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Stem Chem 3*
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Proof of Efficacy Doc

1. View of Voltaic Cells | Negative Terminal | Positive Terminal

(Copper, Felt, Zinc)

(Zinc)

(Copper)

2. For our design, we set out to create a battery. This battery consisted of separate voltaic cells that were then combined to form a tall stack of cells. The cell was a combination of copper, felt, and zinc sheets in that specific order. Each individual layer had its own special purpose; the copper served as a cathode, the zinc served as an anode, and the felt was soaked in salt water to serve as the necessary electrolyte. We duplicated this 3 part cell a total of 15 times to form our completed battery. When we connected our battery up to our circuit, the stored potential energy within the battery is converted into electrical energy. Our original plan was to power a hand-held fan, but ended up lighting an LED instead. This produced light energy.

3. Our final project had progressed a great deal from our original design. We still began by creating a voltaic cell. However it looked much different. Rather than using felt as out electrolyte, we incorporated cardboard. This proved to be a failure because regardless of how much we soaked the cardboard, its electrolyte capacity was too low. There is a minimum amount of electrolyte density necessary to conduct enough electricity between each terminal that it simply could not meet. Felt was our next reasonable electrolyte idea because it was able to hold more electrolytes, reaching the amount necessary to conduct our electricity.

4. Technical Specifications:

a. Energy Sources

i. **Chemical Energy:** Chemical energy is defined as the potential of a chemical substance to undergo a transformation through a chemical reaction to transform other chemical substances. In the case of our project, the battery stored potential energy energy within its zinc and copper plates. Two reactions release this potential energy. Starting with the anode, an oxidation reaction occurs, forming the equation: $Zn_{(s)} \rightarrow Zn^{2+}{}_{(aq)} + 2e^{-}$. Next, a reduction reaction occurs at the cathode, forming the question $Cu^{2+}{}_{(aq)} + 2e^{-} \rightarrow Cu_{(s)}$. The combination of these two reactions is what allows the flow of energy throughout the battery.

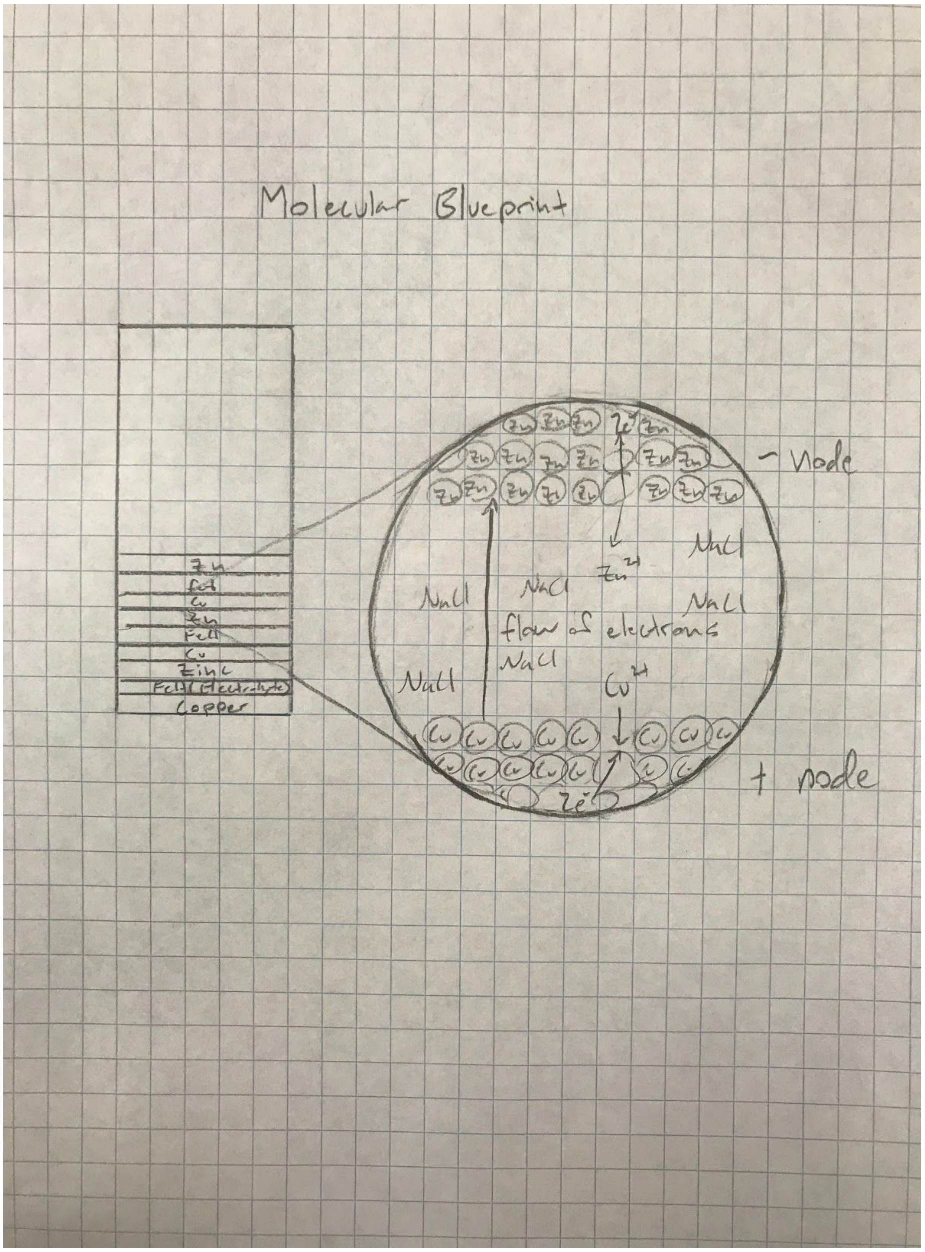
ii. **Electrical Energy:** Electrical energy is defined as an electric charge that lets work be accomplished. Our specific electrical energy is produced by harnessing the reactions from within the battery. When we attached the battery up to a circuit, electrons travel from the anode to the cathode. The electricity flowing through the circuit can be used as a power source to power things such as handheld fans or LEDs.

iii. **Light Energy:** Light Energy is defined as how nature moves energy at an extremely rapid rate, and how it makes up about 99% of the body's atoms and cells, and signal all body parts to carry out their respective tasks. In the case of our project, light energy is produced by an LED. The battery generates electrical energy, which is then gathered and utilized by the LED to produce the light. Electroluminescence is the process occuring where light emitting diodes are creating light. The process happens when an electron enters the LED that came from a power source, like our battery. The electron that entered then recombines with an electron hole in a semiconductor, which releases a photon. Depending on the frequency of the released photon, various colors of light are displayed. To be even more specific, the frequency of the photon depends upon the energy level of the photon. This is determined by how much energy is required for the electron to cross the band cap in the semiconductor, so varying semiconductors will vary colors.

b. Energy Output Data:

Trial	Design	Issues	Changed	Voltage	Amperage
T1	A voltaic cell comprised of 3x3cm copper, 3x3cm cardboard dipped in saltwater, 3x3cm zinc	Did not conduct electricity	First design not applicable	0	0
T2	Voltaic cell comprised of copper, felt soaked in saltwater, zinc	Provided minimal energy	Switched cardboard to felt to achieve higher density of electrolytes. Was able to conduct electricity	~0	~0
T3	Stacked 4 sets of 4 voltaic cells into a larger voltaic pile.	Connections between each sub pile were poor	Increased power output	3.7 V	56 mA
T4	Made one big voltaic pile of all 16 voltaic cells	Low amperage	Removed connections between sub piles to increase efficiency	4.1 V	58 mA
T5	Added more salt to electrolyte solution	Still low amperage	Salt levels in electrolyte solution	4.5 V	58 mA
T6	Added more wire connections to each terminal of the battery	No noticeable change in amperage	Tried to allow more flow of electrons to increase amperage	4.5 V	59 mA
Final	16 voltaic cells as described in Trial 2 stacked in series into 1 voltaic pile	Low amperage	Remained with 1 wire instead of multiple	4.5 V	57 mA

c. Molecular Blueprint:



5. Main Selling Points:

<u>PROS:</u>

- Successfully generated and circulated electrical
- All materials can be acquired easily for cheap
- Capable of producing reasonably high voltage
- Can light an LED among select other functions
- Somewhat professional appearance

CONS:

- Large compared to store bought batteries
- Heavy compared to store bought batteries
- Produced a low amperage
- Due to electrolyte evaporation, very short lifespan

-Extra Reflection:

If I were to redo this project, I would focus on producing more current. A lack of current was what made it impossible for us to power the hand-held fan. To do this, I would experiment with things such as a parallel circuit. I would however stay with our main idea, maintaining originality compared to things such as lemon batteries.