Comparing the potential difference of a variety of natural food batteries.

The Beginning and new ideas

Our idea was brought to life after an experiment we completed in our science lessons where we were using a potato and lemon to make a battery and we questioned the idea of using different foods other than a potato or lemon to provide potential difference.

What are the aims of our experiment?

- In our experiment, we aim to find which fruits would induce the highest potential difference.

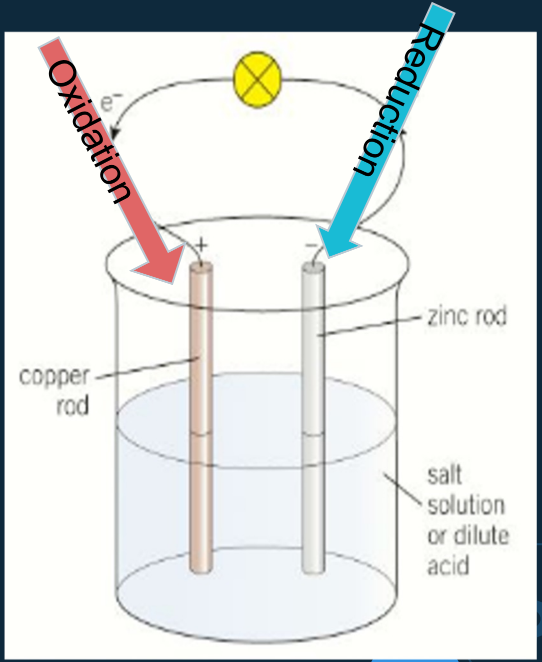
- We also aimed to use the electrochemical cell with the highest potential difference to power our mini-robot (requires a 1.5V AAA battery)

What are electrochemical cells?

- An electrochemical cell is a device that generates a potential difference between electrodes using a chemical reaction.

- The type of electrochemical cell that we used to develop our food battery was a voltaic cell. A voltaic cell is a device where electric current is generated by a spontaneous redox reaction.

- In a voltaic cell, the two reactions (oxidation and reduction) are placed into two different containers and a wire is used to drive the electrons from one side to another.



Apparatus

- ❑ Magnesium Strip
- ❑ Copper Strip
- ❑ Zinc strip
- ❑ Beakers
- ❑ Voltmeter
- ❑ Wires
- ❑ Different types of fruit

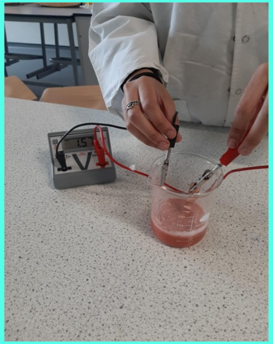
Foods Used

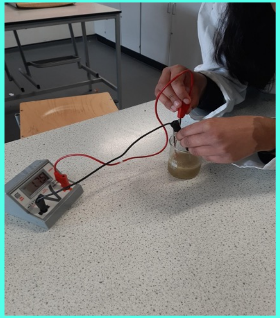
Fruits:

- ❑ Honey
- ❑ Kiwis
- ❑ Lemons
- ❑ Oranges
- ❑ Strawberries

Method

1. Fruit skins were removed.
2. 50g of fruit was weighed by using a weighing scale
3. A blender was used to blend the fruit into a smoothie consistency, releasing the juices (electrolyte).
4. 75ml of distilled water was added to the blended fruit.
5. Fibrous and large fruit pieces were filtered to create a solution.
6. 100ml of each fruit solution was measured and placed in a beaker.
7. The magnesium and copper electrodes were placed in the beaker.
8. Crocodile clips were used to connect the wires to the electrodes and were also connected to a oltmeter.
9. The potential difference was measured
10. This was repeated in order to calculate a mean potential difference.





Electrodes: Copper and magnesium

Results table

Fruits	First trial potential difference (v)	Second trial potential difference (v)	Mean potential difference (v)
lemon	1.86	1.84	1.85
Orange	1.67	1.47	1.57
Strawberries	1.69	1.65	1.67
Kiwi	1.75	1.62	1.69
Honey	1.58	1.59	1.59

Results table

Electrode: Copper and Zinc

Fruit	First trial potential difference (v)	Second trial potential difference (v)	Mean potential difference (v)
Orange	0.96	0.90	0.93
Lemon	0.97	0.92	0.95
Kiwi	0.91	0.82	0.87
Strawberries	0.93	0.84	0.89
Honey	0.92	0.95	0.94

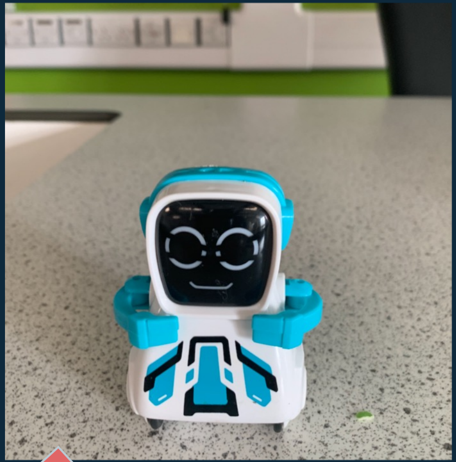
Mineral Count

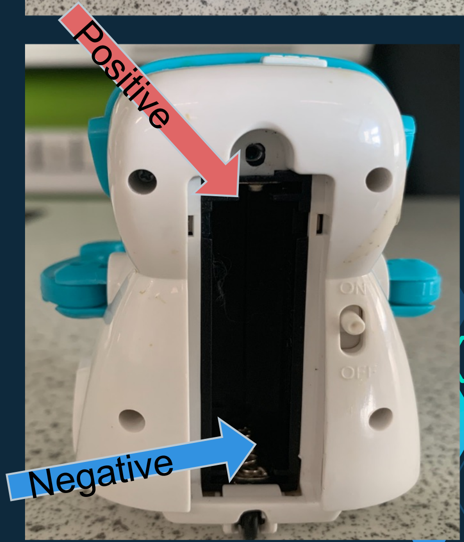
Fruits	Ions	Mg + Cu Mean Potential Difference (v)	Zn + Cu Mean Potential Difference (v)
Lemons	Hydrogen ions (H^+) Citrate ions ($[C_6H_5O_7]^{3-}$)	1.85	0.95
Oranges	Calcium (Ca^{2+}), Copper (Cu^{2+}), Iron (Fe^{2+}), Magnesium (Mg^{2+}), Manganese (Mn^{2+}), Potassium ion (K^+), Phosphorus ion (P^{3-})	1.57	0.93
Kiwi	Calcium (Ca^{2+}), Copper (Cu^{2+}), Iron(Mn^{2+}), Magnesium (Mg^{2+}), Phosphorus (P^{3-}), Potassium (K^+), Selenium ion	1.69	0.87
Strawberries	Calcium (Ca^{2+}), Copper (Cu^{2+}), Iron(Mn^{2+}), Magnesium (Mg^{2+}), Phosphorus (P^{3-}), Potassium (K^+),	1.67	0.89
Honey	Calcium (Ca^{2+}), Potassium (K^+), Magnesium (Mg^{2+}), Sodium(Na^+)	1.59	0.94

Powering our Mini-Robot

- We tried to power our mini-robot by connecting the wire from the anode to the negative electrode, and the wire from the cathode to the positive electrode.

- Unfortunately, despite many attempts, and exposing the copper wire to improve connection, we were unable to get enough current to flow through the robot.





Conclusion

- In conclusion we found that when we used zinc and copper electrodes there was a lower potential difference compared to when we used magnesium and copper.
- This is due to the difference in reactivity between the two metals.
- Magnesium is more reactive than zinc. The difference between the reactivity of copper and magnesium is much more than that of copper and zin.

True or false

Potential difference is measured in Amperes.

False. It is measured in volts ( ).

True or False

Magnesium is less reactive than copper.

False.

Magnesium is more reactive than **copper**.

True or false

The metal electrodes have to be different so there is a difference in reactivity.

True.

A greater difference in reactivity allows a there to be a greater potential difference

True or false

A redox reaction involves the transfer of protons.

False.

A redox reaction involves the transfer of electrons.

Our Motto:

The scientist is not a person who gives the right answers, he's the one who asks the right questions

~Claude Levi-Strauss

Thank You!

Any questions?