SN IN HIGH SCHOOLS
January 21, 2017
Charging the Future

Student Guide: Building the Best Battery

You can make a simple battery using a beaker or clear plastic cup partially filled with a liquid electrolyte, and with two different types of metal electrodes partially immersed in the electrolyte but not touching. You can connect the battery to a multimeter to measure voltage, or even to light a lightbulb. You can choose the electrode types, electrolyte composition, electrode spacing and other design details to optimize your results. Listen to your teacher for more specific instructions for your class.

1. Fill the beaker at least halfway with water. What is the approximate volume of water as shown on the beaker (or measure the amount of water with a graduated cylinder)?
2. Weigh out a small amount of salt between 1 and 2 grams and record the value. Stir it into the water in the beaker until it is fully dissolved. How much salt did you add?
3. Use sandpaper or steel wool to clean the electrodes before your experiment. Note how each electrode material looks before and after cleaning.
4. Using the chart below, write down the theoretically predicted voltage for each pair of electrodes using a standard reduction potential table (provided by your teacher). Note that the table is for standard cell conditions which are defined as 25 degrees Celsius, 1 atm for any gas participating in the reaction, and 1 M concentration for each ion participating in the reaction. Then put the pair of electrodes in the beaker (not touching each other) and use the multimeter to record the actual voltage between the electrodes. How much does that differ (in %) from your theoretical prediction? Make sure the distance between the electrodes remains approximately the same among all trials.

Electrode 1	Electrode 2	Theoretical voltage	Measured voltage	% difference
Copper	Copper			
Copper	Zinc			
Copper	Iron			
Copper	Aluminum			
Zinc	Zinc			
Zinc	Iron			
Zinc	Aluminum			
Iron	Iron			
Iron	Aluminum			
Aluminum	Aluminum			

5. What factors could account for differences between your measured voltages and the theoretically predicted voltages?

6. Closely observe the surfaces of the electrodes after you remove them from the electrolyte. What do you see? What caused what you see? After your experiments, be sure to dry the electrodes and then clean them with sandpaper or steel wool.

7. Can you improve the performance by adjusting the spacing between electrodes? Record your results.

8. Can you improve the performance by using a different electrolyte? Try larger or smaller amounts of salt, different mixtures of water and vinegar ranging from pure water to pure vinegar, etc. Refer to your teacher for more specific instructions. Record your results.

9. Can you light a lightbulb with your battery? If one battery cannot produce enough voltage, you can connect two or more batteries in series (the positive terminal of one battery to the negative terminal of the next battery). Record what setup works best.

10. Summarize your results. What conditions were optimal for creating a battery that produced the highest voltage?

11. Reflect on your experimental quest for making the best battery. What did you enjoy about it? What made it difficult? After reading “Charging the future,” how do you think your experience compares to the challenges battery scientists face?