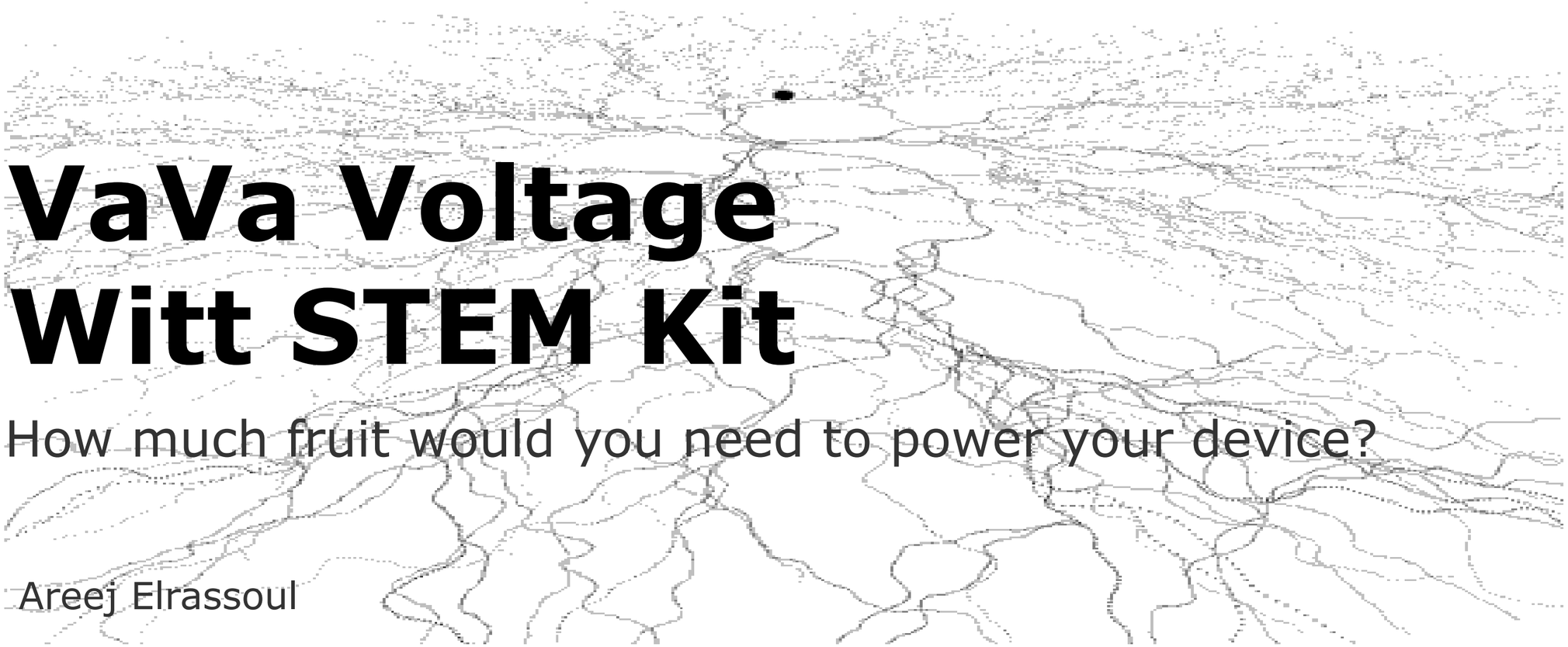


# VaVa Voltage Witt STEM Kit

How much fruit would you need to power your device?

Areej Elrassoul

# What is STEM?

- STEM stands for Science, Technology, Engineering and Mathematics

- The aim of STEM is the integration of these four disciplines together in teaching and learning.  As in the real world, these four disciplines rely heavily and seamlessly on each other.

- STEM helps strengthen key life skills such as analytical thinking, problem solving, creativity, teamwork, and technical skills

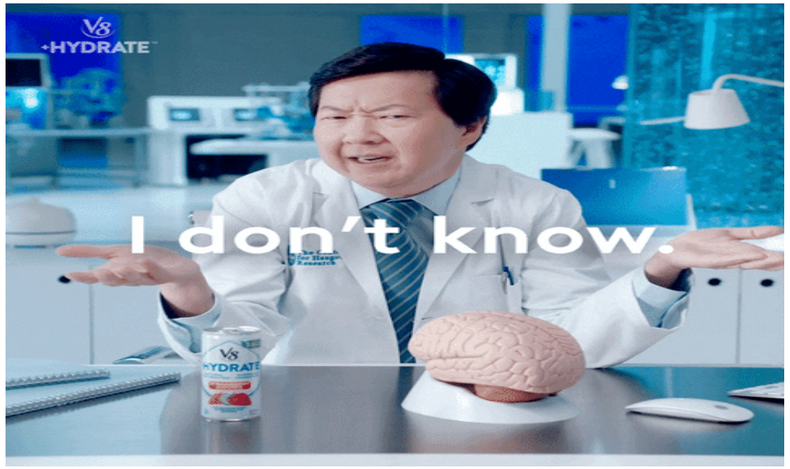
# What is WiTT?

- WiTT stands for Women in Technology and Trades

- WiTT is a group that increases opportunities and supports for women in technology and trades in all fields, through a rich networking and support community

- WiTT welcomes industry, staff, students and faculty across all areas of the college and all genders, backgrounds, races and orientation to become involved and contribute to the support of women in technology and/or trades.

# What is this kit?




In this kit you will create a code that will read the voltage of your produce. This information can be used to discover how many fruits can be used in series to charge your phone, power a light bulb, or anything you can imagine.

Not only that, but the Adafruit Circuit Playground can be used for endless activities like turning your produce into a drum set or even a video game using the capacitors. These codes will be available when the kit is completed.

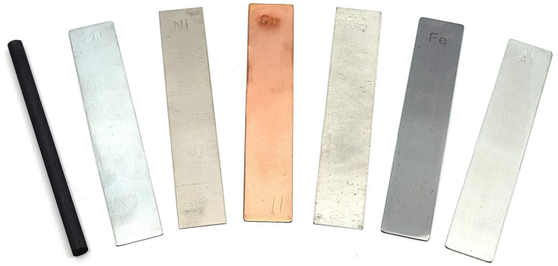
#VaVa Voltage

# Curriculum Points

- Grade 12, University Preparation. Page 112. Part C. Structure and Properties of Matter. Subpart C2. Developing Skills of Investigation and Communication. Section C2.4, C3.4. These sections involve conductivity.
- Grade 11, College Preparation. Page 74. Part F Plants in the Natural Environment. Subpart F2. Developing Skills of Investigation and Communication. Section F2.3. This section involves how the pH of soil affect plant growth
- Grade 11, Workplace Preparation. Part A. Scientific Investigation Skills and Career Exploration. Subsection A1. Scientific Investigation Skills. Section A1.2. This section talks about using pH probes.
- Grade 12, Workplace Preparation. Page 246. Part C. Subpart C2. Developing Skills of Investigation and Communication. Section C2.2. how pH impacts a chemical reaction. C2.5 the use of pH paper.  Subpart C3. Understanding Basic Concepts. Section C3.3 - understanding and interpreting pH scale
- Grade 12, College Preparation. Part D. Electrochemistry. D2. Developing Skills of Investigation and Communication. D2.1 using terminology like oxidation, anode, and electrolyte
- Grade 12, Communications Technology. Part A. Communications technology fundamentals. Subsection A3. Technical Terminology and Scientific and Mathematical Concepts. Section A3.2. digital encoding
- Grade 11, University/College Preparation. Part A Communications technology fundamentals. Subsection A3. Technical Terminology and Scientific and Mathematical Concepts.. Section A3.2. sensor

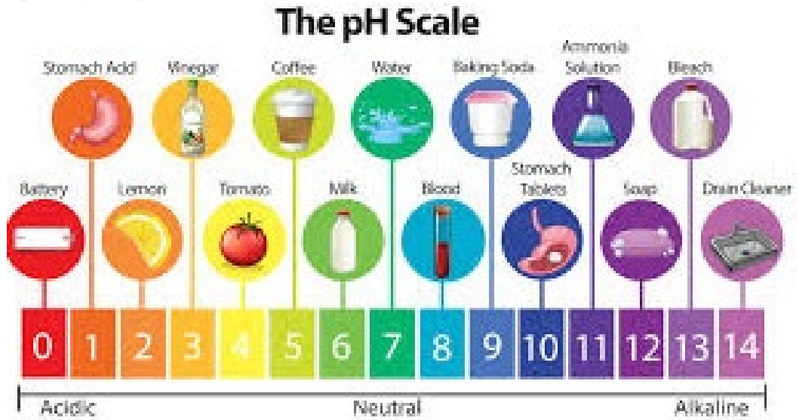
#VaVa Voltage

# Kit Detail



The factors in this kit are the produce used, the pH of the produce, the type of electrode, the distance of the electrodes and the surface area of the electrode.

The goal of this project is to determine how many fruits in series will be required to power a device.



# Kit Requirements

-Computer (Windows 10 required for live readings)

-Adafruit circuit playgrounds($30.00, amazon)

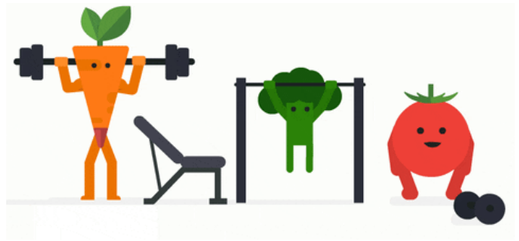
-Produce of choice ($5.00, Grocery Store)

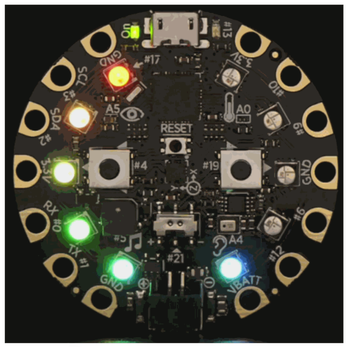
-Alligator clips($15.00, amazon)

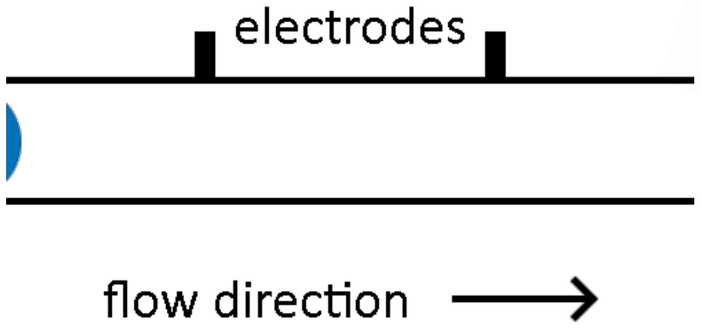
-Electrode Set ($13.81, amazon)

-Ruler

-Marker

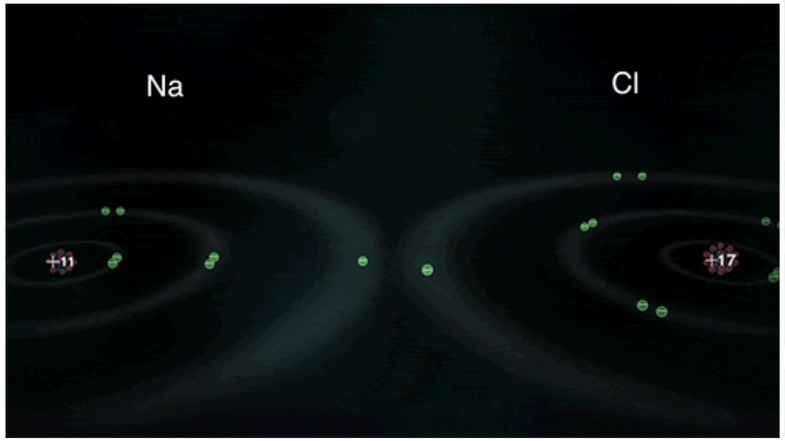


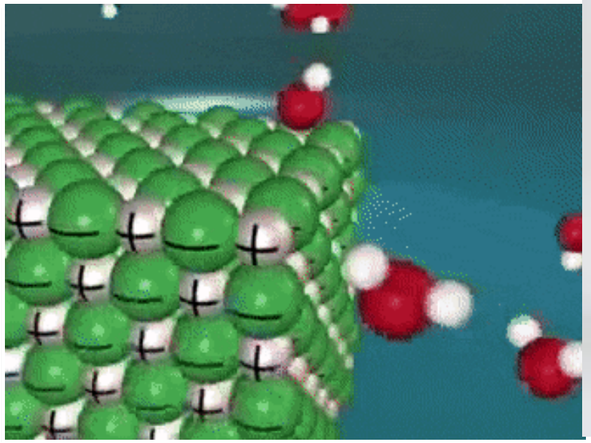




# Good To Know!





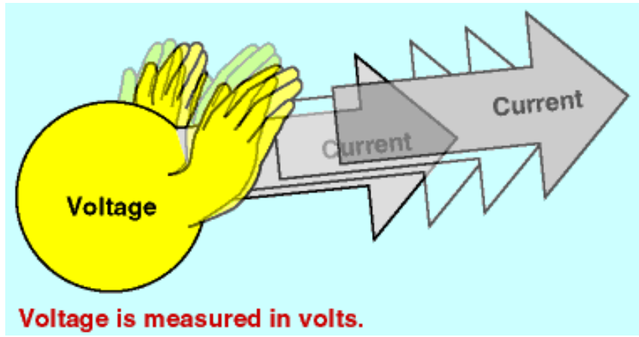
In this experiment, we will explore how a battery operates and how ionic conductivity is important in the operation of a battery. Ionic compounds, like NaCl, contain discrete cations and anions. Many are completely soluble in water.

When ionic compounds dissolve, they dissociate or ionize into cations and anions forming electrolytic solutions, or solutions which conduct electricity.

Arrhenius stated that when cations and anions in solution encounter a charged electrode, current is formed. This current produces a voltage which can be measured. The higher the conductivity, the stronger the current and the higher the voltage.

Fruit and vegetables have natural juices in them. These juices are electrolytic solutions which also contain weak acids. The presence of weak acids increases conductivity. Depending on the strength of the weak acid, the conductivity and voltage will vary.

# Good To Know!




## The pH of Produce

The weak acid present in the produce will determine how much current will be generated and the voltage that will be recorded. In other words, as the weak acid strength increases, pH will decrease, and voltage will increase.

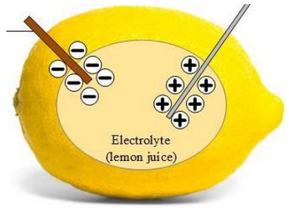
## Surface Area of the Electrode

How much of the electrode is in contact with the produce's electrolytes should theoretically effect the readings.

## Conductivity, Current, Voltage

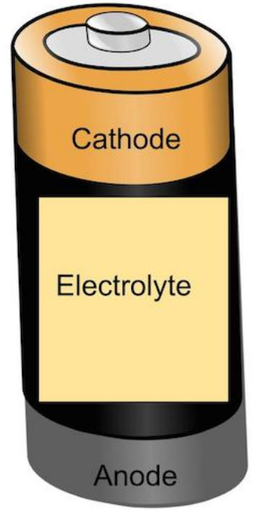
High conductivity indicates more current flow. Current and voltage are directly proportional, but pH and voltage are inversely proportional.

## Type of Produce




Different produce will have higher voltages because they contain different electrolytes and different weak acids.

## Type of electrodes




When thinking of electrodes, imagine a battery: there is a negative end (electrode) called the anode and a positive end (electrode) called the cathode.  For a battery to work, current must flow from the anode to the cathode. This current flow is carried by electrolytes inside the battery. The same principle applies to current flow between the anode and the cathode. The juices in the produce carry the current.

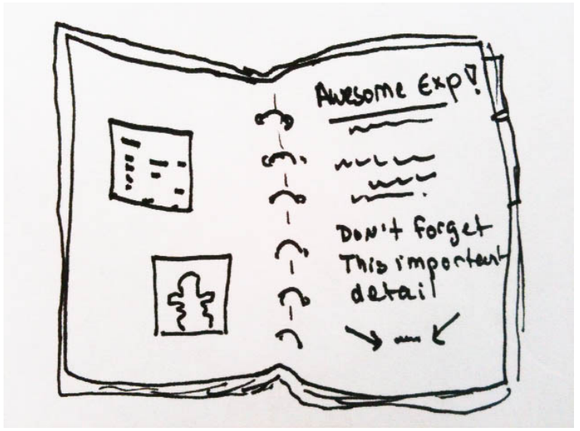
The type of electrodes also impacts voltage readings. Try using different combinations of anodes and cathodes to see how it effects your results!

# Kit Instructions


- Prepare notebook
- Insert electrodes into the fruit
- Insert or build code into https://makecode.adafruit.com/
- Download the code onto the adafruit
- Analyze live readings of the voltage and record in your notebook
- Repeat with different electrodes and produce

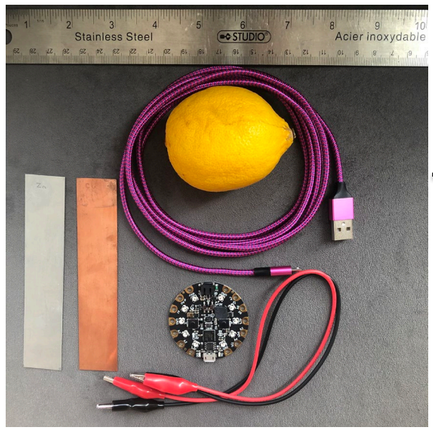
# Notebook Rules

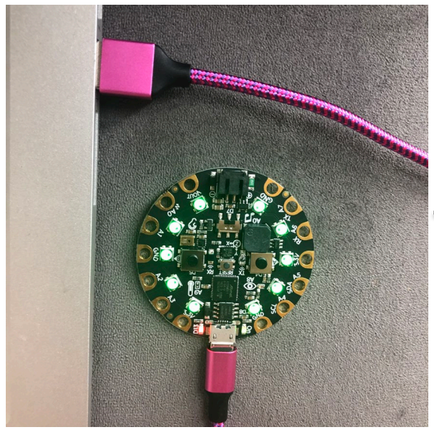
Although not a requirement for this experiment it is good to know how to properly set up your notebook

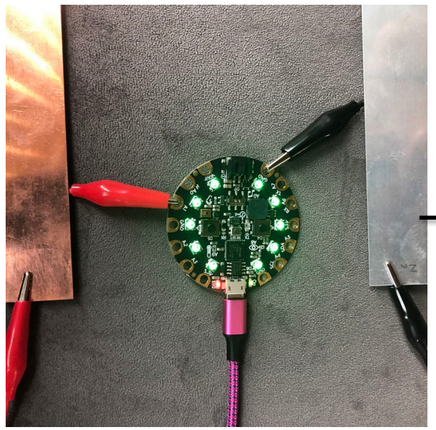


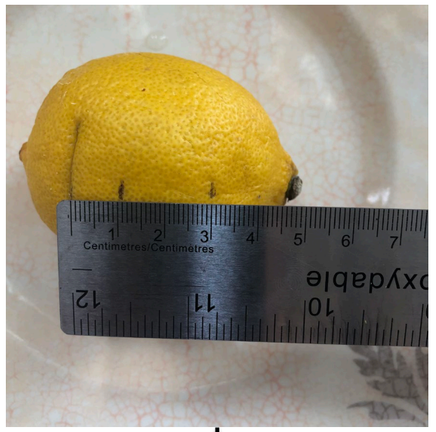

- Only use a black non-erasable pen
- Write clearly
- Make a flow chart and tables
- If a mistake is made use one line to cross it out and initial next to the mistake
- Put a page number, your name and date on each page
- If there is extra space on the bottom of the page put a line across it and initial

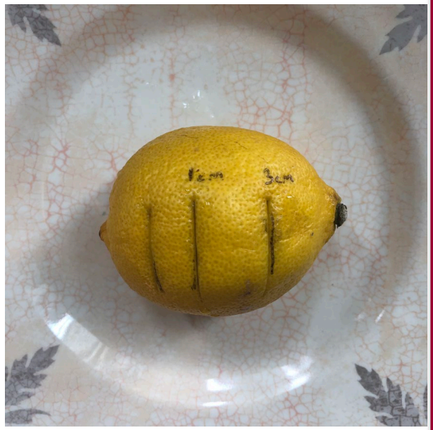
# Procedure: Flow Chart



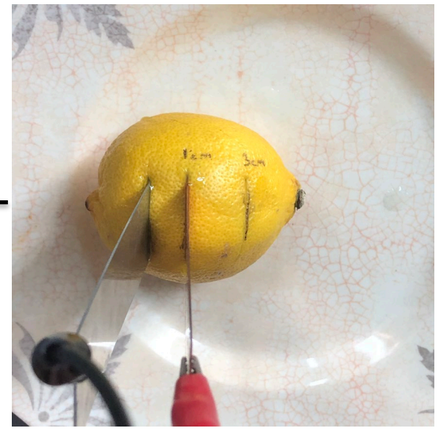



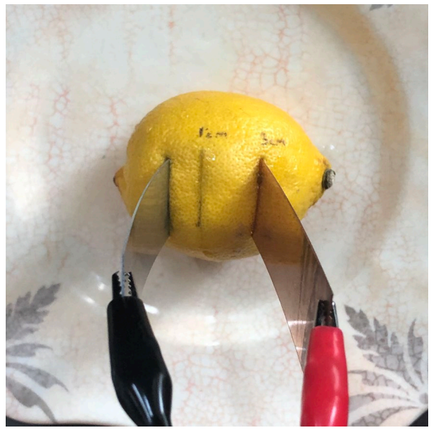




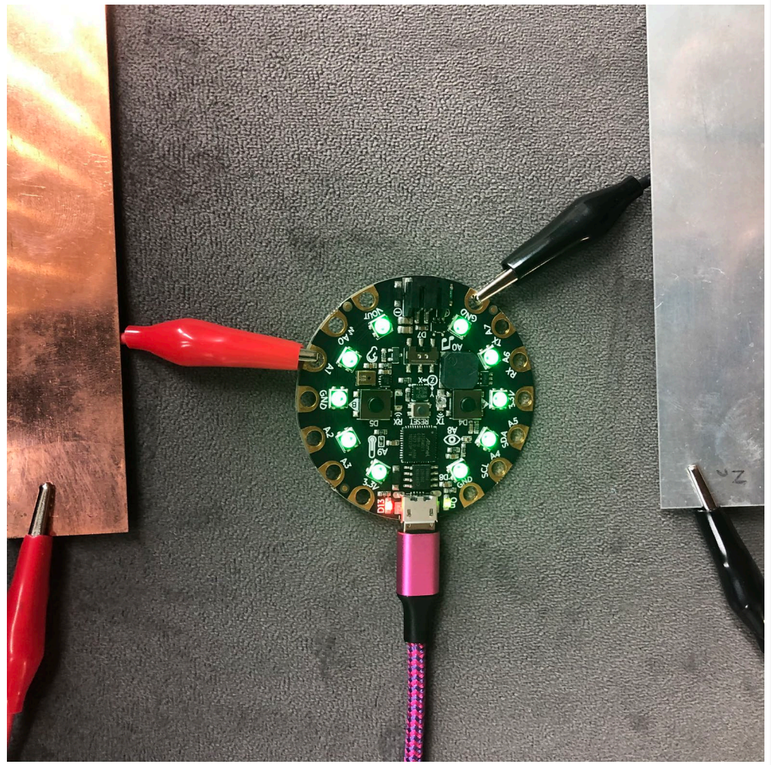




# Procedure: AdaFruit Set up

1. Attach the USB wire provided into your computer and into the Adafruit. Note: For live reading Windows 10 is required
2. Turn on the Adafruit by pressing the middle button until it flashes
3. Clip the black wire to Zinc and ground using a 2-sided alligator clip
4. Clip the red wire to the Copper and pin A1



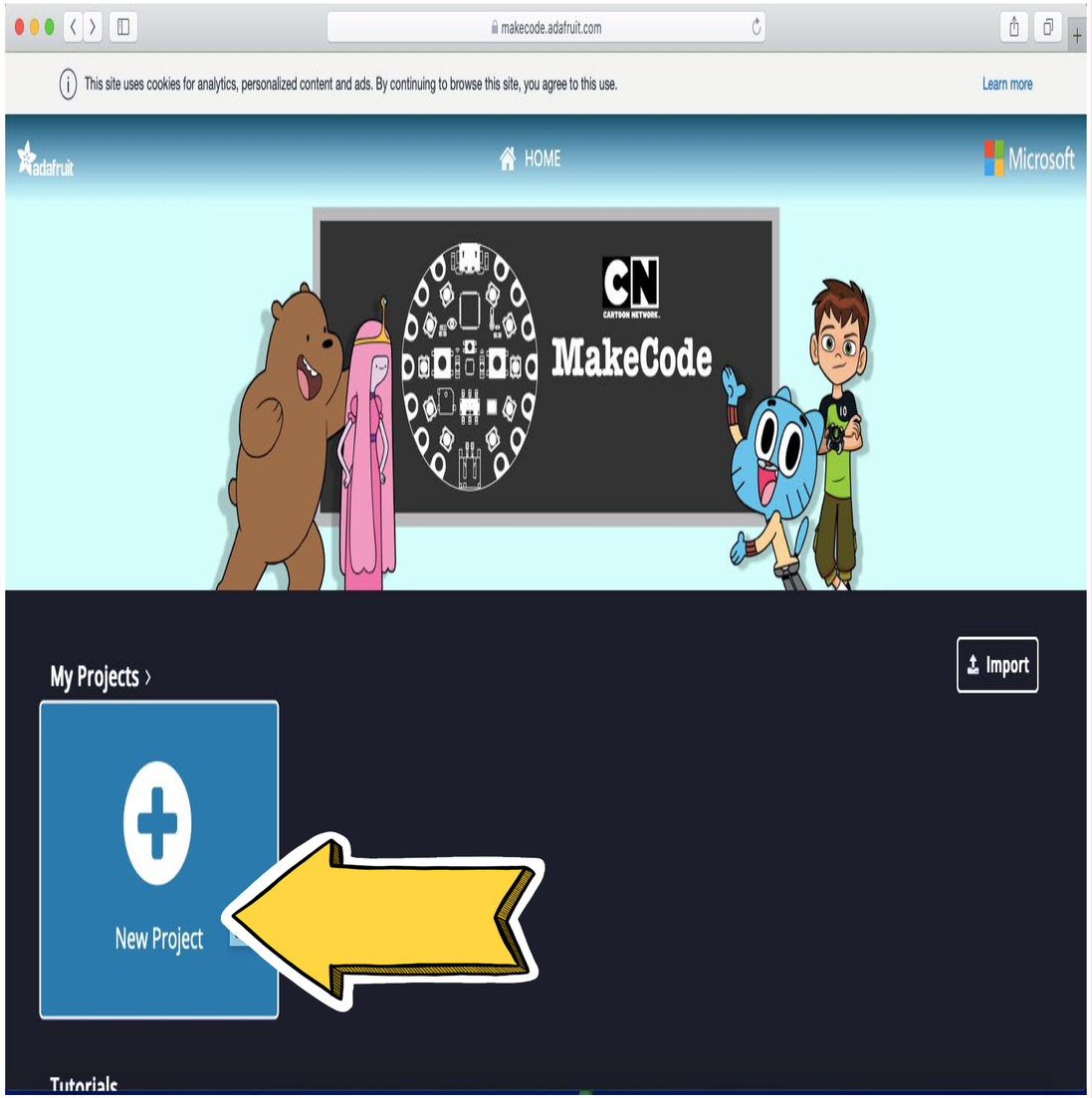
# Procedure: Code

5. Go to your internet browser and access https://makecode.adafruit.com/

6. Click “New Project”

7. Now either build the code with blocks or JavaScript. The next slide will provide both

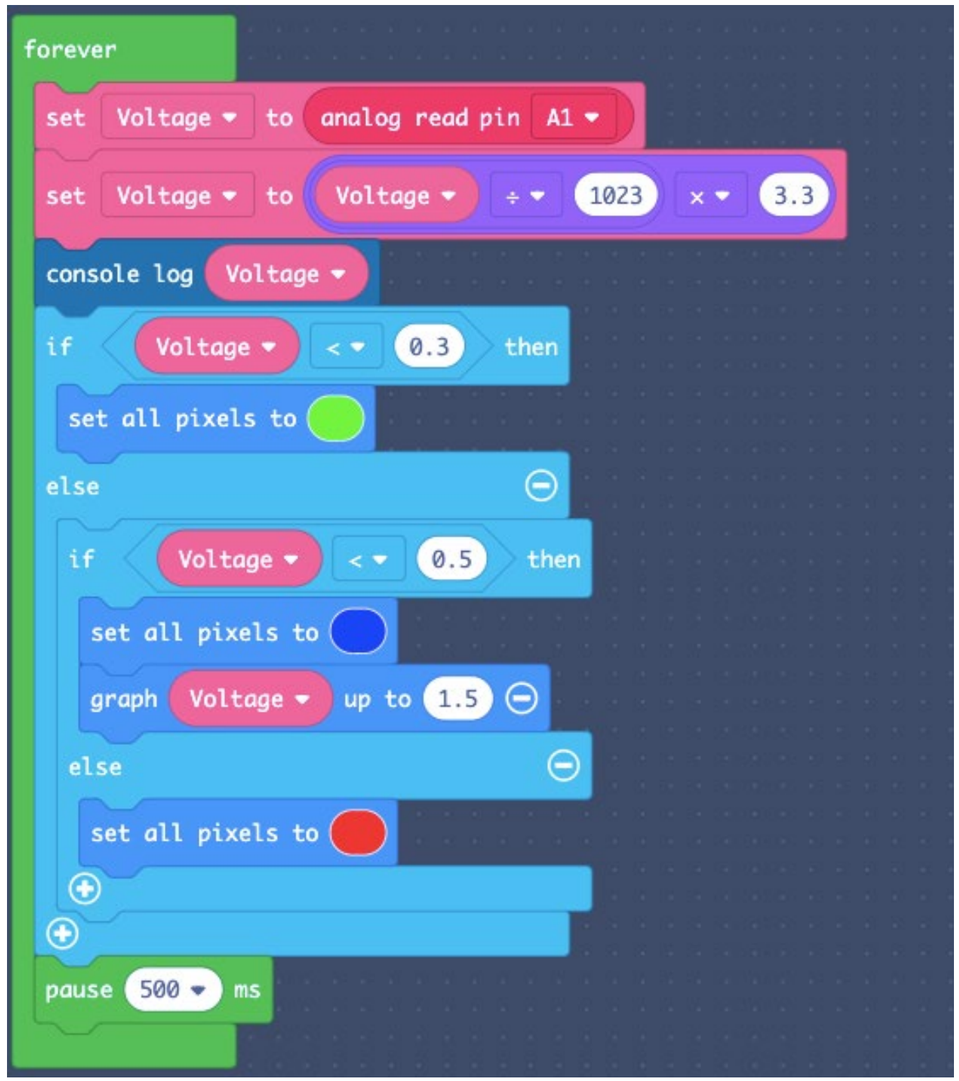
8. Download this code onto your Adafruit



# Procedure: Code with Javascript

```
let Voltage = 0
forever(function () {
Voltage = pins.A1.analogRead()
Voltage = Voltage / 1023 * 3.3
console.log(Voltage)
if (Voltage < 0.3) {
light.setAll(0x00ff00)
} else {
if (Voltage < 0.5) {
light.setAll(0x0000ff)
light.graph(Voltage, 1.5)
} else {
light.setAll(0xff0000)
}
}
pause(500)
})
```

# Procedure: Code in Blocks



# Procedure- Electrode Set up

9. Take a lemon and 3 other fruits or vegetables of your choice and set them aside (example tomato, potato, apple, onion). Bring 2 of each.
10. Take a lemon and make a slit the same width as the electrode.
11. Measure and mark 1 cm and 3 cm from this point.
12. Make slits at the 1 cm and 3 cm mark. The distance of these slits may effect the voltage reading.
13. Insert a Zinc and Copper electrode 1 cm apart.
14. The depth of the insert should be 1 cm as well. Report SA of exposed area to your notebook

#VaVa Voltage

Good To know!

Electrode Combinations:

-Zinc & Copper (Great)

-Aluminum & Copper (Good)

-Copper & Steel (weak)

-Zinc & Steel (Weakest)

# Procedure-Next Step

15. Record the voltage from live reading in your notebook and any colour seen from Adafruit
16. Remove the Copper electrode and put it into the 3 cm mark
17. Immerge the electrode 3 cm into the lemon
18. Calculate Surface Area and record into your notebook
19. Test the voltage and see if there is a difference in the reading. Note if there is little to no voltage from the lemon that is an indication that there is no current flow from the anode to cathode making it a dead battery. In this instance get a new lemon.

# Procedure- Next Steps

20. Take a Zinc and Steel and insert it into them 1 cm apart.
21. Clip Zinc to ground and Steel to pin A1
22. Record Voltage and repeat with 3 cm apart
23. Report if the reading are different from the other electrode set
24. Repeat steps with the other produce, electrode combinations, SA’s (amount inserted) and record results

# Questions

1. In theory, a phone needs 5V to be able to charge. How many potatoes would be needed in series to satisfy this charge. Use the results monitored from the makecode.
2. In theory, lemons only hold this charge for 30 minutes, how many lemons would you need in total to charge your phone for 3 hours. Use the results monitored from the makecode
3. The pH of an apple is about 3.4, the pH of a lemon is about 2.2 and the pH of a white onion is about 5.5. List these fruit from highest voltage to weakest. Hint: how is pH related to voltage?





# Additional Fun!

- Music with fruit:
- https://learn.adafruit.com/circuitpython-fruitbox-sequencer-musically-delicious-step-pattern-generator
- https://learn.adafruit.com/circuit-playground-express-piano-in-the-key-of-lime
- Video Game with adafruit!
- https://learn.adafruit.com/custom-controllers-for-makecode-arcade





# Thank you to RBC for Sponsoring WiTT Curriculum Kits

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# You have completed this kit!

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