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Topic: Batteries
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A battery does work to move charges

A good illustration of the concepts of electric potential and potential difference is the way in which a battery powers an electrical apparatus, such as a flashlight, a motor, or a clock. A battery is an energy-storage device that provides a constant potential difference between two locations, called *terminals*, inside the battery.

Recall that the reference point for determining the electric potential at a location is arbitrary. For example, consider a typical 1.5 V alkaline battery. This type of battery maintains a potential difference across its terminals such that the positive terminal has an electric potential that is 1.5 V higher than the electric potential of the negative terminal. If we designate that the negative terminal of the battery is at zero potential, the positive terminal would have a potential of 1.5 V. We could just as correctly choose the potential of the negative terminal to be –0.75 V and the positive terminal to be +0.75 V.

Inside a battery, a chemical reaction produces electrons (negative charges) that collect on the negative terminal of the battery. Negative charges move inside the battery from the positive terminal to the negative terminal, through a potential difference of $\Delta V = -1.5$ V. The chemical reaction inside the battery does work on—that is, provides energy to—the charges when moving them from the positive terminal to the negative terminal. This transit increases the magnitude of the electrical potential energy associated with the charges. The result of this motion is that every coulomb of charge that leaves the positive terminal of the battery is associated with a total of 1.5 J of electrical potential energy.

Now, consider the movement of electrons in an electrical device that is connected to a battery. As 1 C of charge moves through the device toward the positive terminal of the battery, the charge gives up its 1.5 J of electrical energy to the device. When the charge reaches the positive terminal, the charge's electrical potential energy is again zero. Electrons must travel to the positive terminal for the chemical reaction in a battery to occur. For this reason, a battery can be unused for a period of time and still have power available.

Quick Lab

A Voltaic Pile

MATERIALS LIST

- **salt**
- **water**
- **paper towel**
- **pennies**
- **nickels**
- **voltmeter (1 V range)**

Dissolve as much salt as possible in the water. Soak the paper towel in the salt water and then tear it into small circles that are slightly bigger than a nickel. Make a stack alternating one penny, a piece of paper towel and then one nickel. Repeat this stack by placing the second penny on top of the first nickel. Measure the voltage between the first penny and the last nickel by placing the leads of the voltmeter at each end of the stack. Be sure to have your voltmeter on the lowest dc voltage setting. Try stacking additional layers of penny–paper towel–nickel, and measure the voltage again. What happens if you replace the nickels or pennies with dimes or quarters?