Energy and Society Electricity and Magnetism **Grade 11 – Going Off Grid**

Creating a Saltwater Battery (Teacher)

Most household (and camp) batteries are "dry" batteries and made up of rare elements that must be mined from the earth, however, in pairs, we can demonstrate the same chemical energy storage principles by creating a "wet" battery.

Group Materials:

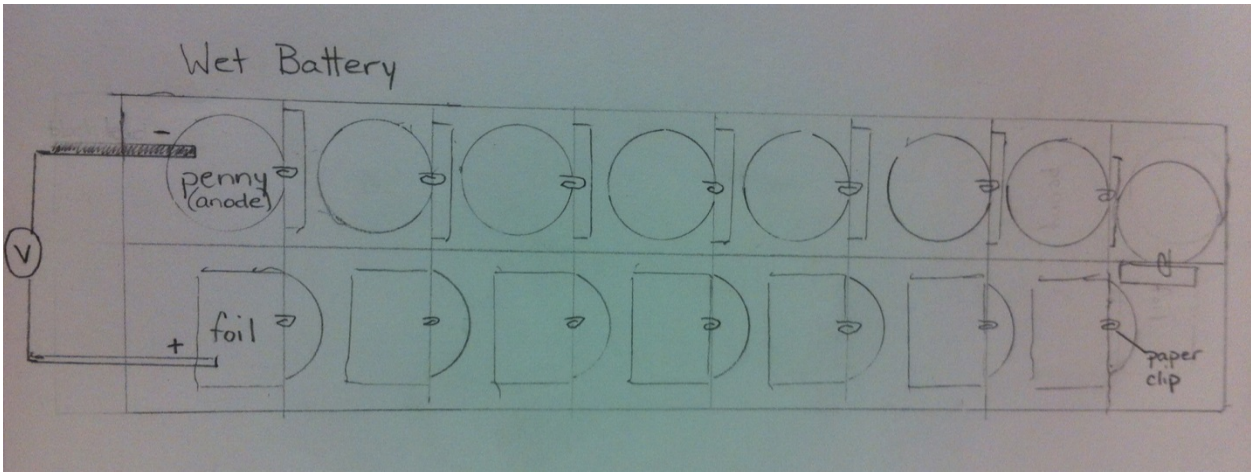
- Ice cube tray
- 2 cups of water
- 2 tablespoons of salt
- 15 Canadian pennies, pre-1997 (these contain approximately 98% copper, which is the anode)
- 30 cm^2 of Aluminum foil (~98% aluminum, which is the cathode)
- Solar LCD calculator with solar panel removed (try the Dollar Store)
- 15 paper clips
- Multimeter
- Tape
- An empty container or basin for underneath the ice cube tray

Instructions:

1. Fill a container with 2 cups of water and 2 tablespoons of salt.
2. Tape the pennies into the ice cube tray, one penny per cube. Place them such that they are taped to the divider between cubes (the side of the cube) and the tape is looped under the penny in the tray (instead of overtop).
3. Fold up small pieces of aluminum foil (around 2 cm squared) and tape them, similarly, into the cubes on the other side of the dividers.
4. Connect the anode and the cathode with a bent paper clip.
5. Pour saltwater into each cell of the ice cube tray. Make sure each metal is covered, but do not fill the cube to the top.
6. Measure the voltage of the battery using the voltage setting of the multimeter. Put the black lead into the anode side, and the red lead into the cathode side.
7. Now, attach the calculator and see if the battery can power it.

Discussion Questions

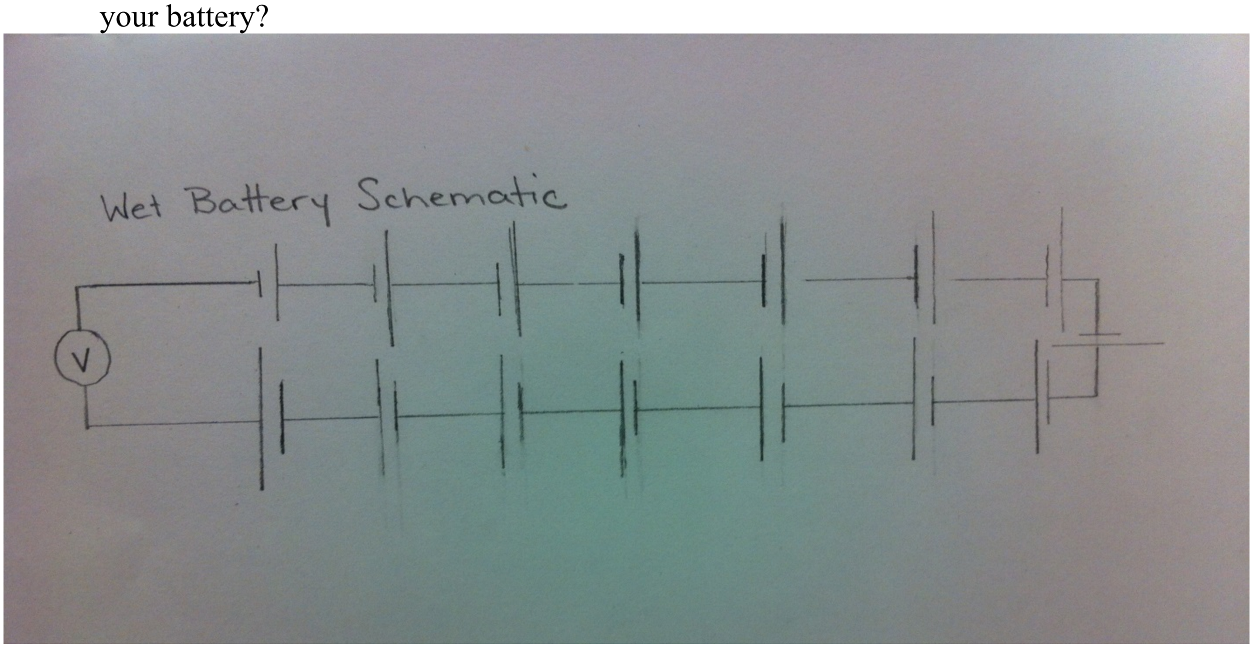
1. Draw a diagram of your "wet battery"; label the anode(s) and the cathode(s).



2. How do you think your battery works to create an electric potential difference?

If you put two dissimilar (differently charged) metals into the electrolyte, the positive ions will migrate towards one metal and the negative ions will migrate towards the other metal. If a good conductor connects the metals, a current will flow through the conductor. There is a potential difference between the two dissimilar metals (Copper and Aluminum), and a current passes through the electrolyte (saltwater) to the penny, through the paper clip conductor, to the foil, and back to the electrolyte.

3. Draw a schematic of how the cells in your battery are connected. What is the voltage of your battery?



Voltage will vary depending on set-up.

4. Try measuring the voltage for just one cell, then two cells, etc. Plot the Voltage versus Number of cells. Use a ruler and label each axis. Based on this graph, how many cells would you need to power the calculator?

   Graph should be linear in theory. The teacher may ask why voltages per cell may vary (depending on quality of connections, different sized foil, pennies of different age, concentration of salt in each cell, etc.). Calculators will also have different voltage requirements.

5. Based on the graph, are the cells connected in series or parallel? How do you know?

   The cells are connected in series – the graph should be close to linear since, in a series circuit, voltages are additive.

Activity adapted from https://www.clarkson.edu/highschool/k12/project/documents/energysystems/LP_3fuelcell.pdf.