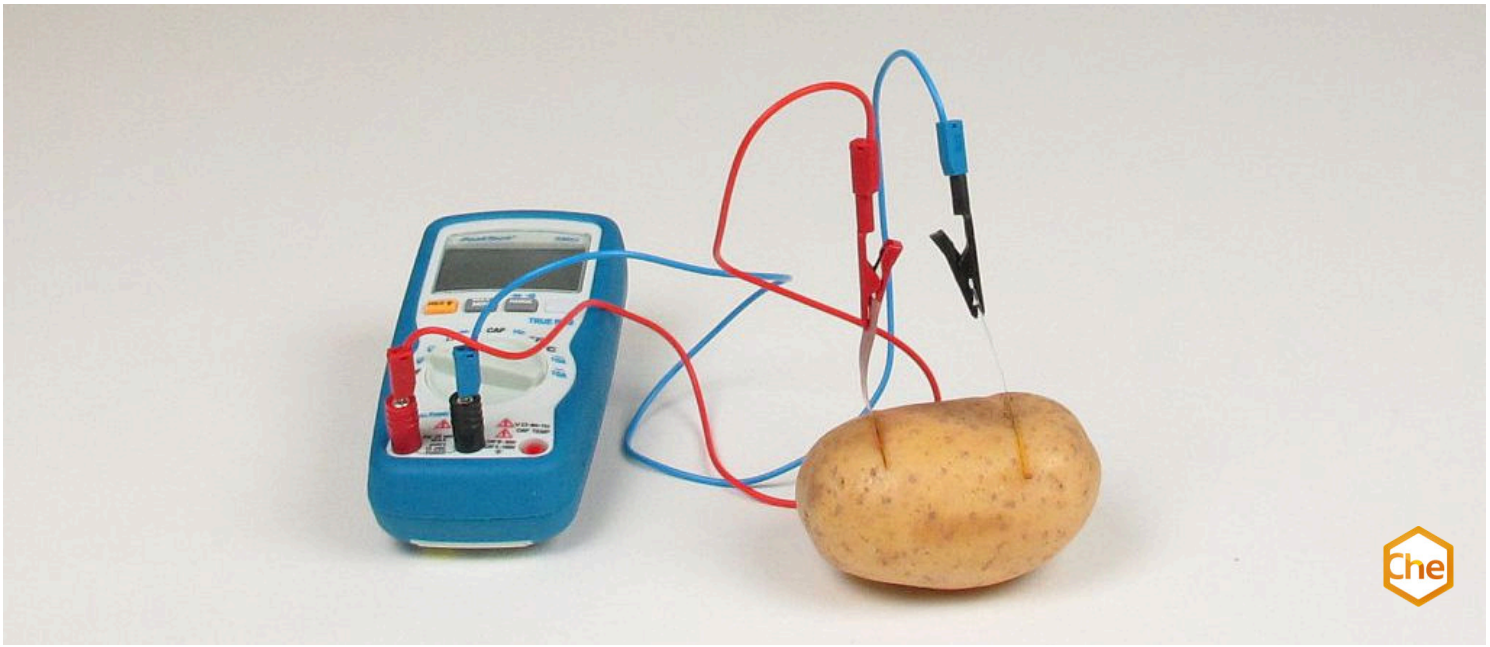
A remarkable source of electric current



The students gain an insight into the field of electrochemistry and learn the basics of how a battery is constructed.

Chemistry > Physical chemistry > Electrochemistry > Electrochemical measurement set

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/634994808ada380003588781

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Teacher information

Application

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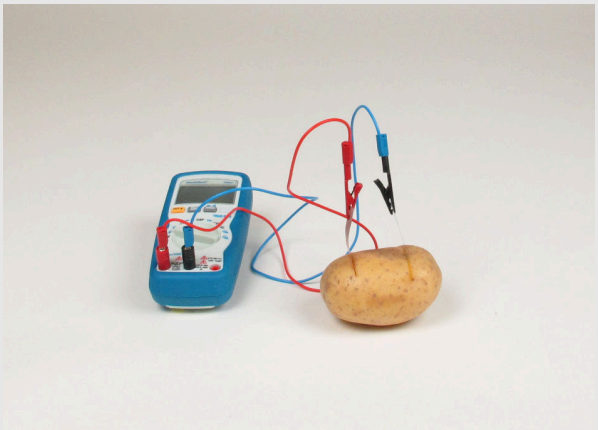

Experimental setup

The difference in the electrical standard potentials of different metals can be used to generate electrical voltage. Among other things, this makes the mobile power supply of a wide variety of electrical devices possible, which significantly shapes our current standard of living. The functioning of batteries is based on a unified principle - the difference in the standard electrical potentials of substances and elements. Thus, the voltage that a battery can generate is determined by the standard potentials of the materials used in it.

In this experiment, an electrical voltage is to be generated using a so-called "potato battery".

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Other teacher information (1/3)

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Prior knowledge

Students should already know how a galvanic cell works and how it is constructed. They should also know the basics of "voltage", such as the units and the measurement methods.

Principle

Two different metal electrodes, in this case made of zinc and copper, are inserted into a potato. It should be possible to measure a voltage of 1.11 V under optimal conditions. This results from the difference in the redox potentials of copper (Cu) und zinc (Zn). Due to the non-constant conditions, the measured voltage may deviate slightly.

Other teacher information (2/3)

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Learning objective

The students should gain an insight into the field of electrochemistry and learn the basics of the structure of a battery. They should also learn that the measured voltage results from the difference in the standard potentials of the different metals. This voltage can be calculated for different metals using the voltage series of metals.

Tasks

A galvanic cell is to be constructed from a potato and one zinc and one copper electrode. The voltage generated by this cell is to be measured and documented using a handheld multimeter.

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Safety instructions

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- During the experiment, all persons in the room must wear protective goggles!
- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student information

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Motivation

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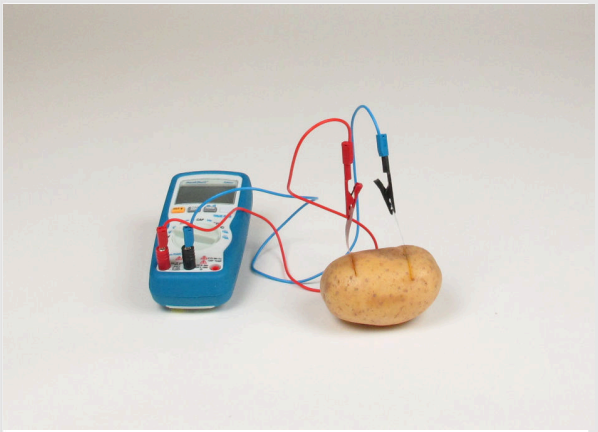

Experimental setup

Without batteries, today's modern world would be unimaginable, like without your smartphone. Have you ever wondered how a battery is made? To create a battery and thus electricity, you need two different substances that are conductively connected to each other. The functioning of batteries is based on a uniform principle - the difference of the electrical standard potentials of substances and elements. Thus, the voltage that a battery can generate is determined by the standard potentials of the materials used in it.

In this experiment, an electrical voltage is to be generated by means of a so-called "potato battery".

Tasks

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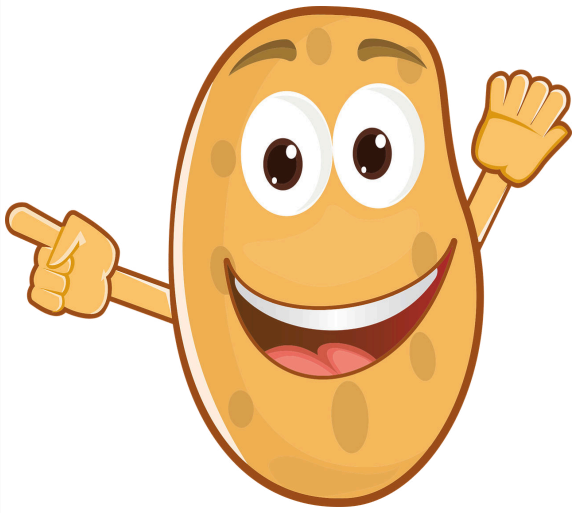

Build a galvanic cell from a potato and one zinc and one copper electrode. Measure the voltage generated with it using a hand-held multimeter.

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Equipment

Position	Material	Item No.	Quantity
1	Glass rod,boro 3.3,l=200mm, d=4mm	40485-02	1
2	PHYWE Digital multimeter, 600V AC/DC, 10A AC/DC, 20 MΩ, 200 µF, 20 kHz, −20°C…760°C	07122-00	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	Reducing plug 4mm/2mm socket, 2	11620-27	1
6	Alligator clip, insulated, 2 mm socket, 2 pcs.	07275-00	1
7	Set Strip electrode (Al, Fe, Pb, Zn, Cu)	07856-00	2
8	Emery paper, medium	01605-00	1

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Set-up

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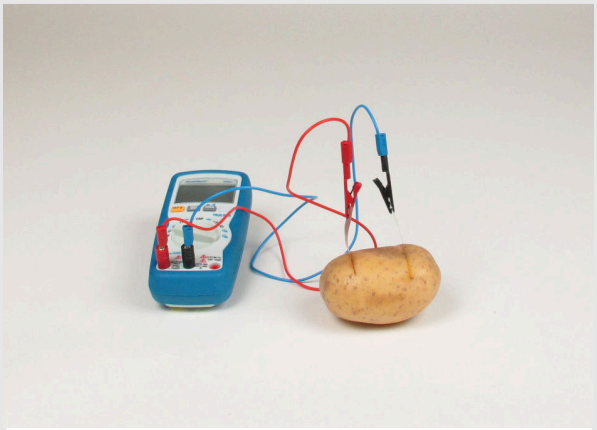
Cut a 15 mm x 40 mm electrode from each of the copper and zinc sheets.

If the copper has oxidised due to storage, use a piece of emery cloth to clean it.

Insert the electrodes about the same depth into the potato, a few centimetres apart.

Connect the electrodes with the alligator clips to the connecting leads and the leads in turn to the hand-held multimeter by means of reducing plugs. Connect blue=zinc to ground sign and red=copper to "V" in the meter.



Experimental setup

Procedure

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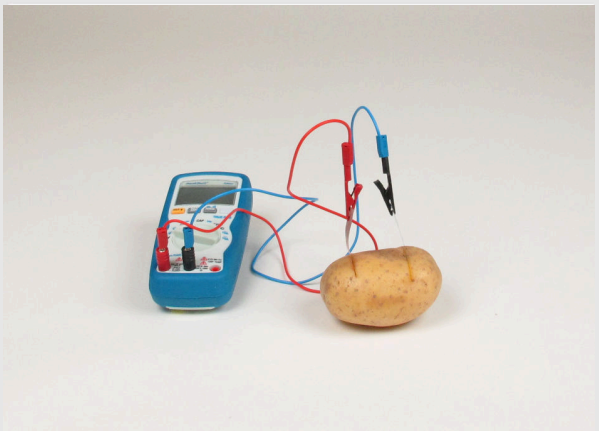
Before you switch on the meter, make sure that the wiring is correct (blue=zinc to ground sign and red=copper to "V" in the meter). If you are unsure, ask the teacher.

Now set the multimeter to voltage measurement and the measuring range to 2 volts.

Then switch on the multimeter and note the voltage displayed.



Measurement

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Report

Task 1

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Below are different voltages. Which one is closest to the voltage you wrote down?

- ○ Range 1: 1.11 V.
- ○ Range 4: 4.44 V.
- ○ Range 3: 3.33 V.
- ○ Range 2: 2.22 V.

Check

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Task 2

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How can any deviations from the literature value be explained if you are to calculate the standard potential of zinc on the basis of the measured results?

- [ ] Differences may appear depending on the purity of the metals used.
- [ ] If a large part of the acid present in the medium (here: potato) has already been consumed, less/no current can flow because the acid acts as an electrolyte. This can also influence the standard potential calculation.
- [ ] The potato is a natural product that can have different properties depending on the variety, origin, etc...

Check

Task 3

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What happens if you try to operate such a battery with two identical electrodes (e.g. copper)? What voltage would be measured? Why?

- ○ No voltage could be measured. The principle of the potato battery is based on the fact that the less noble of the two electrodes inserted dissolves, thus creating positive ions. The more noble metal thus becomes positive because electrons are withdrawn from it. This results in a different charge, which can be measured.
- ○ The measurable voltage would be much higher because both metals introduced are exactly the same. The electrons can therefore move back and forth between the electrodes much better, resulting in a higher voltage.

Check

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Slide	Score / Total
Slide 13: Potato tension	0/1
Slide 14: Standard potential	0/3
Slide 15: Two identical electrodes	0/1

Total 0 / 5

Solutions Repeat

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