



Curiosity Guide #310

Electric Batteries

Accompanies Curious Crew, Season 3, Episode 10 (#310)

5-Cent Battery

Investigation #1

Description

Make your own working battery from a handful of pennies!

Materials

- 5 or more pennies made after 1982
- 100-grit sandpaper
- Corrugated cardboard, boxboard, or matboard.
- Red, high-intensity LED light. You may choose to have other colors on hand to try.
- Electrical tape
- Voltmeter
- Scissors
- Paper towel
- Cup of water
- Vinegar
- Salt
- Spoon
- Ruler

Procedure

- 1) Set one penny aside.
- 2) Using the sandpaper, sand the "tails" side of the other four pennies. Sliding the penny on the sandpaper may be easier than rubbing the sandpaper on the penny.

- 3) Sand each of the four pennies until the shiny zinc is exposed under the copper coating.
- 4) Fill a cup half full of water.
- 5) Stir salt into the water until the salt stops dissolving.
- 6) Add a teaspoon of vinegar to the salt mixture.
- 7) Measure and cut four $\frac{1}{2}$ -inch squares from the cardboard.
- 8) Trace the penny you set aside on each of the squares. Cut the cardboard circles out.
- 9) Soak the cardboard circles in the cup of salt-and-vinegar water for one minute.
- 10) Remove the cardboard circles with a spoon. Lay the circles on a dry paper towel. The circles should be used when still damp.
- 11) Lay one of the sanded pennies with its copper side down on the table.
- 12) Place a piece of soaked cardboard circle on the sanded zinc side.
- 13) Continue to stack the pennies and cardboards, alternating a zinc-side-up penny with a soaked cardboard circle.
- 14) Place the penny that you set aside, the one with no sanding, on the top of the pile.
- 15) Notice that the LED light has a long wire and a short wire. Place the long wire on the top of the un-sanded penny. Place the shorter wire touching the bottom penny.
- 16) Be sure that the wires touch only the two ends of the stack of pennies.
- 17) Did your light turn on?
- 18) You can even wrap the whole thing with electrical tape to keep the light lit.

More to try: Can you increase the height of your stack to power a blue LED light? You may be interested in trying other colors of LED lights, too. You can also test the voltage of your battery with a voltmeter.

My Results

Explanation

Batteries are used to change chemical energy into electrical energy through a redistribution of electrons between different metals and a solution. Every battery has three components: an electrolyte and two types of electrodes-- an anode, and a cathode.

The electrolyte is a liquid or gel-like substance that connects the two different metals, providing a path for electrons to move from one metal to the next and creating a chemical reaction. The anode and cathode each connect to an opposite end of the battery. At these points of contact, there is a chemical reaction. The anode loses electrons and the cathode receives them. Because the two metals have different voltages, the electrons move from the concentrated negative terminal, or anode, toward the lower concentrated positive terminal, or cathode. Placing a device that requires electrons, like an LED, between the anode and the cathode makes the light turn on.

In this case, post-1982 pennies are made of zinc and are copper-plated. Exposing the underlying zinc on four of the five pennies results in a zinc electrode on one side of the penny and copper electrode on the other. The vinegar-soaked cardboard acts as the electrolyte to carry the free electrons. Each sandwich pair is considered one cell of the battery. Stacking the cells make a series, also known as a Voltaic Pile. Alessandro Volta developed the very first battery in 1798 when he stacked a pile of metal discs, each separated by cards that had been saturated with salt water. Volta noted that the stack produced a current of electricity when the zinc released electrons to copper. Measuring with a voltmeter shows that each cell will produce .6 volts, and this stack of four cells is more than enough to power an LED, which requires about 1.7 volts. Although the cardboard will dry out, this battery could last all day!

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