Electrochemistry

Goals

- ✓ Assemble and run a salt water battery
- ✓ Maximize the generated electric current
- ✓ Make calculations based on data

Background

Electrochemistry is a branch of scientific study that has been around for hundreds of years. Almost as soon as experiments with electricity were developed, it was recognized that there were chemical processes that could produce an electric current.

Now we know that electrochemistry is involved in your own brain, and that the thoughts, feelings, and memories you have would not be possible without a near-constant movement of electrically charged ions in and around the cells of your brain.

Electrochemistry is closely related to redox reactions. All electrochemical reactions involve two electrodes: an anode and a cathode. The anode is defined as the electrode where oxidation occurs and the cathode is the electrode where the reduction takes place. So the anode is negatively charged and the cathode is positive.

In our battery, the anode is made of magnesium, while the cathode is actually the air around it, so the overall reaction is:

$2Mg + O_2 + H_2O \rightarrow Mg(OH)_2$

Between the two electrodes is an electrolytic solution of salt water. Can we change the electrical output of the battery simply by changing the solution?

During this activity, you will use different solutions of salt in water determine the effects on the battery's electric current.

Procedure

1. Get salt water solution from your teacher and put it in the graduated cylinder. Make sure to get at least 25mL. And be careful, it's hot!
2. Using the syringe, transfer 15mL of the salt water solution into the bottom of your battery.
3. Snap the blue top of the battery onto the white bottom.
4. Attach one red wire to two red plugs on the left and right sides of the battery at the back.
5. Connect the wires from the motor to the red and black plugs nearest to them on the front of the frame.
6. Connect the loose wires from the battery to the other plugs on the front of the frame.
7. Use the stopwatch to time how long your car takes to complete the track. Repeat and record your results in the table below.
8. When you're finished with the salt water battery, rinse the top and bottom with distilled water.

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Observations

Data Table

Trial	Time (sec):	Observations:
1		
2		
3		

Experimentation

1. Run your battery like you did in the Procedure section, but this time measure out different volumes of salt water to see what happens to the motor. Record your observations below.

Volume (mL):	Time (sec):	Observations:
5		
7		
10		
12		
15		
18		

2. How can you maximize the amount of electric current generated by your battery? Using the volume that worked best in the previous experiment, work with your group to think of ways that you can make the motor move faster by generating more electricity. Change the characteristics you think might have an effect and record your observations below:

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Trial:	Time (sec)	Observations:
1		
2		
3		
4		
5		
6		
7		
8		

Some examples of things students could try: different concentrations of salt water, different solution temperatures, different wires, different air temperatures, different air humidity.

Measurement

For this section, you will need a multimeter or the Horizon Renewable Energy Monitor. For an introduction to using a multimeter, click here.

1. Raise the front wheels off the ground and measure the current in Amps and the voltage in Volts while running the battery with different volumes of salt water. Record your answers below:

Volume (mL):	Current (A):	Voltage (V):
5		
7		
10		
12		
15		
18		

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2. Voltage is equal to the current multiplied by the resistance (V = IR), so according to your data what is the resistance of the fan motor?

Resistance: _____ Ω

3. Construct an explanation of what you observed as you tested salt water solutions of different volumes.

Analysis

1. Make a scientific claim about what you observed while running your battery.

2. What evidence do you have to back up your scientific claim?

3. What reasoning did you use to support your claim?

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4. Design an experiment that would determine the effect of the size of the anode on the performance of the battery. Describe your experiment below:

Conclusions

1. Based on your observations, what is the relationship between the volume of the salt water solution and the amount of electricity generated by the battery?

2. What other factors did you identify that affected the output of the battery?

3. Based on your experiments, what would be the best possible conditions for maximizing the electrical output of the battery?