Two Italian Guys and a Piece of Fruit (or Alessandro and Luigi Go to The Market)

Background

All forms of energy fit into one of two catagories--potential or kinetic. Examples of potential energy are nuclear, chemical and energy an object has due to position or condition like a stretched rubber band or a rock on top of a cliff. Examples of kinetic energy are heat, electromagnetic and energy an object has due to its motion.

In the 1780's an Italian scientist named Luigi Galvani (1737-1798) was doing an investigation using frog legs. Galvani found that when a frog leg was hanging on a hook of one type of metal and was touched with a probe of a different metal, the frog leg (which was detached from the frog) would move! This caused all kinds of excitement. Some thought he had found the mysterious "life force" that caused things to be alive. Galvani thought he had discovered a type of animal electricity.

Another Italian scientist named Alessandro Volta (1745-1827) heard about Luigi's great discovery and decided to do some testing of his own. Volta repeated some of Galvani's experiments on several unlucky animals ranging from headless grasshoppers to bodyless cows. After this experimentation he concluded that this was not a new form of electricity but the same old thing--electricity coming from the two dissimilar metals. In 1800 he placed silver and zinc disks alternately in contact and separated by moistened cardboard. This became the first battery and was called a Voltaic pile. This solved the mystery of "animal electricity." Today we know that if you place two dissimilar metals connected with an electrolyte (simply a substance that contains charged particles called ions) you can cause a flow of electricity.

The electrical energy here is a result of the stored chemical energy. There is a potential difference between the two metals just as there is a potential difference between a book on top of a high shelf and a book on the floor.

Problem Statement

Using the EA100 to gather data and the CFX-9850G to graph and analyze it, we are going to investigate different fruits and veggies to see which would be more useful as an electrolyte. We will learn to use the Data Logger function of the EA100 to investigate what happens to our "battery" over time. We will also learn to transfer data from the EA100 to the CFX-9850G calculator.

Hypothesis

What do you think will happen with two dissimilar metals in different types of fruits and veggies? Using your personal experience and what you know about these objects, which would you predict to be the better electrolyte? Write your hypothesis:

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Equipment (for each group of 2)

Casio EA100 Data Analyzer and voltage probe
Casio CFX-9850G Color Graphing Calculator
copper pennies and zinc washers
various fruits and veggies
knife or other sharp instrument

Procedure

1. Plug the voltage probe into the EA100 in Channel One (CH1) on top of the data analyzer. Turn the EA100 on and push the SHIFT key. Then press the MODE button which will put us into the mode to setup the Data Logger.

2. Your display will show you different time selections in seconds (1 sec, 2 sec, 5 sec, 10 sec, 20 sec, 30 sec, 60 sec, .000sec, 10 millisec, 20 millisec, 50 millisec, 100 millisec, 200 millisec, 500millisec). This represents how often you want the EA100 to take a sample. You select this option by pushing the DataLOG key. We will use the 10 second setting so that a sample will be taken every 10 seconds.

3. Press the TRIGGER button next and now the display shows you how many samples the data analyzer will take. Choices are: 200, 20, 30, 50, &100. Again to change your choice press the DataLOG button. Choose the 100 samples option.

4. Press the TRIGGER button again and now we have options to decide how the samples will be taken. There are three options here: 0, 1 and 2. We want to use "time recording on (absolute)" which is setting 1. Again use the DataLOG key to change to the "1" selection.

5. Press the TRIGGER button and the EA100 will display "READY".

6. Now cut two openings in your fruit or vegetable using a scaple or knife. Put a penny (copper) in one opening and a washer (zinc) in the other.

7. Connect the electrical probes to the penny and the washer. Press the TRIGGER button to start collecting data. The display screen should flash "SAMPLING". Since we are taking 100 samples 10 seconds apart it will take a while for this to run. This will give you time to learn how to transmit from one calculator to another and get the program "LIST" from your instructor.

8. When the data has been collected the EA100 screen will display "DONE". To look at the 100 samples collected press the DataLOG button. You can go through all of them and record them if you like. But there is a much better way.

9. We are going to link the calculator to the data analyzer and transfer the data through the wonders of modern technology. Using the link cable connect the two devices.

10. Turn your calculator on and select "PRGM" from the menu. You should have the LIST program from step 7. Select that program and push EXE button on calculator. The EA100 needs to be in the Communication mode, out of Data Logger. (HINT: If the display on the EA100 does not read MULTIMETER, then you can assume that you are in the communications mode!) If all goes well the calculator will display "DONE".

11. Press the Menu key on your calculator. Highlight the STAT function and press the EXE key. Now you will see that the data the EA100 collected has been placed in List 1 and List 2.

12. Press F1 (GRPH) key. Press F1 (GPH1) key. You should get a graph displayed. This represents the change in voltage during the time the data logger took the 100 readings. You may need to change the window, or exit back to change settings in F4 (SEL) or F6 (SET).

13. Print your graph using the computer. Your instructor will assist you with this.

Data

Record:

How many data points did you use?____

How long between each point?____

Total time of recording?____

Lowest voltage and when it occurred? ____

Highest voltage and when it occurred?____

Attach a copy of your graph:

Results

State your interpretation of your graphical data.

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Conclusions

Relate your conclusions to your hypothesis in a narrative.

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