

2. WE BUILD A VOLTA CELL (Who was Volta?) – a very simple experiment.

Short description:

Building a simple single Volta cell. The experiment provides an understanding of the role of electrolytes in the current flow process, introduces children to the construction of a cell, and develops the ability to connect a multimeter.

Materials:

materials from the box	materials to prepare
<ul style="list-style-type: none">⇒ copper nail/wire – 5 pcs;⇒ galvanised nail/wire – 5 pcs;⇒ multimeter (voltmeter scale) with wires – 1 pc;⇒ 3,8V light bulb - 1 pc;⇒ bulb holder – 1 pc;⇒ buzzer;⇒ demineralised (distilled) water 200 ml in a bottle – 1 pc;	<ul style="list-style-type: none">⇒ low glass jar, e.g. jam jar;⇒ table salt;



Course of the experiment:

- ☞ pour distilled water into the crystalliser;

- ☞ place the copper and galvanised nails/wires in the crystalliser so that they are not in contact;
- ☞ connect the meter with one end to the copper nail/wire and the other end to the galvanised nail/wire;
- ☞ read the result (NO INDICATION!!!) – the brave can try touching both nails/wires at the same time with their tongue to see if it pinches;
- ☞ disconnect the meter;
- ☞ pour some salt into the water, wait a while for it to dissolve; the brave can try touching both nails/wires at the same time with their tongue again – pinches?
- ☞ connect the meter again and read the results (they are here!!!)
- ☞ you can connect a bulb or a buzzer to the circuit and check the effect;

Substantive description:

A galvanic cell is a system consisting of two electrodes (in this case a copper nail/wire and a galvanised nail/wire) and an electrolyte (in this case a solution of NaCl, i.e. table salt dissolved in demineralised water). The electrolyte is a substance with free ions that ‘carry’ an electrical charge and it is a conductor of electricity. Demineralised water has no charge-carrying ions and therefore does not conduct electricity. Dissolved sodium chloride (table salt) dissociates in water into sodium cations (positive ions) Na^+ and chloride anions (negative ions) Cl^- . Due to the dissociation of salt, an oxidation reaction takes place on the galvanised surface, resulting in the formation of zinc and the release of free electrons. At the same time, a reduction reaction takes place on the copper surface - for this reaction to take place, the electrons from the galvanised electrode (those released in the oxidation reaction) move to the copper electrode. There, free electrons are attached and the chloride ion is neutralised. The system of these two reactions - reduction and oxidation - is called redox reactions. The directed, orderly movement of electrons (from zinc to copper and only in that direction) that occurs in redox reactions is the electric current. The current can flow, because there is an excess of electrons released at the zinc electrode and their deficiency at the copper electrode. This situation results in a potential difference at the electrodes, and this difference is the prerequisite for an electric current to flow.

The Volta cell model is based on physico-chemical laws that make it possible to force the orderly movement of electrons, i.e. to produce a current. The most important elements of the cell are the two electrodes and the electrolyte in which these electrodes are placed. The function of the electrolyte is to provide positive and negative electrical charges. This happens through the dissociation of the substance, usually salt solutions (NaCl – table salt) or acid solutions (Coca-Cola solution, citric acid [from lemon juice], vinegar [which is actually acetic acid]). The electrodes are

made of conductors with a high difference in normal potential. This allows electrons to move from the zinc to the copper substance.

Trivia:

- * The creator of one of the first galvanic cells was the Italian physicist Alessandro Giuseppe Antonio Anastasio Volta.
- * The unit of voltage was named the *volt* [V] in Volta's honour.
- * World Battery Day is celebrated on Volta's birthday, i.e. 18th February.

Intriguing questions:

- * Does the length of the nails/wires have any influence on the results of the experiment?
- * Can other objects be used instead of nails/wires?
- * Where do we use galvanic cells?

Modify the experiment:

- * Try replacing salt with lemon juice. Coca-Cola, pickled cucumber or vinegar.
- * See if the juice from pickled cucumbers or sauerkraut affects the outcome of the experiment.
- * Try changing the size of the electrodes.
- * Try using electrodes made of other materials.
- * Spróbuj zastąpić sól sokiem z cytryny, Coca-Colą, kiszonym ogórkiem lub octem.

Guidelines for trainers:

The experiment is perfectly safe. If the voltage on the meter is negative – connect the electrodes in reverse. If the buzzer does not work – try connecting in reverse. If, despite these measures, the voltage on the electrodes is zero or too low – it is likely that a deposit of insulating compounds has formed on the electrodes, which should be cleaned with sandpaper.