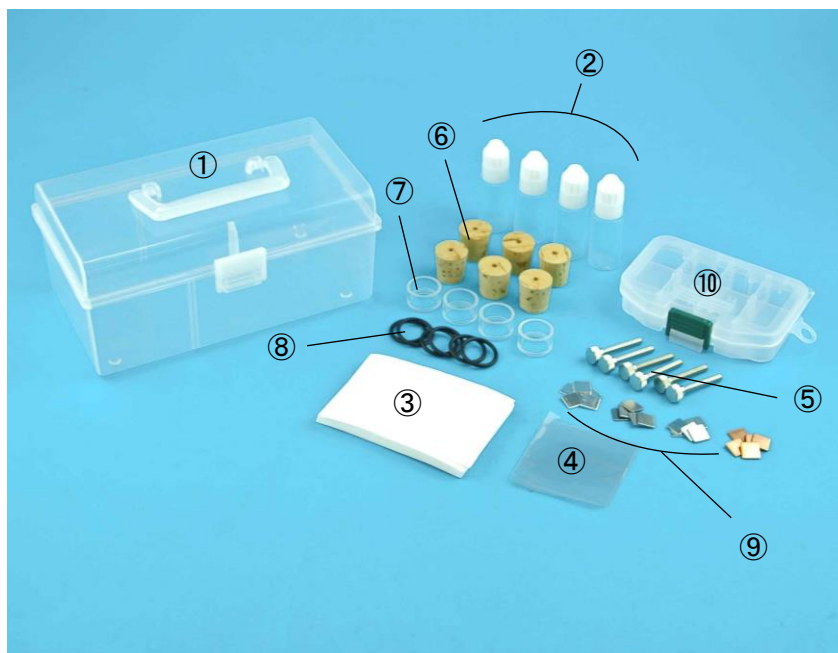
Chemical reaction at each electrode of Daniell cell is as follows:



In the reaction, Zn ion is increased at the negative electrode and Copper ion is decreased at the positive electrode. When the two kinds of electrolyte solution are completely separated, the chemical reaction stops. That is the reason that Daniell cell needs porous plate that allows ion transfer to the other side. This product uses a semipermeable membrane instead of the traditional porous plate in order to make a Daniell cell very small.

Components

B10-2014-W0-W0 Miniature Basic Daniell Cell set DH-B



- ① Carrying case
 - ② Drop bottle 10mL 4 pcs
 - ③ Paper filter 60 × 90mm 25 pcs
 - ④ Cellophane 50 × 50mm 40 pcs
 - ⑤ Screw for electrode 37mm 6 pcs
 - ⑥ Cork plug with a hole 6 pcs
 - ⑦ Plastic cylinder 4 pcs
 - ⑧ Rubber ring 6 pcs
 - ⑨ Metal plate 10 × 10 × 1mm
(5 pcs each of Cu, Zn, Fe, Al)
 - ⑩ Organizer case 103 × 73 × 23mm
- * Chemical solutions are not included.

B10-2014-X0 Miniature Full Daniell Cell set DH-F



- ① Carrying case
- ② Drop bottle 10mL 4 pcs
- ③ Paper filter 60 × 90mm 25 pcs
- ④ Cellophane 50 × 50mm 40 pcs
- ⑤ Screw for electrode 37mm 6 pcs
- ⑥ Cork plug with a hole 6 pcs
- ⑦ Plastic cylinder 4 pcs
- ⑧ Rubber ring 6 pcs
- ⑨ Metal plate 10 × 10 × 1mm
(5 pcs each of Cu, Zn, Fe, Al)
- ⑩ Organizer case 103 × 73 × 23mm
- ⑪ Propeller motor 1 unit
(1.5 – 12V, 10 – 21mA)

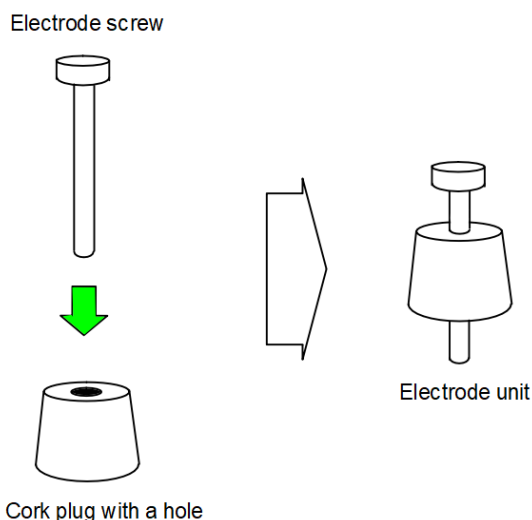
⑫ Electric melody 1 unit (1.2 – 3.6V, 0.15 – 0.3mA)

⑬ 1 pcs each of lead wire with clips Red & Black

* Chemical solutions are not included.

How to Use

1-1. Make an electrode unit following the figure below.



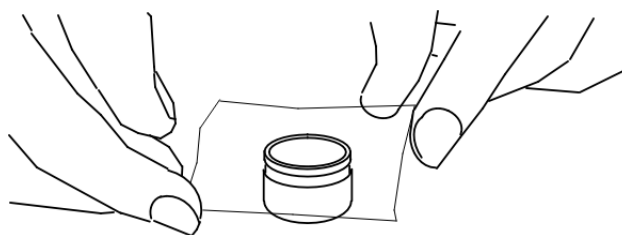


Check This Movie!!
(in Japanese)

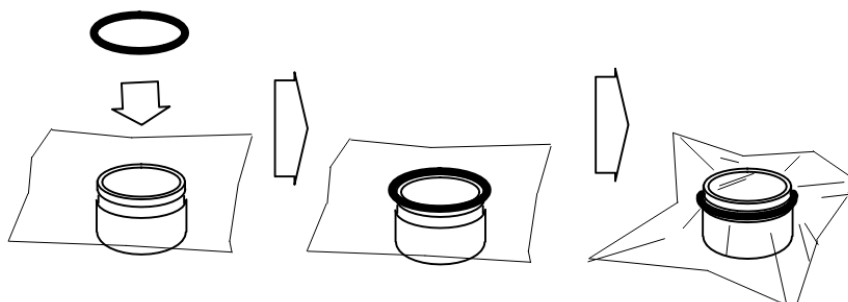
Precautions:

Do not push the electrode screw into a cork plug by using too much force. In case of difficulties inserting the electrode screw into the hole of the cork plug, please rotate the screw slowly and push into the hole. Make sure to insert the electrode screw like on the figure above, with the slimmer part of the cork on top.

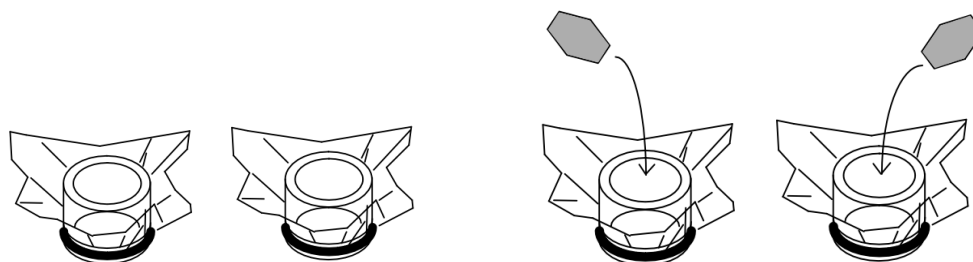
1-2. Put a cellophane on top of a plastic cylinder (see fig. below) with the rim for Rubber ring on top. You can put Cellophane any side you want. Cellophane may curl because of humidity or sweat on your hands, but this has no effect on its function.



1-3. Put a Rubber ring on the cellophane film and overwrap the film to the plastic cylinder with the Rubber ring (see fig. below). In this step, please be careful not to tear the film. We will call this part a Container. You need to make two containers.



1-4. Put two containers on a table upside down (see fig. below). Then, cut out from the paper filter enclosed 2 square (or hexagonal) pieces with size 15 x 15mm. After that insert the two pieces of paper into each container (see fig. below).

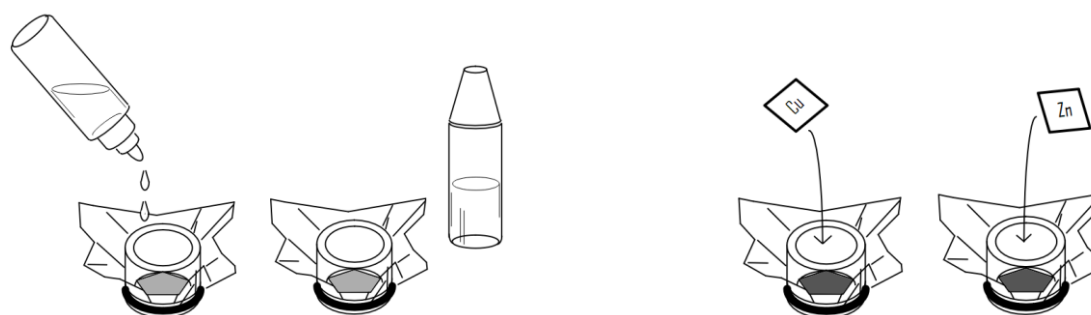


Tips: Suitable size of paper filter to put inside the container is 15mm x 15mm because the inner diameter of container is 17mm. And you can use tweezer to put the paper inside easily.

1-5. Drop two drops of chemical solution from the dropper bottle onto the paper filter of the container (see fig. below). One drop of chemicals solution is not enough volume to make a good contact of metal and electrode. And three drops of chemical solution might be too much.

You need to prepare Zinc sulfate solution and Copper sulfate solution beforehand as it is not included. Recommended concentration of Zinc sulfate solution is 7% and the recommended concentration of Copper sulfate solution is 14%. Please use the drop bottles included for the solutions.

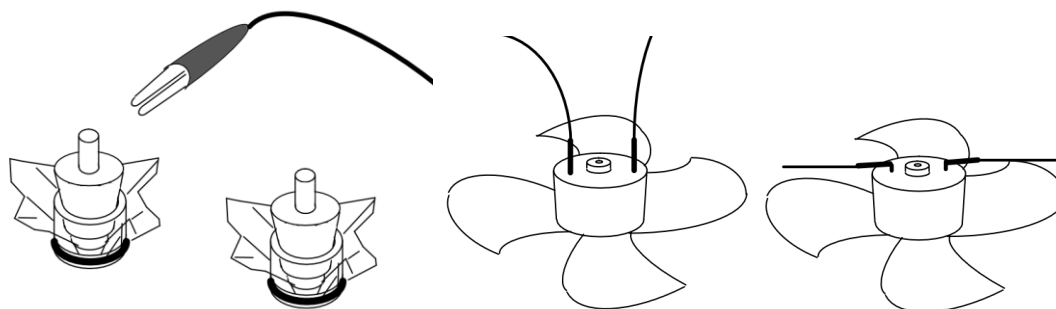
1-6. Put metal plate on the paper filter in the container (see fig. below). Put zinc metal plate in container with zinc sulfate solution, and copper metal plate in container with copper sulfate solution.



1-7. Assemble the electrode units and the containers together to make two reactors. Make sure that the electrode unit and the metal plates in the container are connected with each other. Daniell cell will not work if the metal plates are not connected with each other.

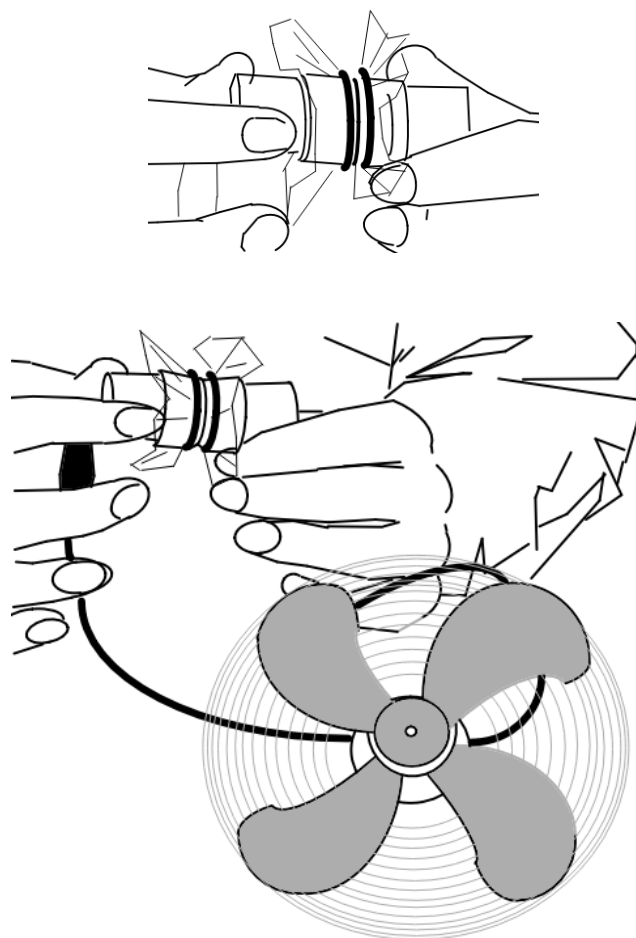


1-8. Attach the electrodes of the reactors by the clips of the lead wires. If you use the propeller motor, connect the reactors to the propeller motor. Tips for using the propeller motor, bent its terminals 90 degrees to make it stable on the table (see fig. below).



1-9. Connect the surfaces of the reactors with each other, so that the cellophane surfaces are completely in contact with each other and electricity will be generated (see fig. below). Daniell cell is complete. You can measure current and voltage using an ammeter or a voltmeter. Also if the propeller motor or electric melody is connected to Daniel cell, the propeller motor or electric melody will work.

Tips, if the propeller motor is not stable on the table, work in pairs, so that one person hold the propeller in their hands and the other person holds the Daniell cell connected together.



Clean up After Experiments

Disassemble the reactors completely after the experiments and separate all the parts, especially metal parts, paper filters and cellophanes.

- Wash and clean the plastic cylinders and the rubber rings, the electrodes by water if some solution got on it and dry them afterwards.
- Wash and dry the metal parts.
- Dispose the paper filters with chemicals after drying them.
- Dispose the cellophane after drying it too. If you want to re-use it, it can be done, just wash and dry it.

If you will be reusing the metal parts because the surface of the metal most likely has stains or oxidized by chemical reaction in the reactor, you should polish the metal parts surface by sandpaper (not included).

Storage

Please store this product and its parts away from direct sunlight, high temperature and high humidity. Especially, cellophane is particularly vulnerable to humidity, therefore we recommend storing it properly and use all of it soon. Chemical solutions should be removed from the bottle and the bottle should be washed and dried.

Precaution:

We do not recommend to store the solutions in the drop bottles as the water in the solution will evaporate eventually and the solution will solidify in the bottom of the bottle, cap or nozzle.

Troubleshooting

When Daniell cell does not generate electricity...

- * Check if there is contact between the electrode and the metal in the reactor.
- * Check if the paper filter inside the reactor is wet enough with chemical solution. If not, add one or two drops of chemical solution from the respective dropper.
- * Check the condition of the surface of the metal plate inside the reactor whether the metal has stains or oxidized. If that is the case, change the metal plate or clean it from stain or oxidation by sandpaper.

Additional Information

It is possible to change metal combination from Copper and Zinc to Copper and Aluminium, and others that are enclosed in the set. For more investigation of Daniell cell or other battery types, Miniature DC Voltmeter is useful item to compare these combination of metal regarding electricity (electromotive force).

A05-7065-W0 DC Voltmeter "Crabee" CT-V

Measurement: $\pm 25.0V$

Size: 53 x 21 x 15mm (280mm with lead wire)



Replacement items

Metal Plate			
Copper Plate	F35-8101-W1	100 pcs/set	10 x 10 x 1mm
Zinc Plate	F35-8101-W2		
Aluminum Plate	F35-8101-W3		
Iron Plate	F35-8101-w4		
Drop Bottle	S75-1140-Y6	12 bottles/set	12mL
Cellophane file	B10-2014-W1	40 pcs/set	50 x 50mm
Cork Plug	S75-3100-W6	10 pcs/set	You need to make a hole with diameter 3.5mm in the cork plug by yourself.
O Ring	P70-2465-X8	10 pcs/set	
Paper filter	Any common paper filter can be useful.		
Motor	P70-2653-W0	1 unit	
Propeller	P70-3937-W0	10 pcs/set	
Electric Melody	P70-3934-W1	1 unit	
Lead wire with clips	B10-6503-W0	10 pair/set	300mm, Red and Black

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