LabQuest® 3 – User Manual

Version 3.0.0
August 2020

ABOUT THIS GUIDE

LabQuest 3, released in August 2020, ships with a Quick-Start Guide to get you started with basic data collection and analysis. The LabQuest 3 User Manual is an extended guide detailing the hardware and software features of LabQuest 3.

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 contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
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.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;*
2. *L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est 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.

CONTENTS

I. GETTING STARTED WITH LABQUEST® 3

What's Included

LabQuest 3 interface
Rechargeable battery (in unit)
AC power adapter
USB Computer connection cable
Quick-Start guide

Preparing for First Time Use

Remove the Protective Battery Tab

LabQuest ships with the battery in place; however, there is a protective tab covering the battery contacts that must be removed. Remove the battery and discard the tab before using LabQuest.

Remove the Protective Screen Covering

Remove and discard the protective screen cover that comes on the unit. This cover is intended to prevent damage to the screen during shipping. It is not intended as a protective cover for everyday use.

Charge Overnight

We recommend charging the battery for at least 12 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 Charging Station (order code LQ3-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. 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.

Powering on LabQuest

Press the power button located on the top of the unit, near the left edge. LabQuest will complete its booting procedure and automatically launch the LabQuest App. This can take 45 seconds to complete.

If the screen momentarily shows a charge battery icon or does not light after a moment, check to be sure you have removed the protective battery tab and properly replaced the battery. Connect the power adapter to LabQuest and to an AC power source, and then try the power button again.

Power Button Behavior

Power on/Resume – If the screen is off for any reason (LabQuest is shutdown, suspended, or the screen is off to conserve battery power), press and release the power button to turn LabQuest on.

If LabQuest was shut down, it will need to fully boot, taking about 45 seconds. If LabQuest was only suspended, it will take only a few seconds to come on. If the screen is only powered off, pressing the power button will turn the screen back on immediately.

Suspend – When LabQuest is on, press and release the power button once to put LabQuest into a suspend mode. In this mode, LabQuest uses less power but the battery can still drain.

Shut down – To shut down LabQuest, press and hold the power button for about five seconds. A message indicating the unit is shutting down is displayed on the screen. Release the power button and wait for LabQuest to shut down. To cancel the shutdown procedure, tap Cancel before the countdown is complete. This is the lowest energy state of the device, but the battery can still drain very slowly.

Forced shutdown – If you hold the power button down for more than eight seconds, LabQuest powers off uncleanly. This should be avoided whenever possible as it is equivalent to pulling the battery out of the unit while it is running. You will likely lose your data and potentially cause file system corruption, so only do this if you have no other way to power off the unit.

Using the Touch Screen

LabQuest has a capacitive touch screen like those found on tablets and smart phones. LabQuest is controlled primarily by touching the screen. If desired, you can use a stylus design for capacitive touch screens with this device (not included).

Common Gestures

Single-tap – Use a single-tap to interact with most objects on the device.

Touch and drag – Use touch and drag to select regions on a graph or to scroll through menus.

Long Press – Use the long press to activate special functionality on some objects such as holding down the keyboard shift key to enable shift lock.

Two-Finger Pinch/Zoom/Pan – Use this gesture to manually scale graphs or pan the data table.

Double-tap – Double-tap to scale the graph to fit the data or to edit elements of the data table such as cell data (when allowed), column name, or dataset name.

Single-finger swipe (from edges) – This gesture is used to change what app is displayed. See Device Navigation below for more information.

Device Navigation

Using the Top Notification Bar

Tap or swipe down from the home side of the Notification bar to access applications available on LabQuest. Tap to launch an app or return to an app already running.

The home side of the Notification bar shows the apps that are currently running. The LabQuest App launches by default when the unit is powered on.

Tap or swipe down from the settings-side of the Notification bar to customize the LabQuest settings.

The settings side of the Notification bar shows battery level and charging status as well as Wi-Fi and GPS signal strength. (GPS signal strength is only shown when the GPS sensor is being used. See Internal Sensors for more details.)

Switching Between Running Apps

Swipe left or right from the edge of the screen to switch between running apps. The app order is represented by the app icons in the notification bar. The order that the icons appear relates to the order the apps were initially launched.

LabQuest App Navigation

The LabQuest App Meter, Graph, Table, and Notes screens are accessed by tapping the associated tab icons. For more information, see Navigating LabQuest App.

Customizing the Settings

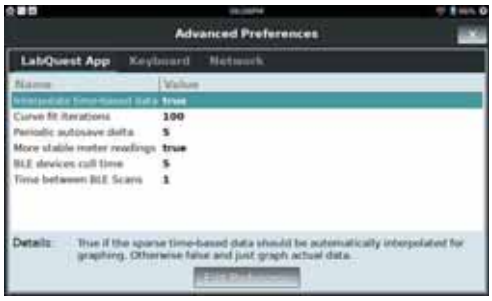
Tap or swipe down from the settings side of the Notification Bar to access the apps that control the device settings.

Connections – Wi-Fi, Data Sharing, and Email Settings

Use the Connections app to connect your device to a Wi-Fi network. Tap the network icon to connect to an available wireless network.

TIP! Data Sharing requires connection to a Wi-Fi network. Email requires connection to a Wi-Fi network with internet connectivity.

Advanced Preferences



Advanced feature options can be found in Advanced Preferences. Tap on the name of the feature you are interested in to view details and edit the settings.

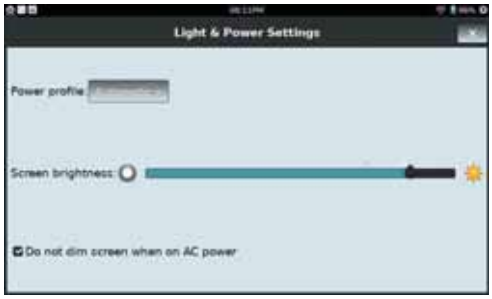
Audio

Use the slider to adjust the volume of the built-in speaker or the Audio Out port. You can also enable system sounds, such as a chirping sound, when the unit powers off.

Language

Specify the language you want LabQuest to use when displaying text.

Light & Power



Adjust the screen brightness and select different power profiles that can help extend your battery life between charges. When using AC power, you can select to have the screen always on.

	Battery	AC
Dim screen	after 1 minute	after 2 minutes
Screen off	after 3 minutes	after 5 minutes[1]
Suspend[2]	after 30 minutes	after 60 minutes
Shut down[2]	after 2 days	after 2 days

[1] After 15 minutes while collecting data
[2] Unit will not suspend/shutdown while collecting data

Time & Date

Set the LabQuest time and date. The time and date are used to timestamp when files are saved and when data collection begins (used with Logger *Pro* 3 software).

TIP! When connected to a Wi-Fi network, the time and date are automatically updated. The time zone is not updated.

Connecting Sensors

Wired Sensors

Connect your wired sensor to the appropriate sensor port. LabQuest App will automatically set the default collection rate for the sensor.

Analog Sensor Ports (CH 1, CH 2 and CH 3) – LabQuest has three sensor ports for analog sensors such as our pH Sensor, Temperature Probe, and Force Sensor. Also included are two full-size USB ports for USB sensors such as spectrometers, USB flash drives, and other USB peripherals.

Digital Sensor Ports (DIG 1 and DIG2) – LabQuest has two digital sensor ports for Motion Detectors, Drop Counters, and other digital sensors.

Full-sized USB Ports–LabQuest has two full-size USB ports for USB sensors such Go Direct sensors, Go!Temp, and Go! Motion. These ports can also be used with USB flash drives and other peripherals.

Additional ports (not for use with sensors)

Audio out port – This port is for use with our Power Amplifier, headphones, or speakers.

Micro-USB port – This port is for using LabQuest as a sensor interface with a computer or Chromebook™.

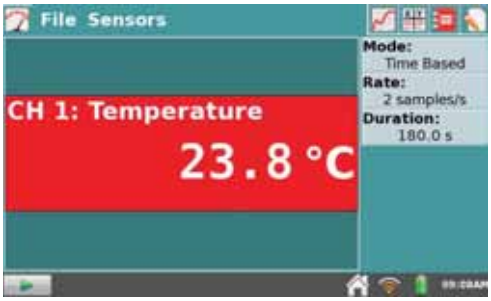
Wireless Sensors

Choose New from the File menu. Power on the sensor, tap Sensors ► Wireless Device Setup, and choose the matching sensor type.

Select your sensor from the list of available sensors and tap OK.

LabQuest App will automatically set the default collection rate for the sensor. For additional information, see Sensor Setup.

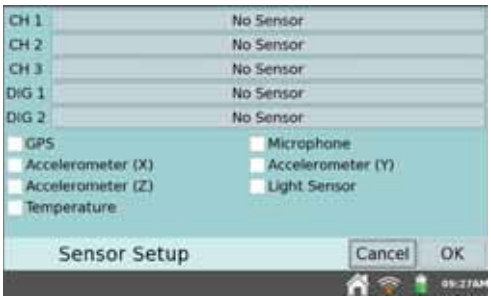
TIP! At most, three Go Direct sensors and three Go Wireless sensors can be connected at a time. You will be prevented from attempting to connect a fourth sensor.



Internal Sensors

LabQuest also has two built-in sensors, GPS and microphone.

To enable an internal sensor, choose Sensor Setup from the Sensors menu. Within the Sensor Setup dialog box, select the check box to enable the associated sensor. Tap OK to return to the Meter screen.



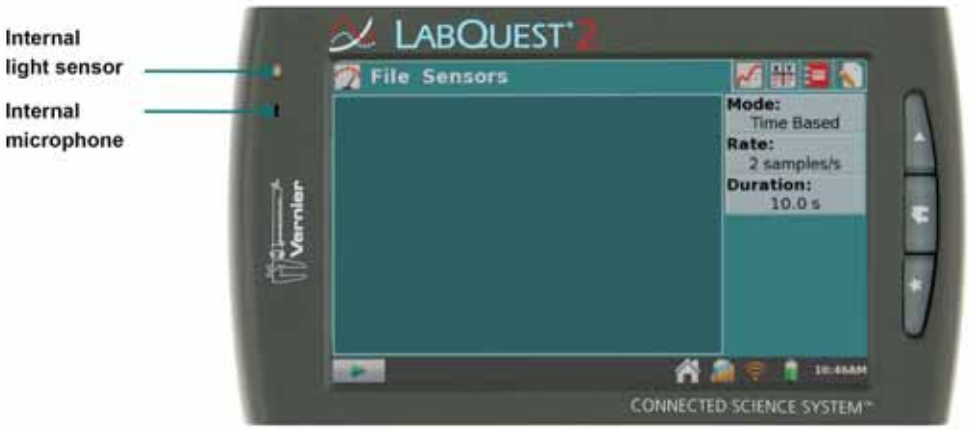
LabQuest will automatically set the default data-collection rate for the sensor.

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.

TIP! It may take 15 minutes or more to acquire signals from enough GPS satellites to report your position. This is especially true the first time you use the sensor or after not using the sensor for a while. We do not recommend using GPS indoors.

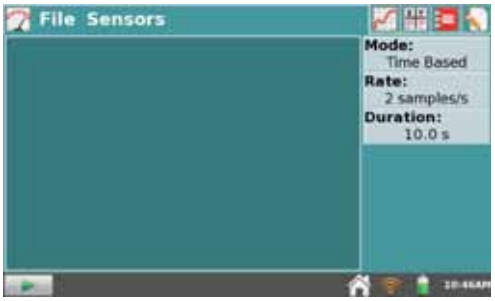
- **Microphone** – The internal Microphone is located on the back of LabQuest, below and to the right of the power button as shown below. The sensor is used to show waveforms of the sound inputs. It does not measure sound level (decibels).

TIP! This sensor cannot be used with external sensors.



II. QUICK START TO DATA COLLECTION AND ANALYSIS

Follow these steps to quickly get started with basic data collection. For more detailed instructions, see Data Collection.

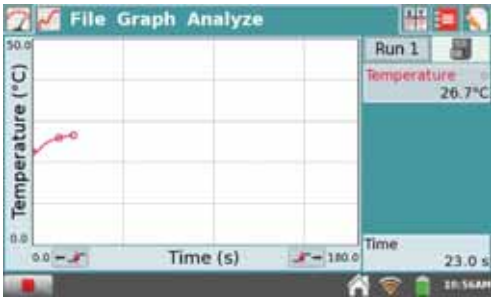


1. Press and release the power button located on the top edge of LabQuest to turn on the unit. LabQuest App launches automatically.

2. Connect a sensor.

   Choose New from the File menu. Connect your sensor as described in the Connecting Sensors section.

   LabQuest App will auto-ID the connected sensor and automatically set the default collection rate for the sensor.



3. Tap Collect . LabQuest App switches to the Graph Screen and data collection begins. Data are collected in real time.

   You can stop collection early by tapping Stop .

   Once data collection is complete, the graph automatically scales the graph to fit the data.

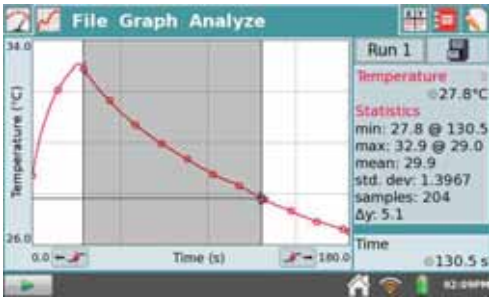
4. Tap the graph to examine a point of interest. The coordinates of the point are shown in the panel to the right of the graph. Tap another point or tap the Examine buttons to move the cursor left and right .

   TIP! You can pan and zoom the graph as desired using a two-finger pinch gesture. Double-tap the graph to rescale the graph to fit the data.

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

   TIP! To analyze all data, you do not need to select a region first.

Statistics



To view statistics for the selected data on the Graph screen, choose Statistics from the Analyze menu. Tap the check box to select a data column. 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, and then tap the checked box to clear the selection.

Curve Fit

To fit a curve to the selected data on the Graph screen, choose Curve Fit from the Analyze menu. Tap the check box to select a data column. Tap Choose Fit and choose the desired fit equation. (The Linear fit is shown by default.)

LabQuest automatically determines and displays the fit coefficients and displays a preview of the curve fit on the graph. Tap OK to apply the fit and return to the Graph screen.

To remove the fit, choose Curve Fit from the Analyze Menu, and then select the checked box to clear the selection.

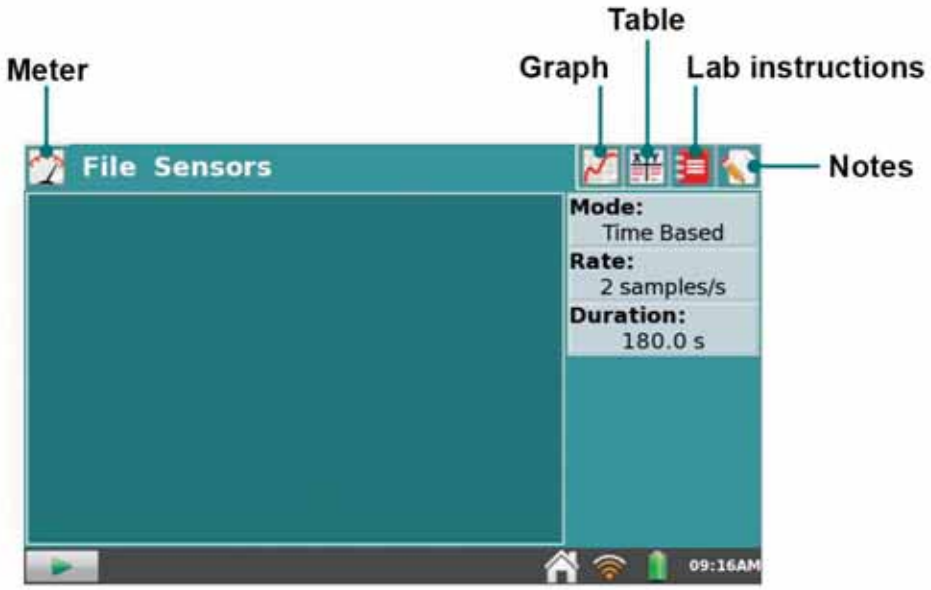
TIP! The Curve Fit coefficients cannot be manually adjusted. To enter your own parameters, see the Model tool within Data Analysis.

III. LABQUEST® APP

The data-collection and analysis software, LabQuest App, is the heart of LabQuest. When you turn on LabQuest, the LabQuest App starts automatically. If the LabQuest App is not displayed on your screen, launch LabQuest App from the app home screen.

Navigating LabQuest App

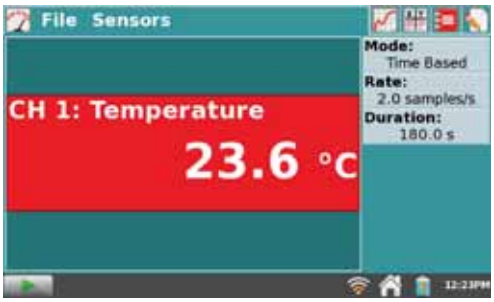
LabQuest App has four different screens. Tap on the desired tab to display the associated screen.



LabQuest App

- **Meter screen** – Set up sensors, set data-collection parameters, and see a 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 analyses, including curve fits.

For a detailed description of how the Graph screen is used for data analysis, see Data Analysis.

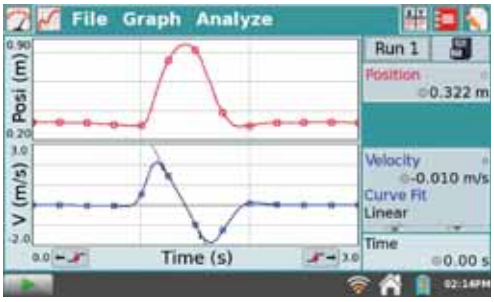
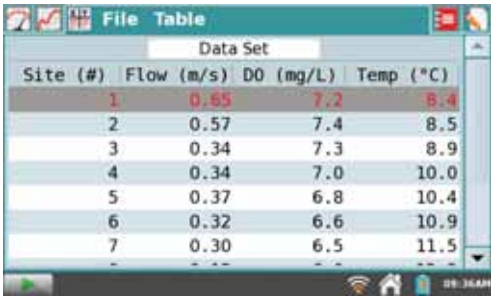


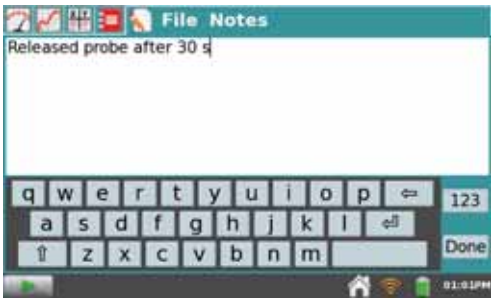
Table screen – See a tabular representation of your data, create calculated columns, and manually enter data.

For a detailed description of how the Table screen is used for data analysis, see **Error! Reference source not found.**.



Notes screen – Record observations about your experiment.

For more information, see Adding Notes to Your Experiment.



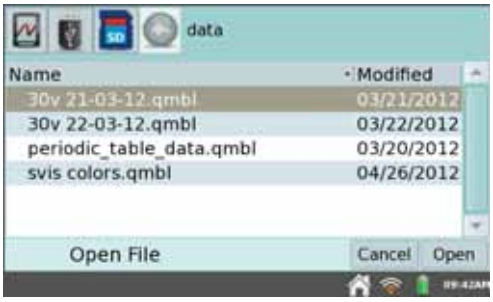
File Menu

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 a USB flash drive. LabQuest App files can also be opened and manipulated on a computer with Logger *Pro*® 3 or Logger Lite software.

All 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, as well as adjusting file settings, printing, and more.

New – Choose New from the File menu to reset all data-collection parameters and sensor calibrations back to default values. If you have unsaved data, you will be prompted to either save or discard the data before continuing.

Open – Choose Open from the File menu to display a list of files that you have saved on LabQuest. To open a file, tap the file name and tap Open.



TIP! If you have a USB flash drive connected when you access the dialog, the dialog will default to showing you files from your flash drive.

Save – Choose Save from the File menu to display the Save As dialog box where you can tap on a source icon (USB, LabQuest) to select a destination. Tap in the File name field to assign a name to the file.

TIP! If you have a USB flash drive connected when you access the dialog, the dialog will default to saving files to your flash drive.

Delete – Choose Delete from the File menu to display a file list similar to the open file dialog. Tap on a source icon (USB, LabQuest) to select the source where the file is located, tap the desired file name, and tap Delete. You can delete only one file at a time.

TIP! If you have a USB flash drive connected when you access the dialog, the dialog will default to selecting files to deleting from your flash drive.

Email – Choose Email from the File menu to email a Data File, Graph, Text File, or screenshot from the current file.

LabQuest must be connected to a wireless network while connected to the internet to use this feature. For detailed instructions on setting up email, see Emailing from LabQuest.

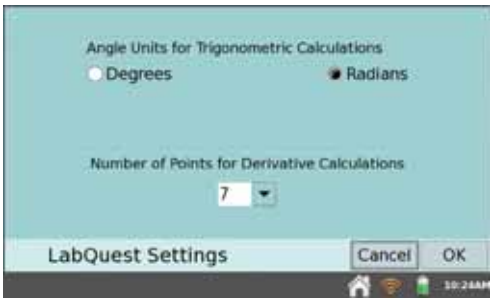
Export– Choose Export from the File menu to export the current data file in a text format for use with other applications. A USB flash drive must be attached to your LabQuest in order to use this feature.

A typical use of this feature is to export a text file to a USB flash drive for further data manipulation on a computer with a spreadsheet program. The exported tab-delimited file contains all column values from all

runs in the current session. For more detailed instructions on using the Export feature, see Storing LabQuest App Files.

Print – Choose Print from the File menu to print the Graph, Table, Notes, or Screen from the current session. *NOTE: The initial release of LabQuest 3 only supports Print to File. Network and USB printer support will come in a future update to the software.*

Use this option to save a PDF file to a USB flash drive for printing from a computer or importing into a lab report. For detailed instructions, see Using Print to File On LabQuest.



Settings – Choose Settings from the File menu to adjust file settings for the current session. These settings are specific to and saved within the LabQuest file. These settings return to 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; the default is radians.

- Number of Points for Derivative Calculations

  Calculated columns, curve fits, modeled functions, and some calculated sensors columns (e.g., automatic Motion Detector velocity and acceleration columns) can 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 experiment), or a smaller number for cart-based Motion Detector experiments (e.g.,, our Impulse and Momentum experiment).

Quit – Choose Quit from the File menu to exit LabQuest App. Since other applications can run simultaneously with LabQuest App, there is typically no need to quit LabQuest App during standard use.

Data Collection

Data collection with LabQuest starts from the Meter screen, which is the default screen for LabQuest App. From this screen, you can view sensor readings updated in real time as well as a summary of the data-collection settings. Additionally, you can access tools to modify and customize these settings for your particular experiment.

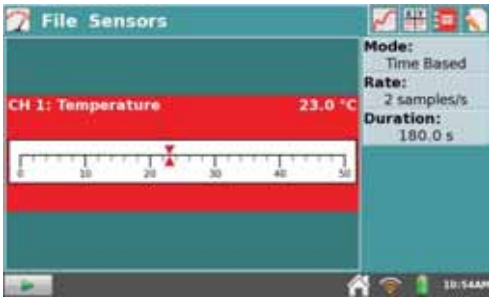
Digital Meters

A digital meter for each connected sensor is shown on this screen. Tap on a meter to change sensor settings. The available options will depend on the sensor and may include options to set up channels, change units, calibrate, zero, and reverse the sensor. Most of these options can also be accessed from the Sensors menu.

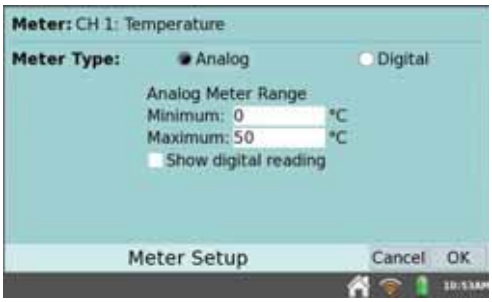
Analog Meters

To display an analog meter, choose Meter Setup from the Sensors menu, or as a shortcut, tap the digital meter on the Meter screen.

TIP! The Vernier Energy Sensor and Go Direct Energy sensor use analog sensors by default. All other sensors use digital sensors.



Within the Meter Setup dialog box, select the meter type. For analog meters (bar or pointer), enter the minimum and maximum values for the meter range; you can also hide the digital display value if desired.



Data-Collection Summary

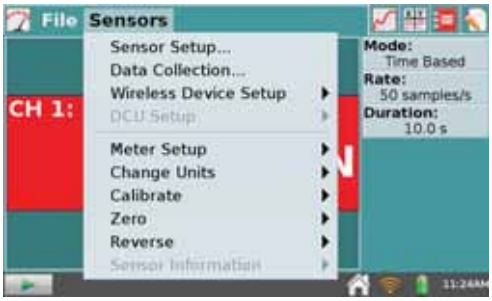
A summary of the data-collection settings (Mode, Rate, and Duration) is shown in the panel to the right of the Meter screen. For most sensors, the default data-collection mode is Time Based. The default collection rate for the connected sensor is automatically set up when LabQuest identifies the sensor. To modify the data-collection settings, tap the summary box. Alternatively, you can choose Data Collection from the Sensors menu. For detailed descriptions of data-collection modes and parameters, see Data-Collection Settings.

Data-Collection Controls

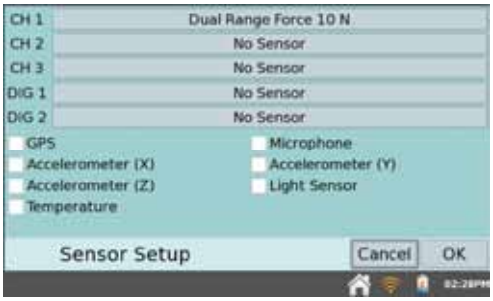
To start data collection from any LabQuest App screen, tap Collect . During data collection, tap Stop to end data collection early. In selected data-collection modes (for example, Events with Entry), a Keep button will appear to the right of the Stop button. In this mode, you must tap to record the data point in the data table. For more information,

see Events with Entry.

Data-Collection Settings

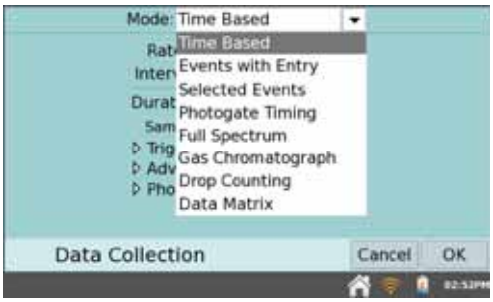


The Sensors menu provides access to detailed setup controls. Use this menu to set up internal sensors, non-auto-ID sensors, and wireless sensors. You can also use this menu to change the data-collection parameters and adjust sensor-specific settings.

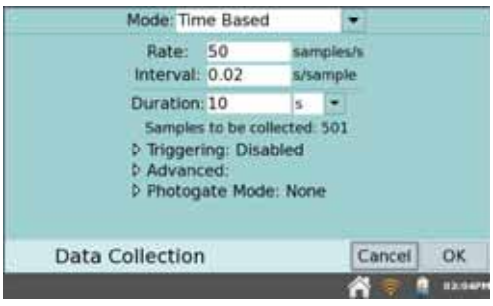


Sensor Setup – Choose Sensor Setup from the Sensors menu to view sensors connected to the analog and digital ports. To manually set up non-auto-ID sensors, tap the field displaying "No Sensor" for the channel to which your sensor is connected. Then choose the appropriate sensor from the list and tap OK.

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



Data Collection – Choose Data Collection from the Sensors menu to set the data-collection mode and associated parameters. The parameters listed will depend on the mode selected. Data-collection modes include Time Based, Events with Entry, Selected Events, Photogate Timing, Full Spectrum, Gas Chromatograph, Drop Counting, and Data Matrix.



- **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 duration of data collection. The total number of samples to be collected based on these parameters will be displayed.

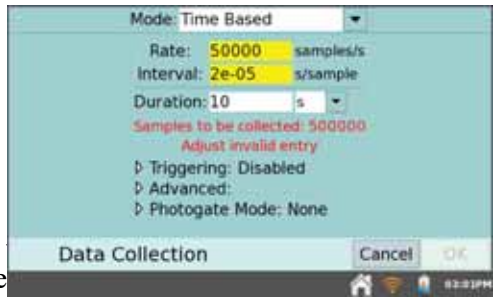
Warning Messages

Under some circumstances, the Rate and Duration text may be yellow or red. The *yellow-text* warning indicates that the rate has been set to a value slower or faster than

what is recommended for the connected sensor, or that the number of samples could lead to performance issues. You can still collect data using these settings; however, you may have undesirable results.

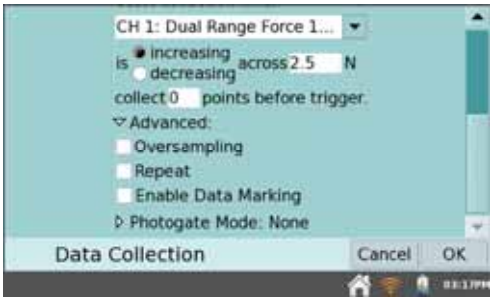
The *red-text* warning indicates one of the following, and you cannot exit the dialog box until the warning condition has been resolved:

- 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
- The number of samples exceeds 2000 (for rates faster than 80,000 samples/s)



Triggering – Time-Based data collection waits for a trigger condition to be met before recording data collection. To set the trigger, choose the sensor and set the threshold conditions. 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 selecting the associated check box.

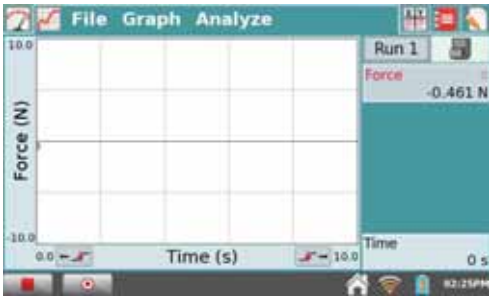


- **Oversampling** can be used with data-collection rates less than ten samples per second. When enabled, the sensor will sample at a higher rate than the number of samples per second that you set, and then LabQuest averages those readings and records the averages in the data table. This setting can be used to reduce measurement noise by combining a burst of readings into one value. As an 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 enabled, a new data-collection run is started as soon as the current run has

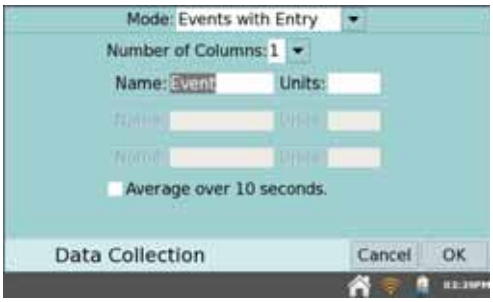
ended. Data for each run is overwritten when a new run is started. This setting is helpful when doing exploratory investigations.

- **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 during data collection. Tap to mark that particular point as a point of interest. After completing data collection, data marks can be named using the panel to the right of the graph.



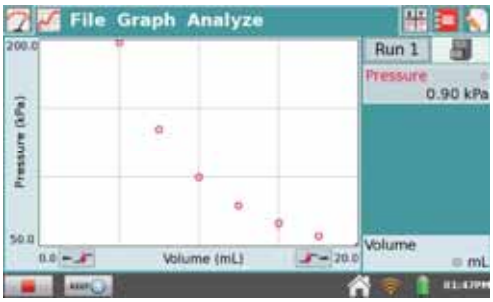
- **Photogate Mode** is used for photogate experiments that also use a time-based sensor such as a force sensor. Examples include impulse and momentum and centripetal force experiments. See Photogate Timing.

o **Mode: Events with Entry** – Sometimes experiments depend on a quantity other than time. For example, a Boyle's law experiment investigates the pressure as a function of the volume of gas. In Events with Entry mode, no time information is recorded.

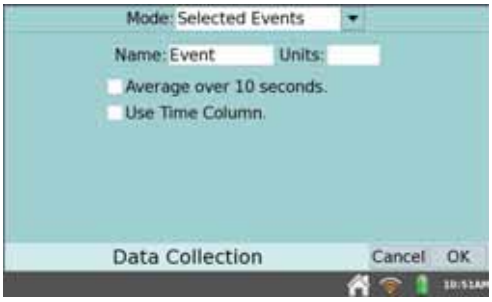


Enter a name and units for each independent variable. You also have an option to average data over ten seconds and report the averaged reading.

In Events with Entry mode, a Keep button appears during data collection. Tap Keep to record the sensor value (e.g., gas pressure in the Boyle's law experiment). In response, LabQuest prompts you to enter a value for the independent variable (e.g., gas volume in the Boyle's law experiment). Sensor data are plotted against the independent variable, as shown in the screenshot to the right.



- **Mode: Selected Events** – Selected Events mode is similar to Events with Entry, except that entries of 1, 2, and 3... are automatically recorded as the independent variable. To record time information in place of an entry value, select the check box for Use Time Column.



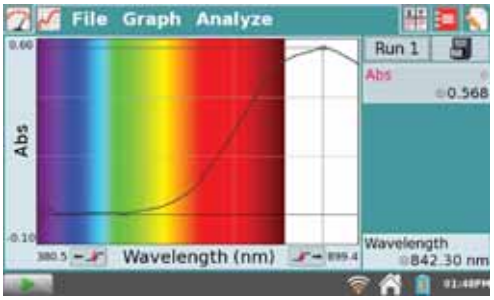
- **Mode: Photogate Timing** – Photogates require a different set of timing options. When a wired (BTD) photogate is detected, LabQuest enters the Photogate Timing mode.

  You have two options for ending data collection in this mode: tap Stop or end collection after a defined number of events. A block/unblock pair counts as two events.

  Choose the proper Photogate Mode for your experiment. For more information, see www.vernier.com/til/3329

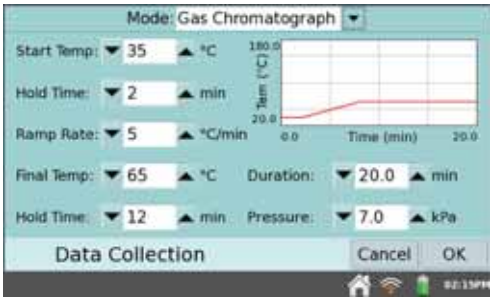
- **Mode: Full Spectrum** – When a spectrometer is detected, LabQuest enters the Full Spectrum mode. In this mode, Intensity, Absorbance, Fluorescence, or %Transmittance can be measured as a function of wavelength.

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



- **Mode: Gas Chromatograph** – When a Vernier Mini Gas Chromatograph (Mini GC) is detected, LabQuest enters the Gas Chromatograph mode. In this mode, various parameters are available for the user to establish a temperature and pressure profile adequate for the current experiment.

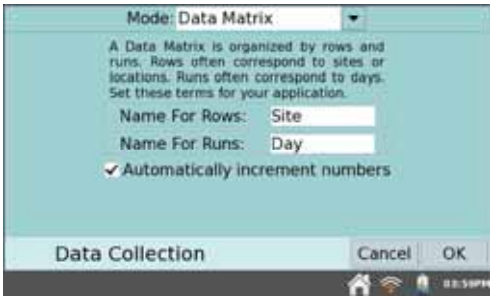
When starting data collection, a set of default parameters is displayed. Tap the parameter field to enter a new value, or adjust the default value using the arrows. These values will be reflected in the preview of the time-dependent temperature graph displayed to the right. After setting the parameters, tap OK to initiate the Mini GC warm up.



For more detailed information on the Vernier Mini Gas Chromatograph, see www.vernier.com/gc2-mini/

- **Mode: Drop Counting** – This mode is used with the Vernier Drop Counter or Go Direct Drop Counter. When using this mode, data points are recorded every time a drop is detected by the drop counter. For information on calibrating a drop counter, see www.vernier.com/manuals/vdc-btd or www/vernier.com/manuals/gdx-dc

- **Mode: Data Matrix** – This mode is helpful for field work. It provides a way to collect data referenced to two parameters, such as the locations of your sampling sites and the dates they were sampled. You can collect data from an unlimited number of sensors by swapping the sensors in and out of LabQuest during data collection. For more detailed information, see www.vernier.com/til/2366/



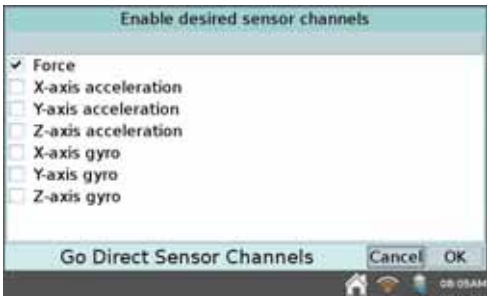
Wireless Device Setup – Use Wireless Device Setup to connect to wireless sensors and interfaces, such as our Go Direct® sensors, Go Wireless® Heart Rate, Go Wireless Link, or Wireless Dynamics Sensor System.

- **Go Direct…** – Choose Wireless Device Setup ► Go Direct from the Sensors menu to scan for and select Go Direct senors such as Go Direct Temperature, Go Direct Force and Accleration, or Go Direct pH. Select the serial number of your device from the list, and tap OK. Repeat as needed to connect up to three Go Direct sensors.

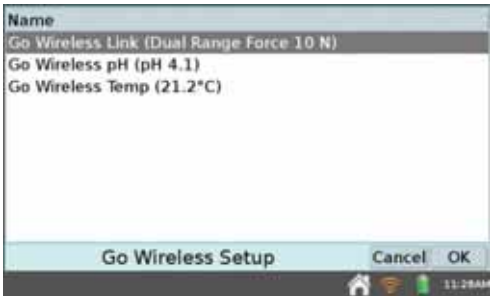
Once connected to a Go Direct device, tap on its meter and choose Go Direct ► to access additional setup options.

- Choose Device Details to determine the battery level or to view hardware and firmware details.
- Choose Identify to flash the LED on the Go Direct sensor to ensure you are connected with the desired sensor.
- Choose Disconnect to end connection to the sensor.

Some Go Direct sensors have multiple sensor channels. These sensors have a default configuration that do not typically use all available sensor channels. Choose Sensor Channels to modify the Go Direct sensor channel configuration as needed for your experiment.



- **Go Wireless** – Choose Wireless Device Setup ► Go Wireless from the Sensors menu to scan for and select Go Wireless sensors such as Go Wireless Heart Rate, Go Wireless Temp, Go Wireless pH, or Go Wireless Link. Select the name of your sensor from the list, and tap OK. Repeat as needed to connect up to three Go Wireless sensors.



Once connected to a Go Wireless sensor, tap on its meter and choose Go Wireless to access additional setup options.

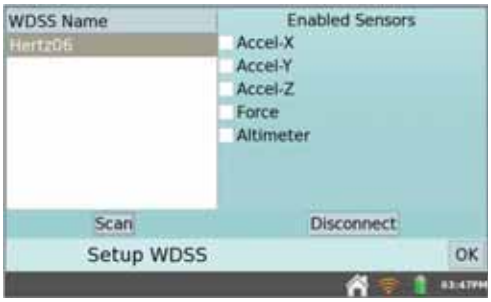
- Choose Sensor Info to view or change the device name, determine the battery level, or view hardware and firmware details.
- Choose Identify to flash the LED on the Go Wireless sensor to ensure you are connected to the desired device.
- Choose Disconnect to end connection with the sensor.

- **WDSS** – Choose Wireless Device Setup ► WDSS from the Sensors menu in LabQuest App to scan for, select, and configure Wireless Dynamics Sensor Systems (WDSS). If no WDSS units are found, tap Scan to search for WDSS sensors again. The scan may take 20 to 30 seconds and may have to be repeated several times to find your particular WDSS. Once a scan has found your WDSS, select its name in the list, and tap OK.

Select which of the five sensors you want for data collection and tap OK.

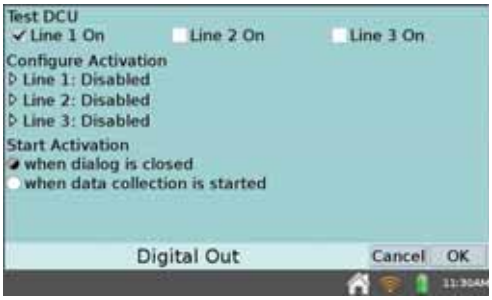
To adjust the data-collection parameters, choose Data Collection from the Sensors menu. See Data-Collection Settings for more information.

TIP! WDSS cannot be set up for remote data collection using LabQuest. Use Logger Pro® 3 on a computer to set up WDSS for remote use.

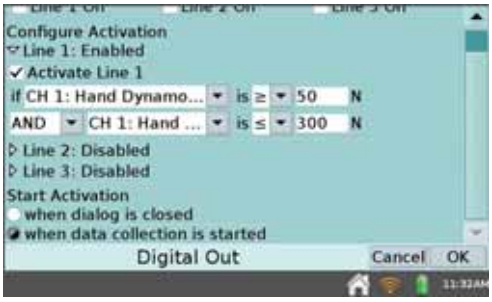


DCU Setup – Connect a Digital Control Unit (DCU) to one of the LabQuest digital ports. Choose DCU Setup from the Sensors menu and select the DCU for setup.

- **Test DCU** – Manually turn on and off the digital lines.
- **Configure Activation** – Use logic statements to activate digital lines based on sensor readings.
- **Start Activation** – Apply digital output logic immediately or only while collecting data.



TIP! Once digital output has been activated, automatic identification of sensors is disabled for the port used by the DCU. The LabQuest App will not detect the removal of the DCU or the addition of any other digital sensor in that port. To turn off the digital output and enable auto-ID, tap **File ► New**.



Change Units – In some cases, you may have the option to display the sensor data in another set of units. Choose Change Units from the Sensors menu to select a different set of units. Choosing a new unit will have existing and subsequent data for that sensor use the new unit. If this menu item is grayed-out, or the sensor is not listed, then the data for that particular sensor cannot be displayed in another set of units.

Calibrate – Most sensors use a custom calibration identified by LabQuest. However, some sensors do require calibration. Choose Calibrate from the Sensors menu to calibrate a sensor.

Follow the detailed calibration instructions provided in the sensor booklet available online at www.vernier.com/support/manuals

Zero – Choose Zero from the Sensors menu to set the current sensor reading to zero. This adds an offset to all subsequent sensor readings. Existing data is not affected.

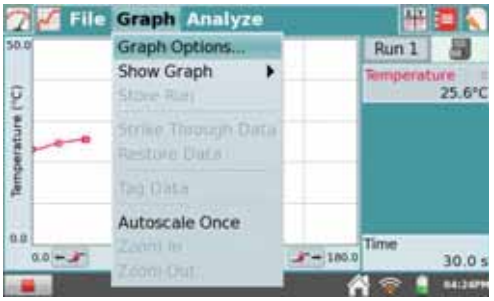
Not all sensors can be zeroed.

Reverse – Some sensors read both positive and negative values. For example, the Dual-Range Force Sensor reads positive values when pulled, and negative values when compressed, by default. Choose Reverse from the Sensors menu to swap the sign of the readings with respect to the default settings.

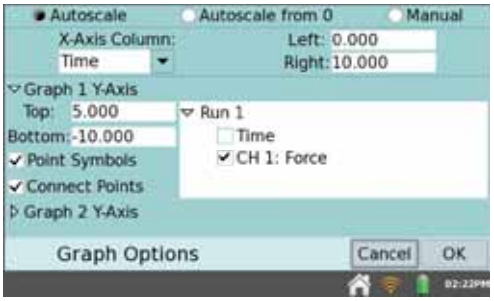
Not all sensors can be reversed.

Graph Settings

LabQuest App displays the Graph screen when data collection begins. From this screen, you can adjust graph settings. You can choose what is plotted, how the graph is scaled, and how the data are formatted.



Graph Options – To control how the data are graphed, choose Graph Options from the Graph menu. Here you can choose the columns used for the x- and y-axes and the axes range limits. See Adjusting the Graph screen for more information.



Select **Autoscale** to adjust to the data range after data collection ends. **Autoscale from 0** does the same but also includes the origin.

Manual scaling will respect values entered in the range limits. 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 mark (e.g., a circle or triangle). You can easily identify a trace by the corresponding mark in the graph legend. Tap the checked box to disable this feature.

The **Connect Points** option connects contiguous data points (as shown in the data table) with straight-line segments. These lines help the eye follow the data trend, but in some cases are not appropriate. Tap the checked box to disable this feature.

From this screen, you can also select the data to be graphed. For the x-axis, choose the desired column from the **X-Axis Column** dropdown menu. For the y-axis, select one or more columns from the run(s) listed under the expanded **Graph 1 Y-Axis** field.

LabQuest can display a single graph or two graphs sharing a common x-axis 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.

Data Analysis

You can analyze data from the Graph screen or the Table screen .

Examining Data on the Graph Screen

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

In some cases, you may want to examine a selected region of your data. To select a region for analysis, touch-and-drag across the graph. You can adjust the trailing endpoint of the selected region using the Examine Buttons. For greater control, use the two-finger pinch/zoom/pan gesture to focus on a particular section of the graph before selecting the region.

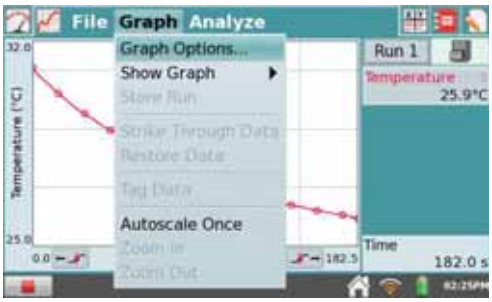
Adjusting the Graph screen using Gestures

Change what is plotted – Tap on a graph axis label to change the data that are plotted on that axis.

Manually scale the graph – Use a two-finger pinch/zoom/pan gesture to rescale the graph as desired. Rescaling the graph during data collection is not recommended as a new data point may force the graph to rescale back to ensure it is shown.

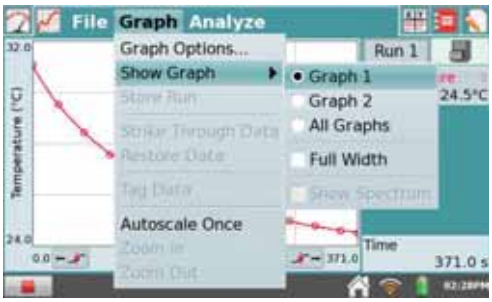
Show all data on the graph – Double-tap the graph to rescale the graph to fit the data.

Adjusting the Graph screen using the Graph Menu



You can adjust the graph screen in real-time during data collection by applying one of the following actions from the Graph menu.

Graph Options – Tap **Graph Options** to manually adjust graph settings. To adjust the graph screen, change the values in the **Left** and **Right** fields for the x-axis and **Top** and **Bottom** fields for the y-axis.



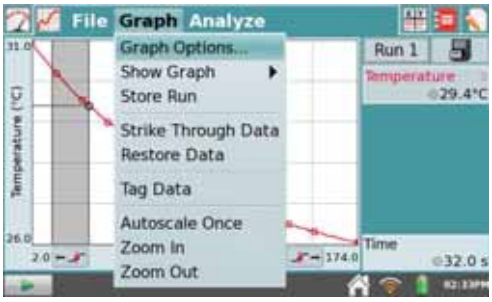
Show Graph – Choose **Show Graph** from the Graph menu to quickly jump between displaying one or two graphs. You can also choose the Full Width option to remove the data-collection summary box and maximize the graphs on the screen.

When using spectrometers to collect full spectrum data, the spectrum is displayed on the graph background by default. Accordingly, Show Spectrum > Full Spectrum is selected under the Show Graph options. To hide or resize the spectrum, tap on Show Spectrum and change the selected option.

Autoscale Once – Choose **Autoscale Once** from the Graph menu to scale the graph to the data you have collected so far. This can also accomplish by double-tapping the graph.

TIP! The graph will automatically rescale larger to show data collected that would otherwise be off the graph.

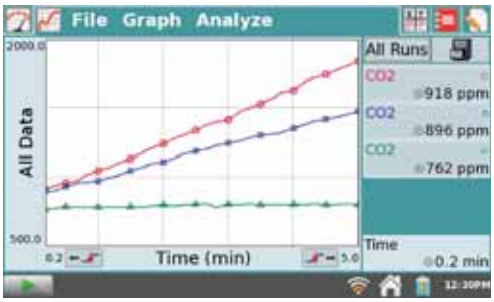
Once data collection has ended, zoom options are also available.



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.

Collecting Multiple Runs

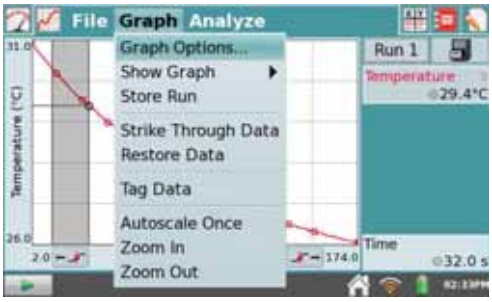


Store Run – You can collect several runs for comparison. Choose Store Run from the Graph menu to save the current run and proceed with data collection. As a shortcut, tap the File Cabinet .

To collect another run, tap Collect. Your new dataset is displayed on the graph. To see your first dataset, 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.

Striking and Tagging Data from the Graph Screen

To strike or tag data from the graph screen, tap on a data point or touch-and-drag to select a region of data. Then, choose the desired tool from the Graph menu and 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 large mark (for example, a circle or square) will be displayed on the graph to tag the data. To add a comment, tap in the panel to the right of the graph 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, choose the desired tool from the Analyze menu. If prompted, select the desired column.

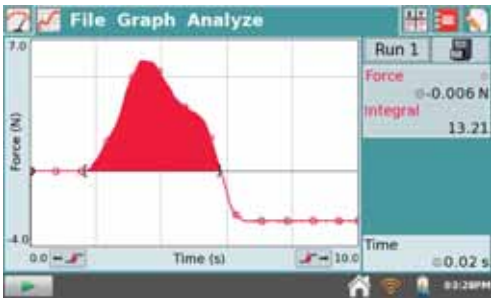
Upon enabling an analysis tool, a summary of analysis information is displayed in a panel to the right of the graph. You can touch-and-drag to scroll the panel, if needed

You can tap the summary to display the values in a detail dialog for ease of reading.

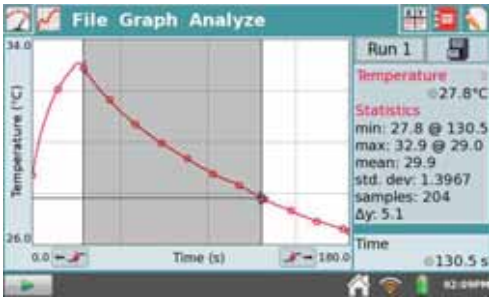
The following analysis tools are available from the Analyze menu.

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.

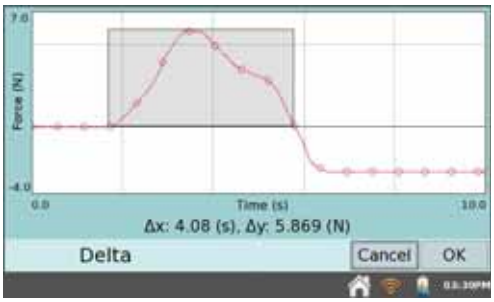
Integral – The Integral tool numerically integrates graphed data. Select a region, if needed, and choose Integral from the Analyze menu. Enable the tool by tapping on the displayed sensor or column name. The area representing the integral is shaded and the numeric result is displayed in the panel to the right of the graph.



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



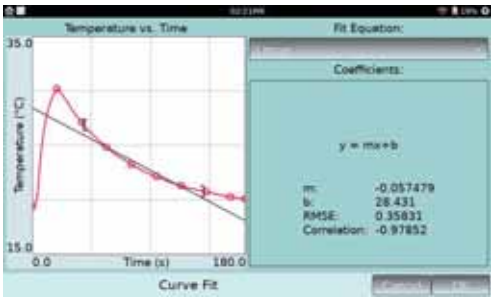
Delta – The Delta tool opens a preview window where you can examine x- and y-deltas. Choose **Delta** from the Analyze menu to open the preview window. Then, touch-and-drag to create a box overlaid on the graph. The vertical side of the box yields Δy, and the horizontal side of the box yields Δx. To redo the selection, touch-and-drag again.



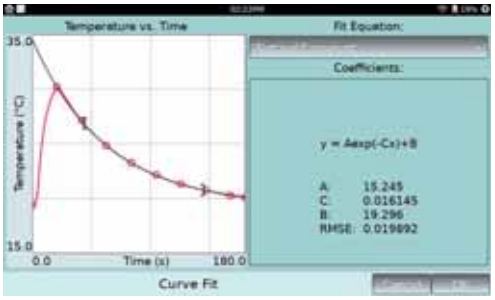
Tap OK to keep these values and display the box on the Graph screen. To exit the Delta tool without displaying the box on the Graph screen, tap Cancel.

Curve Fit – The Curve Fit tool fits 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.

Choose **Curve Fit** from the Analyze menu. Enable the tool by tapping on the displayed sensor or column name. A linear fit is displayed by default.



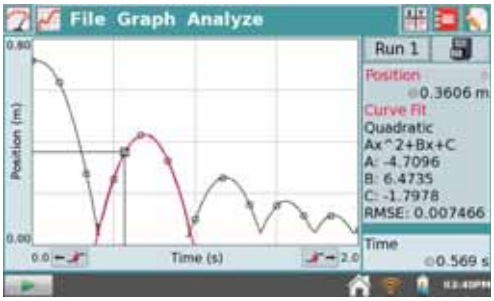
Tap the fit equation and choose the desired fit equation. LabQuest displays the fit in the preview graph at the left. The fit coefficients and Root Mean Square Error (RMSE) are also displayed. For linear fits, the correlation coefficient is also displayed.



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 points are to the fitted line. The RMSE has the same units as the y-axis data.

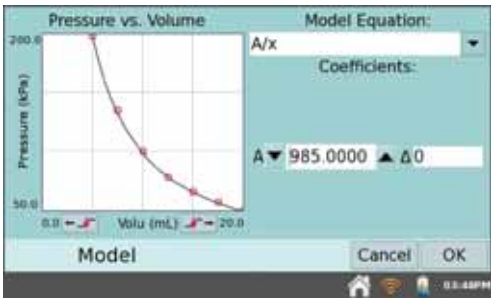
Interpolate – Once you have performed a curve fit, you can use the Interpolate tool to read values from the fitted function. Choose **Interpolate** from the Analyze menu, then tap on the graph. The Examine cursor now locates a position on the fitted function. Coordinates are shown in the panel to the right of the graph. One way to determine that LabQuest is in the Interpolation mode is by the square cursor, gray data, and colored fit equation curve.



Model –The Model tool manually fits a chosen function to your data. Choose **Model** from the Analyze menu. Enable the tool by tapping on the displayed sensor or column name.

Choose the desired model equation from the Model Equation list. LabQuest displays the modeled function in the preview graph.

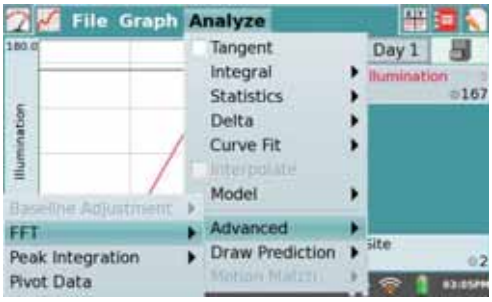
The model parameters (for example, A, B, and C) are adjustable. Change them by direct entry or by using the arrows.



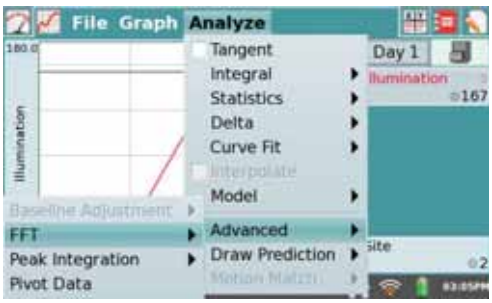
Tap OK to keep this function and display the modeled function on the Graph screen. To exit the Model tool without applying the function, tap Cancel.

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

Advanced – Choose **Advanced** from the Analyze menu to access advanced analysis tools including a Baseline Adjustment for use with our Spirometers, Fast Fourier Transform (FFT) for analyzing sound and other data, and Peak Integration for use with our Mini GC.

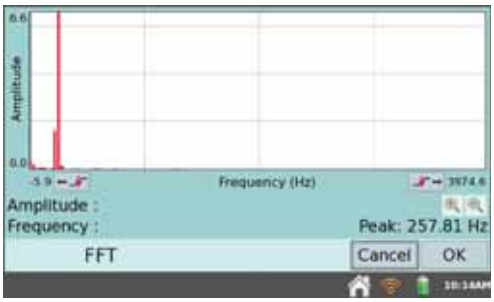


- **Baseline Adjustment –** This tool is used when analyzing Spirometer data. The baseline adjustment applies a factor that raises or lowers the x-axis. Because LabQuest App uses the x-axis as its baseline when calculating an integral, adjusting the baseline can result in a better lung volume measurements.

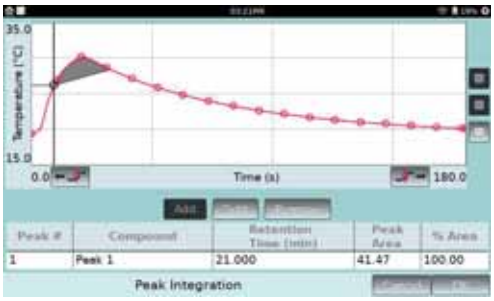


- **FFT** – FFTs or Fast Fourier Transforms are typically used when analyzing Microphone data. The tool calculates the FFT of the selected data. The results are displayed in a separate graph that can be analyzed.

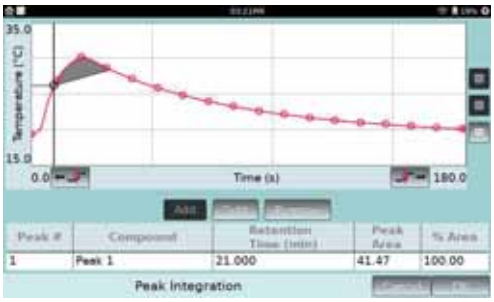
  For more information, see www.vernier.com/til/2310



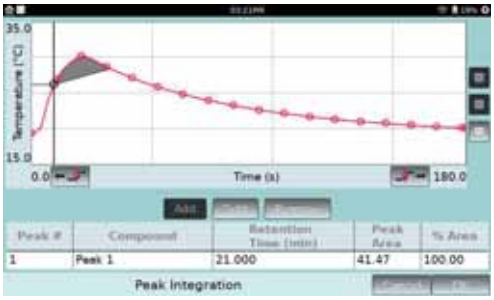
- **Peak Integration** – This tool is most commonly used with the Vernier Mini GC, but it can be applied to any data plot. It calculates the integral for a selected portion of a graph. Peak Integration differs from the Integral tool in that it does not use the x-axis as the baseline. Instead, the integral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



- **Pivot Data** – This tool is only available in Data Matrix mode. It transposes the rows (graphed as the x-axis data typically 0100representing the sampling site) with the runs (the datasets typically representing the sampling day).

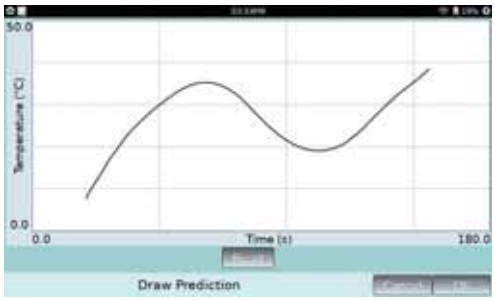


  With this tool you can view the daily data as the location changes, or pivot the data and view the location data as the day changes.



Draw Prediction – The Draw Prediction tool is 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.

Choose **Draw Prediction** from the Analyze menu. Select one of the graph options to activate the tool.

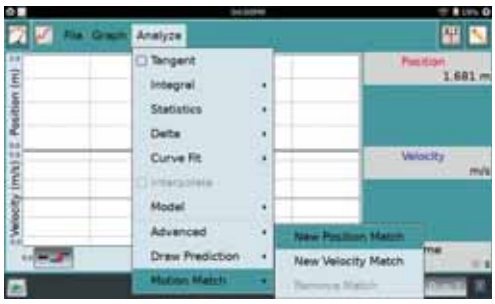


Touch-and-drag across the screen for smooth curves, or tap the screen to connect subsequent taps with straight-line segments. The Reset button removes your sketch if you need to start over.

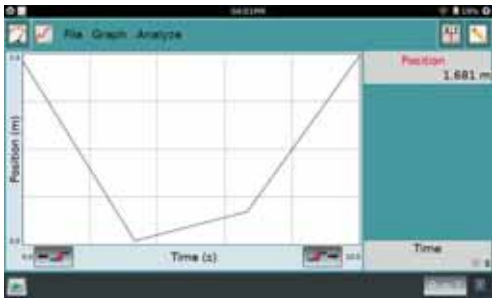
Tap OK to place your sketch on the main graph. To remove a prediction, choose Draw Prediction again from the Analyze menu.

Motion Match –Use motion match to add a target position or velocity plot on your graph that you can match as you collection data. The Motion Match menu item is only available if a Motion Detector, Motion Encoder, or Go Direct Sensor Cart is connected.

Choose **Motion Match** from the Analze menu. Choose New Position or Velocity Match to activate the tool.

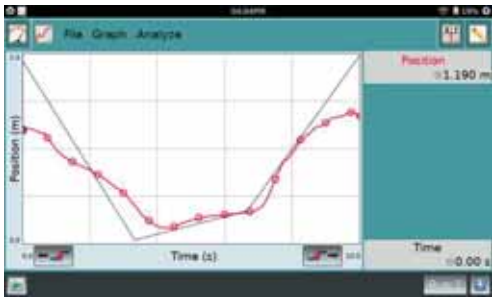


In either case, a random target graph is generated for the matching exercise. Only the selected graph, Position or Velocity, is shown.



TIP! When using Motion Match, automatic graph scaling is disabled. The graph will not automatically scale to fit the data during or after data collection.

Tap the Collect button to start data collection. The collected data will be graphed over the target data. You may collect data over the target graph as many times as you like.



TIP! You can change or remove the target graph by again choosing ***Motion Match*** *from the Analyze Menu and selecting one of the options.*

TIP! For additional information on using Motion Detectors, see www.vernier.com/til/5.

Adjusting the Table screen using Gestures

In addition to viewing and manipulating data from the Graph screen, you can also access data from the Table screen.

Edit a Cell – Double-tap a cell to edit its value. Note that cells containing data from sensors cannot be edited.

Modify Data Column Options – Double-tap a column header to change the column name, units or displayed precision. If the column is a calculated column, you can also modify the equation and coefficients. Since datasets in LabQuest are symmetric, changes to a column in one dataset will be reflected in the corresponding column in all datasets.

Change the Dataset Name – Double-tap the dataset name to create a more descriptive title.

Change the Displayed Dataset – Tap name of the dataset you want to view.

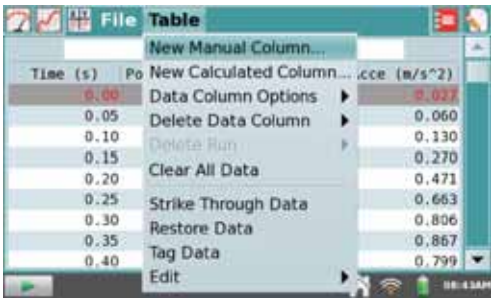
Select multiple cells – Touch-and drag across the screen to select multiple cells. Note that whole rows are selected when you tap on a single cell. Use the selected cells in conjunction with strike through data and copy/paste edit tools found in the Table menu.

Scroll the data table – Swipe up and down to scroll the data table.

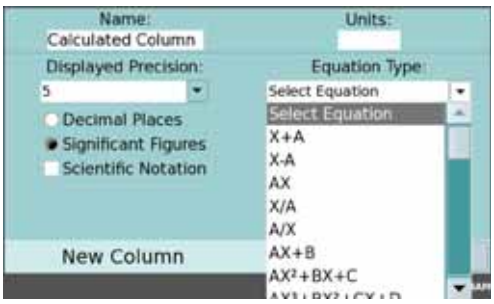
Pan the data table – When there are more than five columns in your data table, you can touch and drag the table to view the additional columns.

Adjusting the Table screen using the Table Menu

From the Table menu, you can create, modify, or delete columns of data. The following tools are available from the Table menu:



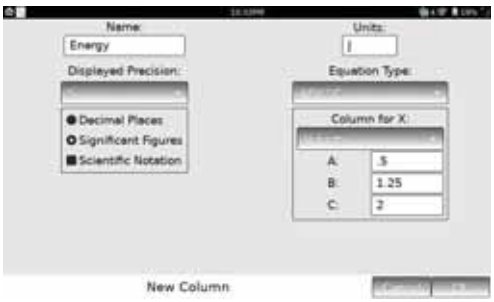
New Manual Column – Choose **New Manual Column** to create an empty column where you can enter or generate values directly. You can add a manual column to an experiment file that includes sensor data, or you can create a new experiment file consisting entirely of manually entered data.



New Calculated Column – Choose **New Calculated Column** to create a column with values that are based on other columns through a mathematical formula. For example, you might define a calculated column as the inverse square of another column.

Tap the Name field to enter a name for the column, tap the Units field to enter units, and then select an equation from the Equation Type list.

Once you have selected the equation, you will define the data columns (X, Y and Z) and coefficients (A, B, C, etc.) to create the desired equation.



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 – Use these options to access the fields for setting the column name, units, and displayed precision.

Delete Data Column – Use this 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 available in 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 dataset created.

Clear All Data – This action will clear all data in the table. Upon choosing this option, you will be prompted to confirm. This option is used when you wish to clear previously collected data without changing any of the data-collection parameters or sensor setup information.

Strike Through Data – Use this tool to ignore selected data. Struck data are ignored for analysis and graphing, and the graph will update accordingly. Note that you can also access this tool from the Graph menu on the Graph screen.

Restore Data – Use this tool to restore struck data. If you select a region of struck data only data from that region will be restored. If you do not select a region, all struck data will be restored. Note that you can also access this tool from the Graph menu on the Graph screen.

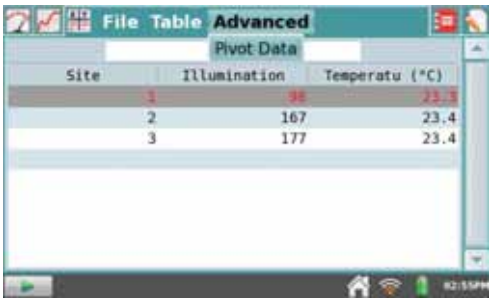
Tag Data – Use this tool to tag a data point with a comment. After selecting the data point within the table, choose **Tag Data** from the Table menu. Note that a point that is tagged is not identifiable in the data table. A tagged data point is marked with a circle on the graph.

To add a comment to a marked point, tap the Graph tab, then tap the info panel to the right of the graph. A list of Data Tags will be displayed. Tap in the blank field to enter a comment for the tag.

Edit – Use this tool to copy and paste values from one location to another. For example, you might copy a range of values from the table and paste them into notes on the Notes screen.

Advanced Table Option

When LabQuest is in the Data Matrix mode, an Advanced Menu option is displayed adjacent to the Table menu. Choose **Pivot Data** from the Advanced menu to transpose the rows (usually graphed as the x-axis and representing the sampling site) with the runs (usually selected by tapping on the button to the left of the Filing Cabinet and representing the sampling day). You can view field data as the location changes or as it is pivoted to be viewed as the day changes.



Viewing Vernier Experiments

In previous versions of the LabQuest App, you could acces Vernier experiments from within the LabQuest App. In LabQuest 3, Vernier Experiments are accessed using the Experiment Viewer App. See Experiment Viewer App for more details.

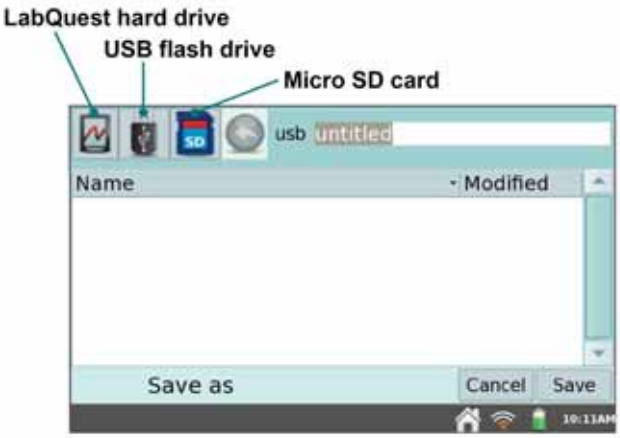
Adding Notes to Your Experiment

From the Notes screen you can enter notes as you perform an experiment. The menu provides access to standard edit commands 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 a USB flash drive. LabQuest App files can also be opened and manipulated on a computer using Vernier Logger *Pro*® 3 or Logger Lite software.

The USB flash drive can be formatted in FAT16 or FAT32 (the most common Windows® and macOS® formats) for reading and writing. LabQuest cannot read NTFS or HFS+ formatted drives.



To save a LabQuest App file, follow these instructions:

1. If saving to a USB flash drive, make sure the drive is inserted in the appropriate port on LabQuest. It can take several seconds for LabQuest to recognize the drive.
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
   - USB flash drive
4. After selecting your destination, tap on the name field and enter the file name. Tap OK.
5. Tap Save to save the file.

TIP! You cannot create directories within LabQuest App, but you can use directories that already exist on a USB drive. We recommend using a computer to creating any needed folders on a flash drive before you use the drive with LabQuest.

Exporting LabQuest App files

In some cases, you may wish to export the LabQuest App data in a text format (.txt) for further analysis within a spreadsheet or other application.

To do this, choose Export from the File menu. Follow steps similar to those described in Storing LabQuest App Files, but choose Export from the File menu instead of Save As. You must have a USB flash drive connected in order to export a file.

To open the exported .txt file in a spreadsheet program, confirm the program's file browser is set to look for *all* file types, then select your text file.

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

IV. DATA SHARING: USING LABQUEST® 3

As part of the Connected Science System®, LabQuest 3 serves as a Data Sharing source that can wirelessly stream sensor data to Graphical Analysis™ 4 running on computers, Chromebook™ notebooks, or mobile devices such as iOS and Android™ tablets and phones.

How Data Sharing Works

- Students in a lab group set up an experiment with Vernier sensors and LabQuest 3.
- Students use Graphical Analysis 4 app to wirelessly connect to the LabQuest 3 using Wi-Fi.
- Experiment data are streamed from LabQuest 3 to each student's device.
- Each lab group member performs an individual analysis of the shared data on their device.
- Students can take their data and analysis home for further analysis and lab report creation.

Set Up Data Sharing on LabQuest

To set up LabQuest as a Data Sharing source, you will need to connect LabQuest to a Wi-Fi Network and enable Data Sharing.

Connect LabQuest to a Wi-Fi Network

1. Launch the Connections app from the Settings screen.

2. Verify Wi-Fi is

3. Tap the Network Settings icon to open the Network Configuration dialog box. This dialog lists any 2.4 GHz networks within range, as well as options to manually join or create a network.

4. Select a netwo

Existing Network (Infrastructure Network)

To connect to an existing Wi-Fi network, follow these instructions.

a. Locate the network within the list and tap on the network name to select it.

If prompted, enter your network's passphrase and tap Connect.

TIP! If your network requires additional network authentication information or if you have an enterprise network that requires a network certificate, see our website for more instructions: www.vernier.com/til/2836

b. Verify LabQuest is attempting to connect to the network. The network status should indicate Connecting.

c. Verify LabQuest has successfully connected to the network. The network status should change to a numeric IP address.

When LabQuest has successfully connected to the network, tap OK to return to the Connections app.

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 3.

TIP! Students can connect to a LabQuest 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.

a. Select Create Network.

TIP! If you are in an area with several Wi-Fi networks, you may need to scroll to the bottom of the network list to locate "Create Network."

b. Tap the Network Name field and assign a name to this new network (e.g., Ms. Johnson classroom). Then, tap Create.

c. Verify LabQuest is attempting to create a network. The network status should indicate Connecting.

d. Verify LabQuest has successfully created a network. The network status should change to a numeric IP address.

   When LabQuest has successfully created a network, tap OK to return to the Connections app.

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

Enable Data Sharing on LabQuest

In addition to connecting to a Wi-Fi network, you will need to set up LabQuest as a Data Sharing Source using the following instructions.

1. Launch the Connections app from the Settings screen.

2. To easily identi
   recommended you give your LabQuest a unique name. To do this, tap the Name field edit icon.

Edit the LabQuest name as desired. Only alpha and numeric characters are allowed. You cannot uses spaces or punctuation marks in the LabQuest name. Tap Done to save the name.

3. From the Connections app, tap the Data Sharing icon to open the Data Sharing Settings dialog.

4. Verify Data Sharing is enabled (On).

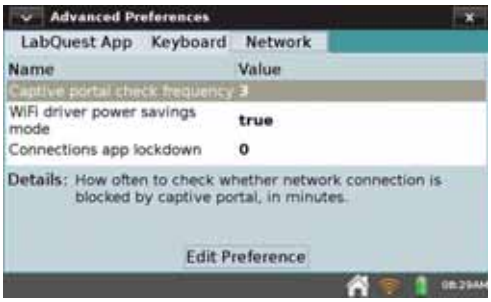
   TIP! If you want to allow students to start and stop data collection from their computing device, select the check box to enable this feature.

   Tap OK to save the setup.

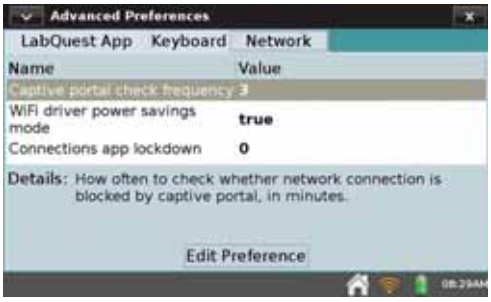
Restricting Access to the Connections Setup

Once your LabQuest is configured as desired, you can set the Advanced Preferences to restrict access to the Connections setup information. This prevents students from inadvertently changing your network and Data Sharing settings.

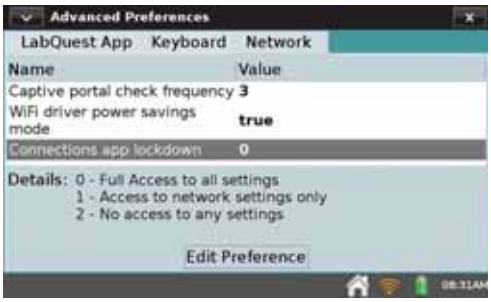
1. Tap Advanced Preferences from the Settings screen.



2. Within the Advanced Preferences dialog box, tap the Network tab.



3. Select Connections app lockdown and then tap Edit Preference.



4. Select the desired setting.

   TIP! Changes to the Connections main screen will not show if the lockdown mode is changed while the Connections app is running. Tap ✕ *to close the application, then launch the Connections app again.*

Connect to LabQuest 3 from Your Device

After setting up LabQuest as a Data Sharing source, you can connect to this LabQuest from your computer, Chromebook™, tablet, or smartphone.

Access LabQuest 3 Data Using Graphical Analysis™ 4

1. Connect your Chromebook or mobile device to the same Wi-Fi network to which you connected LabQuest 3.

2. Launch Graphical Analysis on your computer, Chromebook, tablet or phone.

3. From the New Experiment dialog, select Data Sharing. Discovered Data Sharing Sources will be listed automatically.

4. Tap the name of the LabQuest 3 source to connect. If your LabQuest 3 source is not listed in Data Sharing sources, you can connect by choosing Specify Source and manually entering the LabQuest Data Sharing source address or by scanning the QR Code.

Access LabQuest 3 Data Using the Data Share Web App

1. Launch the Connections app from the Home screen.

2. Connect your computer, Chromebook, tablet, or phone to the same Wi-Fi network to which you connected LabQuest 3.

3. On your computer, Chromebook™, tablet or phone, open a supported browser and enter the Data Sharing Source Address. Alternatively, if you have a QR code reader on your device, you can access this via the provided QR code.

V. USING LABQUEST® 3 WITH A COMPUTER OR CHROMEBOOK™ VIA USB

LabQuest 3 can be used via USB connection with the following software:

- Logger *Pro*® 3 – www.vernier.com/lp
- Graphical Analysis™ 4 – www.vernier.com/ga4
- Logger Lite – www.vernier.com/logger-lite

Collecting Data using Computer Software

LabQuest 3 can be used as a sensor interface with a computer or Chromebook. To collect data, follow these steps:

1. Connect a wired (BTA or BTD) sensor to LabQuest. *Note: USB and wireless sensors must connect directly to the computer or Chromebook and not to the LabQuest.*

2. Connect LabQuest to your computer or Chromebook using the included USB cable. The micro end of the cable connects to LabQuest and the full-sized end connects to an available USB port on your computer or Chromebook.

3. Open the data-collection software on your computer or Chromebook. The software will detect LabQuest and the attached sensor(s), displaying a graph ready for data collection. LabQuest will display a screen with two arrows indicating it is controlled by another device.

4. Click the Collect button in the computer or Chromebook software to start data collection.

Transferring Data from LabQuest to Logger *Pro* 3 or Logger Lite

Automatically Transferring Data

If you collect data in LabQuest App and subsequently connect LabQuest to a computer, Logger *Pro* 3 or Logger Lite will automatically detect the presence of the remote data and display a message indicating the data can be retrieved from LabQuest. Follow the onscreen instructions to download data to the computer.

Manually Transferring Data

To manually transfer saved data from LabQuest (see Storing LabQuest App Files), open Logger *Pro* 3 or Logger Lite on your computer. Choose LabQuest Browser from the computer File menu, and then choose Open. Choose the desired LabQuest file from the displayed list and click Open. Once opened on the computer, you may then choose to save the file as a Logger *Pro* (*.cmbl*) or Logger Lite (*.gmbl*) file by choosing Save As from the computer File menu.

TIP! If sensors are still connected when a LabQuest file is opened using Logger Pro *3 or Logger Lite, the sensors will be ignored. To enable the sensors, choose New from the File menu in Logger Lite or Logger* Pro *3.*

Another method for manually transferring data from LabQuest to Logger Lite or Logger *Pro 3* is to choose LabQuest Browser from the File menu in the computer software, then choose Import. Import differs from Open in that only the data in the LabQuest file are added to the current computer session. You can 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 LabQuest devices by repeatedly importing data into a single Logger Pro *3 or Logger Lite file.*

Manually Moving Data from Logger *Pro* 3 or Logger Lite to LabQuest

Data and/or sensor configurations can be saved to LabQuest from your computer. To do this, open an existing Logger *Pro* 3 or Logger Lite file or set up a new file with the desired data-collection settings. Choose LabQuest Browser from the File menu, then choose Save As. Enter a descriptive filename. Any data, as well as the sensor configuration, will be stored on 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 from Logger *Pro* 3 or Logger Lite

To delete data on LabQuest from Logger *Pro* 3 or Logger Lite, choose LabQuest Browser from the file menu, then choose Delete. Choose the desired file for deletion from the displayed list and click Delete.

TIP! Use this feature to mass delete files from LabQuest by selecting multiple files from the displayed list.

Transferring Data from LabQuest to Graphical Analysis 4

Collected data can only be transferred from LabQuest to Graphical Analysis 4 through wireless Data Sharing via Wi-Fi. You cannot access data saved on LabQuest 3 through a USB connection.

For more information on Data Sharing, see Data Sharing: Using LabQuest® .

VI. EMAILING FROM LABQUEST® 3

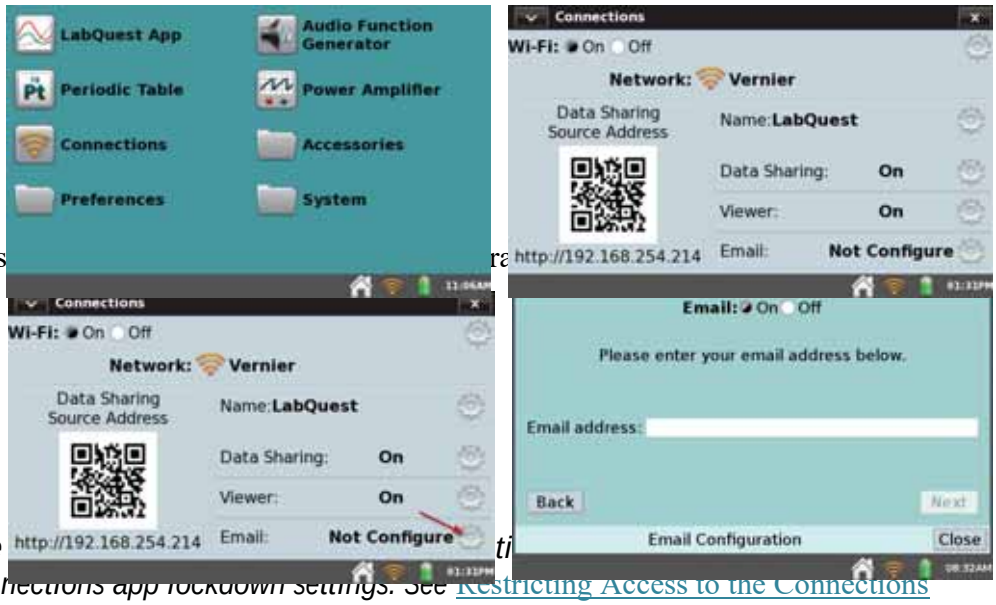
If LabQuest is connected to a network with Internet access, you can email your data file, graph, text file, or screenshot to an email client. To set this up, follow these instructions:

1. Connect LabQuest to a network with Internet access. For detailed instructions, see Connect LabQuest to a Wi-Fi Network

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

2. Launch the Connections app from the Settings screen.

3. Tap the Email s



   TIP! If you are ti update the Connections app lockdown settings. See Restricting Access to the Connections Setup for more information.

4. Verify email is enabled (On).

5. Enter the email address you want to use with LabQuest.

   TIP! This is used to access the outbound email server associated with this email account required for sending emails. You cannot receive incoming emails on a LabQuest.

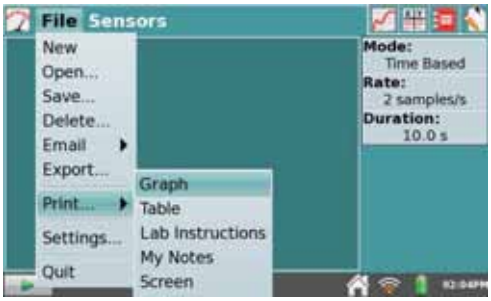
6. Follow the on-screen prompts to register LabQuest with your email provider (e.g., Gmail).

VII. USING PRINT TO FILE ON LABQUEST® 3

Use the Print to File feature to create PDF files of a graph, data table, notes, or LabQuest screen (as currently displayed). Use the files to include with lab reports. The files can be printed from a computer.

TIP! The initial release of LabQuest 3 does not support printing directly to a printer. Future software updates will support printing directly to a compatible USB or network printer.

To use Print to File, connect a USB flash drive to your LabQuest. Choose Print from the File menu, and then choose the item that you want to print (Graph, Table, My Notes, or Screen).



TIP! Options for printing Table and My Notes are not available when those items have no data to print.

Use the Print Options dialog box to set additional print settings. You can choose to add a title, footer, or print in grayscale. Tap Print to save a PDF file of your selection to the flash drive.

VIII. PROJECTING AND MONITORING STUDENTS' LABQUEST® 3 DEVICES

Use our LabQuest Viewer software (order code, LQ-VIEW) for Windows® and macOS® computers or LabQuest Viewer® for iPad® to view and control LabQuest wirelessly from your computer or iPad. LabQuest Viewer can be used in conjunction with a projector to share the LabQuest 3 screen with the entire class.

Instructors can use LabQuest Viewer to demonstrate LabQuest 3 to the class and have students present their work to fellow classmates.

With LabQuest Viewer, you can:

- View and control one or more LabQuest units from a computer or iPad.
- Connect to a projector or interactive white board for class demos or student 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.

System Requirements

Windows – Windows 7 (SP1), Windows 8, Windows 8.1, and Windows 10

macOS – macOS X 10.8 or newer

iPad – iOS 8 or newer

LabQuest Setup

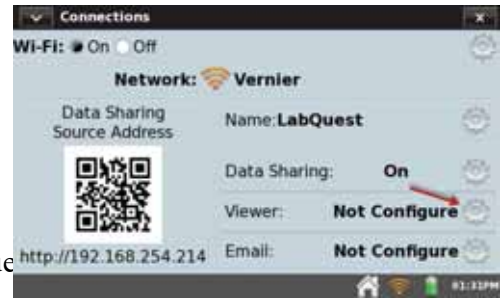
To set up your LabQuest to communicate with LabQuest Viewer App for iPad, or LabQuest Viewer software on your macOS or Windows computer, follow these instructions.

1. Connect LabQuest to a network. For detailed instructions, see Connect LabQuest to a Wi-Fi Network

   TIP! The Network used for the LabQuest Viewer does not require Internet connectivity.

2. Launch the Connections app from the Settings screen.

3. Tap the Viewer settings icon to open the Viewer Settings dialog box.



4. Enable LabQue

5. Select the check box to Allow screen control.

6. Tap OK to exit the LabQuest Viewer settings.

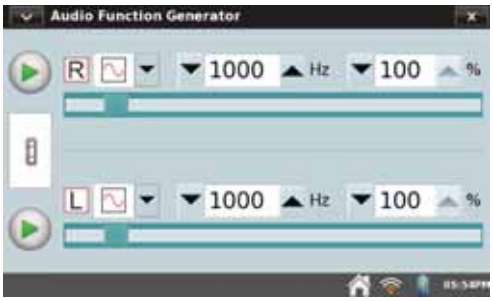
   TIP! If Wi-Fi is not available, you can Enable Viewer over USB to connect with the LabQuest Viewer computer software via USB. While this option is selected, your LabQuest cannot be used as a USB interface with Logger Pro *3, Graphical Analysis 4 or Logger Lite computer software.*

IX. ADDITIONAL APPS ON LABQUEST® 3

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

Access additional apps and accessories from the Home screen.

Audio Function Generator



The Audio 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 channels start and stop together. Tap the link icon to control the channels independently.

Use the sliders to adjust the frequency.

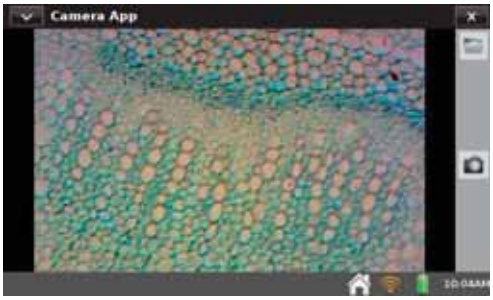
A common use of the Audio Function Generator is to create tones and beats for waveform study using a microphone. For the best waveform quality, connect a powered computer speaker to the LabQuest audio output jack.

Calculator

The Calculator App is a standard scientific calculator that uses algebraic notation. You can copy a calculator result and paste it into the Notes tab or into a manual column cell.

Camera App

The Camera App works with digital (USB) cameras. See www.vernier.com/til/3659 for more information regarding supported digital cameras. Use the Camera App to view a live image feed from the camera and to capture images for later viewing.



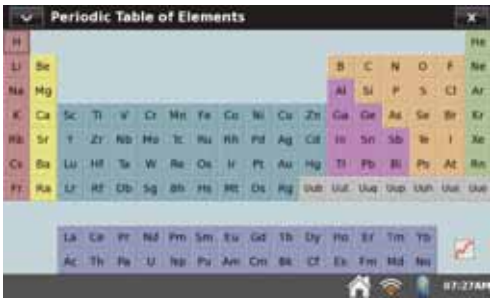
Experiment Viewer

The Experiment Viewer is a PDF reader that can access over 75 experiments that come on your LabQuest. You can also use this app to access documentation for the internal sensors and this user guide. You can also use this application to view other PDF files saved on a USB Flash Drive. These files can be saved directly to your LabQuest, if desired.

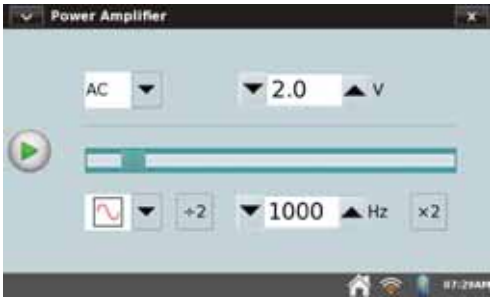
Periodic Table

The Periodic Table app contains standard reference information on the elements. Tap an element to see details.

Data from the periodic table app is available as a saved data file in the LabQuest App. Choose Open from the LabQuest App File menu and select the Periodic Table Data file. Tap on the y-axis label to select different values to plot.



Power Amplifier



The Power Amplifier app controls 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 port.

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.

Sound Recorder

The Sound Recorder app captures 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. Tap the disk button 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.

Stopwatch

The Stopwatch app 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 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, the calculator, or a manual column cell.

X. APPENDICES

Appendix A – LabQuest 3 Technical Specifications

Display

15.4 cm × 8.6 cm (17.7 cm diagonal) screen

800 × 480 pixel color display at 188 dpi

LED backlight

Landscape screen orientation

Processor

2 GHz Application Processor

Connectivity

Wi-Fi 802.11 b/g/n

Bluetooth 4 for Wireless Sensors

User Interface

Capacitive touch screen

Touch navigation

Power

Rechargeable, high-capacity battery

DC charging/powering through external adapter (included)

Data Acquisition

12-bit resolution

Built-in GPS and microphone

Ports

5 sensor channels

2 USB port for sensors, flash drives, and peripherals

USB micro port for computer connectivity

DC power port

Audio Out port for use with Vernier Power Amplifier, headphones and powered speakers

Maximum Sampling Rate

1 sensor: 100,000 samples/s (0.02 seconds maximum duration)

2 or more sensors: 10,000 samples/s (0.21 seconds maximum duration)

Minimum Sampling Rate

0.00125 samples/s (800 s/sample)

Maximum Samples (standalone)

1 sensor: 2000 samples 20K–100K samples/s

1 sensor: 14,000–21,000 samples*at ≤ 10K samples/s

2 or more sensors: 12,000–14,000 samples* at ≤ 10K samples/s

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: 11.7 cm × 19.0 cm × 4.0 cm

Weight: 350 g

Storage

500 MB

Expandable with 2 GB USB flash drive

Non-compatible Sensors

LabQuest 3 does not support the following:

Heat Pulser

Vernier Flash Photolysis Spectrometer

**Highest number of samples is for the very first collection after starting LabQuest. The smaller number of samples depends on the number of previous collections and stored runs during this LabQuest session.*

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 to charge the LabQuest battery. A replacement adapter can be purchased from our website (order code LQ3-PS).

The battery takes about 12 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.

When using LabQuest 3 as a computer interface, either the battery must be charged or LabQuest must be connected to AC power. LabQuest 3 cannot operate on USB power alone.

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. Data loss due to a loss of power is minimized through periodic saving of a backup file.

Battery life depends on the sensors and features used. To access power-saving options, choose the Light & Power app from the Settings screen. Optimize day-to-day battery life by setting the screen brightness to the minimum acceptable level and power off (Suspend) the unit whenever the unit is not in use.

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 and the battery will begin to swell. 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 website (order code LQ2-BAT). Recycling information is available at www.call2recycle.org.

LabQuest Power Profiles

There are three power profiles available, Battery, AC, and Automatic. Select the power profile that best matches how your use your LabQuest. While the Battery and AC profile names suggest when they should be used, these profiles do not depend on how you are powering your

LabQuest. The Battery profile is designed to conserve battery power during times the LabQuest is idol. The AC profile also applies power saving options however there is more time between the different power saving steps.

Automatic profile option is the default option. When using this profile, LabQuest automatically detects if you are running on AC or battery power and applies the appropriate profile. Note that the LabQuest cannot distinguish between power coming from an AC adapter or an external backup battery such as the LabQuest Battery Boost 3. When using an external battery, you may want to use the Battery profile to conserve power of the external battery.

If you are setting up a LabQuest for display, you may not want the unit to dim at all. To do that, connect your unit to AC Power and choose the option to not dim the screen while on AC power.

Here is a summary of the power profile stages to conserve power:

	Battery		AC	
	Not in Use	**Collecting Data**	**Not in Use**	**Collecting Data**
Dim Screen	after 1 minute	after 1 minute	after 2 minutes	after 2 minutes
Screen off	after 3 minutes	after 3 minutes	after 5 minutes	after 15 minutes
Suspend	after 30 minutes	never	after 60 minutes	never
Shut down	after 2 days	never	after 2 days	never

Note that even while the screen is off, LabQuest will provide power to sensors connected to the ports. This can be helpful for sensors that need to stay powered to retain powered between measurements when doing field work.

LabQuest Case and Screen

LabQuest is water and shock resistant. Do not submerge LabQuest in liquids or allow liquids to sit on the screen for any extended time. Wipe it clean with a damp cloth only; do not use any solvents including ammonia or glass cleaners.

For information on disinfecting you LabQuest unit, see https://www.vernier.com/til/6551

LabQuest Software Updates

LabQuest arrives with software 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 website: www.vernier.com/downloads/

Getting Additional Help

For access to user manuals, forums, and our Technology Information Library, please visit our website at

www.vernier.com/labq3

You may also contact Vernier directly:

888.837.6437
support@vernier.com
www.vernier.com/labq3

Appendix C – LabQuest Keyboard

LabQuest App automatically displays the keyboard when text can be entered.

Standard

The standard keyboard displays lowercase letters and some punctuation marks. To delete the previous entry, use the Backspace key ⇦. To start a new line, use the Carriage Return ⏎.

To access capitalize letters and additional punctuation marks, use the Shift key ⇧.Touch and hold the shift key to apply the caps lock.

Tap Done to dismiss the keyboard.

Numeric and special characters

To access the numeric keyboard from the standard keyboard, tap 123.

Tap the shift key ⇧ to access additional characters such as Greek characters, superscripts, and subscripts characters. Touch and hold the shift key to lock this keyboard option.

Tap 123 to return to the standard keyboard.

Appendix D – 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 www.gnu.org/licenses

Appendix E – 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. This warranty covers educational institutions only.

The LabQuest 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. For more information about the LabQuest battery, see LabQuest Battery

Appendix F – Curriculum Resources

Vernier offers a complete set of lab books for elementary through college. For more information, see www.vernier.com/books

Appendix G – Accessories, Replacement Parts, and Related Products

LabQuest Viewer

Display and control LabQuest on a computer to teach students how to use LabQuest, demonstrate experiments, or share class data.
www.vernier.com/lq-view

Also available, LabQuest Viewer® for iPad®
www.vernier.com/lq-view-ipad

LabQuest Charging Station

Charge and store up to four LabQuest 3 interfaces with this compact and affordable station.
www.vernier.com/lq2-crg

LabQuest Battery Boost 3

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-boost3

Vernier Lanyard

The LabQuest neck strap helps prevent accidental drops during field studies.
www.vernier.com/lq-lan

LabQuest USB Computer Cable

Replacement LabQuest-to-computer USB cable
The cable has a USB micro plug and USB standard-A plug. One cable is included with each LabQuest 3.
www.vernier.com/cb-usb-micro

LabQuest USB-C Computer Cable

LabQuest to computer USB C cable
The cable has a USB micor plug and USB-C plug. This cable is recommended for computers and Chromebook™ notebooks that only have USB-C ports.
www.vernier.com/cb-usb-c-micro

Replacement Battery for LabQuest 3

Replacement high-capacity, rechargeable, lithium-ion battery for the Vernier LabQuest 3.
One battery is included with each LabQuest 3.
www.vernier.com/lq3-bat

LabQuest Power Supply

Replacement power supply for the LabQuest
One power supply is included with each LabQuest 3.
www.vernier.com/lq3-ps

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

Version 3.0.0
Revised August, 2020