Which Battery Lasts Longest?

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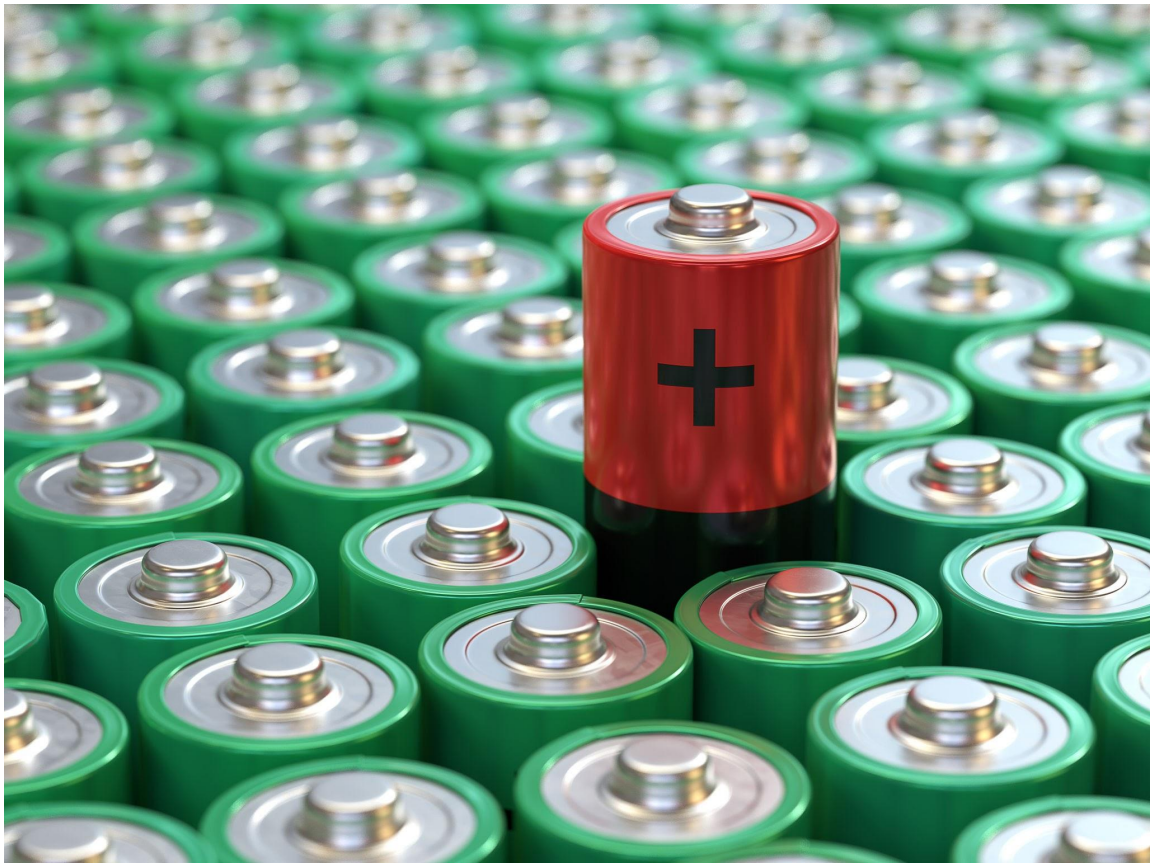


Purpose

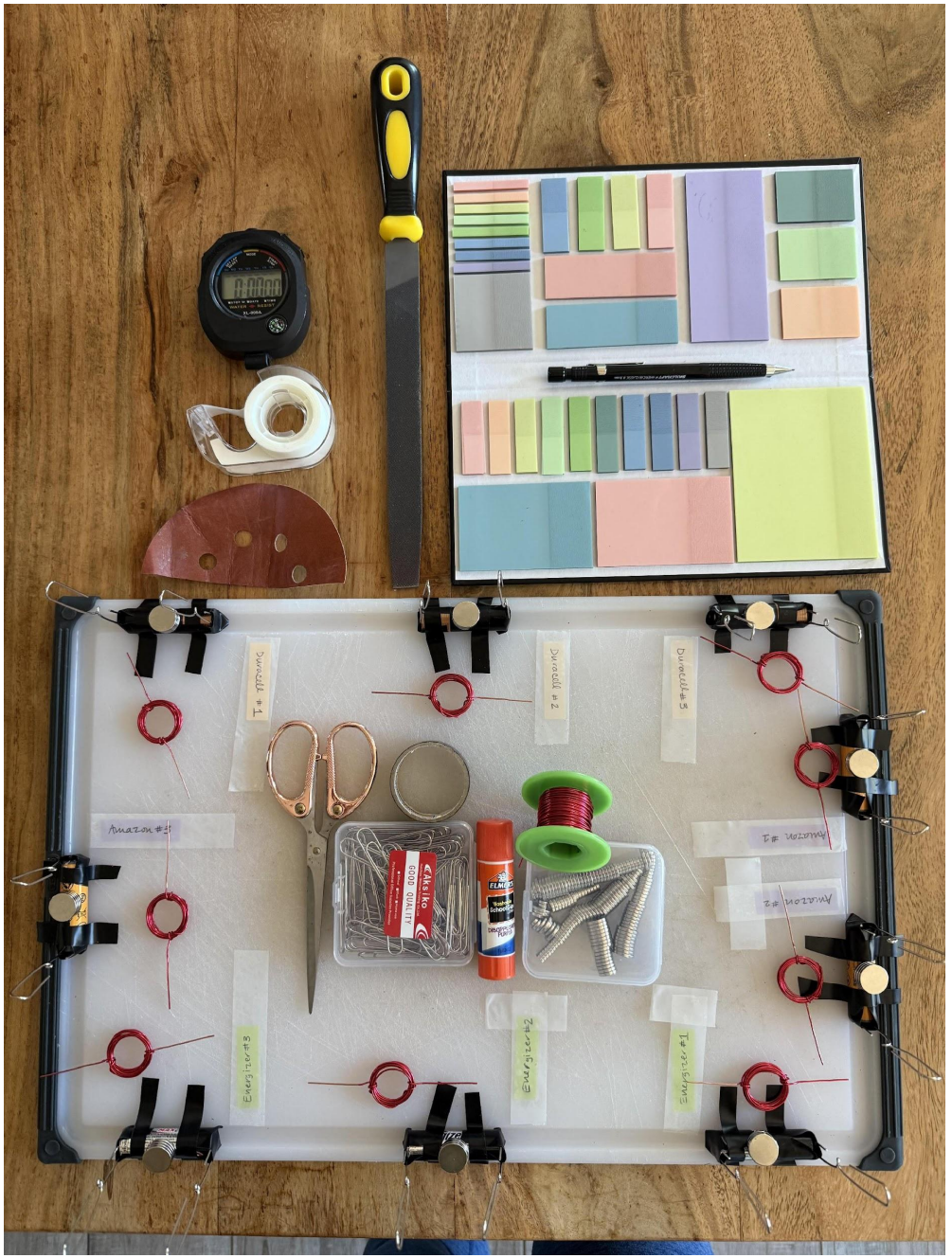
To power toys and appliances, the average household goes through lots of AA batteries. The characteristics of what is powered drives how long the battery will last, but this projects explores powering wire homopolar motors to test the variability of battery life for three types of alkaline battery.

Hypothesis

I think the branded batteries (2 and 3) will last the longest because they are made with higher quality materials and are designed to hold power for a long time. The non-branded batteries (1) will probably be the weakest and run out of power faster because they are cheaper and not made as well. This means that the type of battery will affect how long it can keep something working.

Materials

- 2 branded batteries
- 1 non branded battery
- insulated copper wire
- neodymium magnets
- cylindrical object
- electrical tape
- stopwatch
- sandpaper
- paperclips
- metal file
- scissors
- pencil



Procedure

Step 1: Craft wire motors from insulated wire. Wrap wire 10 times around a standard cylindrical object like a glue stick. Wrap the ends tightly around the sides of the coils to keep wires together. Sand insulation off one end arm completely and only the top half of the other side when coil is upright.

Step 2: Bend paperclip such that there is a loop at the center for the motor arms to fit into. Attach the ends of the paperclips using electrical tape to both sides of each battery.

Step 3: Test the symmetry of each motor by spinning it in your fingers to make sure you don't need a lot of torque to spin it. Make small bending adjustments to improve motor symmetry. Make some extras so that if charring or imbalance occurs during operation before a battery is dead, we can change out the motor and keep going.

Step 4: Place each motor into its stand, kickstart its spinning motion, and note the time it started spinning on its own.

Step 5: If a motor stops, note the time it stops. Check the motor for balance and charring, making bending adjustments or sanding off charred spots as able. Reinsert the motor or insert a new balanced motor. If the motor starts spinning, note the new start time.

Step 6: After all batteries are drained, subtract all start times from corresponding end times and add them together to get total motor spin-time for each battery.

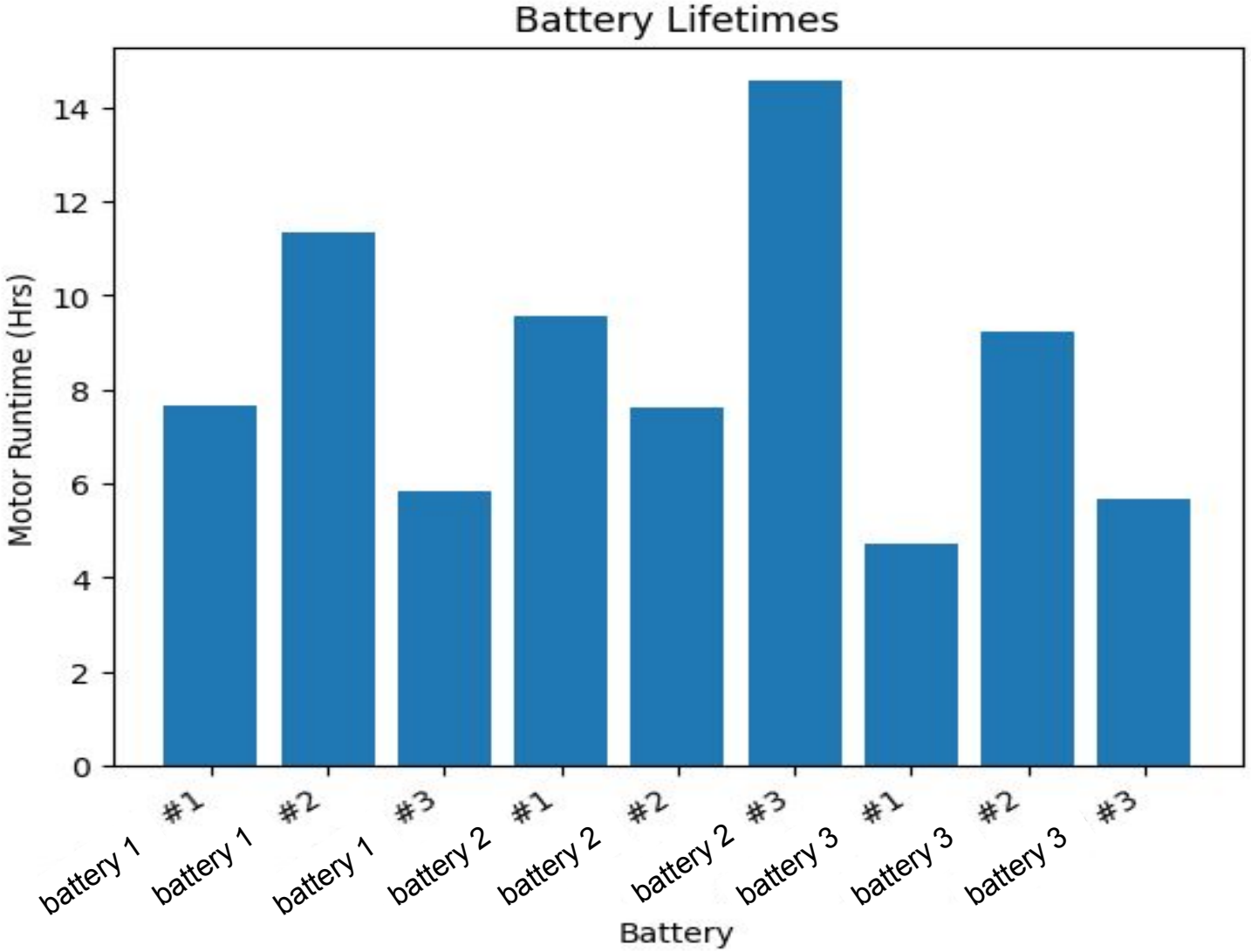
Variables

Independent Variable: The battery types.

Dependent Variable: The time the battery was spinning the motors.

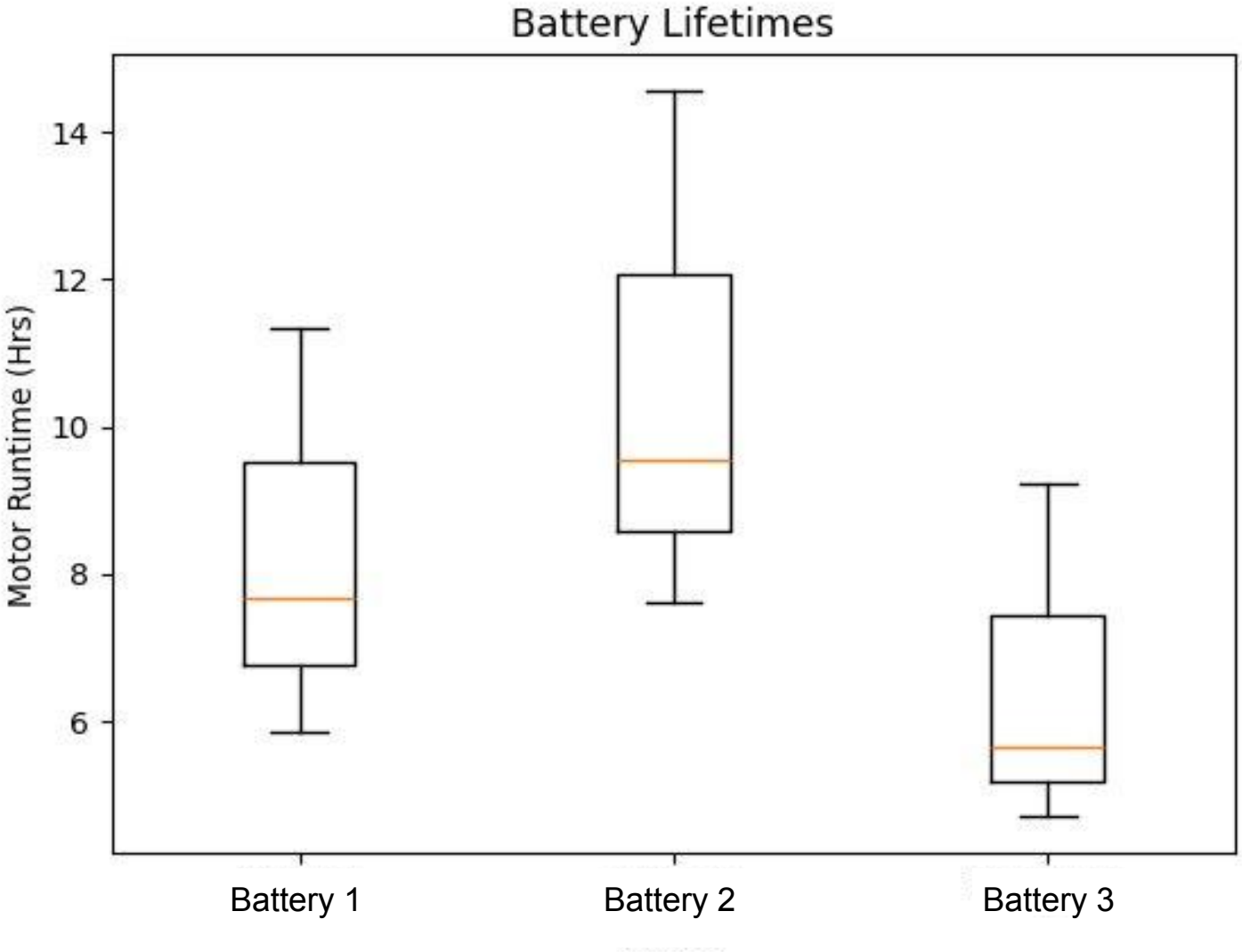
Controlled variable: The time of day, test environment, motor type, and motor characteristics.

Data and Results



The bar graph shows the battery lifetimes for every data point. The longest lasting battery powered a motor for just over 14 hours, while the shortest powered a motor for just over 5 hours, showing a large range in lifetime.

Data and Results



The orange line in the box-and-whisker plot to the left shows the average for each set of batteries, and whiskers extend to the maximum and minimum values for each.

Data and Results

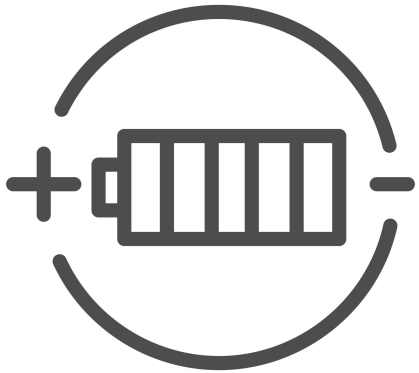
	Battery Brand	Cost per Battery (Dollars)	Mean Battery Life (Hrs)	Cost per Hour (Dollars)
0	Battery 1	0.27	8.29	0.03
1	Battery 2	0.78	10.57	0.07
2	Battery 3	1.5	6.53	0.23

The final table above shows the cost per battery type and the summary average mean battery life for each type. The final cost per hour for each battery type comes from dividing the cost per battery by the mean battery life.

Conclusion

On average, Battery 2 (branded) lasted the longest, followed by Battery 1 (non-branded). Battery 3 (branded) had the shortest average battery life. My hypothesis was partially correct because a branded battery did last the longest, but the non-branded battery did not come in last.

When looking at the cost of the batteries, this experiment showed that the non-branded battery gave the best bang for your buck, at least for devices like the homopolar wire motors we tested. For other devices, like a favorite toy, the experiment would need to be repeated to see which battery works best. Overall, this experiment helped our family decide that Battery 1 (non-branded) is the best choice to buy for everyday use.



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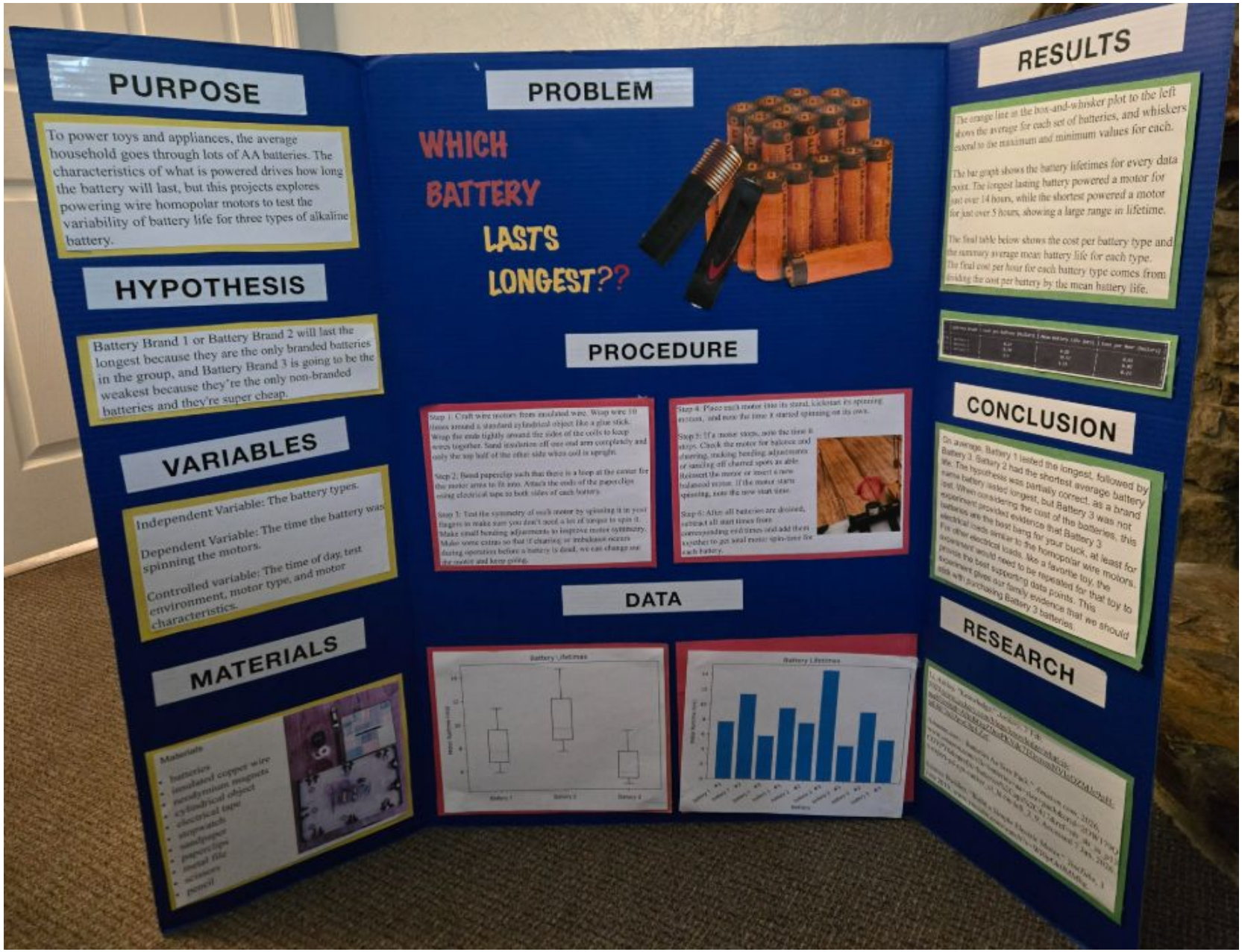
Final Project