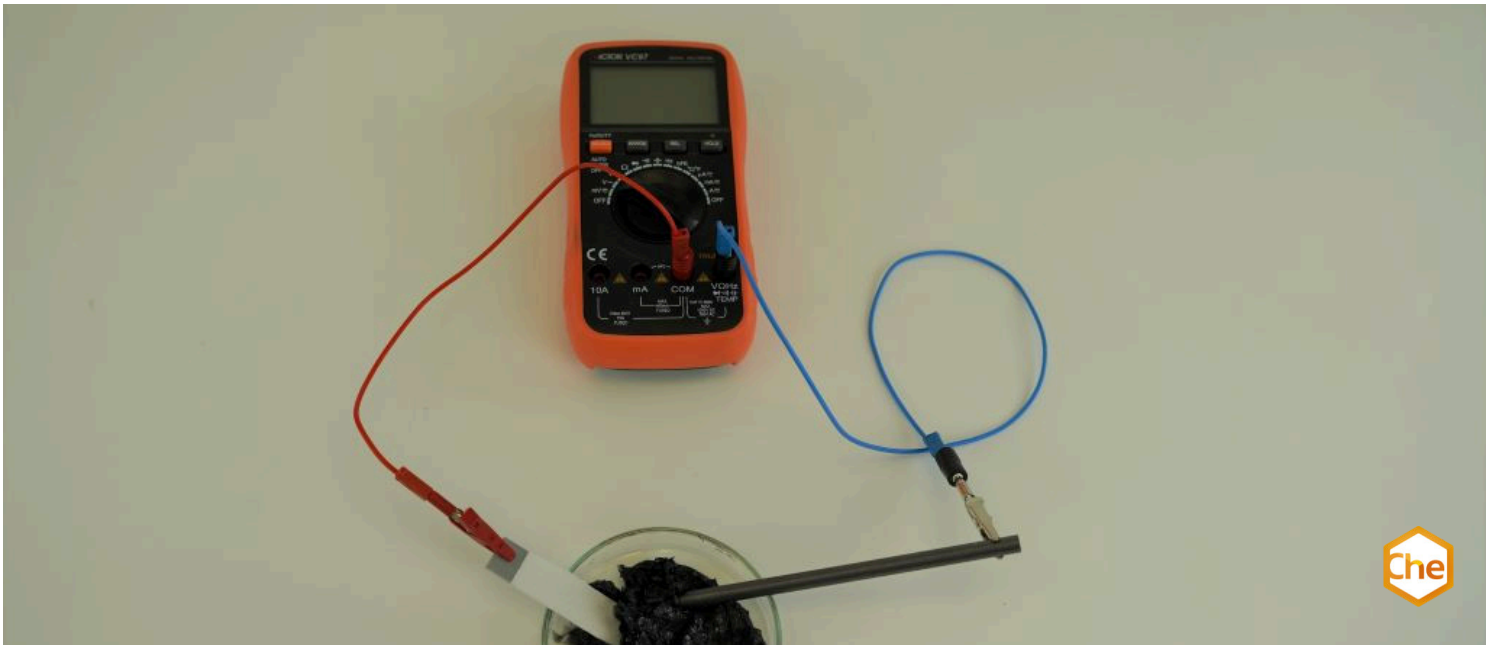
Leclanche element (model structure)



Students learn about the structure and function of a battery using a model of the Leclanché element.

Chemistry > Physical chemistry > Electrochemistry > Galvanic elements, fuel cells

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/61a8e09e22e1e50003a26e78

PHYWE

Teacher information

Application

PHYWE

Known as a precursor to the modern battery, the Leclanché element offers students the opportunity to make a rudimentary battery in the Petri dish with simple tools in class.

This model battery has a voltage of approximately 1.5 V and was developed by Gerorges Leclanché as early as 1866. Our modern alkaline manganese battery is based on the consistent further development and improvement of the Leclanché element.

Experiment setup

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/3)

PHYWE

Previous knowledge

The students should be familiar with the function of an electrolyte. They must also have a basic knowledge of the structure of a battery and the process of electrolysis.

Scientific Principle

The Leclanché element consists of a carbon electrode, a zinc electrode and a viscous slurry, which consists of manganese dioxide (manganese dioxide), ammonium chloride, starch and water. This slurry acts as the electrolyte.

Other teacher information (2/3)

PHYWE

Learning objective

Students learn about the structure and function of a battery using a model of the Leclanché element.

Tasks

The students build a model of a Leclanché element and measure the voltage generated.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (3/3)

PHYWE

Further information

In the experiment carried out here, a redox reaction takes place:

$$Oxidation: Zn \longrightarrow Zn^{2+} + 2e^-$$

$$Reduction: 2MnO_2 + H_2O + 2e^- \longrightarrow MnO(OH) + 2OH^-$$

Alternative test possibility

In addition to using the voltmeter, the supplied motor can also be operated with the Leclanché element to indicate the applied voltage.

Safety instructions

PHYWE

- Wear protective goggles and gloves.
- For the H- and P-phrases please refer to the corresponding safety data sheets.
- The general instructions for safe experimentation in science lessons apply to this experiment.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

PHYWE

Student Information

Motivation

PHYWE

Model of a modern battery

Today's batteries are an indispensable part of everyday life. Almost everyone has to deal with them every day: in the remote control, the flashlight, the clock or even the kitchen scales.

The forerunner of today's battery is called the Leclanché element and was developed by Gerorges Leclanché around 1866. This rudimentary battery has a voltage of 1.5 V and can be replicated with little effort.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Tasks

PHYWE

1. Build the model of the Leclanché element.
2. Measure the voltage that is generated.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Equipment

Position	Material	Item No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Digital multimeter, 750V AC/DC, 10A AC/DC, 40MΩ, 100mF, 30 MHz, -20...1000°C, Auto range	07123-12	1
3	Connecting cord, 2 mm-plug, 5A, 500 mm, red	07356-01	1
4	Connecting cord, 2 mm-plug, 5A, 500 mm, blue	07356-04	1
5	Graphite electrode,d=5,l=150,6pc	44510-00	1
6	Set Strip electrode (Al, Fe, Pb, Zn, Cu)	07856-00	1
7	Reducing plug 4mm/2mm socket, 2	11620-27	2
8	Alligator clip, insulated, 2 mm socket, 2 pcs.	07275-00	1
9	Manganese-IV oxide,powder 500 g	30138-50	1
10	Ammonium chloride 250 g	30024-25	1
11	Starch,soluble 100 g	30227-10	1
12	Petri dish, d 100 mm	64705-00	1

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Structure and procedure (1/2)

PHYWE

- Clean the zinc and carbon electrodes used. Use lubricating gel paper for stubborn dirt.
- Prepare a saturated ammonium chloride solution.
  - The solubility of ammonium chloride in water is about 372 g/L. To 50 ml of ammonium chloride solution you add 19 g (exactly: 18.6 g) of ammonium chloride.
- To this ammonium chloride solution you now add manganese dioxide until you reach a silver colour.
- Now thicken this liquid with the starch until you get a thick paste (picture on the right).

Adding the starch creates a thick slurry.

Structure and procedure (2/2)

PHYWE

- Wrap the zinc electrode with cellulose paper. This prevents a short circuit later on.
- Leave a small piece free at the top where you can attach the alligator clip later.
- Now you put the prepared slurry into a petri dish.
- Now add the two electrodes (zinc and carbon).
- Make sure that the electrodes do not touch each other!
- Attach an alligator clip to each electrode, connect the electrodes to the voltmeter and measure the resulting voltage (picture on the right).

Experiment setup

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

PHYWE

Report

Task 1

PHYWE

What tension can you create with the model of the Leclanché element?

- ○ With the model of the Leclanché element no tension can be generated.
- ○ With the model of the Leclanché element a voltage of about 1.5 V can be generated.
- ○ With the model of the Leclanché element a voltage of about 4.5 V can be generated.
- ○ With the model of the Leclanché element a voltage of about 3 V can be generated.

Check

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 2

PHYWE

What type of reaction is this experiment?

- ○ There is no reaction in this experiment.
- ○ This experiment is a precipitation reaction.
- ○ This experiment is an acid-base reaction.
- ○ This experiment is a redox reaction.

Check

Task 3

PHYWE

Which of these statements are correct?

- ☐ None of the answers are correct.
- ☐ The starch in this experiment is that substance through which the flow of current is made possible.
- ☐ If this reaction is allowed to run for some time, a voltage drop can be measured.
- ☐ The starch in this experiment is used to thicken the liquid in which the electrodes are placed.

Check

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Slide	Score / Total
Slide 14: Voltage Leclanché element	0/1
Slide 15: Reaction type	0/1
Slide 16: Statement on the test	0/2

Total 0 / 4

Solutions Repeat

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de