Science Fair Logbook - Saif Shariff-Ramji

January 7, 2024

* Talked to my Masi in Atlanta about ideas and brainstormed ideas
* Decided I want to do a fruit battery experiment

January 8, 2024

* Sent proposal to Mrs. Ghosh
* Ordered a voltmeter on amazon

January 9, 2024

* Voltmeter arrived from amazon ‘
* Tested the voltmeter using a better (1.5V battery); it was correct

January 11, 2024

* Mrs Ghosh replied saying to add an element to my experiment

February 1, 2024

* Copper and iron plates arrived by amazon

February 4, 2024

* Bought potatoes from Superstore

February 5, 2024

* Mrs Ghosh approved my experimental design

February 6, 2024

* Tested potatoes and apples with the voltmeter and light bulb
* Weighed 6 potatoes that all weighed close to 200 grams
* Put 1 potato in the freezer, 1 in the fridge, 1 on the deck outside; 3 on the counter

February 7, 2024

* Complete one trial experiment

February 17, 2024

* Complete second trial

February 19

* Complete third trial

Experimental Design

Complete each section below. Be specific and detailed.

The Big Question: How does temperature affect the voltage of a fruit or vegetable battery (electrochemical cell)?

Independent/Manipulated Variable: Temperature of the fruit or vegetable.

Dependent/Responding Variable: Voltage

Controlled Variables (for each controlled variable listed, tell how you are going to control it):

1. Type of fruit or vegetable - I will only use potatoes.
2. Size of fruit or vegetable - I will use potatoes of the same weight. I will weigh each potato individually and use the potatoes that are most similar in weight.
3. The metals used to build the battery - I will use the same kind of metals to make the battery for each potato.
4. Voltmeter - I will use the same voltmeter to measure the voltage.
5. Time - I will measure the voltmeter for the same amount of time for each potato
6. Distance between copper and zinc - I will use a ruler to measure the distance between them which should be the same for each potato
7. Depth of the copper and zinc - measure a line on each so that they go in the same depth on each potato.

Proposed steps in your experiment (if you included a step by step in your big question proposal, you can copy and paste):

1. Take 6 same weight potatoes
2. Put one potato in the fridge overnight
3. Put one potato in the freezer overnight
4. Put one potato on the front patio
5. Take one potato and put it into boiling water for 4 minutes
6. Take one potato and put it into boiling water for 8 minutes
7. Take one potato and leave it at room temperature
8. Make a mark on each potato where the copper and zinc strips will go. Use a ruler to make sure the slits on each potato are the same distance apart. The copper and zinc need to be spaced the same distance apart on each potato.
9. Place a copper strip and a zinc strip into each slit in each potato. Insert them to the same depth in each potato (for example, 2 cm apart and 3 cm deep. The exact distances you pick may depend on the size of your potatoes).
10. Use a thermometer to take the temperature of each potato before starting the voltmeter
11. Set the voltmeter dial to measure in the 2 V range.
    * Plug the red multimeter probe into the port labeled VΩmA.
    * Plug the black multimeter probe into the port labeled COM.
    * connect the black probe to the copper electrode.
    * connect the red probe to the zinc electrode.
    * Record the voltage in my logbook
12. Repeat this 3 times

**Hypothesis**

When the potato gets hotter it will produce more electricity and will have a higher voltage.

|  |  |  |  |
| --- | --- | --- | --- |
| Temperature | Weight (g) | Voltage (20V setting) | Date |
| Outside   * -6 | 210 | .02  1.55  1.57  .32  1.57  .18  .33  .22  .10  1.58  1.58 | February 7, 2024 |
| Fridge   * 5C * 5C | 195 | 1.60  1.4  1.58  1.57  After 1 minute  1.55 | February 7 |
| freezer   * Could not get a good reading * Put the thermometer in the freezer * -20 | 215 | .68  1.56  1.40  1.5  1.57  1.58  1.56 | February 7, 2024 |
| Room temperature   * 20C | 195 | Held for 10 seconds  1.62  1.61  0.07  1.59  1.58  After 1 minute  1.54 | February 7, 2024 |
| 4 min boil   * 23C | 195 | 1.50  1.48  1.47  1.46  After 1 minute  1.44 |  |
| 1 min micro   * 60C |  | 2.00  1.40  1.41  1.42  1.41  1.36 |  |
| 8 min boil   * 55C | 205 | 1.38  1.37 |  |
| Room temperature  22C | 245 | .913  .911  .908  .905 | Feb 17, 2024 |
| Two Min Microwave  72C | 245 | .838 |  |
| 20C - room temperature | 75 | .923 |  |
| 70C - 1 min micro | 110 | .853 |  |
| Apple - from the fridge  7C |  | .938  .941 |  |
| Room temperature | Cut white potato into 4 | 1.0 | February 18 |
| Room temperature | ¼ piece | .763 | February 18 |
| Boiled  · 60C | Cut white potato into 4 | 1.8 | February 18 |
| Boiled  · 60C | 2 small ruby potatoes in series | 1.773 | February 18 |
| Regular battery |  | 1.689 | Feb 18 |
| Boiled  · 60C | 2 small ruby potatoes in series | 1.553 | Feb 18 |
| Room Temperature  · 22C | 1 baby red potato | .903 | Feb 18 |
| Boiled  · 60C | 1 baby red potato | .713 | Feb 18 |
| Red potato 22 | 190 | .88 | Feb 21 |
| Room temperature  · 22 | Red potato  190 | .88 | Feb 21 |
| Room temperature  · 22 | Two Red potatoes in series  185 | 1.51 | Feb 21 |
| 10min boil  · 60C | Red Potato  190 | .767 | Feb 21 |
| 8 min boil  · 54C | Red Potato | 1.615 | Feb 21 |
| Boiled and room | 2 boiled and 1 room temperature Red potatoes in series | 1.8 | Feb 21 |
| Boiled | 1 Red potato | .9 | Feb 21 |
| Boiled and room | 4 Red potatoes (2 boiled and 2 room) | 1.9    Clock worked | Feb 21 |
| Boiled | 2 Red in series | 1.55    Clock worked | Feb 21 |
| Boiled and room | 2 Red boiled and 1 room in series | 1.55    Clock worked | Feb 21 |
| Boiled  · 69C | One red | .75  Clock did not work | Feb 21 |
| Room Temperature  · 26C | One red | .683 | Feb 21 |
| Room Temperature  · 26 | One red | .62 | Feb 21 |
| Room temperature | Two red in series | 1.31 | Feb 21 |
| Room  20C | Red 100 | .88  .87  .875 | Feb 25 |
| Room Temperature | 150 | .895  .895 | Feb 25 |
| Room Temperature | 100 | .909 | Feb 25 |
| Room temperature | 2 potatoes in series | 1.75 | Feb 25 |
| Boiled | Baby red | .881 | Feb 25 |
| Boiled | 100 | .806 | Feb 25 |
| Boiled | 150 | .797 | Feb 25 |

* Couldn’t get the copper and zinc into the frozen potato and couldn’t get an accurate temperature of the frozen potato
* Were measuring at 20V and should have done 2V as that was too high; changed to 2V
* voltage went less for the potatoes that went in the Microwave; I made holes in those potatoes and maybe the acid in the potato escaped or evaporated
* In the test on February 21st, I found that if I measured the voltage after about 20 minutes of the copper and nickel sitting in the potato, the voltage was higher.
* I took the voltage of an apple and regulatory battery to just to see their readings
* I tried 3 types potatoes to see if the reading changed