

Oct 4 (2025)

Main aim: Can every day food (Lemon, Potato and Apple) be used to make a simple battery and which food will produce the highest voltage and usage current.

Variables:

Independent Variables (something you change)

- Potato
- Lemon
- Apple

Dependant Variables (stays the same)

- Open circuit voltage
- Current
- Voltage decay

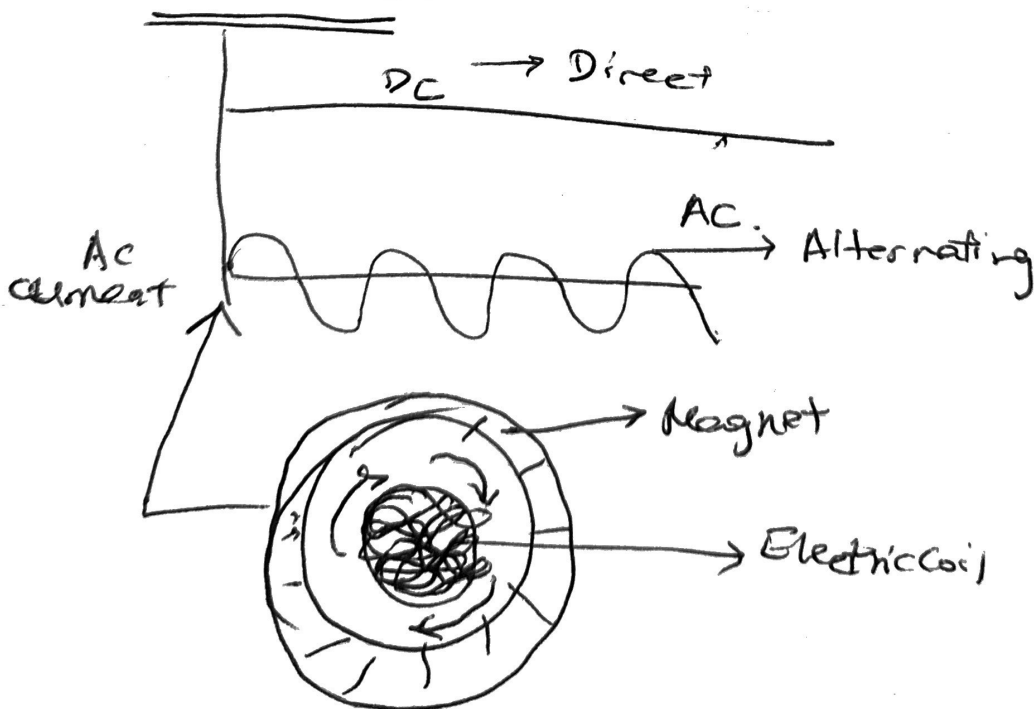
Controlled Variables

- Electrode Metals (Copper and zinc)
- Spacing of the electrodes (3cm)
- Fruit size and mass
- Room Temperature
- Same measurement method / Multimeter

Our Control is a standard AAA battery

Functions of a Multimeter

1. What is a multimeter: A multimeter is a device used to measure voltage, current and resistance.
2. What we learnt: We learnt that a multimeter can measure AC voltage and DC voltage, AC current & DC current & Resistance.
3. What is AC & DC Current & Voltage Units of measurement.
4. What is resistance.
5. What does a Battery provide? DC current.



Nov 4 - 19 2025

Materials used:

- Red and Black wires
- Multimeter
- Electrodes
- Small LED bulb
- Motor
- Digital clock
- Beeper
- Alligator clips
- AAA Battery
- Apple, Lemon and potato
- Resistor.

Test all materials for functioning

Clock-works.

Multi-Meter-works.

Leads are functional.

Motor-works.

We only picked LED's that work.

Copper electrode - positive Confirmed.

Zinc electrode - Negative Confirmed.

Oct 27, 2025

1 Hypothesis

If we ^{measure} ~~measure~~ the voltage of Apple, potato and lemon, then lemon will produce more voltage, because it has higher concentration (Acidity).

2. Hypothesis

If we measure the current ~~across~~ across the lemon battery, then the current measured will be less than a normal battery because of the high internal resistance of the Lemon battery (Food battery).

3 Hypothesis

If we had enough ~~fruits and vegetables~~ ^{food} connected in series producing high voltage, then we should be able to light the LED power the beeper, motor and clock because higher voltage should be able to power the gadgets.

Science fair

Winter break plan

Dec 17 Research the definition of conductivity
- write down the definition for voltage, define electrolyte and electrons
write down what cathode and anodes is. Write down
if copper or zinc is negative or positive. Battery, P_n , electrode
Dec 18 double check the list of materials with dad

Start documenting in Report.

Dec 19 write a very detailed procedure.
Completed. Document in Report.

Dec 20 Run first experiment
Record data in a bar graph, table and take pictures

Dec 21 Write bullet points with the results

After the 4 trials write a full paragraph with results
like we did for the Whirly bird

Dec 22 Document in Report.

Dec 23 More Research on Sensors, Application
Complete research Sections

Dec 24 - Break

Dec 25 - Break

Dec 26 Break

Dec 27 Experiments more of them with voltage and current measurements
Voltage decay

Record Readings / Report 4 Trials

Dec 28 Heated food experiments

Record Reporting 4 Trials

Dec 29 Record and cleanup reporting

Dec 30 Continue cleanup and result discussion with Daddy. Understanding more concepts
Background research.

Dec 31 Break

Jan 1 Break.

Jan 2

Jan 3: Prepare presentation: Slideshow with all of the headings from CYSF Platform

1. Introduction

- Purpose
- Hypothesis
- experimental design
- background research

2. Materials + Methods

3. Results

4. Discussion

- Application
- source of error

5. Conclusion

6. Acknowledgements

7. Citations

Jan 4: Polish presentation

Jan 5: Practise Presentation

should be about 6-7 minutes Max 10 min

Practice More Practice

Draft

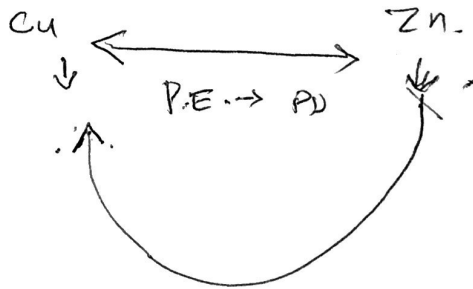
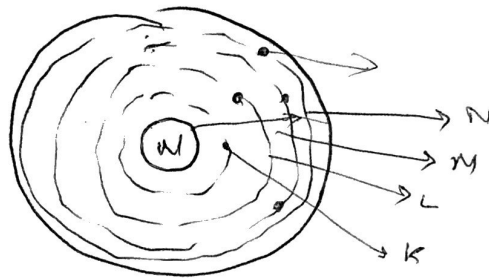
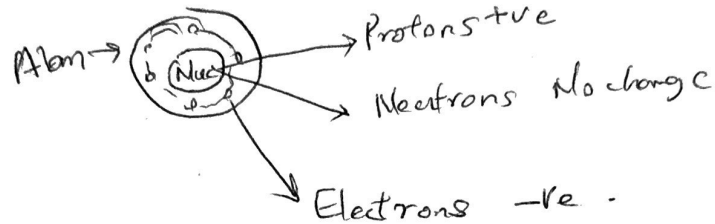
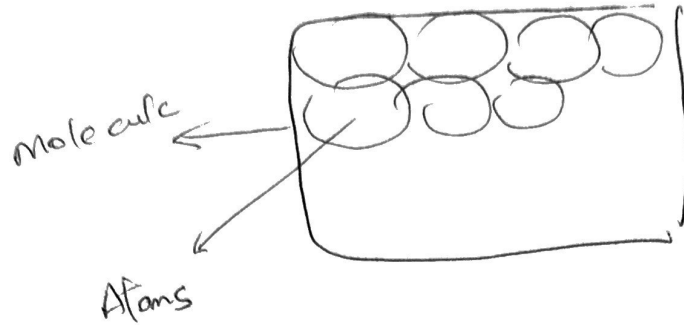
final versions

Jan 26 Add Background Research

Jan 28 Add more data feedback from mentor

Explanation of Atoms / Molecules / Electrons

Discussion with Dad



Reporting

→ Planning

→

As we were doing the experiment, started putting all material → document.

→ Gather all documents / Information into one document.

→ Align them with Requirements

→ Edits (drafts) in Each Section.

→ Now formatting.

Dec 26/2025

Starting Apple

Measure the open circuit Voltage for apple.

Fruit	time	Voltage	Temp
1 Apple	8:30 PM	1.051V	22°C
2 Apples 1	8:37 PM	2.05V	22°C
2 Apples 2	8:49 PM	1.98V	21°C
2 Apples 3	9:11 PM	1.91V	21°C
2 Apples 4	9:25 PM	1.84V	21°C

Two Apples

time	V _{OH}	T _{temp}
9:40	1.80V	21.2°C
9:55	1.77V	21°C
10:10 PM	1.75V	21.1
10:25 PM	1.73V	21°C
10:40 PM	1.72V	20.9
10:55 PM	1.7V	20.8

2 apples were able to light the LED



- 2 apples were also able to make the beeper beep.



- 2 apples were not able to make the motor spin because it did not have enough current, even though the ^{Voltage} ~~current~~ was sufficient.

- 2 apples were able to power the clock because it had enough voltage.

- We measured the current on the 2 apple configuration it was 0.088mA. again suggesting high internal Resistance

The solid phase bacteria powered
Bio battery could be a low cost
power source for the internet of
disposable things

- eepower.com

The internet of disposable things (IoDT)
is a phenomenon in which wireless sensors
are attached to nearly any type of device
in order to provide up to date information,
via the internet. for example, a sensor
could be attached to food packaging
to monitor the freshness in the food inside.

- eepower.com

1. Executive Summary
2. Introduction
 - Purpose
 - Hypothesis
 - Experimental design
 - Background Research
3. Materials & Methods
4. Results
5. Discussion
 - Application
 - Sources of Error
6. Conclusion.
7. Acknowledgement
8. Citations.

Prepare Template for Recording

Food Sample

Sample	V	Current
1		
2		
3		
4		

4 Samples
— Mentor
ms Fauzia Mr
H

Avg V = Avg I

$$\text{Average} = \frac{1+2+3+4}{4}$$

How many we need

4 Apples

4 Potato

4 Lemon

LEMON

Table A1 – Voltage and Current 4 samples for lemon at room temperature

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	0.90	0.088
2	0.92	0.091
3	0.92	0.090
4	0.93	0.91
	Average V = 0.92	Average I = 0.09

HEATED LEMON

Table A2 – Voltage and Current 4 samples for heated lemon

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	0.83	0.27
2	0.84	0.23
3	0.86	0.24
4	0.87	0.24
	Average V = 0.85	Average I = 0.245

APPLE

Table A3 – Voltage and Current 4 samples for apple at room temperature

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	1.05	0.088
2	1.06	0.088
3	1.06	0.088
4	1.07	0.088
	Average V = 1.06	Average I = 0.088

HEATED APPLE

Table A4 – Voltage and Current 4 samples for heated apple

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	0.92	0.23
2	0.92	0.19
3	0.92	0.21
4	0.92	0.21
	Average V =	Average I = 0.21

POTATO

Table A5 – Voltage and Current 4 samples for potato at room temperature

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	0.86	0.11
2	0.87	0.11
3	0.87	0.11
4	0.88	0.11
	Average V = 0.87	Average I = 0.11

HEATED POTATO

Table A6 – Voltage and Current 4 samples for heated potato

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	0.80	0.98
2	0.83	1.00
3	0.84	1.03
4	0.81	1.03
	Average V =	Average I = 1.01

Table A7 – Voltage and Current for electrode distance of 1cm – Heated Potato

Note that this step was only done for one food item as changes were minimum.

Sample #	Open Circuit Voltage (V)	Loaded Current (milli Amp)
1	0.81	1.02
2	0.82	1.01
3	0.81	1.01
4	0.81	1.01
	Average V = 0.812	Average I = 1.01