Curiosity Guide #310
Electric Batteries

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

Voltaic Pile

Investigation #3

Description

You can make a battery like Alessandro Volta did in 1798!

Materials

- 16 discs from a zinc electrical junction box, purchased from a hardware store
- 16 copper pennies
- Sheet of thick cardstock or cardboard
- Cup
- Vinegar
- Clay
- 4 wooden skewers
- Two alligator clip cables
- LED light
- Voltmeter
- Hammer
- Nail set
- Needle-nosed pliers
- Scissors
- Spoon
- Paper towel
- Small motor

Procedure

1) Use the nail set and hammer to punch out the zinc circles from the electrical junction box. Use the pliers to twist the circles out without bending them.
2) Use one disc as a tracer. Trace 16 circles on the cardboard. Cut the circles out. Set them aside.
3) Fill a cup half full with vinegar.
4) Soak the cardboard circles in the vinegar until the circles are saturated.
5) Remove the circles from the vinegar. Set the circles aside on a paper towel.
6) Place a large lump of clay on the table. Shape the clay so it forms a base larger than a zinc circle.
7) Begin to stack layers of zinc circle, wet cardboard, and a penny on top of each other on top of the clay base. Repeat this series until you have stacked all the zinc, cardboard, and pennies.
8) The stack should end with a penny on top.
9) Pierce the four skewers into the clay so that the skewers stand up vertically and hold the pile of zinc, cardboard, and pennies in place.
10) Clip the alligator clip around one of the top skewers so that the metal of the clip is pressing against the top penny.
11) Clip the second alligator clip on the bottom under the zinc base in the same way.
12) Connect the two clip wires to a voltmeter, attaching the positive wire to the copper side, and the negative wire to the zinc side.
13) Is there voltage?
14) Disconnect the voltmeter. Replace the voltmeter with an LED light, with the longer wire going to the positive copper end of the stack of pennies.
15) Can you get the LED light to light up?

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 electrodes—an anode and a cathode.

A chemical reaction happens when two different metals are connected by an electrolyte, which provides a path for electrons to move from one metal to the next. At the point of contact with the electrodes, a chemical reaction occurs, where 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 the anode, toward the lower concentrated positive terminal, the cathode. Placing a device that requires electrons between the negative and positive electrodes powers the device. For example, an LED light will turn on.

In this case, the zinc electrode sends electrons to the copper electrode through the soaked cardboard electrolyte. Each sandwich pair is considered one cell. The stacked cells make a series, or 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 Voltaic Pile produced a current of electricity when the zinc released electrons to copper. Measuring with a voltmeter will show that electrical potential difference is enough to power an LED, which only requires about 1.7 volts. As the cardboard dries, the electricity will stop flowing, and the light will turn off.

Think about this! Batteries surround us every day. Batteries surely make our lives more enjoyable, but have you ever wondered how batteries work? Batteries are used to change chemical energy into electrical energy. Each battery has three parts: an anode, an electrolyte, and a cathode. The anode is usually a metal like zinc that chemically reacts in substances and loses some of its electrons. Those electrons travel freely through an electrolyte solution to the cathode. That movement of electrons is electricity! The more electrons we can move, the more powerful our batteries can be. How energizing!

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