“Add Them Up” for TI-Nspire™

Materials: TI-Nspire™, Vernier Easy Link™, Voltage Sensor, 5 same size 1.5 volt batteries (A, AAA, etc.), ruler

Data Collection:

1. Open a new .tns document on the TI-Nspire™.

2. Connect the Vernier EasyLink™ to the TI-Nspire™ using the mini-USB port. The Auto Launch window will appear. Choose **Lists and Spreadsheets**, (tab) to “**OK**”, then press .

3. Connect the voltage sensor to the other end of the EasyLink™.

4. Press (menu) > **Experiment** > **New Experiment** in order to reset the program and clear out old data.

5. Place one battery in the groove of a ruler. Touch and hold the appropriate voltage leads to the appropriate terminal: red to (+) and black to (-). A series circuit has now been created with the calculator.

6. Wait for the voltage reading to stabilize and then, one at a time, read the voltage of each of the 5 batteries. You should notice that these readings are very close to the same for each battery measured.

7. Press (menu) > **Experiment** > **Set Up Collection** > **Selected Events.** Next, collect data as the circuit is increased by one battery at a time.

8. Press in order to begin collecting data. The current voltage is displayed on the lower portion of the screen. Touch the red voltage lead to the (+) terminal and the black voltage lead to the (-) terminal of one battery and wait for the voltage reading to stabilize. Press to record the reading.

9. Line up two batteries in series. Touch and hold the appropriate voltage leads to the ends of the line of batteries. Press to record the reading.

10. Continue for a total of 5 trials. With each recorded value, a new data point will be displayed on the spreadsheet. When finished, press (tab) three times, then press in order to stop the data collection.

11. To remove the data collection bar, press (tab) twice, then press .

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Data Analysis:

1. Using the collected data, have students predict the voltage of a series of 6, 10, 20, and *n* batteries. Next, have students use their data to write an equation that describes the relationship of voltage to the number of batteries.

2. Press menu > **Data** > **Quick Graph** in order to create a split screen with a dot plot of the data—the variable "dc01.events" is the default for the x axis of the graph.

3. To create the y axis variable, arrow over the left side of the Quick Graph screen and press . Choose "dc01.voltage1".

4. Press menu > **Analyze> Add Moveable Line,** then grab and move the line to create a line of best fit for the data. The regression equation will change as the line is moved. Grab and move the regression equation if you can't see the entire equation.

5. Press menu > **Analyze> Regression** and choose the appropriate regression equation to display. Grab and move the text of the regression equation if you can't see the entire equation. Compare this to the equation that which was found with the moveable line. Have students identify the meaning of the y-intercept as well as compare and contrast the values of the y-intercepts on the two equations.

6. Have a discussion with students regarding slope. Help them to understand that the slope of a line is a measure of the steepness or the rate of change of the line. The numerical value of the slope can be related to many physical models. The unit of slope in this model is voltage/battery. Have students compare and contrast the values of the rate of change on the two equations as well as the equation that they determined by themselves.

7. Have students summarize their findings by writing a description on the worksheet or by pressing > **Notes** to insert a notes page.

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Name

____
Date

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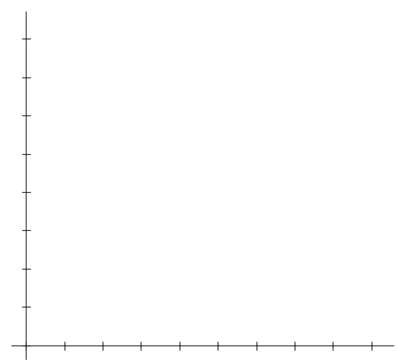
- Record the voltage for each of the five batteries in the table below:

Battery	1st	2nd	3rd	4th	5th
Voltage					

- Based on the data collected from measuring the series of one battery, then two batteries, then three, and so on, draw a graph of the data. Label the axes with the appropriate units.



- If the points on the graph were connected, describe the general shape of the graph.

  ____

- Record the data from the Lists and Spreadsheets page in the table provided here. What do you notice about the voltage measurements?

  ____
  ____

# of Batteries (X)	Voltage (Y)
1	
2	
3	
4	
5	

- Predict the voltage of a series of six batteries: ________, of 10: ________, of 20 _________, of *n* batteries _______________.

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- If X = number of batteries and Y = the voltage, use your data to write an equation that describes the relationship of voltage to the number of batteries. Use your equation to fill in
  M = ___________ B = _____________ where Y = MX + B.

- Record the values from the TI-Nspire™ when you used the Add Moveable Line feature. M=________ B=________ Y=________________________

- Record the values from the TI-Nspire™ when you used the Regression feature.
  M=________ B=________ Y=________________________

- For the equation of the line, Y = MX + B, M is called the _______________ and B is called the _______________. Are the TI-Nspire™ values of M and B the same as the values that you determined earlier? Compare and contrast your values and the TI-Nspire™ values.
  ____
  ____

- Summarize your investigation. Write a description of the total voltage a battery operated device will receive if several batteries are lined up in series. Include a sketch of the batteries in series here. _____________________________________
  ____
  ____

Sketch: