Electrochemistry in Action: Building A Battery Challenge

Lab Safety 101: You should NEVER smell or eat/drink anything in a Lab because it can be very dangerous. For this lab we are working with electrical currents so make sure you follow all directions and ask your teacher if you have any questions.

Important Vocabulary:

Anode: _____

Cathode: _____

Ions: _____

Which type of atom(s) makes a good cathode or good anode?

Anode	**Cathode**

Electrolyte:_____

Separator:_____

Answer the following questions while watching the Video: How do Lithium-ion Batteries Work?

1. Why does lithium prefer to give up its outermost electron at the anode?

2. Discuss the importance of the electrolyte in allowing lithium ions to migrate between the anode and cathode of a lithium-ion battery while preventing the flow of electrons.

3. What happens to lithium ions during the battery charging process?

4. Why do electrons flow from the anode (negative) side to the cathode (positive) side instead of staying on the negative side?

5. What happens if the cathode and the anode accidentally touch?

Materials:

Voltmeter	Iron Nails	Aluminum Nails
Galvanized (Zinc) Nails	Copper Nails	Alligator Clips
Periodic Table of Elements	Potato or Yam	Lemon or Lime
Gatorade or Powerade	Apple or Orange	Warm Water
Paper Towels-optional	Cups to hold liquid	1 tablespoon Salt

Procedure:

1) Make sure you have all of your materials before you start the experiment. Completely read this procedure and make sure to ask if you have any questions after reading it.
2) Roll the lemon gently on a table to soften it without breaking the skin. This will help release the juice inside, improving conductivity.
3) Insert the Electrodes by iInserting the copper nail into the lemon about 1 inch deep. Then Insert the zinc nail into the lemon about 1-2 inches away from the copper nail. Make sure the nails do not touch each other inside the lemon.
4) Connect the Voltmeter by attaching the positive (red) probe of the voltmeter to the copper nail. Then attach the negative (black) probe of the voltmeter to the zinc nail.
5) Measure the Voltage by turning on the voltmeter and set it to measure DC voltage (if not already set).
6) Observe the reading on the voltmeter. It should show a small voltage, typically around 0.3 to 1 volt. Record the voltage on your data table.
7) Repeat steps 3-6 with the zinc nail and iron nail.
8) Repeat steps 3-6 with the aluminum and copper nail.
9) Repeat steps 3-6 with the aluminum and iron nail.
10) After finishing the experiment with the lemon, complete the experiment (steps 3-9) with each of the following electrolytes: apple, yam, gatorade, water, salt water.

Data Table I - LEMON:

Cathode	Anode	Voltage Trial 1	Voltage Trial 2	oltage Trial 3	Average
Zinc (Zn)	**Copper (Cu)**				
Zinc (Zn)	**Iron (Fe)**				
Aluminum (Al)	**Copper (Cu)**				
Aluminum (Al)	**Iron (Fe)**				

Data Table II - APPLE:

Cathode	Anode	Voltage Trial 1	Voltage Trial 2	Voltage Trial 3	Average
Zinc (Zn)	Copper (Cu)				
Zinc (Zn)	Iron (Fe)				
Aluminum (Al)	Copper (Cu)				
Aluminum (Al)	Iron (Fe)				

Data Table III - POTATO:

Cathode	Anode	Voltage Trial 1	Voltage Trial 2	Voltage Trial 3	Average
Zinc (Zn)	Copper (Cu)				
Zinc (Zn)	Iron (Fe)				
Aluminum (Al)	Copper (Cu)				
Aluminum (Al)	Iron (Fe)				

Data Table IV - BANANA:

Cathode	Anode	Voltage Trial 1	Voltage Trial 2	Voltage Trial 3	Average

Zinc (Zn)	**Copper (Cu)**				
Zinc (Zn)	**Iron (Fe)**				
Aluminum (Al)	**Copper (Cu)**				
Aluminum (Al)	**Iron (Fe)**				

Data Table V- WARM WATER:

Cathode	**Anode**	**Voltage Trial 1**	**Voltage Trial 2**	**Voltage Trial 3**	**Average**
Zinc (Zn)	**Copper (Cu)**				
Zinc (Zn)	**Iron (Fe)**				
Aluminum (Al)	**Copper (Cu)**				
Aluminum (Al)	**Iron (Fe)**				

Data Table VI: WARM SALT WATER

Cathode	**Anode**	**Voltage Trial 1**	**Voltage Trial 2**	**Voltage Trial 3**	**Average**
Zinc (Zn)	**Copper (Cu)**				

Zinc (Zn)	**Iron (Fe)**				
Aluminum (Al)	**Copper (Cu)**				
Aluminum (Al)	**Iron (Fe)**				

Data Table VII: GATORADE

Cathode	**Anode**	**Voltage Trial 1**	**Voltage Trial 2**	**Voltage Trial 3**	**Average**
Zinc (Zn)	**Copper (Cu)**				
Zinc (Zn)	**Iron (Fe)**				
Aluminum (Al)	**Copper (Cu)**				
Aluminum (Al)	**Iron (Fe)**				

Answer the following questions.

1) Which cathode gave you the highest voltage between Zinc and Aluminum? _____

2) Which anode gave you the highest voltage between Copper and Iron? _____

3) What are the characteristics of an atom that would make a good anode?

4) What are the characteristics of an atom that would make a good cathode?

5) What is the function of the anode in a battery?

6) What is the function of the cathode in a battery?

7) How does the electrolyte facilitate the movement of lithium ions within the battery?

8) Label the batteries with each of your vocabulary words and draw lines to indicate which direction the electrons are flowing.

