



## **Activity:** Exploring Volta's batteries

Primary level: 11-12 yrs old

### **Goal of experiment**

Fuel cells are essentially Volta-like piles, that use as current generating electrodes hydrogen and oxygen (or ethanol – air, etc) gases instead of metals. The goal of this series of experiments is to deepen knowledge on electrochemistry and Volta's piles.

Operative (skills) goal: read-out low voltages and current with a digital meter

Items needed for the experiment (per group):

1. multimeter with cables and "crocodile"
2. distilled water (  $\frac{1}{2}$  l), salt (NaCl)
3. iron nails, iron paper clip, pieces of kitchen aluminium foil, other pieces of metals that appear different from iron or copper, eurocent coins, flat zinc washers, circles of thick filter paper (coffee filter paper or paper towel) - both the washers and paper circles should be of similar size as eurocent coins
4. tea spoon, paper towels
5. some vegetables and fruits (cucumber, lemon, apple)

Instructions for experiments:

### **Part I – the fruit battery**

1. Set the multimeter for voltage readout, 2V range (or more)
2. Short cut the two wires of the voltmeter. Write down the readout, repeat twice.
3. Catch the coin and the nail by two crocodiles, shortcut the coin with the nail, read the voltage. Repeat twice, write down.
4. Insert partially a copper coin and an iron nail into your vegetable, measure the voltage.
5. Change the metals, change the distance between them when inserting into the vegetable, write down the voltages read.
6. What is the reason of the voltage that appears? What are the main factors (distance, the type of metal, the type of the vegetable) that influence the voltage read?

**Do not eat the fruit after the experiment – some of the toxic metals may have dissolved into the fruit!**



## **Part II – Voltaic pile**

1. Fill container with water and add as much salt as possible.
2. Soak the filter paper circles in the salt solution until they cannot soak up any more.
3. Place one eurocent coin on aluminum foil. Place one soaked paper circle on that coin and cover it with the zinc washer.
4. Using multimeter measure the DC voltage (at least 2V range) between the aluminum foil and the washer and DC current (using 2 mA range or more) flowing through the pile. Write down the value of measured current and the number of coins used.
5. Repeat the procedure adding another stack composed of a coin, a soaked paper circle and a zinc washer. This is a series connection. Each time measure the DC voltage and DC current and write down the results.
6. Is the DC voltage dependent on the number of coin used? Is the DC current dependent on the number of coin used?
7. Built similar second voltaic pile and place it on the aluminum foil next to the first one. Cover both piles with second aluminum sheet. This is a parallel connection. Measure the DC voltage and DC current between aluminum foils. Write down the results.
8. Is the DC voltage dependent on the number of piles used? Is the DC current dependent on the number of piles used?
9. If possible try to build a similar voltaic piles using different coins than one eurocent. Check how it affects the voltage and the current.



## Exploring Volta's batteries - worksheet

Name \_\_\_\_\_

Hypothesis:

1. Is it important to insert metals into fruits in order to get a measurable voltage difference between them? Can we get the same voltage difference without fruits?

2. Is it important to soak the filter paper in salty water for Voltic pile? Can the clean water give the same results?

Observations:

1. What is a correlation between the number of coins in Voltaic pile and the values of DC voltage and DC current.

2. What is a correlation between the number of Voltaic piles covered with the same aluminum sheets and the values of DC voltage and DC current.

Conclusions:

1. How can we increase the voltage produced by the battery?

2. How can we increase the current produced by the battery?

3. What applications would such batteries be useful for?