

Introduction to Data Collection on a TI-Nspire Handheld

Data collection is a very important part of science. Meteorologists collect weather data over time to keep a historical record and to help make forecasts. Oceanographers collect data on the salinity (saltiness) of seawater to study changing trends in our Earth's oceans. While data have been collected by hand for thousands of years, the technology to collect data electronically has been around for fewer than 80 years. Only in the last 20 years has this technology been available to schools.

This experiment was designed to introduce you to two of the most common modes of data collection that will be used in this book. Part I will guide you through collecting and analyzing data over time. A Temperature Probe will be used to record the temperature of water for 60 seconds at a rate of one sample every two seconds. In Part II, you will collect data using a mode called Events with Entry. This style of data collection allows you to collect one point of data, then will ask you to enter a corresponding value. In this experiment, the data collected will be the temperature of your hand and the value you enter will be your name.

OBJECTIVES

In this experiment, you will

- Become familiar with TI-Nspire handheld and the DataQuest application.
- Use a Temperature Probe to make measurements.
- Analyze a graph of the data.
- Use this graph to make conclusions about the experiment.
- Determine the response time of a Temperature Probe.

MATERIALS

TI-Nspire handheld
EasyTemp **or** Go!Temp with adapter **or**
Temperature Probe and data-collection interface
two 250 mL beakers

cold tap water
hot tap water
ice

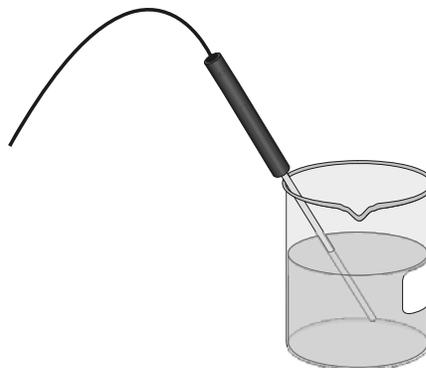


Figure 1

PROCEDURE

Part I Time Graph

- Place about 100 mL of cold tap water into a 250 mL beaker. Add two or three ice cubes.
- Set up the handheld for data collection.
 - Start from a new document.

*To open a new document, press **on** and select **New Document**. You may be prompted to save the current document.*
 - Connect the Temperature Probe to the data-collection interface. If you are using an EasyTemp or Go!Temp with an adapter, you do not need a data-collection interface.
 - Connect the interface to the TI-Nspire handheld.

Connecting an interface or direct-connect USB sensor will automatically launch the DataQuest application in your new document.
- Set up the data -collection parameters.
 - Choose New Experiment from the  Experiment menu.

*Press **menu** to access the DataQuest menus. Select  **Experiment** then **New Experiment**.*
 - Choose Collection Setup from the  Experiment menu.

*Press **menu**, select  **Experiment** then **Collection Setup**.*
 - Enter **0.5** as the rate (samples/second).

*The default collection rate for a temperature probe is 2 samples per second. To modify this value, press **tab** to highlight the **Rate (samples/second)** edit box and type **0.5**. The interval value will automatically update to show 2 seconds between samples.*
 - Enter **60** as the experiment duration in seconds.

*The default duration for a temperature probe is 180 seconds. To modify this value, press **tab** to highlight the **Duration (seconds)** edit box and type **60**. The number of data points collected should show 31.*
 - Select OK.

*Press **tab** until the **OK** option is highlighted and press **enter**.*
- Place the Temperature Probe into the cold water and stir briefly. Then position the probe in the cold-water beaker as shown in Figure 1. **Note:** Make sure the beaker will not tip over from the weight of the Temperature Probe.
- Place about 150 mL of hot water into a second 250 mL beaker.

Note: In Step 7, you will switch the Temperature Probe from the cold water to the hot water at exactly 10 seconds after you have started data collection.
- When everything is ready, start data collection. Do not stir or move the water.

Here are three ways you can start data collection.

 - Click the Start Collection button – Use the touchpad or arrow keys to move the cursor over the Start Collection button () and press **↵**.*
 - Use the menus – Press **menu**, select  **Experiment** then **Start Collection**.*
 - Tab to the Start Collection button – Press **tab** until the Start Collection button is in focus (highlighted by a black border) and press **enter**.*

Note: When data collection begins, the DataQuest Application view will change from Meter View () to Graph View () and the Data Collection button will show the stop icon (.

7. When exactly 10 seconds have gone by, quickly move the Temperature Probe to the beaker containing hot water and allow data collection to continue. Do not stir the water or move the Temperature Probe during the remainder of the data-collection period.

8. Data collection will stop automatically after 60 seconds.

Note: When data collection ends, the data-collection button will again show the start icon () and the graph will autoscale to show all of the data.

9. Remove the Temperature Probe from the beaker and dry it with a paper towel.
10. Determine the elapsed time when the highest temperature was reached.

- a. Examine the data pairs on the displayed graph to find the highest temperature.
Use the touchpad or arrow keys to move the cursor near a desired point. Press  to select the point. Use the arrow keys to examine other points on the graph.

- b. Record this temperature and the time when it was first reached in the data table.
The coordinates of the point you are examining will be displayed in the Graph View details box to the left of the graph.

- c. Verify that you found the maximum temperature using statistical analysis. The maximum temperature should match what you found in Step 10b. Did you get the same time both ways?

To perform a statistics calculation on your data, press , select  Analyze then Statistics.

11. Sketch or print copies of the graph as directed by your instructor.

Note: To print the graph, you must first import the file to a computer running the TI-Nspire computer software. You cannot print the file directly from a TI-Nspire handheld.

12. You can also confirm the time when the highest temperature was reached by viewing the data table directly.

- a. Change to the Table View to view the data lists.

Here are two ways you change views:

- *Clicking the Table View tab – Use the touchpad or arrow keys to move the cursor over the Table View tab () and press .*
- *Using the menus – Press , select  View then  Table.*

- b. Find the time when the highest temperature was first reached.

Here are three ways to scroll through the data table.

- *Using the table's vertical scroll buttons – Use the touchpad or arrow keys to move the cursor over the table scroll buttons and press .*
- *Using the table's slider bar – move the cursor over the black portion of the slider, press and hold  or press  followed by , and then use the touchpad or arrow keys to scroll the table. (Press  to release the slider.)*
- *Arrow through the table – Use the touchpad or arrow keys to move the cursor over any cell in the table and press  to highlight the table cell. Use the arrow keys to move through the table cells.*

Part II Events with Entry

13. Insert a new problem into your TI-Nspire document and insert a DataQuest Application.

*Inserting a new problem will allow you to retain the data from Part I as you do Part II. To add a new problem, press **doc** (ctrl) for a clickpad handheld), select **Insert** then **Problem**. You will notice that a new tab labeled **2.1** will be added to your document. To add the DataQuest app to this page, select **Add Vernier DataQuest**.*

14. Set up the data-collection parameters.

- a. Choose Collection Mode ► Events with Entry from the **Experiment** menu. Press **menu**, select **Experiment**, **Collection Mode**, and then **Events with Entry**.
*To add upper case letters, press **↑shift** followed by the desired letter. If you want all upper case letters, press **ctrl** followed by **↑shift** before typing any letters.*
- b. Enter **Name** as the Name and leave the Units field blank.
*To add upper case letters, press **↑shift** followed by the desired letter. If you want all upper case letters, press **ctrl** followed by **↑shift** before typing any letters.*
- c. Select OK.
Note the Keep button (Keep) located to the right of the Start Data Collection button. You will use this button to control when a sensor reading is recorded.

15. Start data collection (Start).

In Events with Entry mode, starting data collection does not cause a temperature vs. time graph to be created. In this mode, no temperatures will be collected until you click the Keep button (Keep). After you have started data collection, notice that the Keep button is active.

16. Measure the hand temperature of the first test subject.

- a. The first test subject should pick up the Temperature Probe and hold its tip in the palm of his or her hand, as shown in Figure 2. Watch the live temperature readout.
The current sensor reading will be displayed in the details box to the left of the graph.
- b. When the temperature stops rising, click the Keep button (Keep).
Like in Step 6, there are three ways to activate the Keep option. As you collect data, try the different options to see which you prefer.
- c. You will be prompted to enter the test subject's name. Enter the test subject's name, then select OK. The temperature and name have been saved.

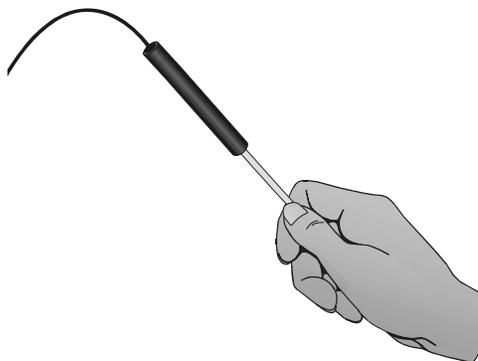


Figure 2

A data point representing the temperature for this test subject will be added to the graph. Since there is no numerical value associated with the name you typed, the row number associated with this data point is used to locate the point on the independent axis.

17. Cool the Temperature Probe down by placing it in the cold water from Part I. Monitor the temperature on the screen and remove it from the water when the temperature reaches 25°C.
18. Pass the Temperature Probe to the second test subject and repeat Steps 16–17.

*After collecting the second data point, it is recommend that you autoscale the graph. To do this, press **menu**, select **Graph** then **Autoscale Now**.*

19. Repeat Steps 16–18 until you have tested everyone in your group.

*Note: If you accidentally select Stop Data Collection instead of Keep, restart data collection and choose the option to **Append** the data to the latest data set.*

20. Stop data collection.

In order to perform any analysis on the data points, you must stop data collection.

21. Record your data in the data table. It may be necessary to add additional rows to your table.

You can find the data value by examining the data on the graph (see Step 10a) or by viewing the data table (see Step 12).

22. Find the average hand temperature for the subjects you tested by selecting Statistics from the  Analyze menu.

To perform a statistics calculation on your data, press , select  Analyze then Statistics.

23. Sketch or print copies of the graph as directed by your teacher.

DATA

Part I Time Graph

| Maximum temperature (°C) | Elapsed time (s) |
|-----------------------------|---------------------|
| | |

Part II Events with Entry

| Group member number | Group member name | Maximum temperature (°C) |
|---------------------|-------------------|-----------------------------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| Group average | | |

QUESTIONS

Part I Time Graph

Note: To get back to your data from Part I, you can do the following:

- Use the arrow keys – Press **ctrl** followed by **←** (**[←]**) to move to the previous page in your TI-Nspire document.
- Click on the Page number – Use the touchpad or arrow keys to move the cursor over the **1.1** page tab and press **↵**.

1. Describe the appearance of your graph in Part I.
2. Why is time plotted on the horizontal axis in this experiment?
3. Why is temperature plotted on the vertical axis?
4. Determine the Temperature Probe's response time. To do this, use your data to find how long it took for the Temperature Probe to reach the maximum temperature after moving it from the cold water to the hot water.
5. Explain how you determined your answer to Question 4.

Part II Events with Entry

6. Who had the hottest hand in your group?
7. Who had the coldest hand in your group?