

LEMON BATTERY FOR THE SQUEEZER



The Squeezer is of course already very green by completely "squeezing" empty batteries. But a green alternative can also be chosen for the batteries: Lemons! A little warning in advance: This is something for the experimenters among us!

A normal battery is made up of two different metals (the electrodes) and an electrolyte. The electrolyte is based on an acid. (You may have heard of battery acid?!)

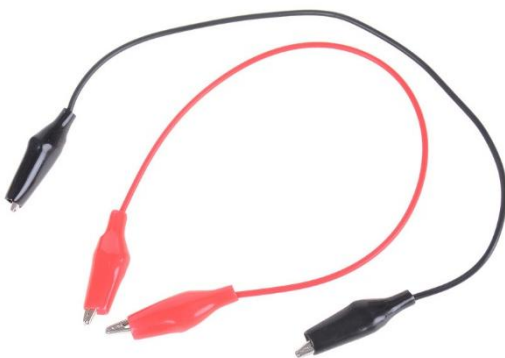
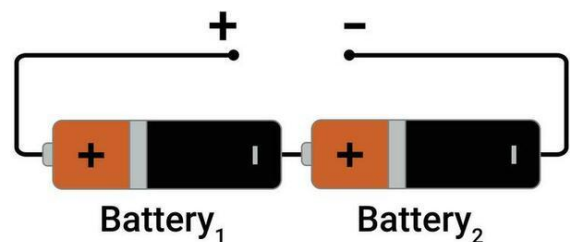
In our experimental battery, we are going to use the juice of the lemon as the acid. For the electrodes we use a piece of copper and a piece of zinc.

A piece of copper water pipe can be used for the copper, or a piece of printed circuit board material with copper.

For the zinc you can use some sheet material (e.g. for gutters) or (with a bit of luck) a galvanized nail.

The simplest battery can be made by inserting the electrodes directly into the lemon. Don't forget to sand the materials clean with steel wool, then they will conduct better. Such a battery is fine to use to run a digital clock (you probably have to connect two lemons in series). The positive pole of the battery is the copper electrode, the negative pole is the zinc electrode. If you connect the batteries in series, you connect the positive pole of one battery to the negative pole of the other. You connect the two free electrodes to the clock.

Series Connection



To make the connections, you can conveniently use cords with crocodile clips.

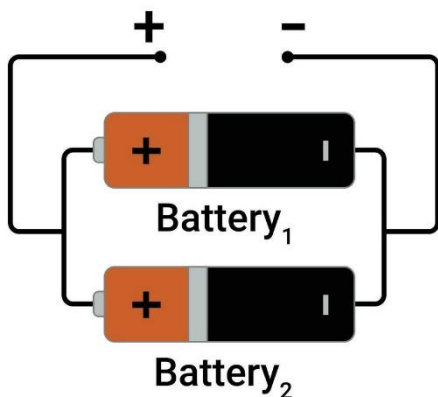
For the Squeezer it is not necessary to connect lemons in series, the voltage of 1 lemon is already sufficient. But: It is not possible to get the Squeezer to burn on the battery described above, so the electrodes directly in the lemon.

The reason is that the internal resistance is too high, what this means is described at the end of this document.

For the Squeezer, you will have to squeeze the lemon, put the juice in a (non-metal!) cup and put the electrodes in the juice. When you have enough juice and the electrodes are large enough, the Squeezer may already be able to burn on 1 juice battery. But you may also have to connect several juice batteries in parallel.

Batteries, and therefore also juice batteries, are connected in parallel by connecting all positive poles (copper) and all negative poles (zinc).

Parallel Connection



Because the voltage of the battery is quite low, it is best to connect the juice batteries connected in parallel to the contacts of the battery in the squeezer.

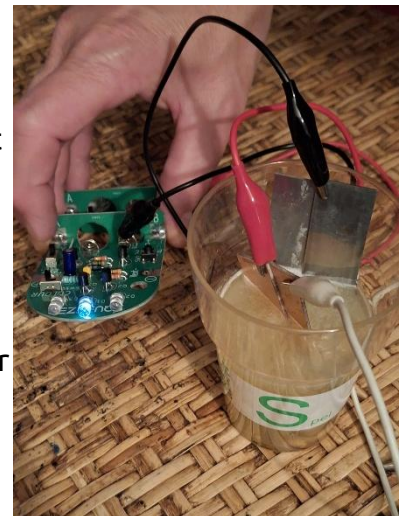
You can connect the negative pole to the spring contact (where the battery is otherwise attached). You can connect the positive pole to the piece of circuit board where the tip of the battery would otherwise make contact.

If you do choose to connect juice batteries in series, connect the wires to Vext+ and Vext- of the Squeezer.

Something else like lemons?

The juice of lemons is very acidic and therefore perfectly suitable for this experiment. But there are other liquids that are suitable, you can also use, for example, (cleaning) vinegar or cola.

By the way, you can also make a battery with a sour apple, but the internal resistance will be too high. This will therefore be perfectly suitable for a digital clock, but not for the Squeezer.



Internal resistance

The maximum amount of current that can be supplied by a battery depends on the internal resistance. This resistance causes the voltage of the battery to drop if too much current is drawn from the battery. This also heats up the battery.

You can see it this way, that the electrons from the electrolyte that move through the battery, experience a certain resistance when they are on their way to the battery electrodes (and thus the connections). This resistance increases as the path becomes more difficult. The flesh of the lemon (or apple) gets in the way. For this reason, the liquid juice works better.

By putting batteries in parallel, the overall resistance is lower. Compare it to a narrow road (1 battery), or a multi-lane highway (batteries parallel), many more cars (electrons) can be used on the highway at the same time.

Have fun experimenting!

