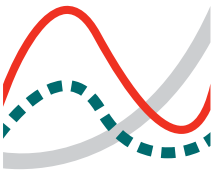


LabQuest® 2

Reference Guide

v1.01

SAFETY INFORMATION

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference and

(2) this device must accept any interference received, including interference that may cause undesired operation

RF Exposure Warning

The equipment complies with RF exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

IC Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Industry Canada - Class B This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled “Digital Apparatus,” ICES-003 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

RF exposure warning: The equipment complies with RF exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout interférence radioélectrique, même si cela résulte à un brouillage susceptible d'en compromettre le fonctionnement.

Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de ***Classe B prescrites dans la norme sur le matériel interférant-brouilleur: "Appareils Numériques," NMB-003 édictée par industrie Canada****. L'utilisation est soumise aux deux conditions suivantes: (1) cet appareil ne peut causer d'interférences, et (2) cet appareil doit accepter toutes interférences, y comprises celles susceptibles de provoquer un disfonctionnement du dispositif. Afin de réduire les interférences radio potentielles pour les autres utilisateurs, le type d'antenne et son gain doivent être choisie de telle façon que l'équivalent de puissance isotrope émis (e.i.r.p) n'est pas plus grand que celui permis pour une communication établie.* ***Avertissement d'exposition RF:*** *L'équipement est conforme aux limites d'exposition aux RF établies pour un environnement non supervisé. L'antenne (s) utilisée pour ce transmetteur ne doit pas être jumelés ou fonctionner en conjonction avec toute autre antenne ou transmetteur.*

ABOUT THIS GUIDE

LabQuest 2, released in March 2012, ships with a Quick-Start Guide intended to get you up and running with basic data collection and analysis. The LabQuest 2 Reference Guide is an extended guide designed as a comprehensive resource detailing the features, hardware, and software of LabQuest 2.

CONTENTS

I. GETTING STARTED WITH LABQUEST 2

What's Included

- LabQuest 2 interface
- Rechargeable battery
- Power adapter
- USB cable
- Quick-Start Guide
- Stylus (in unit)
- Stylus tether
- Logger Lite CD

Using LabQuest 2 for the First Time

Install the Battery

LabQuest 2 ships without the battery installed. To install the battery, follow these simple instructions.

- Turn LabQuest over and open the battery door by sliding the door lock and lifting the battery cover.
- Remove the small protective sticker covering the battery contacts.
- Install the battery with the label side up, ensuring the battery contacts align with the contacts on LabQuest.
- Replace the battery door and make sure the door lock clicks closed.

LabQuest with battery door removed

Charge for 8 Hours

We recommend charging the battery for eight hours prior to using LabQuest for the first time on battery power. To do this, connect the included power adapter to LabQuest and an AC power source. You can also charge LabQuest using the LabQuest 2 Charging Station (order code LQ2-CRG, sold separately).

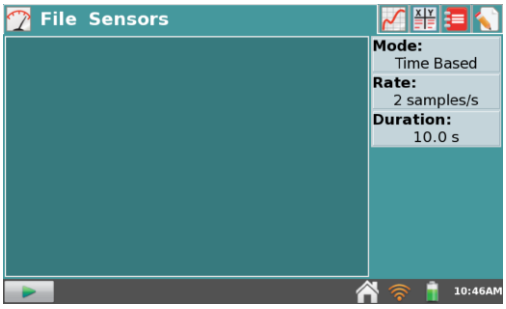
LabQuest uses a high-quality lithium-ion battery. This is the same chemistry used in premium laptop and cell phone batteries, and you can expect similar performance. There is never a need to condition the battery by regular full discharge/charge cycles.

It is safe to leave the battery charging indefinitely, and there is no need to fully discharge the battery before charging. Battery life will depend on the sensors used, but in most cases you can obtain six or more hours of use before recharging. We recommend charging LabQuest overnight to start the next day with a full charge. For more details about the battery, see LabQuest Battery.

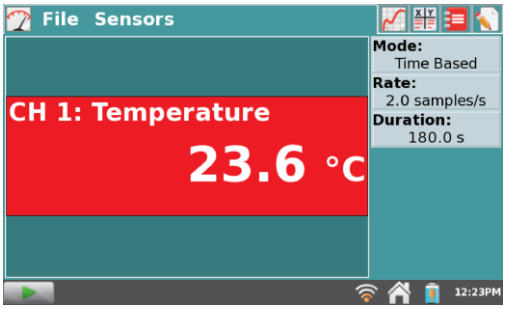
Quick Start to Data Collection

Follow these steps to get up and running quickly with basic data collection. For more details, see Data Collection.

1. Turn on LabQuest by pressing and releasing the power button located on the top edge of LabQuest. The LabQuest App will launch automatically.



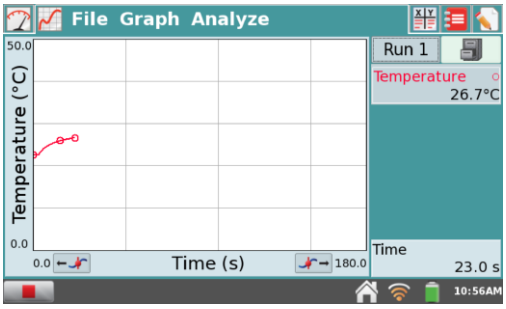
2. Connect an analog sensor to the CH 1 port on LabQuest (or connect a digital sensor to the DIG 1 port). LabQuest App will auto-ID the connected sensor and automatically set up the default collection rate for the sensor.



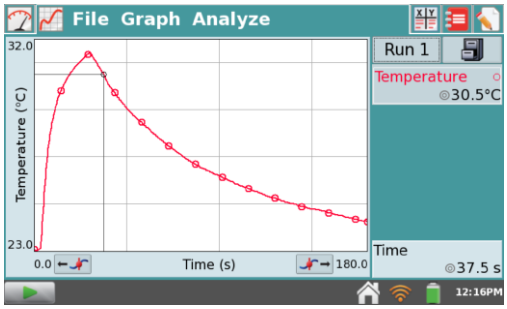
   ***Note**: If your sensor is an older-style (DIN) sensor requiring an adapter, the sensor will not auto-ID. Instead, you will need to set up the sensor manually. To do this, tap the Sensors menu and choose Sensor Setup. Next, tap the field labeled "No Sensor" adjacent to the appropriate port to view a list of sensors. Tap to select the sensor.*

3. Next, tap Collect  . Data collection will begin and LabQuest will graph the data collection in real time.

   You can stop collection early by tapping Stop  .



4. Once data collection is complete, the graph autoscales to the data. Tap the graph to examine a point of interest. The coordinates of the point are shown in the pane to the right of the graph. Tap another point or tap the Examine buttons to move the cursor left and right .

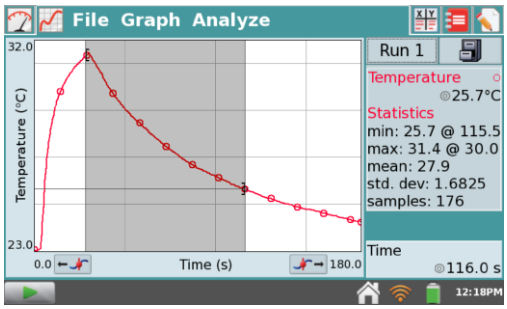


5. To select a region of data for analysis, tap-and-drag across the graph to highlight the desired region.

   ***Note**: To analyze all of the data, you do not need to select a region.*

   Statistics

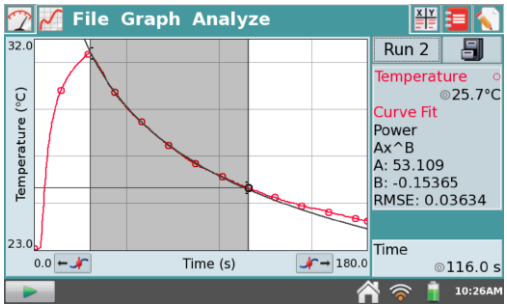
   To view statistics for the selected data, tap Analyze on the Graph screen, then choose Statistics. Tap the checkbox to select a data set. The statistics information is then displayed in the panel to the right of the graph.



   To remove the displayed statistics, tap Analyze on the Graph screen, choose Statistics, then tap the checkbox to unselect the data set.

   Curve Fit

   To fit a curve to the selected data, tap Analyze on the Graph screen, then choose Curve Fit. Tap the checkbox to select a data set. On the Curve Fit screen, tap Choose Fit, then choose the type of equation you would like to fit to the data. LabQuest App will automatically determine the fit coefficients. A preview of the fit applied to the data

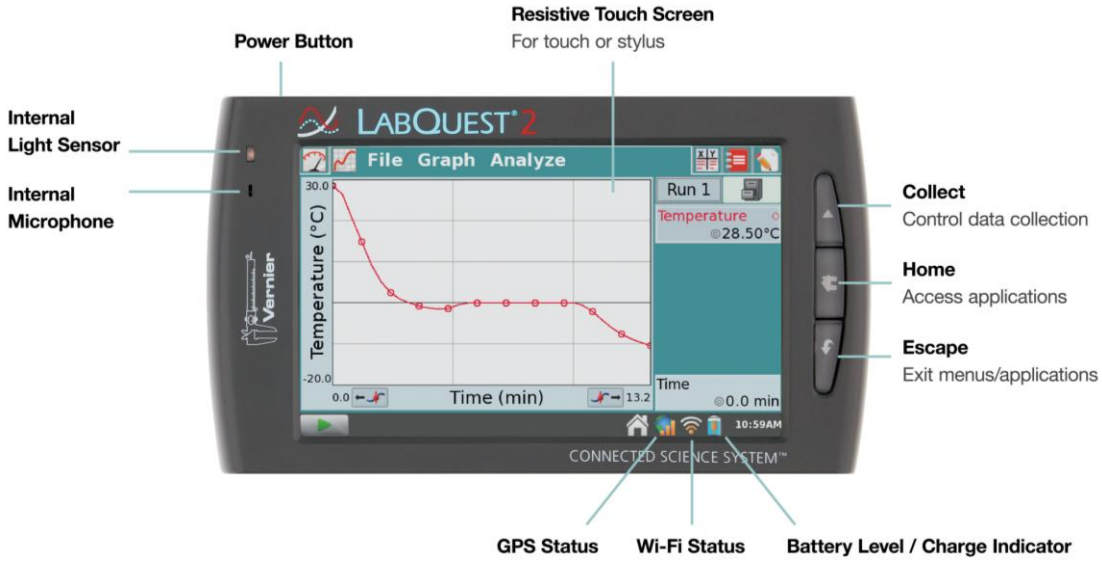


   ***Note**: The Curve Fit coefficients cannot be manually adjusted. To enter your own parameters, see the sub-section Model within Data Analysis.*

   On the Curve Fit screen, tap OK to apply the fit and return to the Graph screen.

   To remove the fit, tap Analyze on the Graph screen, choose Curve Fit, then tap the checkbox to unselect the data set.

II. LABQUEST HARDWARE



Once LabQuest 2 is connected to AC power or the battery has been charged, press the power button located on the top of the unit, near the left edge. LabQuest will complete its booting procedure and then launch the LabQuest App by default, as shown above. If the screen does not light after a moment, connect the power adapter to LabQuest and to an AC power source and try the button again.

Power Button

- **Power on** – If the screen is off for any reason (LabQuest is off, asleep, or the screen has turned off to conserve battery power) pressing and releasing the power button once will turn LabQuest back on. If LabQuest was off, LabQuest will also complete its booting procedure which takes about a minute and then display LabQuest App.

- **Sleep/wake** – When LabQuest is on, pressing and releasing the power button once will put LabQuest into a sleep mode. Note that the sleep mode does not start until you release the power button. In this mode, LabQuest uses less power but the battery can still drain. This mode is useful if you are going to return to data collection again soon, in which case waking LabQuest from sleep is quicker than a cold boot. To wake LabQuest from sleep, simply press and release the power button.

- **Shut down** – To shut down LabQuest, hold the power button down for about five seconds. You will then see a message indicating that LabQuest is shutting down. Release the power button, and allow LabQuest to shutdown. To cancel the shutdown procedure at this point, simply tap Cancel. You can also shutdown LabQuest by tapping Home, tapping the System folder, then tapping Shut Down.

- **Emergency Shutdown** – If you hold the power button down for about eight seconds, the unit will power off uncleanly. This is the same as pulling the battery out of the unit while it is running. This is not recommended unless LabQuest is frozen, as you may lose your data and potentially cause file system corruption.

Touch Screen

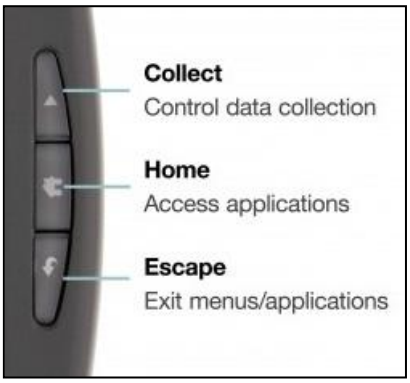
LabQuest has an LED backlit resistive touch screen that quickly responds to pressure exerted on the screen. LabQuest is controlled primarily by touching the screen. The software is designed to be finger-friendly. In some situations, you may desire having more control for precise navigation. In such cases, we recommend using the included stylus.

If you are having trouble viewing the color screen or are using LabQuest outside in bright sunlight, we recommend changing to the High Contrast mode. From the Home menu, tap Preferences, then Light & Power. Tap the checkbox for High Contrast to enable this mode.

Hardware Keys

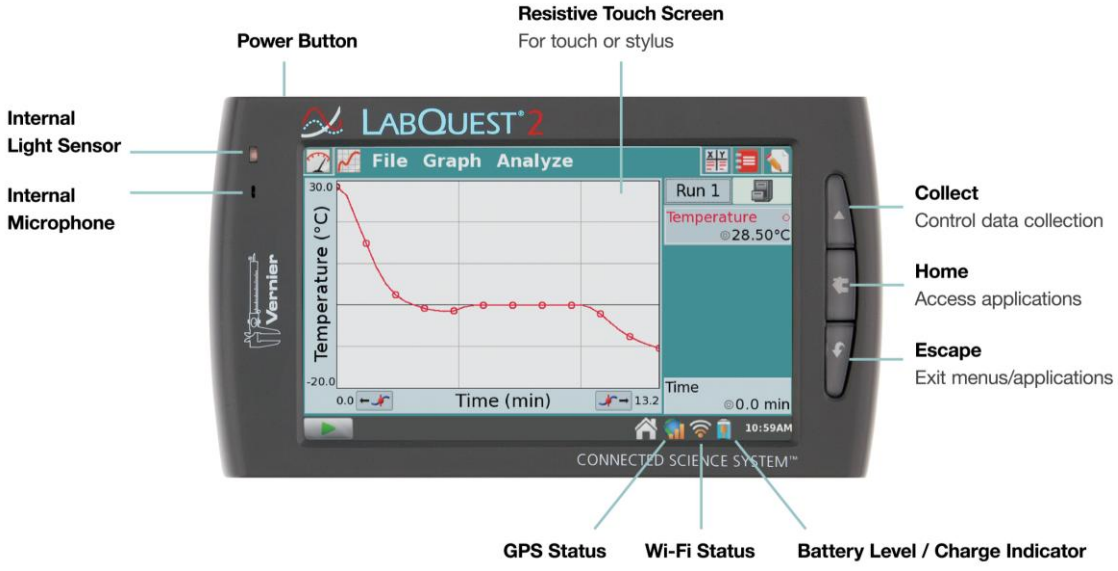
In addition to using the touch screen, the three hardware keys can also be used to control your LabQuest.

- **Collect** – This key starts and stops data collection within LabQuest App
- **Home** – This key launches the Home screen
- **Escape** – This key closes most applications, menus, and exits dialog boxes without taking action (i.e., cancels dialog boxes)



Sensor Ports

LabQuest has three analog sensor ports (CH 1, CH 2, and CH 3) for analog sensors such as our pH Sensor, Temperature Sensor, and Force Sensor. Also included is a full-size USB port for USB sensors, USB thumb drives, and USB printers. In addition to the power button, the top edge of LabQuest has two digital sensor ports (DIG 1 and DIG 2) for Motion Detectors, Drop Counters, and other digital sensors.

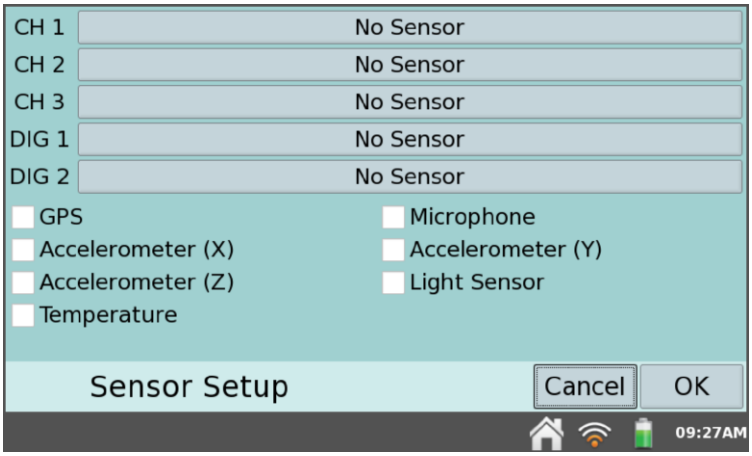


Also located on the top edge are the audio ports and a micro SD card slot for expanding disk storage. On the side opposite of the analog ports, there is a stylus storage slot, an AC power port for recharging the battery, and a mini USB port for connecting LabQuest to a computer. In between these ports, there is a serial connection for charging the unit in a LabQuest 2 Charging Station (order code LQ2-CRG, sold separately), and a stylus tether attachment point.

Internal Sensors

LabQuest also has several built-in sensors, including a GPS, microphone, accelerometers, temperature sensor, and relative light sensor.

To enable internal sensors within LabQuest App, tap Sensors, and choose Sensor Setup. Within the Sensor Setup dialog box, tap a checkbox to enable the associated sensor. Then tap OK to return to the LabQuest App Meter screen.



Sensor Setup dialog box

To enable internal sensors within LabQuest App, tap Sensors, and choose Sensor Setup. Within the Sensor Setup dialog box, tap a checkbox to enable the associated sensor. Then tap OK to return to the LabQuest App Meter screen.

- **GPS** – The internal GPS collects latitude, longitude, and altitude readings, and may be used with other sensors. You can choose units of decimal degrees, degree minutes, or UTM. *Note: It may take up to 15 minutes to acquire an initial signal outdoors. We do not recommend using the GPS indoors.*

- **Microphone** – The internal Microphone is located on the top surface of LabQuest and measures waveforms. *Note: This sensor cannot be used with external sensors.*

- **Accelerometers** – The Accelerometers measure accelerations up to ±2 g in the x-, y- and z-axis directions.

- **Light Sensor** – The internal Light Sensor is located on the top surface of LabQuest. This is an uncalibrated sensor which measures visible light intensity.

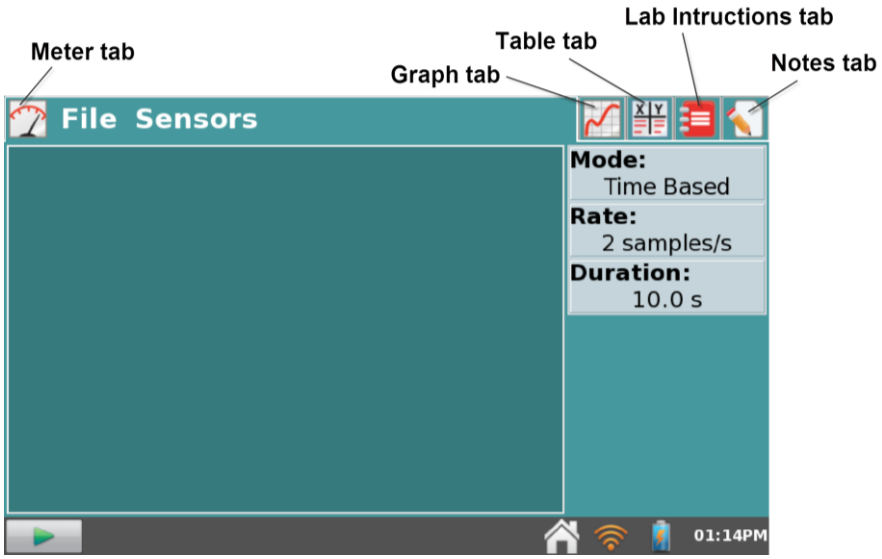
- **Temperature** – The internal Temperature Sensor monitors ambient temperature.

III. LABQUEST APP

The data-collection and analysis software, LabQuest App, is the heart of your LabQuest. When you turn on LabQuest, the LabQuest App starts automatically. If the LabQuest App is not showing on your screen, tap Home, and tap LabQuest App.

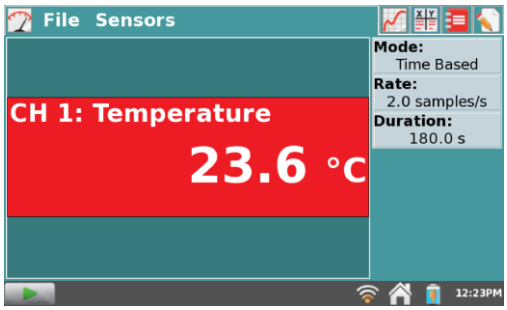
Navigating LabQuest App

The LabQuest App has five different screens. Tap on the desired tab to display the associated screen.

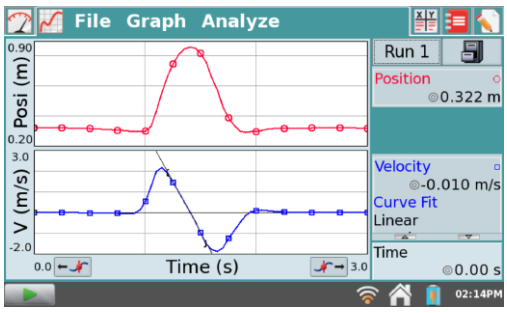


LabQuest App

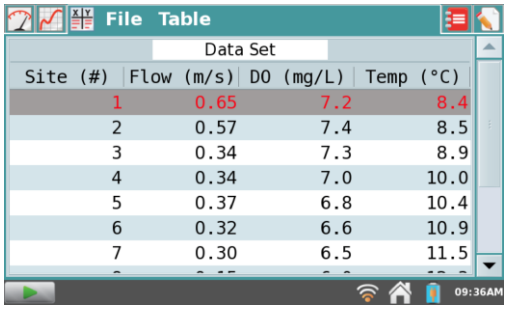
- **Meter screen** – Set up sensors, data-collection parameters, and see a digital meter for your connected sensors. For a detailed description of how the Meter screen is used for data collection, see Data Collection.



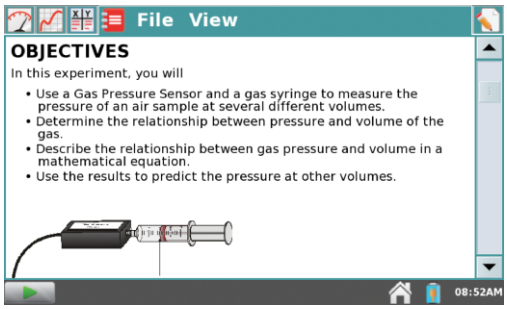
- **Graph screen** – See a graph of your data and perform statistical analysis of your data, including curve fits. For a detailed description of how the Graph screen is used for data analysis, see Data Analysis.



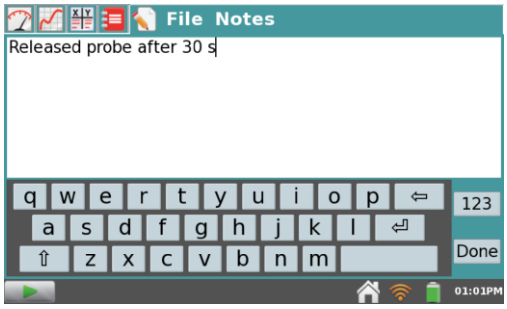
- **Table screen** – See a tabular representation of your data, create manual and calculated columns, and manually enter data. For a detailed description of how the Table screen is used for data analysis, see Manipulating Data from the Table Screen.



- **Lab Instructions screen** – Access one of over 100 preloaded labs for paperless labs (more labs are available online). For detailed instructions for how to add additional labs, see Viewing Vernier Lab Instructions.



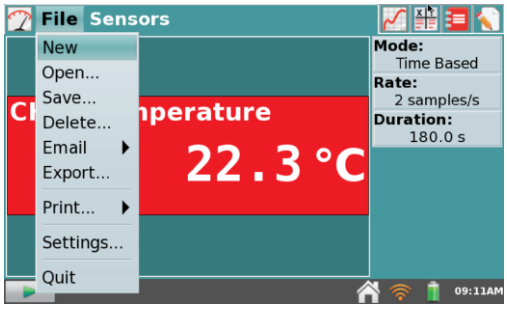
- **Notes screen** – Record observations about your experiment. For more information, see Adding Notes to Your Experiment.



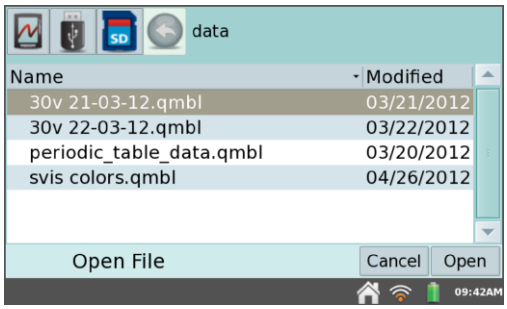
File Menu

A LabQuest App file can contain data collection settings, graphs, data tables, analyses, and even notes. These files have a *.qmbl* extension and can be saved to the internal storage space on LabQuest or to an external storage space such as a USB thumb drive or micro SD card. LabQuest App files can also be opened and manipulated on a computer with our Logger *Pro* software.

All five tabs within LabQuest App share the same File menu which is similar to the File menu on a computer. From the File menu, you can perform a number of tasks related to LabQuest App files, such as opening, saving, and closing files, adjusting file settings, printing, and more. These are described in more detail as follows.



- **New** – Choosing New from the File menu will close the existing file and open a new file. If you have unsaved data, you will be prompted to either save or discard the data before continuing. This is an easy way to reset the data collection mode and calibrations back to default values.



- **Open** – Choosing Open from the File menu displays a list of files that you have saved on LabQuest. To open a file, tap on the file name, then tap Open. To open a file from an external storage source, tap the source icon (USB, SD) to display the files available on that source, then tap on the file name, and tap Open.

- **Save** – Choosing Save from the File menu displays the Save As dialog box where you can tap on a source icon (USB, SD, LabQuest) to select a destination, then tap in the File name field to assign a name to the file.

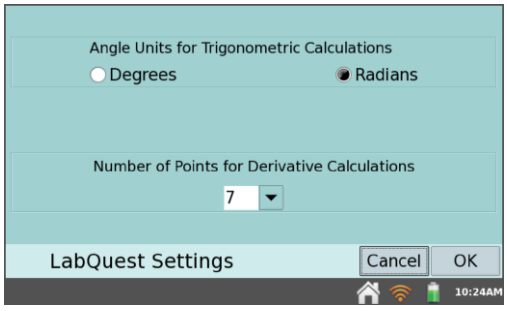
- **Delete** – Choosing Delete from the File menu displays a file list similar to that accessible by choosing open. Tap on a source icon (USB, SD, LabQuest) to select the source of the file to be deleted, then tap the file name to be deleted, then tap Delete. You can delete only one file at a time.

- **Email** – Choosing Email from the File menu allows you to email the Data File, Graph, Text File, or Screen Shot from the current file, if you are connected to a wireless network with Internet. For detailed instructions on setting up this feature, see Emailing from LabQuest.

- **Export**– Choosing Export from the File menu allows you to export the currently opened data file in a text format for use with other applications. Tap on a source icon (USB, SD, LabQuest) to select a destination, then tap OK to complete the export.

  A typical use of this feature is to export a text file to an SD card or a USB flash drive for further data manipulation on a computer with a spreadsheet program. The exported file contains all column values from all runs in the current session, delimited by tabs. For more detailed instructions on using this feature, see Storing LabQuest App Files.

- **Print** – Choosing Print from the File menu allows you to print the Graph, Table, Lab Instructions, Notes, or Screen from the current file to a USB or Wi-Fi-enabled printer. For detailed instructions, see USB Printing and Wirelessly Printing from LabQuest, respectively.



- **Settings** – Choosing Settings from the File menu allows you to adjust file settings for the current session. These settings are not global; rather, they are specific to and saved within the LabQuest file. These settings return to the default upon choosing New from the File menu.
  - **Angle Units for Trigonometric Calculcations** - Calculated columns, curve fits, and modeled functions may use trigonometric calculations; choose Degrees or Radians here. The default is set to radians.
  - **Number of Points for Derivative Calculations –** Calculated columns, curve fits, modeled functions, and even the automatic setup for sensors (e.g., Motion Detectors) may use numerical derivatives. The algorithm for such derivatives utilizes a user-defined number of points. The default value of seven points is good for many

experiments but you may want to choose a larger number for human-scale Motion Detector experiments (e.g., our Motion Match lab), or a smaller number for cart-based Motion Detector experiments (e.g., our Impulse and Momentum lab).

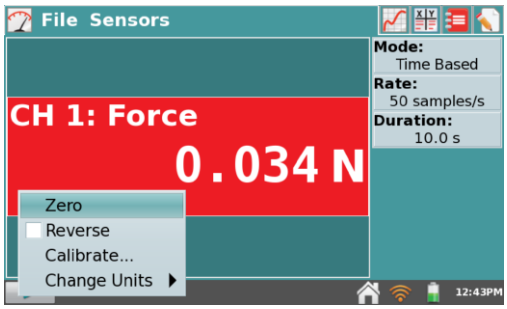
- **Quit –** Choosing Quit from the File menu exits the LabQuest App. Since other applications can be run simultaneously with LabQuest App, there is typically no need to quit the LabQuest App during standard use.

Data Collection

The Meter screen, selectable by tapping the Meter tab, is the default view for the LabQuest App. Use the Meter screen to set up your sensors and data-collection parameters, as well as to monitor a real-time reading of your sensor.

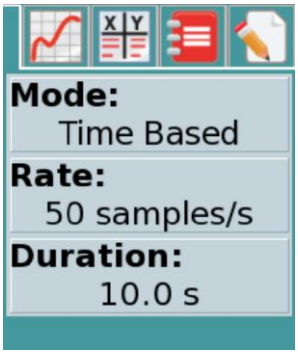
Digital Meters

A digital meter for each connected sensor is shown on this screen. Tap on a meter to change the sensor's settings. The available options will depend on the sensor and may include options such as change units, calibrate, zero, and reverse. These options can also be accessed by tapping Sensors, and choosing the desired option from the menu.



Data-Collection Summary

A summary of the data-collection settings (Mode, Rate, Duration) is shown in the pane at the right of the Meter screen.



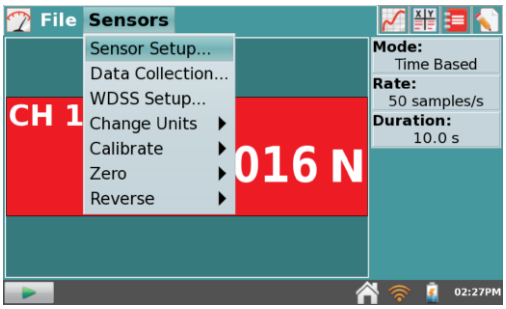
For most sensors, the default data-collection mode is Time Based. The default collection rate for the connected sensors is set up automatically when LabQuest identifies the sensor. To modify the data-collection settings, tap on the summary box. Alternatively, you can tap Sensors, then choose Data Collection. For detailed descriptions of data-collection modes and parameters, see Data-Collection Settings.

Data-Collection Controls

Tap the Collect button displayed in the lower right corner of any LabQuest App screen to start data collection. During data collection, this button changes to a Stop button which you can tap at any time to end data collection.

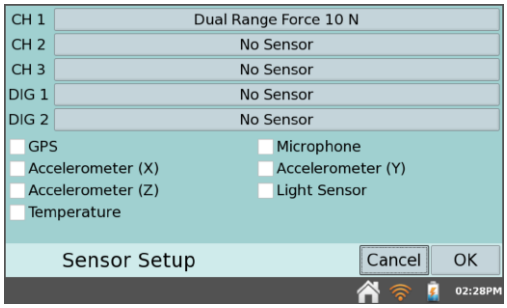
During selected data-collection modes (e.g., Events with Entry), a Keep button will appear to the right of the Stop button. In this mode, you must tap to record the data point in the data table. For more information, see Events with Entry.

Data-Collection Settings



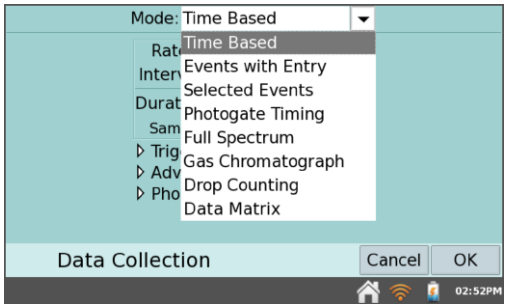
The Sensors menu gives access to detailed setup controls. Use this menu to set up the internal sensors, non-auto-ID sensors, and the Wireless Dynamics Sensor System (WDSS). You can also use this menu to change the data collection parameters and specific sensor settings.

- **Sensor Setup** – Choosing Sensor Setup from the Sensors menu displays a dialog box showing which sensors are currently connected. If you are using a sensor that does not auto-ID, you will need to manually set up the sensor. To do this, tap on the field displaying "No Sensor" for the channel to which your sensor is connected. In response, LabQuest displays a list of possible sensors. Tap to select the appropriate sensor. Then tap OK.

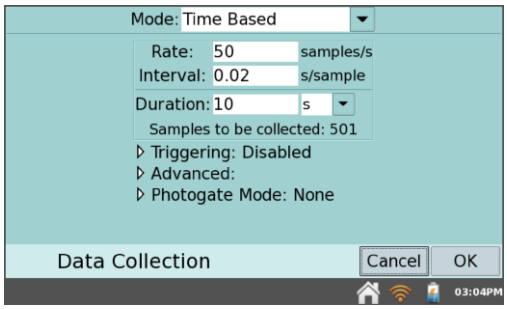


You can also activate (or deactivate) the internal sensors from the Sensor Setup. Check the box next to the desired sensor to make that sensor available for data collection.

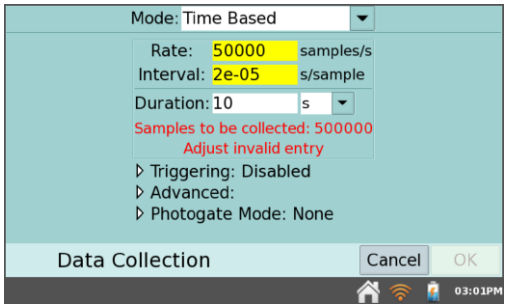
- **Data Collection** – Choosing Data Collection from the Sensors menu displays allows you to set the data-collection mode and associated parameters. The parameters listed will depend on the mode selected.



  - **Mode: Time-Based** – Time-based data collection is the default data-collection mode for most sensors. In this mode, sensor readings are recorded at regular time intervals.



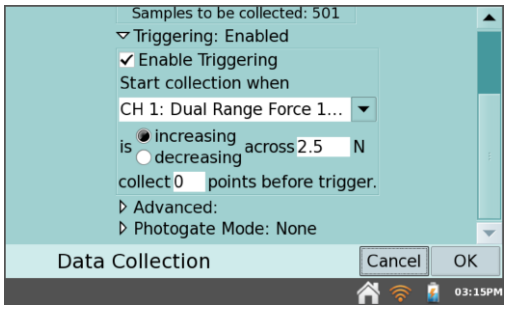
    Adjustable parameters for this mode include the rate (or interval) and the duration of data collection. The total number of samples to be collected based on these parameters will be displayed.



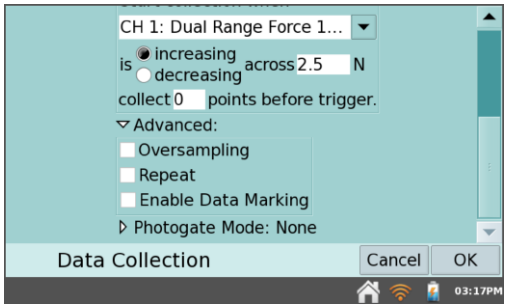
    Under some circumstances, the Rate and Duration fields may be highlighted in yellow or red. The *yellow* warning indicates that the rate has been set to value slower or faster than what is recommended for the connected sensor, or that the number of samples could lead

to performance issues. The *red* warning indicates one of the following: the rate has been set to a value slower or faster than what a connected device and/or sensor configuration can support; the number of samples exceeds the storage available; or, the number of samples exceeds 2000 (for rates faster than 80,000 samples per second).

Triggering – Triggering is only available in the Time Based mode, and can be enabled by simply tapping the associated checkbox. When enabled, LabQuest will wait for a trigger condition to be met before beginning data collection. The sensor name, the level, and the direction of change (increasing or decreasing) can all be set here. You can also set the number of points to be saved before the trigger condition is met.



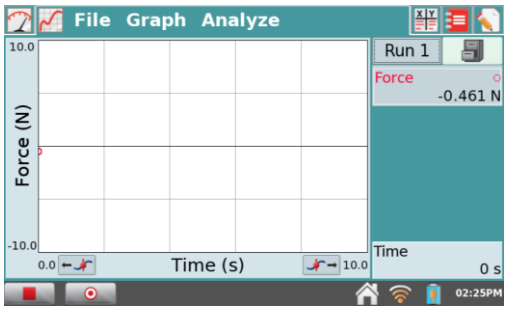
Advanced – The Advanced field has three options that can be independently enabled by simply tapping the associated checkbox.



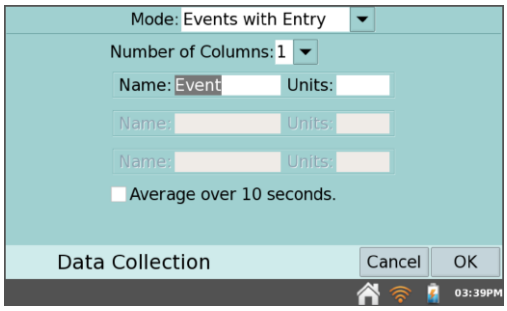
Oversampling can be used with data-collection rates less than ten samples per second. When Oversampling is enabled, the sensor will sample at a rate higher than the number of samples per second that you set, and then LabQuest averages those readings and records the averages in the data table. This setting can be used to reduce measurement noise by combining a burst of readings into one value. For example, oversampling can sometimes reduce the influence of unseen but real variations, such as as those from a flickering light source.

Repeat can be used with data-collection rates less than 250 samples per second. When Repeat is enabled, a new data-collection run is started as soon as the current run has ended. Data for each run is overwritten when a new run is started. This setting is helpful when doing exploratory investigations.

Enable Data Marking can be used to mark points of interest during a time-based data collection. When enabled, a Mark Data button will appear when data is being collected. Simply tap duing data collection to mark that particular point as a point of interest. After completing data collection, data marks can be named as part of the analysis process.



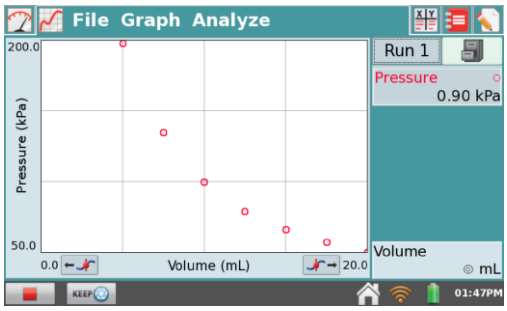
- **Mode: Events with Entry** – Sometimes experiments do not depend on time, but depend on the setting of another quantity. For example, in a Boyle's law experiment one wants to know the pressure as a function of the volume of gas. Thus, in Events with Entry mode, no time information is recorded.



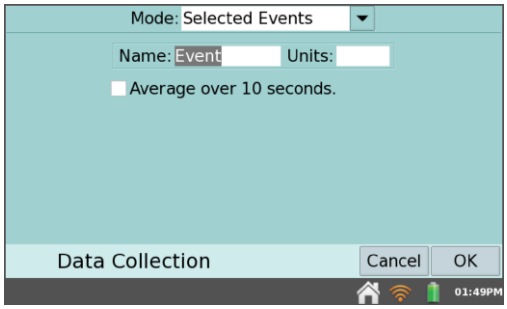
  When setting up this mode, you can enter a name and units for the entry, or independent variable, column. One or two additional columns of data can be entered as you collect data. You also have an option to average data over ten seconds and report the averaged reading.

  In Events with Entry mode, once data collection is started, a Keep button 

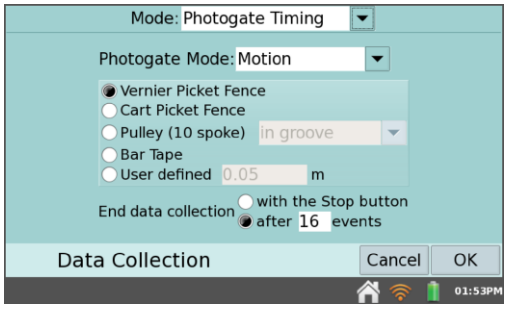
appears. Tap the Keep button to record the sensor value (e.g., gas pressure in the Boyle's law experiment). In response, LabQuest will prompt for the Entry value (e.g., gas volume in the Boyle's law experiment). Sensor values are plotted versus the Entry values, as shown in the screenshot at right.



- **Mode: Selected Events** – Selected Events is similar to the Events with Entry mode, except that entries of 1, 2, 3… are entered automatically for you. No time information is recorded in Selected Events mode.

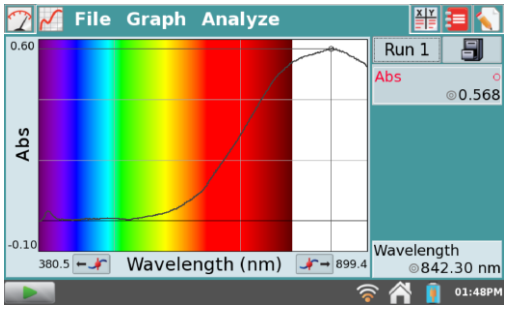


- **Mode: Photogate Timing** – Photogates require a different set of timing options. When a photogate is detected, LabQuest switches to the data-collection mode Photogate Timing mode.



  You have two options for ending data collection in this mode: the collection runs until the user taps Stop, or the collection can be set to end after a defined number of events. A block/unblock pair counts as two events. Various photogate modes are available to set what parameters LabQuest calculates from the block and unblock times. For more information, see www.vernier.com/til/1623/

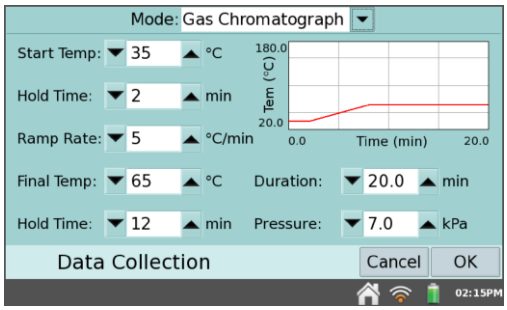
- **Mode: Full Spectrum** – Full Spectrum data-collection mode can only be used with Spectrometers and is the default mode when a Spectrometer is connected. In Full Spectrum mode, Intensity, Absorbance, Fluorescence (SpectroVis Plus only), or %Transmittance can be measured as a function of wavelength.



  Detailed instructions for setting up data collection with spectrometers are included in each of our spectrometer labs.

- **Mode: Gas Chromatograph** – LabQuest 2 supports the use of the Vernier Mini Gas Chromatograph (GC). When a Mini GC is plugged in the LabQuest 2 USB port, the software will automatically identify the Mini GC and select the Gas Chromatograph mode. This mode should not be entered unless a Mini GC is attached.

  In this mode, various parameters are defined for the user to establish a temperature and pressure profile adequate for the current experiment. When the mode is first entered, a set of default parameters is displayed. If you wish to change these parameters, tap in the parameter field to enter a new value or adjust the default value by tapping the arrow buttons. These values will be reflected in the preview of the time-dependent temperature graph displayed at right. After setting the parameters, tap OK to initiate the Mini GC warm up.

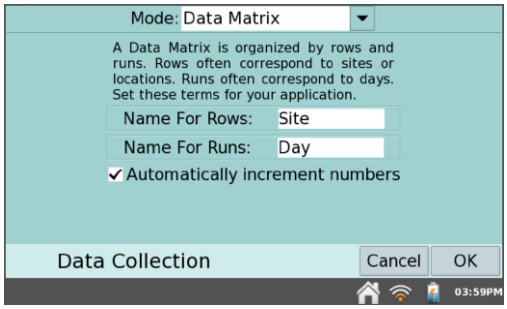


  ***Note**: A new message will appear, "Do not inject until GC is ready." The Mini GC will take a few minutes to warm up and stabilize. When the Mini GC is ready for injection, the message will read, "Inject and select Collect simultaneously."*

  For more detailed information on the Vernier Mini Gas Chromatograph, see www.vernier.com/gc-mini/

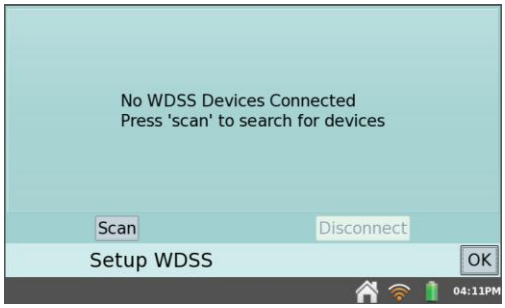
- **Mode: Drop Counting** – In this mode, you can choose to calibrate drops so that the volume of titrant is recorded in units of milliliters. Choose Calibrate from the Sensors menu. The Vernier Drop Counter is set to use a default calibration of 28 drops/mL. If you choose to calibrate the sensor, the volume of an individual drop will be determined by the number of drops that pass through the Vernier Drop Counter and dividing by the total volume of the drops. Follow the instructions on the screen to complete a custom calibration. Alternately, the Equation tab allows you to input a previously determined value for drops/mL. Enter the drops/mL value (e.g., 28.0), then choose OK.

- **Mode: Data Matrix** – This mode is primarily used for field work. It provides a way to collect data referenced to two parameters such as the locations of the sampling sites and the dates on which they were sampled. It also allows you to collect data from an unlimited number of sensors by permitting sensors to be swapped in and out of LabQuest during data collection. For more detailed information, see www.vernier.com/til/2366/

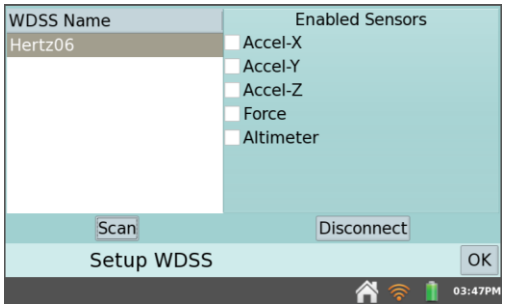


- **WDSS Setup** – Selecting WDSS Setup from the Sensors menu allows you to scan for, select, and configure Wireless Dynamics Sensor Systems.

  You can then choose to scan for any available WDSS devices. This scan may take some tens of seconds, and may have to be repeated several times to find all available WDSS units.



  A list of detected WDSS is displayed. Tap to select the desired WDSS by name and tap OK. Next, select which of the five sensor channels to be used (and/or scan for additional WDSS units, or disconnect from a connected unit). Tap OK to enable sensors.



  Once sensors are enabled, they can be controlled like other sensors in terms of data collection rate and duration.

  ***Note**: WDSS cannot be set up for remote data collection using LabQuest. Use Logger* Pro *on a computer to set up WDSS for remote use.*

- **Change Units** – In some cases, you may have the option to display the sensor data in another set of units. Choosing Change Units from the Sensors menu allows you to select a different set of units. Choosing a new unit will change all existing runs for that sensor to the new unit, as well as any subsequent runs. If this feature is grayed-out in the menu, then the data for that particular sensor cannot be displayed in another set of units.

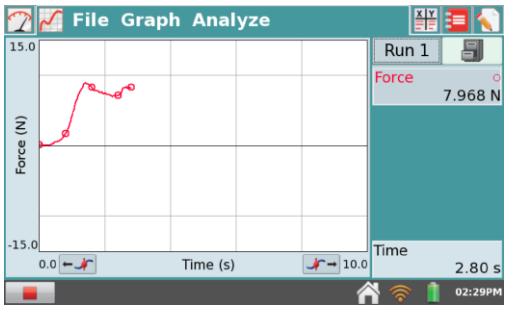
- **Calibrate** – Most sensors do not need to be calibrated, as a factory calibration for that sensor is read from the sensor when LabQuest identifies it. However, some sensors do require calibration and you will use the Calibrate tool accessible from the Sensors menu. In such cases, follow the detailed calibration instructions provided in the booklet included with the sensor. Booklets are also available online at: www.vernier.com/support/manuals/

- **Zero** – Choosing Zero from the Sensors menu will set the current sensor reading to zero by adding an offset to the current reading. Not all sensors can be zeroed.

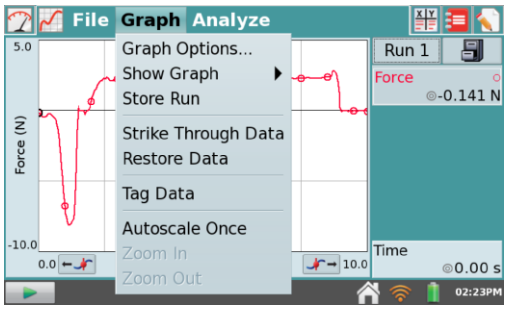
- **Reverse** –Some sensors read both positive and negative values. For example, the Dual-Range Force Sensor reads positive values when pulled, and negative when compressed, be default. Choosing Reverse from the Sensors menu will swap the sign of the readings with respect to the default settings. Not all sensors can be reversed.

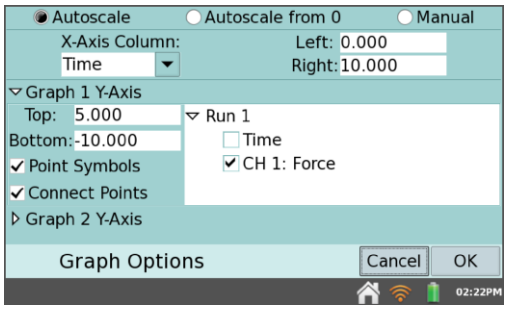
Graph Settings

LabQuest App automatically switches to the Graph screen when data collection begins. From this screen, you can adjust graph settings in real-time during data collection, or after data collection has ended. You can choose what is plotted, how the graph is scaled, how the data is formatted, and choose data to ignore by striking through the values.



- **Graph Options** – To control how the data are graphed, tap the Graph menu and choose Graph Options. Here you can choose the columns used for the x- and y-axes and the axes limits.





Selecting **Autoscale** will cause the graph range to adjust to the data range after data collection ends. Autoscale from 0 does the same, but includes the origin. Manual scaling will respect values entered in the range limits, unless incoming data falls outside the range. In this case the range will expand to include the data. To enter range limits, tap in each field and use the keyboard to enter numeric values.

The **Point Symbols** option is selected by default, and will surround some, but not all, of the points with a circle. This allows easy identification of a trace by the corresponding mark in the graph legend. Simply tap the associated checkbox to disable this feature.

The **Connect Points** option connects data points with straight-line segments. These lines help the eye follow the data trend, but in some cases are not appropriate. On by default, unchecking Connect Points will leave only the actual points on the graph.

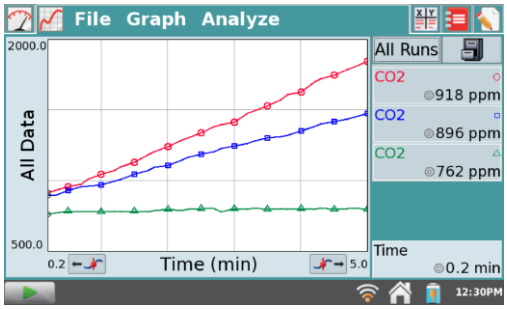
To specify which columns are being graphed, tap the desired column under the proper run heading to place a checkmark.

LabQuest can display a single graph, or two graphs. The two graphs share a common x-axis column and range. Tap the triangle next to Graph 1 Y-Axis or Graph 2 Y-Axis to show or hide the settings for that axis. If no column is selected for Graph 2, only one graph will be drawn.

When you are done setting Graph Options, tap OK to return to the Graph screen.

- **Show Graph** – Choosing Show Graph from the Graph menu lets you quickly jump between displaying one or two graphs. You can also choose the Full Width option, to remove the data collection summary box and maximize the graphs on the screen.

- **Store Run** – You can collect several runs for comparison. Choosing Store Run from the Graph menu allows you to save the current run, and then proceed with more data collection. As a shortcut, you can simply tap the File Cabinet.



Collect another run by tapping the Collect button. Your new run is displayed on the graph. To see your first run, tap the Run 2 button to the left of the Filing Cabinet, and select either Run 1 or All Runs. In this way, you can gather multiple runs for comparison, and view just the ones you want.

Data Analysis

In addition to data collection, LabQuest App also allows you to analyze the data within LabQuest.

Data can be analyzed from the Graph screen, selectable by tapping the Graph tab, as well as the Table screen, selectable by tapping the Table tab. Several common analysis features are described in greater detail, below.

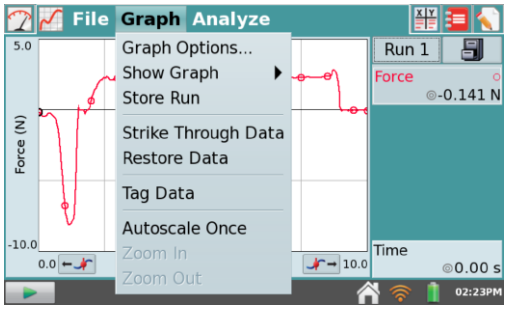
Examining Data on the Graph Screen

To examine data from the Graph screen, tap on a data point of interest. The Examine cursor jumps to the data point with the nearest x-value to that which you tapped. Cursor lines highlight the x- and y-axis values, and the right-side readouts display the associated numerical values of the point. You can make fine adjustments to the cursor location by using the Left Examine Button and Right Examine Button located on either side of the horizontal-axis label.

In some cases, you may want to examine data for a particular region on the graph. To select a portion for analysis, simply tap and drag across the desired region. You can adjust the trailing endpoint of the selected region using the Examine Buttons, if needed. Or, for greater control, you can optionally use the stylus.

Adjusting the Graph View

You can adjust the graph view in real time during data collection, or after data collection has ended, by applying one of the following actions from the Graph menu.



- **Autoscale Once** – Tap Autoscale Once will quickly reset the axes of the currently selected graph based on the data. It is an easy way to automatically scale both axes.
- **Zoom In** – Select a region on the graph, then tap Zoom In to automatically adjust the axes for viewing the selected region.
- **Zoom Out** –Tap Zoom Out to undo a Zoom In and return the graph axes to the previous settings. If Zoom In is used several times, Zoom Out will undo each Zoom In, one at a time.
- **Graph Options** – Tap Graph Options to manually adjust graph settings. To adjust the graph view, change the values in the Left and Right fields for the x-axis and y-axis.

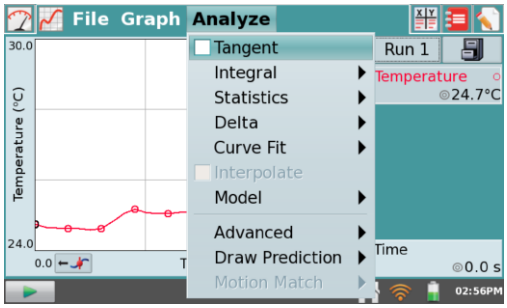
Manipulating Data from the Graph Screen

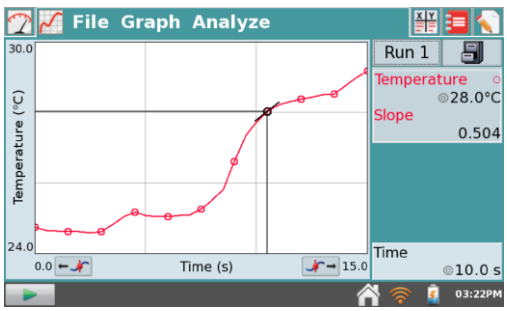
You can manipulate data from the Graph screen or from the Table screen. If using the Graph screen, first tap to select a data point of interest or tap-and-drag to select a region of data. Then, choose the desired tool from the Graph menu. Upon tapping on the tool, the action will be applied to the data.

- **Strike Through Data** and **Restore Data** – Use these tools to ignore/restore selected data. Struck data are ignored for analysis and graphing, and the graph will update accordingly. To restore all data, tap the Graph menu and choose Restore Data.
- **Tag Data** – Use this tool to tag a data point with a comment. After selecting the point and tapping Tag Data, a circle will be displayed on the graph to "tag" the data. To add a comment, tap in the info box at the right and enter a comment into the blank field.

Analyzing Data from the Graph Screen

The Analyze menu on the Graph Screen gives you access to additional tools such as tangent lines, integrals, statistics, and curve fits. To apply one of these tools, tap the Analyze menu and tap to select the desired tool. If prompted, select a column or data set to which the analysis will be applied.



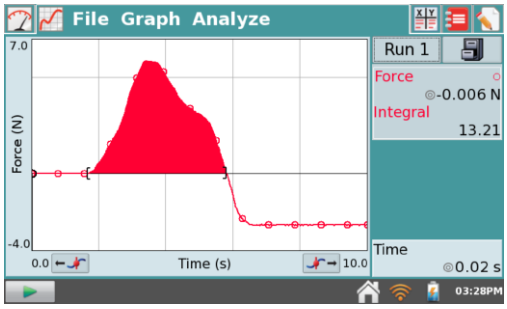


Upon enabling an analysis tool, a summary of analysis information is displayed at the right. Scroll arrows will appear, if needed. Optionally tap the summary to display the values on a detail dialog for ease of reading.

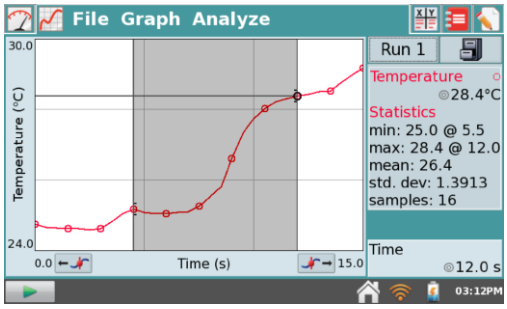
The following analysis tools are available from the Analyze menu.

- **Tangent** – The Tangent mode enhances the Examine cursor by adding a tangent line and numeric display of the slope as you tap different locations on the graph.

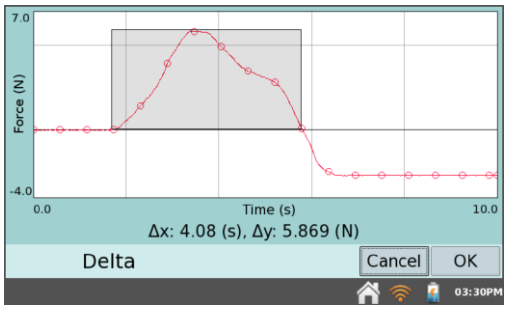
- **Integral** – The Integral tool numerically integrates graphed data. Select a region, if needed, then choose Integral from the Analyze menu. Enable the tool by tapping on the displayed sensor or column name. The integral will be drawn, and the numeric result will be displayed to the right of the graph.



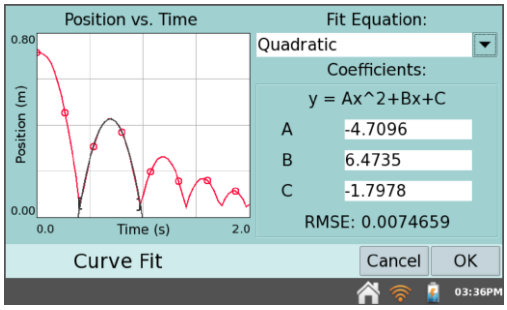
- **Statistics** – The Statistics tool displays statistics for graphed data. Select a region, if needed, and then choose Statistics from the Analyze menu. Enable the tool by tapping on the displayed sensor or column name. Descriptive statistics will be displayed to the right of the graph. If a region is selected, brackets are drawn to indicate the region used for calculations



- **Delta** – The Delta tool opens a preview window where you can examine x- and y-deltas. Choose Delta from the Analyze menu to open the preview window. Then tap-and-drag to create a box overlaid on the graph. The vertical side of the box yields Δy, and the horizontal side of the box yields Δx. Tap OK to keep these values and display the box on the Graph screen. To exit the Delta tool without displaying the box on the Graph screen, tap Cancel.



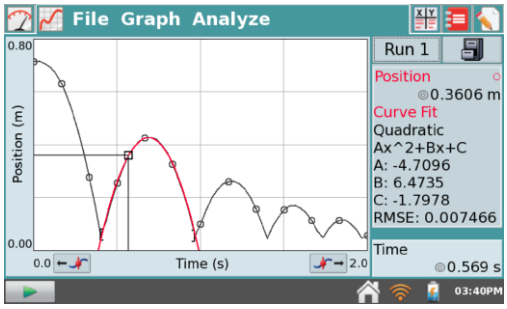
- **Curve Fit** – The Curve Fit tool allows you to automatically fit a chosen function to your data. If a region of the graph is selected, only that region is used for fitting. If there is no selection, the entire graph is used.



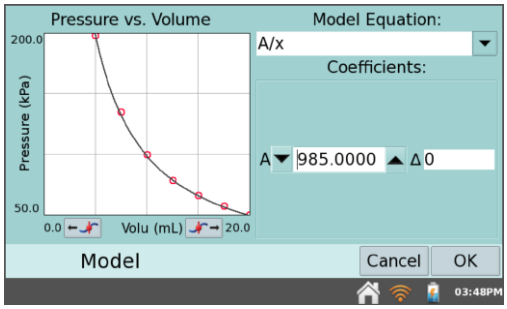
Enabling the curve fit displays a Curve Fit dialog box. Choose the desired fit equation from the drop-down menu. Upon choosing the fit equation, LabQuest will display the fit in the preview graph at left. The fit coefficients and Root Mean Square Error (RMSE) are also displayed. Tap OK to keep this fit and display the curve on the Graph screen. To exit the Curve Fit tool without applying the curve, tap Cancel.

Tip: The RMSE (root mean square error) is a measure of how well the fit matches the data. The smaller the RMSE, the closer the data are to the fitted line. The RMSE has the same units as the y-axis data.

- **Interpolate** – Once you have performed a curve fit, you can use the Interpolate function to read values off of the fitted function. Choose Interpolate from the Analyze menu to enable the tool, then tap on the graph. The lines associated with the Examine cursor now locate a position on the fitted function, and coordinates along the fitted line are shown in the summary box at the right of the graph. You can tell that LabQuest is in the Interpolation mode by the square cursor shown at the Examine point.



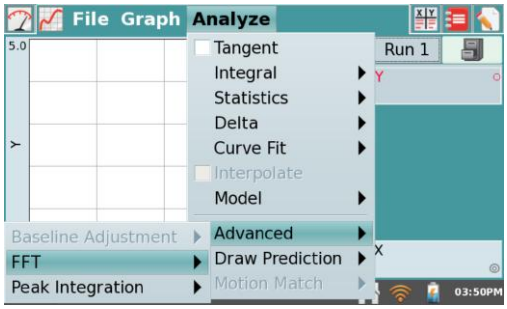
- **Model** –Model allows you to manually fit a chosen function to your data. Enabling the Model tool displays a Model dialog box where you can choose the desired model equation from the drop-down menu.



  The model parameters (e.g., A, B and C) are adjustable. Change them by direct entry or by using the up and down arrows. Upon choosing the equation, LabQuest will display the modeled function in the preview graph at left. Tap OK to keep this function and display the modeled function on the Graph screen. To exit the Model tool without applying the function, tap Cancel.

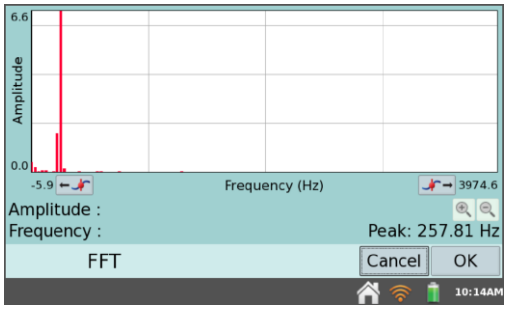
  Tip: If no function appears when modeling, your parameters are defining a curve that is outside of the plot window.

- **Advanced** – Choosing Advanced from the Analyze menu allows you to access advanced analysis tools including Baseline Adjustment, Fast Fourier Transform (FFT), and Peak Integration.



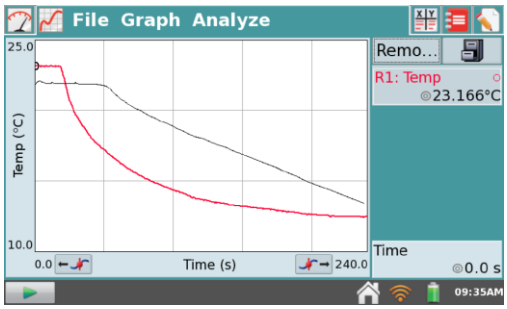
  - **Baseline Adjustment** – This tool applies a factor that raises or lowers the x-axis. Because the LabQuest App uses the x-axis as its baseline when calculating an integral, adjusting the baseline may result in a better integral.

  - **FFT** – The FFT tool calculates a Fast Fourier Transform of the selected data. The FFT is displayed in a special graph that can be analyzed. Tap OK to return to the main graph. The peak frequency will be displayed on the graph legend..



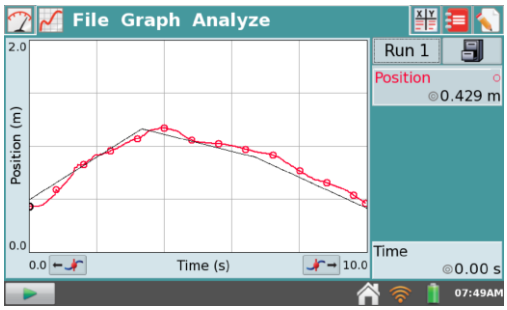
- **Peak Integration** – This option calculates the integral for a selected portion of a graph. It is most commonly used with the Vernier Mini GC, but it can be applied to any data plot. Peak Integration differs from the Integral tool in that it does not use the x-axis as the baseline. Instead, the integral for Peak Integration is evaluated from the minimum y-values to the left and right of a selected peak.

- **Draw Prediction** – The Draw Prediction tool gives you a free-hand sketch tool for drawing on the Graph screen. This can be used for a variety of purposes, but is most often used to sketch a prediction of how a graph will appear once data are subsequently collected.



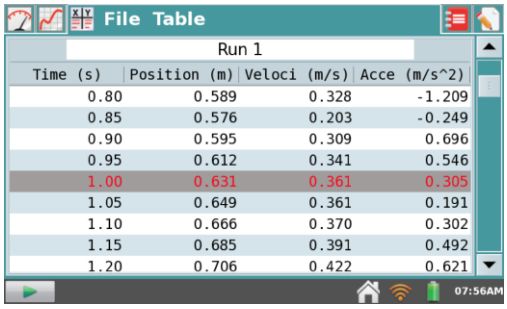
Upon enabling this tool, tap-and-drag across the screen for smooth curves, or tap the screen to connect subsequent taps with straight-line segments. The Reset button will remove your sketch if you need to start over. Tap OK to place your sketch on the main graph. To remove a prediction, choose Draw Prediction again from the Analyze menu.

- **Motion Match** – The Motion Match menu item is only available if a Motion Detector is connected. You have a choice of a new Position or Velocity match. In each case LabQuest generates a random target graph for matching exercises. Only the selected graph, Position or Velocity, is shown in match mode. You may collect data over the target graph as many times as you like. To see a new target graph, choose New Position Match or New Velocity Match again. Remove Match removes the target graph.



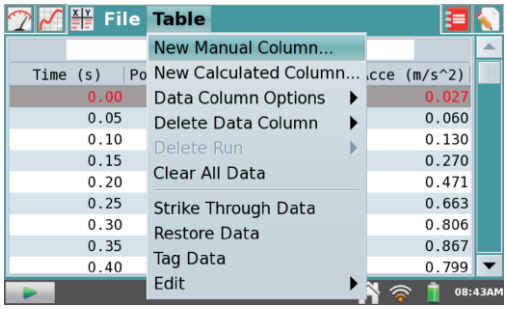
Adjusting the Table View

In addition to viewing and manipulating data from the Graph screen, you can also work with the data from the Table screen. Tap the Table tab to change to the Table screen. There are several shortcuts on this screen. Alternatively, you can also access the fields by choose Data Column Options from the Table menu.



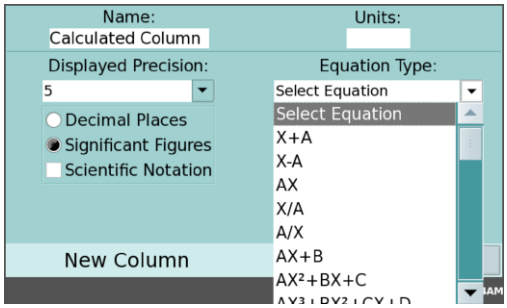
- Tap Run 1 in the name field to rename the run.
- Tap a column header (Time, Position, etc.) to change the column name, units, or displayed precision.

Manipulating Data from the Table Screen



The Table menu allows you to create, modify, or delete columns of data. Anything in columns can be graphed. The following tools are available from the Analyze menu:

- **New Manual Column** –New Manual Column creates an empty column into which you can enter or generate values directly. *Tip: To make a graph of data from other sources, enter values in two manual columns, and then plot them in a LabQuest graph.*



- **New Calculated Column** –New Calculated Column creates a new column whose values are based on other columns by a mathematical formula. Tap the Name field to enter a name for the new column, tap the units field to enter the units, then tap the Equation Type field and choose an equation for the calculations in this column. For example, you might define a calculated column as the inverse square of another column. After creating a calculated column, you can display the calculated data on a graph, or manipulate it further with additional calculated columns.

- **Data Column Options** – This allows you to access the fields for setting the column name, units, and displayed precision. Alternatively, you can access these fields by simply tapping on the column name from the Table screen.

- **Delete Data Column** – This allows you to delete a manual or calculated column of data. Note that you cannot delete data collected from a sensor; however, you can hide data using the Strike Through Data tool.

- **Delete Run –** If you have stored at least one run using the Store Run tool, this option will be selectable from the Table menu. Upon choosing Delete Run, tap the desired run name to delete the run. You will not be able to delete the last run created.

- **Clear All Data** – This action will clear all data in the table. Upon choosing this option, you will be prompted to confirm.

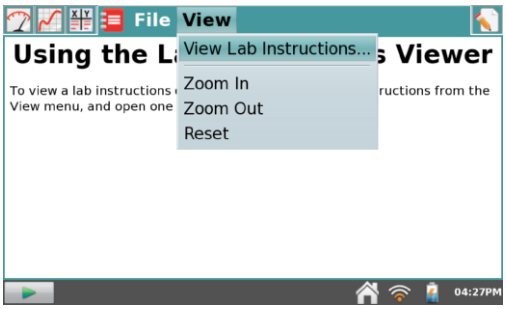
- **Strike Through Data** and **Restore Data** – Use these tools to ignore/restore selected data. Struck data are ignored for analysis and graphing, and the graph will update accordingly. To restore all data, tap the Table menu and choose Restore Data. Note that you can also access these tools from the graph screen by tapping on the Graph menu.

- **Tag Data** – Use this tool to tag a data point with a comment. After selecting the point within the table and tapping Tag Data, a circle will be displayed on the graph screen to "tag" the data. To add a comment, tap to select the Graph tab, locate the tagged point and tap to place the Examine cursor at this point. Then tap the info box at the right and enter a comment into the blank field.

- **Edit** – This tool allows you to copy and paste values from one place to another. In particular, you might copy a range of values and paste them into notes on the Notes screen.

Viewing Vernier Lab Instructions

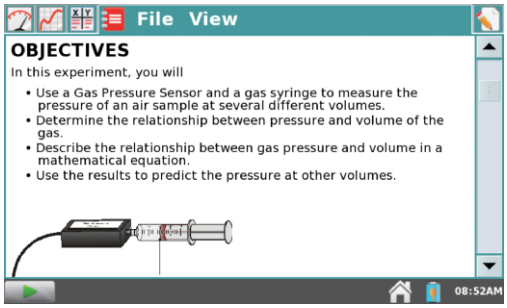
The Lab Instructions screen, selectable by tapping the Lab Instructions tab , allows students to view lab instructions from Vernier lab books. LabQuest comes preloaded with over 100 labs. You can easily download labs from other books that you have purchased and load them onto LabQuest using our easy-to-use web tool, LabQuest Organizer. You can also create new content using our online LabQuest Creator.



Opening Vernier Lab Insructions

From the View screen, choose View Lab Instructions from the View menu. This displays a list of the lab books with labs preloaded on LabQuest. Tap on the desired book, tap OK, then choose the desired lab and tap OK.

In addition to scrolling through the instructions using the scrollbar at right, you can also zoom in on a particular portion of the instructions by selecting Zoom In from the View menu. Selecting Zoom Out from the View menu restores the previous view. Selecting Reset from the View menu restores the original view.



Adding Labs to LabQuest

If you have purchased Vernier lab books and have labs in your books that you would like to load onto LabQuest, you can do so using our online tool, LabQuest Organizer. Follow these simple instructions:

1. Visit our web site: www.vernier.com/labquest/organizer/
2. Select the labs that you wish to add. (Note that you can either select individual labs or add entire books)
3. Follow the on-screen guide to create and download a LabQuest Library update and save it to a USB flash drive or SD card.
4. Follow the provided instructions to transfer the update from the flash drive or SD card to your LabQuest units.

Creating Your Own Labs

If you would like to create your own lab content, you can do so using our online tool, LabQuest Creator.

Follow these simple instructions:

1. Visit our web site: www.vernier.com/labquest/creator/

2. Choose your starting point. You can create a new lab from scratch, start with a template, or paste an existing lab into our Lab Creator.

3. Follow the on-screen guide to create your content. Note that you can save your content and finish another time. Simply click Save, and a web link will be displayed which you can click on and then bookmark from your browser for later access.

4. When your content is complete, follow the on-screen guide to preview, name, and download your lab to a USB flash drive or SD card.

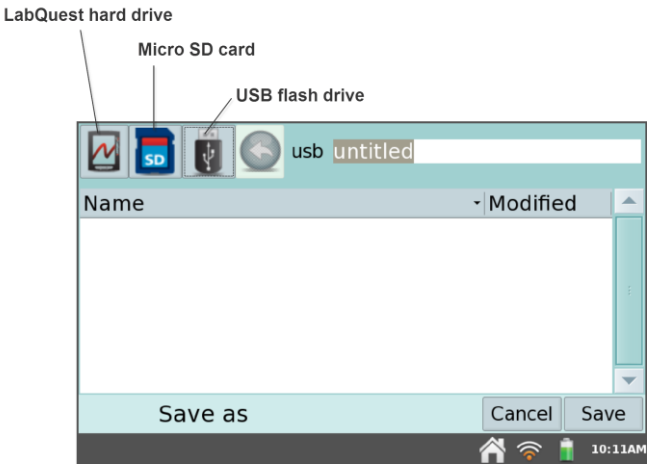
5. Follow the provided instructions to transfer the update from the flash drive or SD card to your LabQuest units.

Adding Notes to Your Experiment

The Notes screen, selectable by tapping the Notes tab , allows students to enter notes as they perform an experiment. The menu gives access to standard edit commands of Cut, Copy, Paste, and Clear All.

Storing LabQuest App Files

LabQuest files have a *.qmbl* extension and can be saved to the internal storage space on LabQuest, or to an external storage space such as a thumb drive. LabQuest App files can also be opened and manipulated on a computer with our Logger *Pro* software.



LabQuest will recognize additional storage space in a connected micro SD (Secure Digital) card or a USB flash drive. The drive or card may be formatted in FAT16 or FAT32 (the most common Windows and Mac OS formats) for reading and writing. LabQuest cannot read NTFS- or HFS+-formatted drives.

To save a LabQuest App file,

1. If saving to a micro SD card or USB flash drive, make sure the drive is inserted in the appropriate port on LabQuest. ***Note****: After inserting the drive wait a few seconds while LabQuest recognizes the drive before proceeding*.

2. Choose Save from the File menu. This opens a Save As dialog box.

3. Tap on the appropriate icon to select your storage destination.

   - LabQuest internal hard drive

- Micro SD card

- USB flash drive (thumb drive)

4. After selecting your destination, tap on the name field to pull up the keyboard. Then enter the file name.

5. Tap OK to return to the Save As screen.

6. Tap Save to save the file.

***Note**: You cannot create directories within LabQuest App, but you can use directories that already exist on the SD card or USB drive. We recommend organizing your files on a USB drive or SD card by creating any needed folders on a computer before you use the drive or card with LabQuest.*

Exporting LabQuest App files

In some cases, you may wish to export the LabQuest App file in a text format (.txt) for further analysis within a program other than Logger *Pro*.

To do this, select Export from the File menu. Follow steps similar to those described in Storing LabQuest App Files and choose Export from the File menu instead of Save As.

To open the file in a spreadsheet program, be sure the program's file browser is set to look for all files. Select your text file, then

If you have access to a wireless network with Internet, you can email the data file, graph, text file, or screenshot. For detailed instructions, see Emailing from LabQuest.

Printing from LabQuest App

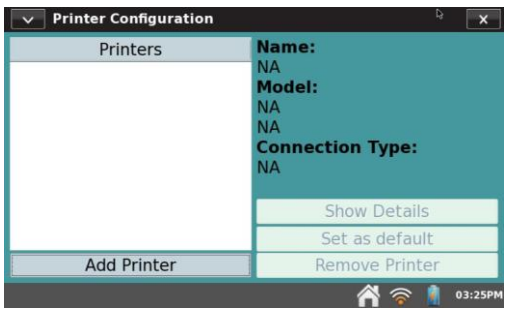
You may choose to print the graph, data table, lab instructions, your own notes, or the screen as it is currently displayed in LabQuest App. LabQuest can print to a compatible printer via a USB cable or via a Wi-Fi network. For a list of compatible printers see: www.vernier.com/til/1659/

USB Printing

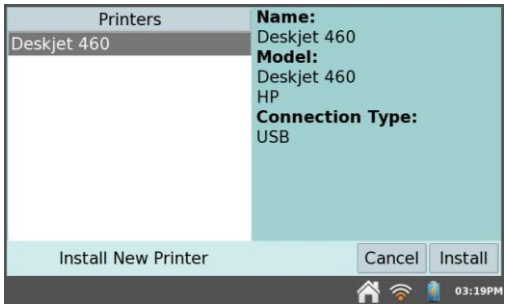
For printing to a USB printer for the first time, simply connect a compatible printer to the full-size USB port on LabQuest, and turn on the printer.

1. Tap the Home icon at the bottom of the screen, tap Preferences, and then tap Printers.

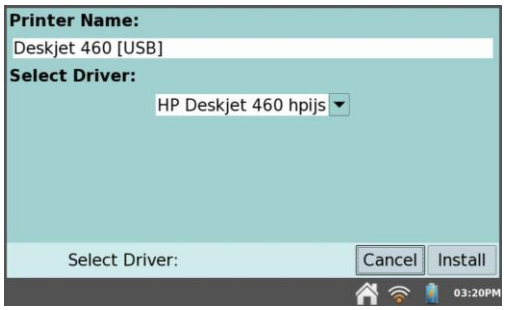
2. Tap the Add Printer button on the Printer Configuration screen.



3. Select the printer that appears in the list and tap Install.



4. Tap Install again to complete the printer installation process.



5. Close the Printer Configuration by tapping the X at the top right of the screen. This procedure need only be performed the first time you connect a particular printer.

To print, choose Print from the File menu. Tap to choose the item that you want to print. The Print Options screen appears and you may choose the printer and enter a Title and/or Footer for your printout. Tap Print to send the item to the selected printer.

Even though your printer may initially appear in the Printer list, a driver may not be found when you tap the Install button. Not all printers are supported - see the compatible printer list above. If a driver is found, printing may still error due to an incompatible printer - see the incompatible list at the end of the compatible list above. If you are sure that the printer is compatible and you are still getting an error, it may be caused by one of the following conditions: out of paper, out of ink/toner, a door on the printer is ajar, a paper jam, or you may have selected the wrong printer on the Print Options screen.

If you have access to a Wi-Fi enabled printer, you can print wirelessly. For detailed instructions, see Wirelessly Printing from LabQuest.

IV. USING LABQUEST 2 WITH A MOBILE DEVICE

LabQuest 2 includes Vernier Data Share, a feature that broadcasts sensor data to one or more devices wirelessly from the LabQuest 2 interface. Using a compatible web browser, students can:

- collaboratively collect experiment data
- analyze an individual copy of the data on their device
- examine their data and perform analyses such as statistics, linear fits, and quadratic fits
- add a title and comment to their graph
- use photo or screenshot features on their device to capture an image of the graph for their lab report

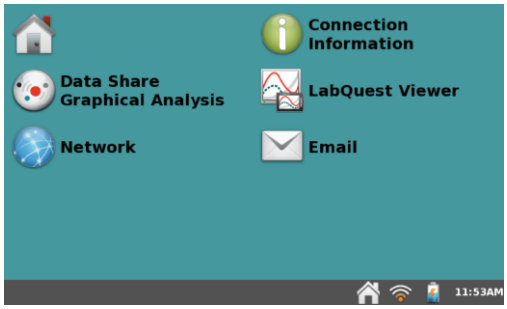
Data Share is used with our *Connected Science System*, a networked collection of technology that supports hands-on, collaborative learning with individualized accountability.

To use LabQuest 2 with a mobile device, follow these instructions.

Set up data sharing on LabQuest

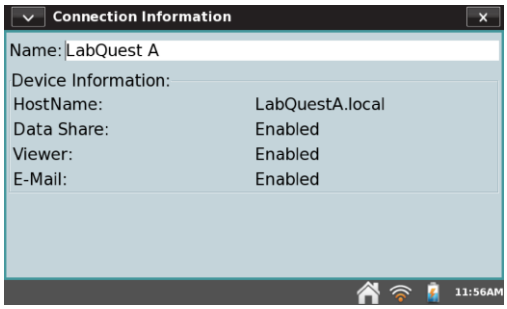
1. From the Home screen, tap Connections.

2. From the Connections screen, tap Connection Information.

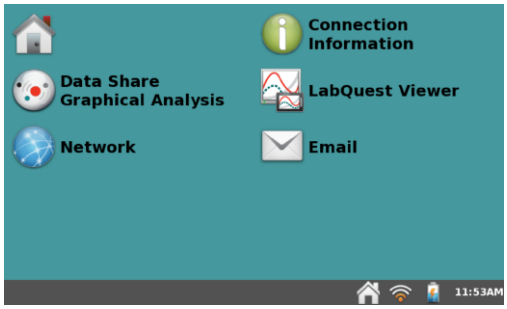


3. From the Connection Information dialog box, tap the Name field to enter a name for the LabQuest (e.g., LabQuest A). Then tap ✕ to close this window.

   Note the HostName that is displayed. The HostName will be a combination of the name (without spaces) followed by *.local* (e.g., LabQuestA.local).



4. From the Home menu, tap Connections, then tap Data Share/Graphical Analysis.



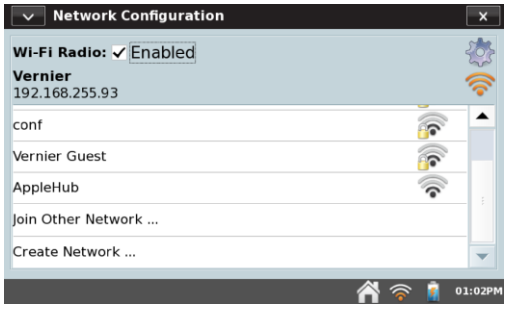
5. From the Data Share/Graphical Analysis dialog, turn on data sharing by tapping On. Optionally, you can also choose to allow remote control of data collection on the LabQuest from the mobile device. Tap ✕ to close this window.

Connect LabQuest to a Network

6. Tap Connections on the Home screen, then tap Network.

7. Tap to enable the Wi-Fi radio.

   A Network Configuration dialog box is displayed listing any networks that LabQuest sees, as well as an option to Create Network.

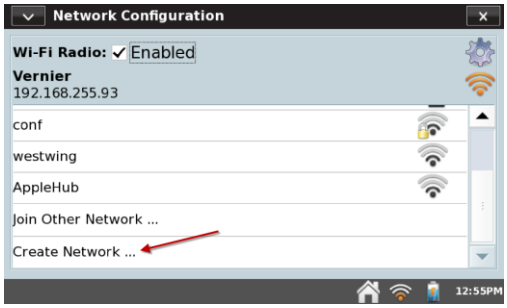


Existing network

If you have an existing network to which you would like to connect, locate the network within the list and tap to select.

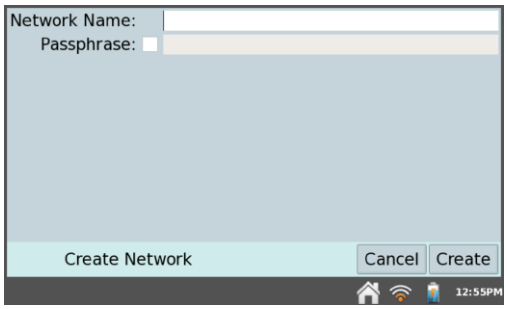
Create a new LabQuest Network (Ad-Hoc Network)

If you do not have access to an existing Wi-Fi network, or are not permitted to access your school's network, you can quickly and easily set up a network with LabQuest 2.
***Note**: This will allow your students to connect to this network with their mobile devices. This network will not support access to the internet. The email function of LabQuest will not work with a LabQuest ad-hoc network.*



- From the Network Configuration box, tap Create Network.
- Tap the Network Name field and assign a name to this new network (e.g., Ms. Johnsons classroom).

- *Optional: Protect your network by assigning a password to your network that you will provide only to your students. To do this, select the Passphrase check box and assign a password to your new network (e.g., science). The Passphrase must meet certain criteria. See our web site for additional information:* www.vernier.com/til/2699/
- Tap Create.



***Note**: Some Android implementations seem to have trouble viewing and connecting to ad-hoc networks. These devices require the use of an existing (infrastructure) network.*

Access LabQuest from your Mobile Device

8. On your mobile device, connect to the same network to which LabQuest is connected (step 7).

9. On your mobile device, open the browser and type in the HostName for your device (e.g., LabQuestA.local).

   Optional: If your mobile device has a QR-code reader, tap Connections from the Home screen on LabQuest and then tap Data Share/Graphical Analysis. A QR-code associated with the HostName is displayed. Use a QR-scanning application on your mobile device to connect to your LabQuest.

Access LabQuest from your iPad®

If your classroom has iPad devices, you might be interested in purchasing our Graphical Analysis™ for iPad® App. This app is used with our *Connected Science System*, a networked collection of technology that supports hands-on, collaborative learning with individualized accountability. This app can be purchased from the App Store. Educational discount pricing is available.

Graphical Analysis for iPad supports advanced networking and exporting capabilities, providing additional features such as:

- automatic discovery of LabQuest 2
- advanced curve fits
- manual data entry
- prediction tool
- auto-saving of projects
- exporting of graphs and/or data
- printing

V. USING LABQUEST WITH A COMPUTER

LabQuest comes with Logger Lite computer software. Use either Logger Lite 1.6 (or newer) or Logger *Pro* 3.8.5 (or newer) with LabQuest 2. If you already own Logger *Pro* 3, updates to Logger *Pro* are available for free download at www.vernier.com/updates/logger-pro/

LabQuest can be used with a computer in one of two ways: (1) data can be collected directly to Logger *Pro* or Logger Lite, or (2) you can transfer previously collected data from the LabQuest to either program. Each of these is described in more detail as follows.

Collecting Data with Logger Lite or Logger *Pro*

1. Connect a sensor to LabQuest.

2. Connect LabQuest to your computer using the included USB cable. The mini end of the cable connects to LabQuest, and the full-size end connects to an available USB port on your computer.

3. Open Logger *Pro* or Logger Lite on your computer. The computer will detect the LabQuest and the attached sensor, and display a graph ready for data collection. LabQuest will display a screen with two arrows indicating it is connected to the computer.

4. Click the Collect button in Logger *Pro* or Logger Lite to collect data.

Transferring Data from LabQuest to a Computer

Automatically Transferring Data

If you collect data in LabQuest App, and you then connect the LabQuest to a computer, Logger Lite or Logger *Pro* will automatically detect the presence of the remote data and offer to retrieve it.

To try this, collect data on LabQuest and then connect the LabQuest to your computer and launch Logger Lite or Logger *Pro*. The computer application will detect the LabQuest and its data, and display a dialog indicating that remote data are available. Follow instructions in that and subsequent dialogs to download data to the computer.

***Note**: If you want to automatically transfer data from a LabQuest to a computer from a file that has been stored on your LabQuest, you must first open the file on the LabQuest.*

Manually Transferring Data

In addition to the automatic detection of recent data in LabQuest by Logger *Pro* or Logger Lite (described in the preceding sections) you can also download any saved data from LabQuest to the computer. After an experiment is complete on LabQuest, choose Save from the LabQuest File menu. Give the experiment an identifying name. You may save multiple LabQuest files on LabQuest this way.

Tip: When taking data in the field, store experiments as files on the LabQuest. To do this, choose Save from the File menu, and give the experiment a descriptive name. Choose either the

LabQuest, or optionally a USB drive or SD card, as the location. This way you can save as many experiments as you like. Later, you can either use LabQuest Browser in Logger Pro or Logger Lite to open the files, or connect the USB drive or SD card to your computer and open the files directly in Logger Pro or Logger Lite.

On the computer, choose Open from the LabQuest Browser, which is found in the File menu. Select the desired file from the LabQuest, and open it. Your LabQuest file will be opened on the computer, including any data, notes, and data collection configuration. Only one file can be opened at a time. You may choose to subsequently save the data as a Logger *Pro* or Logger Lite file.

Tip: If sensors are still connected when a LabQuest file is opened in Logger Pro or Logger Lite, the sensors will be ignored. To enable the sensors, choose New from the File menu in the computer application.

Another option is to Import data from the LabQuest. Import differs from Open in that only the data in the LabQuest file are added to the current computer session. This allows you to compile data from multiple LabQuest sessions into a single computer session for graphing and comparison.

Tip: Compile class results from multiple LabQuest files (or multiple LabQuests) by repeatedly importing data into a single Logger Pro or Logger Lite file.

Manually Moving Data from Computer to LabQuest

Data and/or sensor configurations can be saved to the LabQuest from your computer. Open a computer file, or set up the computer for the data collection details you desire. Choose Save As from the LabQuest Browser (found in the File menu), and enter a descriptive file name. Any data, and the sensor configuration, will be stored on the LabQuest as a LabQuest file. Any features in the computer file not existing on LabQuest (such as embedded images, video analysis, graph annotations, or most calculated columns) will be ignored on LabQuest.

Deleting Data on LabQuest

The LabQuest Browser includes a Delete function. Choose Delete from the LabQuest Browser, and select the file you want to remove from LabQuest.

Tip: Use the LabQuest Browser to mass delete files from LabQuest. Click to select multiple files, and click Delete. This is the only way to delete more than one file at a time.

VI. EMAILING FROM LABQUEST

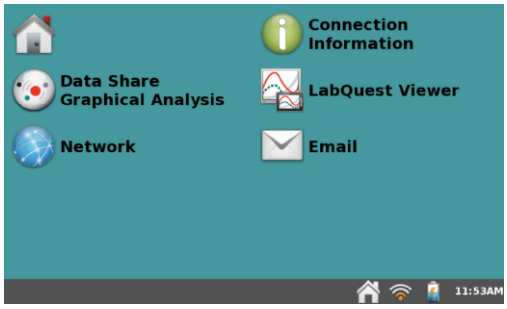
If LabQuest is connected to a network with Internet access, you can email your data file, graph, text file, or screen shot.

To set this up, follow these instructions:

1. First, you will need to connect LabQuest to a network with Internet. To do this, follow steps 6-8 from Connect LabQuest to a Network.

   ***Note**: A LabQuest Network (Ad-Hoc Network) does not have Internet access. You will need to join an existing network with Internet.*

2. From the Home screen, tap Connections, then tap Email.



3. The Email Configuration dialog box is displayed. Enable email by selecting On.

4. Enter your outgoing email server information and tap Save. For additional information, see www.vernier.com/networking

VII. WIRELESSLY PRINTING FROM LABQUEST

As described in USB Printing you may print wirelessly by connecting directly to a compatible Wi-Fi enabled printer or by connecting to a Wi-Fi access point that is wired to a network which includes a compatible printer.

You can set this up as follows:

1. First, you will need to connect LabQuest to a network with Internet. To do this, follow steps 6-8 from Connect LabQuest to a Network.

2. Once you have connected, either to the Wi-Fi printer itself, or to a Wi-Fi access point, you are ready to follow the same instructions as described in USB Printing.

VIII. PROJECTING AND MONITORING STUDENTS' LABQUEST DEVICES

Use our LabQuest Viewer software (order code, LQ-VIEW) to view and control the LabQuest wirelessly from your Windows or Macintosh computer. When LabQuest 2 is connected to a computer wirelessly or via USB, LabQuest Viewer can be used in conjunction with a projector to share the LabQuest 2 screen with the entire class.

This allows an instructor to demonstrate LabQuest 2 for a class, and also allows students to share or present their work to fellow classmates. LabQuest Viewer can also be used with an original LabQuest connected wirelessly to a computer via a Wi-Fi adapter. LabQuest Viewer is part of the Connected Science System.

With LabQuest Viewer, you can:

- View and control one or more LabQuests from a computer
- Connect to a computer and projector or interactive white board for class demos or sharing
- Monitor student progress on any LabQuest connected to your network
- Create screenshots of the LabQuest screen to copy and paste into lab instructions
- Set customizable permissions that permit viewing without control, or password-protect a connection
- Install LabQuest Viewer on any computer in your school or college department with the included site license

System Requirements

- **Windows** – Windows XP (32 bit only), Vista (32 and 64 bit), and Windows 7 (32 and 64 bit)

- **Macintosh** – Macintosh OS X 10.5 (Intel-based Macs only), 10.6, and 10.7

LabQuest Compatibility

- LabQuest 2 (Wi-Fi or USB connection)
- LabQuest with Wi-Fi USB Adapter (Wi-Fi only)

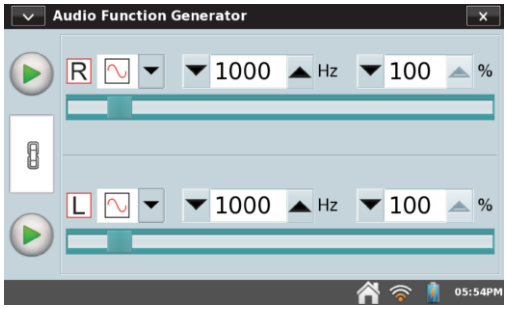
For additional information, see: www.vernier.com/lq-view

IX. ADDITIONAL APPS ON LABQUEST

Several accessory applications can be launched from the Home menu. It is not necessary to quit the LabQuest App to use these accessories; to return to LabQuest App, either close the accessory using the close button in the upper right corner of the screen, or switch to the LabQuest App by tapping LabQuest App from the Home menu.

Access additional apps and accessories from the Home screen

Audio Function Generator

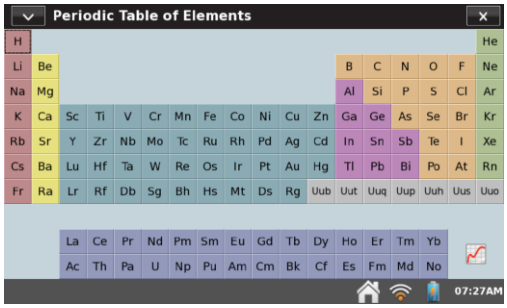


From the Home screen, tap Audio Function Generator to launch this app. The function generator is used to create waveforms in the audio frequency range. Select a waveform, frequency, and volume for each channel. Start and stop using the buttons at left. The link between left and right channels is on by default, so that both start and stop together. Click the link icon to control the channels independently.

The sliders can also be used to control frequency. Tapping left or right of the slider will halve or double the frequency.

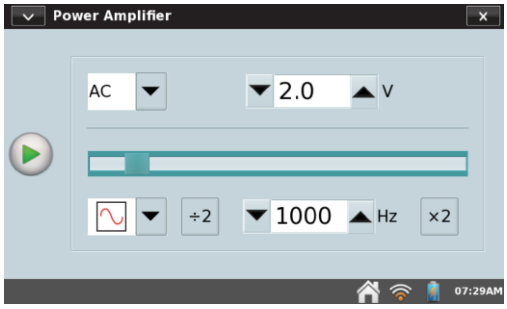
A common use of the Audio Function Generator is to create tones and beats for waveform study using a microphone. For the best waveform quality, connect a powered computer speaker to the audio output jack of LabQuest.

Periodic Table



From the Home screen, tap Periodic Table to launch this app. The Periodic Table contains standard reference information on the elements. Tap an element to see details; close the detail window using the upper right close button.

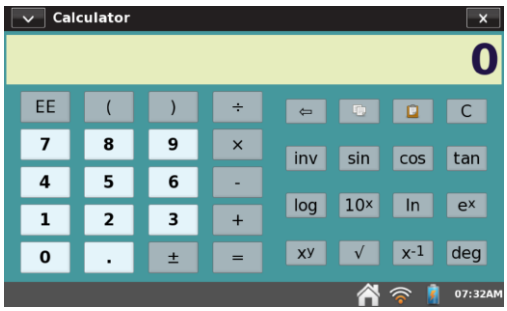
Power Amplifier



From the Home screen, tap Power Amplifier to launch this app. The Power Amplifier App is used to control the Vernier Power Amplifier (order code PAMP) used to create waveforms with up to 10 V amplitude and currents of 1 A. Connect the Power Amplifier to the LabQuest audio output.

Select the desired output (AC or DC). DC output levels are limited to 0.2 V steps. AC waveforms include sine, square, sawtooth, and ramps. Select an amplitude and frequency using the controls. The frequency can be changed by factors of two using either the buttons, or in small steps using the slider. Start and stop the output using the control at left.

Calculator



From the Home screen, tap Accessories, then tap Calculator.

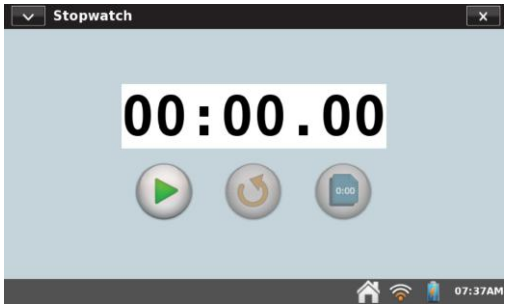
This app is a standard scientific calculator which uses algebraic notation. You can use this calculator at any time; to dismiss it, tap Home. You can copy a calculator result and paste it into the Notes tab.

Sound Recorder

From the Home screen, tap Accessories, then tap Sound Recorder.

The sound recorder is used to capture short audio clips, typically for voice notes. To record a clip, tap the record button . To stop, tap the square red stop button. Play the clip back using the green play button. The disk button allows you to save the clip, which can later be opened using the open file folder icon. The blank page icon clears out any current audio clip.
Tip: Use Sound Recorder to quickly make audio notes on experiments.

Stopwatch



From the Home screen, tap Accessories, then tap Stopwatch.

The Stopwatch Application is a simple timer. Tap the start button to begin timing; tap it again to stop. Subsequent taps will continue to start and stop the timer. Tap the middle reset button to return the timer to zero. The copy button will place the current time on the clipboard for pasting into the Notes screen of LabQuest App, or into the calculator.

APPENDIX A. LABQUEST 2 TECHNICAL SPECIFICATIONS

Display

- 11.2 cm x 6.7 cm (13.1 cm diagonal) screen
- 800 x 480 pixel color display at 188 dpi
- LED backlight
- Portrait or landscape screen orientation
- High-contrast mode for outdoor visibility

Processor

- 800 MHz Application Processor

Connectivity

- Wi-Fi 802.11 b/g/n
- Bluetooth for WDSS

User Interface

- Resistive touch screen
- Touch and stylus navigation for efficiency and precision

Data Acquisition

- 100,000 samples per second
- 12-bit resolution
- Built-in GPS, 3-axis accelerometer (± 2 g), ambient temperature sensor, light sensor (uncalibrated intensity), and microphone

Environmental Durability

- Operating Temperature: 0 – 45°C
- Storage Temperature: -30 – 60°C
- Splash resistant
- Rugged enclosure designed to withstand a fall from lab bench

Size and Weight

- Size: 8.8 cm x 15.4 cm x 2.5 cm
- Weight: 350 g

Ports

- 5 sensor channels
- USB port for sensors, flash drives, and peripherals
- USB mini port
- DC power jack
- MicroSD/MMC slot
- Audio in and out

Storage

- 200 MB
- Expandable with MicroSD and USB flash drive

Power

- Rechargeable, high-capacity battery
- DC charging/powering through external adapter (included)

Non-compatible Sensors

LabQuest 2 does not support the following sensors at this time:

- Digital Control Unit* (DCU)
- Heat Pulser
- Ohaus balance

* Not supported with LabQuest as a standalone device. The DCU can be used with Logger *Pro* software and LabQuest 2.

APPENDIX B. LABQUEST MAINTENANCE

LabQuest Battery

LabQuest uses a high-quality lithium-ion battery. This is the same chemistry used in premium laptop and cell phone batteries, and you can expect similar performance. There is never a need to condition the battery by regular full discharge/charge cycles.

Use only the supplied AC adapter or optional LabQuest 2 Charging Station (order code LQ2-CRG, sold separately) to charge the LabQuest battery. A replacement adapter can be purchased from our web site (order code LQ-PS).

The battery takes about eight hours to completely charge. It is safe to leave the battery charging indefinitely, and there is no need to fully discharge the battery before charging. Battery life will depend on the sensors used, but in most cases you can obtain six or more hours of use before recharging. We recommend charging LabQuest overnight to start the next day with a full charge.

For use with a computer, either the battery must be charged or the LabQuest must be connected to AC power. The LabQuest cannot operate on USB power alone. When the LabQuest is running and connected to the computer, the USB connection will, however, slowly charge the battery.

When using LabQuest as a standalone device, the screen will dim after a few minutes of no use, even during data collection. However, LabQuest will not turn itself off until the battery is almost discharged. No data will be lost, as LabQuest App will save a backup file before shutting down.

Battery life will depend on the sensors and features used. To optimize day-to-day battery life, set the screen brightness to the minimum acceptable level, and turn off LabQuest when it is not in use. Also disconnect any sensors you are not actively using. To access power-saving options, tap Preferences on the Home Screen, then tap Light & Power.

The long-term life of the battery will vary, but you can expect about three hundred to four hundred full charge/discharge cycles before the battery will need to be replaced. In this count, a charge from half-way to a full charge would count as half of a charge cycle. In typical school use, the battery can last three years or more. Exposure to temperatures over 35°C will significantly reduce battery life.

As a battery reaches the end of its useful life, the run time will become shorter and shorter. Eventually the run time will be too short for your application, and you will want to replace the battery. Rechargeable batteries are considered a consumable, and as such are warranted for one year. A replacement battery can be ordered from our web site (order code LQ2-BAT). Recycling information is available at www.call2recycle.org.

LabQuest Case and Screen

The LabQuest is water and shock resistant. Do not submerge in liquids. Wipe clean with a damp cloth only; do not use any solvents including ammonia or glass cleaners.

Stylus Tether

LabQuest includes a stylus and a tether. If desired, you can attach the tether to the stylus and the LabQuest. Additional styluses are available from Vernier.

LabQuest Software

LabQuest arrives with its own software, LabQuest App, preloaded. The LabQuest App will be updated from time to time to introduce new features and to improve performance. Most users will want to run the latest version available.

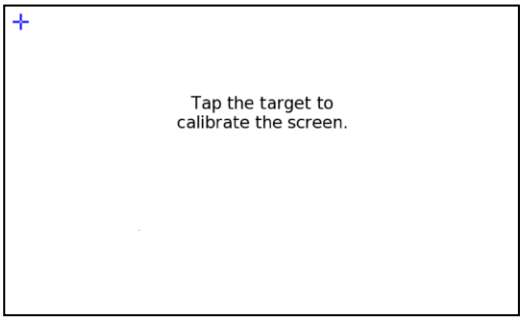
Free updates with step-by-step instructions are available on our web site:
www.vernier.com/downloads/

Screen Calibration

To do this, tap System from the Home menu. Then choose Calibrate Screen.

Follow the on-screen instructions for tapping the plus sign with the stylus.

If you are unable to access the Calibration tool, press and hold the Home key until the Calibration tool is displayed.



Getting Additional Help

For access to user manuals, forums, and our technology information library, please visit our web site at:

www.vernier.com/labq2

If you are located in the United States or Canada, you may also contact Vernier directly:

888.837.6437
info@vernier.com
www.vernier.com

Otherwise, please contact Vernier International:

941.349.1000
info@vernier-intl.com
www.vernier-intl.com

APPENDIX C. LICENSE INFORMATION

This product contains certain open source software originated by third parties that is subject to the GNU General Public License as published by the Free Software Foundation, GNU Library/Lesser General Public License (LGPL) and different and/or additional copyright licenses, disclaimers or notices. These licenses give you the right to redistribute and/or modify the software.

The software is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

Complete source code for the open source software is available on request from Vernier Software & Technology. Contact us at info@vernier.com, or by writing to

Source Code Request
Vernier Software & Technology
13979 SW Millikan Way
Beaverton OR 97005
USA

Source code will be made available for download, or you may request a CD-ROM of the code. A shipping and handling fee will be charged for a CD-ROM.

The exact terms of GPL, LGPL and some other licenses are provided to you with the source code distribution. You may also read the license at http://www.gnu.org/licenses/

APPENDIX D. WARRANTY

Vernier warrants this product (with the exception of the battery) to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.

The LabQuest 2 battery is a consumable, and as such, Vernier warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer.

APPENDIX E. ACCESSORIES, REPLACEMENT PARTS, AND RELATED PRODUCTS

LabQuest 2 Charging Station
Charge and store up to four LabQuest 2 interfaces with this compact and affordable station.
www.vernier.com/lq2-crg

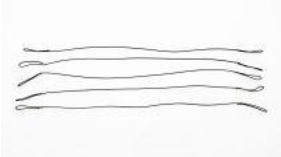
LabQuest 2 Lab Armor
Add extra protection from spills and falls.
www.vernier.com/lq2-armor

LabQuest Battery Boost
With the added power of an external battery, data can be collected for extended periods in the field where AC power is not available.
www.vernier.com/lq-boost

LabQuest 4 GB SD Card
Easily add storage to your LabQuest or move files between LabQuests or a computer.
http://www.vernier.com/lq-sd4/

Vernier Lanyard
A LabQuest neck strap to prevent accidental drops during field studies.
www.vernier.com/lq-lan

LabQuest 2 Stylus (Set of 5)
Replacement LabQuest 2 styluses (5 pack). Two are included with each LabQuest 2.
www.vernier.com/lq2-styl-5



LabQuest Stylus Tethers (Set of 5)

Replacement LabQuest tethers (5 pack). One is included with each LabQuest 2.
www.vernier.com/lq-teth-5

LabQuest USB Computer Cable

Replacement LabQuest-to-computer USB cable. The cable has a USB mini-B plug and USB standard-A plug. One cable is included with each LabQuest 2.
www.vernier.com/lq-cb-usb

LabQuest 2 Battery

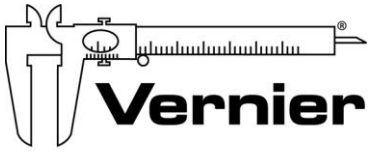
Replacement high-capacity, rechargeable, lithium-ion battery for the Vernier LabQuest 2. One battery is included with each LabQuest 2.
www.vernier.com/lq2-bat

LabQuest Power Supply

Replacement power supply for the LabQuest. One power supply is included with each LabQuest 2.
www.vernier.com/lq-ps

Curriculum Resources from Vernier Software & Technology

Vernier lab books include a CD with word-processing files of the student instructions, essential teacher information, suggested answers, sample data and graphs, and more. Download the student instructions of our experiments to preview before purchasing. Either choose a lab book or go to the experiments section to download previews. For more information, see www.vernier.com/books



Measure. Analyze. Learn.™

Vernier Software & Technology
13979 S.W. Millikan Way • Beaverton, OR 97005-2886
Toll Free (888) 837-6437 • (503) 277-2299 • FAX (503) 277-2440
info@vernier.com • www.vernier.com

Revised May 29, 2012