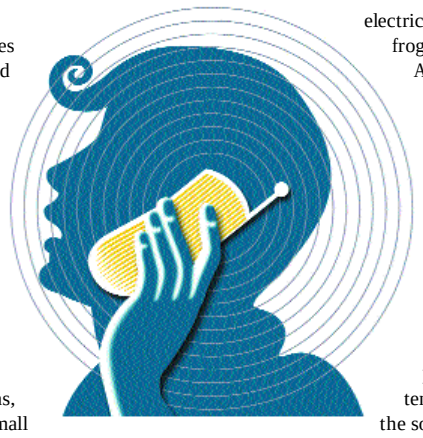
POWERING YOUR CELL PHONE:

Where the Battery Came From and How It Works

Introduction
Students learn about principles behind the electric battery and its history.



Age Group
Activities are appropriate for any age group, depending on the depth of the technical explanations. The audience here is middle school.

Materials

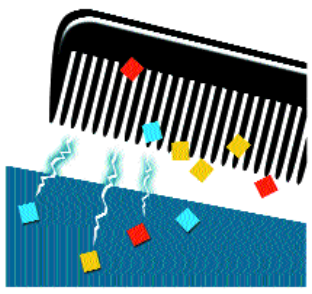
Activity 1: Not necessary, but augment with balloons, plastic hair combs, and small shreds of paper confetti.

Activity 2: Piece of copper wire, piece of zinc wire, voltage meter or small (e.g., flashlight) light bulb with two leads (all available from a hardware store; or a zinc nail and a copper nail, and attach regular wire to each); fruit (citrus fruits like oranges work well; bananas are also fun).

Activity 3: Small bowl, vinegar; Per student: 19 1" x 1" strips of paper towel, 10 copper coins (old copper pennies or else copper blanks), 10 zinc coins (dimes will work but use any non-copper coins or blanks).

Discussion
Ask the students how they get the electricity to power a cell phone that doesn't plug into the wall? Why, a battery of course! But do they know how a battery works? And did they know that the battery is over 200 years old?

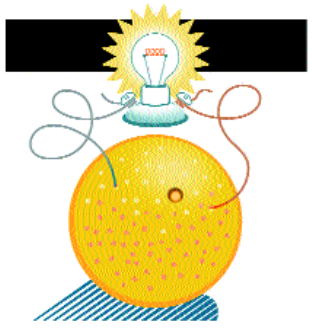
Activity 1: Prior to the 1800s, scientists only knew about static electricity.



Have students rub their feet (in socks or leather shoes—no rubber sneakers!) against a thick carpet. Now have them touch a metal object or their friend's nose. A spark jumps across. Alternatively, rub a balloon on your hair, and stick it to a wall. Or run a comb through your hair, and hold it over small pieces of confetti and show the students how they jump up to the comb. Point out that these effects are all caused by static electricity.

The energy of the rubbing caused electrons—small particles that surround the atoms of which your body and everything in the world is made—to build up in one place. This electric charge can then jump to a place that has a shortage of electricity. However, the jump can only occur once. So, while scientists since ancient Greek times were very interested in studying electricity, they could not apply it in useful ways. The electron was finally discovered in 1897 and named from the Greek word for amber. Amber, a natural resin, was what the Greeks used to produce static electricity by rubbing it with a cloth.

Activity 2: In 1786, Italian scientist Luigi Galvani noticed that a dissected frog's leg would twitch if touched with two dissimilar metals such as copper and zinc. He realized the motion was caused by an electric spark, but thought the electricity was produced by the frog's muscle. His student, Alessandro Volta, proved that instead the electricity was caused by a chemical reaction when two dissimilar metals are placed in any salty solution. He was able to create a "Voltaic Cell" by placing cardboard soaked in a salty solution between a plate of zinc and a plate of copper. Because of the different properties of the metals, one tends to give up electrons in the solution, and one tends to collect them. Volta realized that his cell did not produce just a spark but a continuous flow of electricity, known as a current.

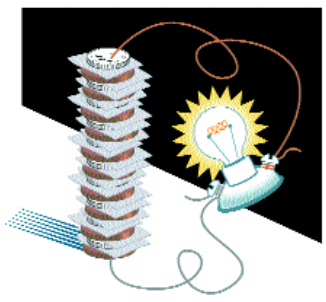


Connect a copper wire to one lead of a voltmeter (or light bulb) and a zinc wire to the other. Place the ends of the copper and zinc wire into a fruit, such as an orange. Point out to the students that there is a voltage proved by the deflection of the voltmeter or having the bulb light up.

Now try other fruit. Observe how different fruits produce different voltages (or different brightness of the light bulb). The chemical properties of the different fruit juices cause them to react with the metals to varying degrees.

Activity 3: Volta realized that he could not get very much current from his cell. But, if he stacked up a number of these cells into what came to be called a "Voltaic Pile," the electrical effect was cumulative. This pile was also called a "battery," from the military term meaning several pieces of artillery lined up and used together. This was the basis of all our modern batteries.

This next activity can be performed as a demonstration or better by an individual or small groups of students.



Place vinegar in a bowl and soak strips of paper towel. Make a pile of coins, alternating 10 pennies and 10 dimes with a strip of the soaked paper between each. Connect the two ends to the voltmeter or light bulb. How much electricity is there now? If the students moisten one fingertip on each hand and hold the pile of coins between those two fingers, they should be able to feel a slight electric shock.

Note: Thank you to IEEE's History Center for this activity. Students can learn more about Galvani, Volta, their discoveries, and inventions—and the engineers and inventions that came after them—at the IEEE Virtual Museum: http://www.ieee.org/museum.