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The CALIPER

Vernier
Measure. Analyze. Learn.™

THE CALIPER IS A PUBLICATION FOR USERS OF VERNIER PRODUCTS

IN THIS ISSUE

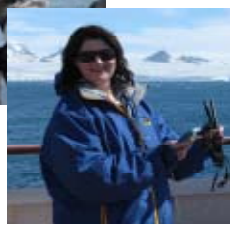
LabQuest in Antarctica

Using the Vernier GPS Sensor with Google™ Maps

By Robyn Johnson

By its name alone, LabQuest seems destined for adventure. When I decided to go on a National Geographic Expedition to Antarctica in January, there was no doubt in my mind that I would be taking mine with me. Sailing from Ushuaia, Argentina, we spent almost two days crossing the infamous Drake Passage.

For eight days, we sailed around the Antarctic Peninsula, seeing incredible scenery, many seals, whales, and literally hundreds of thousands of penguins. I was a curiosity to the group of 140 travelers as well, as each day I pulled out my LabQuest and sensors to take my readings. They thought it was very cool, and many would come back each day to see what the readings were.



Collecting UV and location data in Antarctica

Using the new Vernier GPS Sensor connected directly to the LabQuest, I collected location data,

continued on page 9

NEW Power Amplifier

Standing Waves on a String

Standing waves on a string

Our new Vernier Power Amplifier lets you use LabQuest and LabPro for many lab activities and demonstrations. It will drive speakers, lamps, RLC circuits, DC motors, coils, and more. One of our favorite uses of the Power Amplifier is the vibrating string demo. To do this activity, we usually use a small speaker from an electronics surplus store. We either hot glue a paper clip to the speaker cone, or just connect to the cone by making a hole in it. For the string, we find that the flexible cord of the type used on name tags at conventions works great. Tie the other end of the string to a ring stand and connect the leads from the Power Amplifier to the speaker. Use the new Power Amplifier application that is included with LabQuest App v. 1.2 to set the output for a sine wave with several volts of amplitude. We like to start with a fundamental frequency of about 10 Hz, but you can experiment with what works best for your setup. We can usually produce all the harmonics up to the first eight or nine.

For a complete lab ready to use with your students, go to **www.vernier.com/pamp**

The Vernier Power Amplifier will drive loads at ±10V and 1A, from DC to 10 kHz. It can be used with LabQuest, LabPro, and many other signal sources.

Watch the Video

For a movie of this as a demonstration, go to **www.vernier.com/pamp**

$199 ORDER CODE PAMP

NEW *STEM with Vernier® and LEGO® MINDSTORMS® NXT*

$35 ORDER CODE STEM

About a year ago, we introduced our Vernier NXT Sensor Adapter, which allows about 30 of our analog sensors to be used with the LEGO® MINDSTORMS® NXT Robotics System. We now have our first book of labs and robotics projects using our sensors and this system. This book is designed for use in middle schools, and we hope it will help in stirring more interest in science and engineering among students. It includes 14 labs, mostly taken from our other books, but this time to be done with the LEGO® MINDSTORMS® NXT as the data-collection interface. It also includes four robotics projects using the same sensors. For information on the book, or to download evaluation copies of the labs, go to **www.vernier.com/nxt**

NEW Optics Expansion Kit Updated

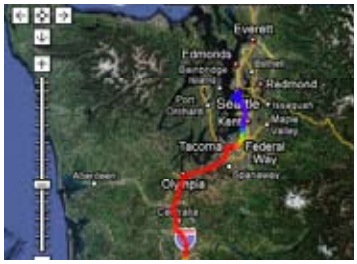
$169 ORDER CODE OEK

The new Vernier Optics Expansion Kit has all the functions of the old kit, but the support parts are all molded plastic. The parts snap onto the track, so they can be left in place while the track is moved. The three lenses are permanently mounted in three plastic supports. The light source is now LED-based, so that it uses less energy and is cooler, while at the same time brighter. The power supply is now the same as the LabQuest, reducing confusion. There is an additional aperture plate to do experiments based on lens diameter and shape. Some possible experiments for the Optics Expansion Kit include image formation by thin lenses, making a telescope, the inverse-square law, and f-stop effects.

OEK Fire Sale: We have a few of the original Optics Expansion Kits available at the reduced price of $99 (order code OEK-OV).

More information at **www.vernier.com/oek**

Using GPS Data in Physics



Speed data collected during a drive

$64 ORDER CODE VGPS

Showing speed and location in Google™ Maps

Logger *Pro* 3.7 has an exciting new feature for use in conjunction with our new Vernier GPS Sensor. If connected to the internet, Logger *Pro* can export location data to Google Maps, something it has done for a while, but it can now color code a line of data from a sensor or any data column.

Recently, a few of us drove from our office in Beaverton, OR to Seattle, WA for a conference. We attached a Vernier GPS Sensor to a LabQuest and collected data throughout the trip. LabQuest not only records the latitude and longitude of each point, but the speed, direction, and altitude, as well. The data were imported into Logger *Pro*, then exported to Google Maps. In the options for this export from Logger *Pro*, you can now choose to plot the data as a line instead of individual points, using the color spectrum for any column. We chose speed as the column to use for color coding, with red being the fastest and violet being the slowest.

What do you think happened in the violet and blue sections? Think of ways you could use this in your physics courses. What would acceleration data look like?

More information at **www.vernier.com/innovate/106**

In the Best Light | Study sheds light on merchandise appeal using spectroscopy

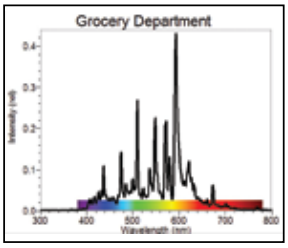
Have you ever noticed that the bananas you bought look different in the store than they do when you get them home? This is because not all lights used in grocery display cases are the same. The main reason for having different lighting is to improve shelf life of perishable products. Nevertheless, you can be sure some research has gone into determining the best light to entice you to make a purchase.

More information at **www.vernier.com/innovate/107**

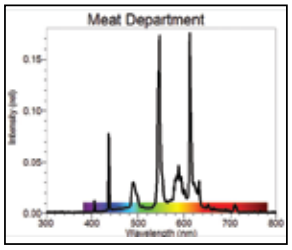
Here are some questions you might ask your students based on our data:

- Compare and contrast the spectra for the different lights used in this grocery store.
- What wavelengths of light are missing from the banana lights compared to the green vegetable lights? What effect might this have on the appearance of the bananas?
- The lights in the floral department have peaks below 400 nm. What portion of the electromagnetic spectrum is this? Give several possible reasons why only the floral department lights would include energy peaks in this region of the spectrum.
- Do any of the lights used in the grocery store contain mercury? Explain how you know.

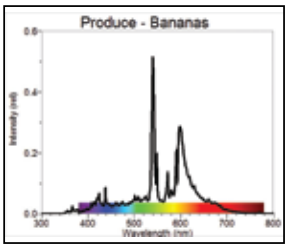
Special thanks to Vernier consultant Walter Rohr for collecting the data at his neighborhood grocery store using a spectrometer and fiber optic cable from Vernier.



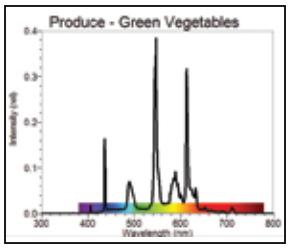
Spectrum in grocery department



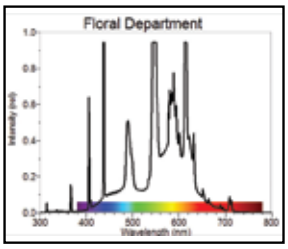
Spectrum in meat department



Spectrum above bananas



Spectrum above green vegetables



Spectrum in floral department

NEW Bumper and Launcher Kit

Hooke's Law

The new Bumper and Launcher Kit is an accessory for the Vernier Dynamics Kit. It includes two different spring bumpers, magnetic bumpers, clay bumpers, and mounting equipment. You can use the kit to study collisions, impulses and energy with your dynamics carts. This kit has many uses during the study of mechanics. Two excellent examples involve the study of Hooke's law, especially as it is applied to energy conservation.

The hoop spring bumpers in the Bumper and Launcher Kit are excellent examples of *Hookean devices*; that is, the length of the hoop spring is directly proportional to the force applied. To investigate Hooke's law, attach a hoop spring bumper to a Dual-Range Force Sensor that is mounted to a Vernier Dynamics Cart on a track. Attach the Track Bracket near the end of the track and position a Motion Detector at the other end of the ramp pointing toward the Track Bracket.

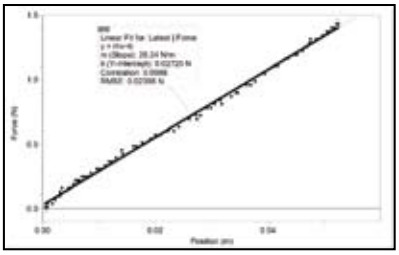
In the software, reverse the direction of positive force for the Force Sensor. Position the cart such that the bumper is almost, but not quite, touching the end stop. With the cart in this position, zero both sensors. Start data collection and slowly move the cart toward the Track Bracket, compressing the spring. Slowly move the cart back out toward the zero position without going past the zero position. Create a scatter plot of force *vs.* position. Fit a straight line to the data to determine the force constant of the hoop spring. Notice the linear response of the hoop spring.

Hoop spring used to launch cart

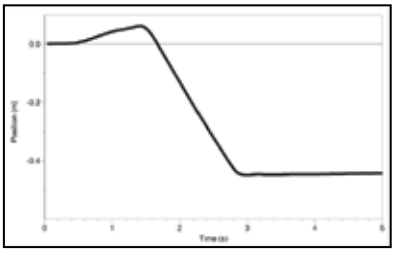
$89 ORDER CODE BLK

Spring potential energy, work, and kinetic energy

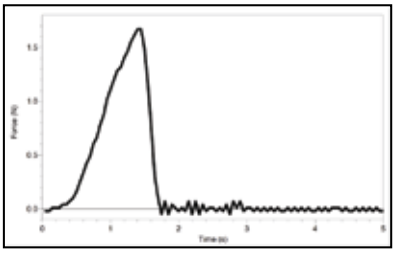
The hoop spring acts as an excellent cart launcher on the Dynamics Track. By combining the hoop spring, a Dual-Range Force Sensor, and a Motion Detector, students can investigate the relationship between spring potential energy, work, and kinetic energy.



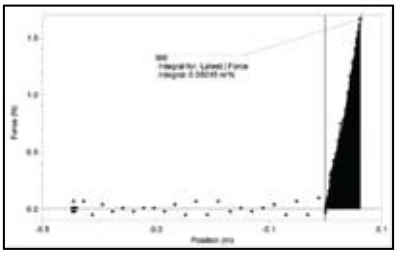
Hooke's law with hoop spring



Position vs. time for cart launch



Force vs. time for cart launch



Work done to compress spring

Use the same setup as described above. Start data collection and move the cart toward the Track Bracket, compressing the spring a few centimeters, and then release the cart.

Next, create a scatter plot of force *vs.* position. The section of the plot with a positive slope represents the compression of the spring; i.e., when work is being done on the spring. The area under the curve for that portion of the plot is the work done on the cart. You can determine the integral using Logger *Pro* software, as long as you sort the data on the position column.

From the position *vs.* time graph, students can determine the launch velocity of the cart. Knowing the mass of the cart, they can determine the kinetic energy and compare it to the work.

Looking for Physics Lab Ideas?

Recent issues of *The Physics Teacher* have had lots of great ideas for demonstrations and labs using our products:

"Computer-Based Experiment for Determining Planck's Constant Using LEDs" by Feng Zhou (Indiana University of PA) and Todd Cloninger (Cleveland CC, Shelby, NC), October 2008, describes a way to use LabPro with five different color LEDs to estimate one of the fundamental constants of nature.

"Video Analysis with a Web Camera" by Edward P. Wyrembeck (Howards Grove HS, WI), January 2009, discusses the use of Logger *Pro* and inexpensive web cameras.

"Millikan Movies" by Xueli Zou, Eric Dietz, Trevor McGuire, Louise Fox, Tiara Norris, Brendan Diamond, and Ricardo Chavez (California State University, Chico), September 2008, explains how to use Logger *Pro*'s video analysis feature to analyze a classic physics experiment.

"A Toy Magnetometer" by A. Cary, E. Mayfield, and J. Mottmann, (Cal Poly, San Luis Obispo), October 2008, shows how to use LabPro and Logger *Pro* to figure out how a magnetic levitation toy works.

"A Physics Road Rally" by Mark A. Ilyes and Whitney Ortman-Link, (Dallastown Area HS, PA), February 2009, has a great activity for physics students using our Wireless Dynamics Sensor System (WDSS) in cars, and figuring out the route based on acceleration data.

"Physics Exam Problems Reconsidered: Using Logger *Pro* to Evaluate Student Understanding of Physics" by Marina Milner-Bolotin (Ryerson University, Toronto) and Rachel Moll (University of British Columbia), November 2008, discusses how to use Logger *Pro* in evaluating students' understanding of physics.

Studying the Diving Reflex in the Laboratory

Using an EKG Sensor and Logger *Pro*

John Melville, our new Biology Staff Scientist, developed an innovative diving reflex laboratory exercise while teaching at Wartburg College. In the lab, students learn basic heart anatomy, histology of arteries and veins, and perform an EKG using Vernier sensors. The students then develop their own experiment, which often involved the diving reflex.

The diving reflex is an adaptation found in marine mammals for diving in cold water. During a dive, there is a reduction in heart rate, referred to as *bradycardia*, or the diving reflex. The majority of research on the diving reflex has been done on seals. The Weddell seal of Antarctica is a great example. Weddell seals can hold their breath for extended periods (20 minutes to an hour) and can dive to depths of 500 meters. During each dive, heart rate and cardiac output decrease dramatically as blood is shunted away from the extremities and directed to the vital organs.

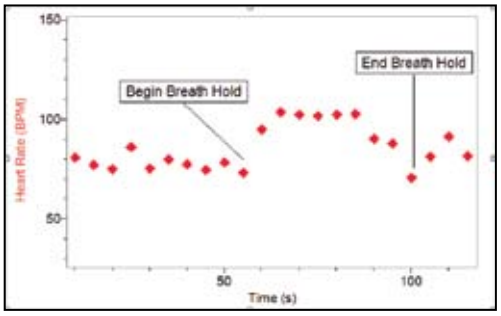
A much smaller version of the diving reflex occurs in humans and is easy to demonstrate in the lab using a few Vernier sensors, a large bowl of cold water, or a cold pack on the face. When cold water (10°C or less) contacts the face, the diving reflex is elicited. Breathing is inhibited and heart rate decreases. This response is not observed during normal breath holding in air or when the face is placed in warm water. Heart rate will actually increase in these two conditions.

The sample data in the top graph show an increase in heart rate when John held his breath in air. The sample data in the second graph show the diving reflex. A distinct drop in heart rate is observed when John held

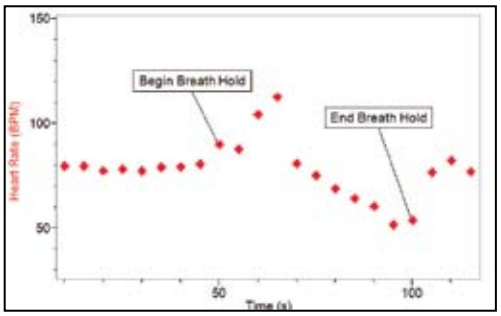
Weddell Seal

his breath and put his face in a bowl of cold water. This diving reflex is most pronounced a few seconds into the "dive." Sample data and graphs from both of these and other conditions (cold water, air, warm water, cold pack on the face) and a full description of the lab exercise can be found on our web site at **www.vernier.com/innovate/109**

If you have any question about this exercise or any of our *Human Physiology with Vernier* exercises, feel free to contact John at jmelville@vernier.com



Holding breath increases heart rate



Holding breath in cold water decreases heart rate

Do you teach IB Science?

Did you know… Logger *Pro* 3.7 offers a new manual configuration mode, which is a special mode of Logger *Pro* designed for instructors wishing to have their students set up data collection and graphing themselves. When in this mode, Logger *Pro* will not auto-ID sensors. It no longer sets the data-collection rate and duration, and graphs are no longer automatically associated with columns in the data table. Also, graph scaling is no longer adjusted to suit the sensor defaults. This mode is perfect for IB teachers wishing to meet ICT data-collection requirements.

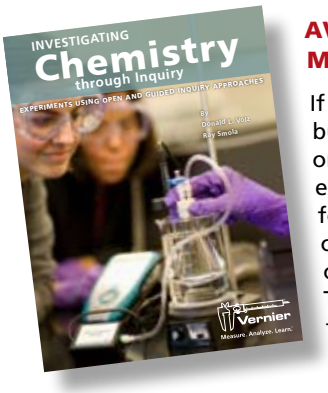
This mode is intentionally difficult to defeat, so enabling it requires a minor edit to a support file of Logger *Pro*. The edit must be done once on each computer where Logger *Pro* is installed. For information on how to enter and, just as importantly, exit this mode, see **www.vernier.com/til/1959.html**

Introducing John Melville, our new Biology Staff Scientist

John graduated from Sonoma State University with a B.A. in Biology and Psychology. He received his Ph.D. in Zoology from Oregon State University, where he specialized in Neuroscience.

John was introduced to Vernier products while teaching the Introductory Biology course at Wartburg College. He was so impressed with Logger *Pro* software and Vernier sensors that he incorporated them into all of his courses. His specialty was designing guided inquiry-based laboratory exercises that were both challenging and fun for his students. He looks forward to assisting biology instructors with any questions they may have.

NEW Investigating Chemistry through Inquiry



AVAILABLE MAY 15, 2009

$48 ORDER CODE **CHEM-I**

If you love Vernier lab books, but want a stronger emphasis on inquiry for your student experiments, this book is for you. This new lab book contains 25 inquiry-based chemistry investigations. The book is authored by two long-time chemistry teachers, Donald L. Volz and Ray Smola, who have enjoyed using the inquiry method in their own instruction. Each experiment includes a preliminary activity, teacher information, sample researchable questions, and sample data for those researchable questions. If you are new to inquiry-based instruction, the extensive teacher section will help guide you through the inquiry-based style of chemistry instruction.

Investigations include:

- Physical Properties of Water
- Baking Soda and Vinegar Investigations
- An Investigation of Urea-Containing Cold Packs
- Conductivity of Aqueous Solutions
- Identifying a Pure Substance
- Investigating the Energy Content of Foods
- Investigating the Energy Content of Fuels
- Evaporation and Intermolecular Attractions in Alkanes and Alcohols
- Enthalpy Changes
- Reaction Stoichiometry
- Beer's Law Investigations
- Colligative Properties of Solutions
- Long Term Water Monitoring
- Vapor Pressure and Heat of Vaporization Investigations
- Acid-Base Properties of Household Products
- The Effect of Acid Deposition on Aquatic Systems
- Acid-Base Titrations
- Conductimetric Titrations
- Oxidation-Reduction Titrations
- Investigating Voltaic Cells
- Baking Soda and Vinegar Investigations Revisited
- Reaction Rates
- Enzyme Activity
- Sugar Fermentation by Yeast
- Nuclear Radiation

These experiments are based on recommendations from the National Research Council report, "Learning and Understanding: Improving Advanced Study of Mathematics and Science in U.S. High Schools" (2002) and leading inquiry-based learning experts.

more online
Download a FREE sample lab, "Evaporation and Intermolecular Attractions in Alkanes and Alcohols," at **www.vernier.com/cmat/chemi.html**

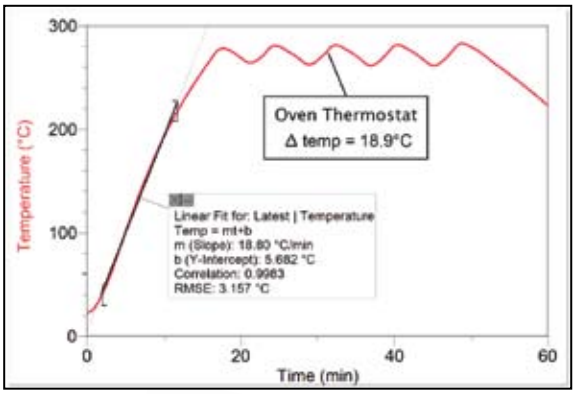
NEW Wide-Range Temperature Probe

USES RTD TECHNOLOGY

For years, chemistry instructors have been requesting a temperature probe with a wider range and greater accuracy at higher temperatures. Our new Wide-Range Temperature Probe features a wide temperature range from –20°C to 330°C. The high upper limit of the sensor allows for melting temperature determinations of most organic compounds. Not only does it have a wider range, but it uses RTD (Resistance Temperature Detection) technology to establish a ±0.1°C accuracy throughout its temperature range, as well as excellent stability and repeatability. Each unit is individually calibrated. Its sealed, stainless-steel shaft can be used in organic liquids, salt solutions, acids, and bases. At 18 cm (7 in) in length, it is long enough to extend into boiling flasks and other common glassware. Its 6 mm diameter allows it to fit snugly into glassware openings designed for traditional thermometers.

Some typical uses include:

- **Fractional distillation**
- **Heat of fusion experiments**
- **Melting temperature of organic compounds**
- **Hess's law experiments**
- **Synthesis and analysis of aspirin**
- **Specific heat experiments**



Temperature cycles of an oven using the Wide-Range Temperature Probe

$64 ORDER CODE **WRT-BTA**

Use this sensor with LabQuest, LabPro, Go!Link, or SensorDAQ

Note: This sensor cannot be used with TI calculators in combination with EasyLink, LabPro, CBL, or CBL 2. Nor can it be used with Palm handhelds with the LabPro interface.

Students Decide To Take Funding Issues into Their Own Hands

While many schools are struggling in today's economy and dealing with budget cuts, students attending Lake Washington District Schools are finding their own funding for the products they want. In early 2008, working in conjunction with the Lake Washington Schools Foundation, students called upon community members and parents to help them raise money for their Secondary Science Education programs. "Calling for Kids" is an event spread over three nights in late February.

Students can earn community service hours for manning a phone during the call sessions. Over 10,000 calls were placed by the 186 students who took part in the event this year.

Currently, the Lake Washington School District has over 24,000 students attending 49 schools throughout multiple cities in Washington state. To raise awareness about the program, the Lake Washington Schools' Foundation works with community members by posting campaign signs within the district, writing letters to area newspaper editors, and promoting the event through school groups. This includes PTA, boosters, secondary science teachers, and choir and band groups, in an effort to recruit students to make calls.

"Although the economic times have caused some people to cut back on donating, the students were able to raise over $20,000."

Vernier Software & Technology was approached by the Lake Washington Schools Foundation about becoming a partner because the students were looking to raise funds specifically to upgrade to the best hands-on science equipment. "Vernier's technology adapts easily and quickly to the ever-changing trends in science education, providing engaging, hands-on and experiential learning that students currently only read about, but can be integrated into any secondary science curriculum," said Tracy Hoien, Executive Director of the Lake Washington School Foundation.

"Calling for Kids" is an event spread over three nights in late February.

In 2007, the Inaugural Phonathon raised over $30,000 for the science curriculum in the District's secondary schools. The 2nd Annual "Calling for Kids" Phonathon was held on February 26-28, 2009. Although the economic times have caused some people to cut back on donating, the students were able to raise over $20,000.

Now, more than ever, students in Lake Washington School District feel empowered because their actions made a difference. They are intrigued and understand that they can be a part of the solution to getting better equipment and funding for their school programs.

LOW-COST SOLUTIONS

On a tight budget? This affordable data-collection technology connects directly to your computer. Includes Logger Lite Software.

Go!Temp: Order Code: GO-TEMP, $39

Go!Link: Order Code: GO-LINK, $61

Go!Motion: Order Code: GO-MOT, $99

More information at **www.vernier.com/go**

Go!Temp *Collect temperature data for only $39 with this USB Temperature Probe.*

Go!Link *Connect any of 46 compatible Vernier sensors to this single-channel interface.*

FREE Vernier Grant Writing Guide

Looking to fund a state-of-the art science lab? Vernier has gathered a variety of resources to help, including available grants and tips for writing a winning grant proposal.

Download the Vernier Grant Writing Guide at **www.vernier.com/grants**

FREE Data-Collection Workshops Nationwide

Join us for one of our FREE, 4-hour, hands-on workshops to learn how to integrate our computer and handheld data-collection technology. The workshops include lunch or dinner and lab handouts.

Visit **www.vernier.com/workshops**

FREE Training Videos

Did you know we have over 65 new training videos on our web site? Whether you are new to data collection, helping someone who is, or just need a three minute refresher before trying out a new sensor, there is something for everyone on the new video section of our web site.

www.vernier.com/videos

Do you own Logger *Pro*?

Unlock the potential of the software you already own

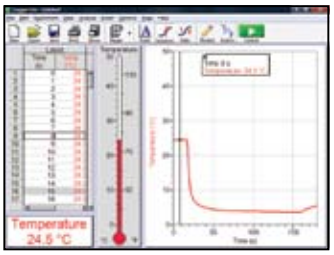
Did you know that...

- Updates from Logger *Pro* 3.x to the new Logger *Pro* 3.7 are FREE
- Logger *Pro* now supports data collection from over 70 different devices

With Logger *Pro*, you can:

- Capture and analyze your own digital videos
- Create multiple-page documents including lab reports
- Re-arrange objects on a page to focus students on regions of interest
- Perform gel electrophoresis analysis of DNA samples
- Draw student predictions on the graph *BEFORE* performing an experiment to force students to evaluate predictions
- Make new graph match shapes with the "Create Graph match" toolbar button to create unlimited student challenge activities
- Display graph legends to discern different data collection runs
- Create graphs with double y-axes to compare multiple variables at the same time
- Insert strip chart style graphs for scrolling data displays
- Rotate horizontal axis labels to make more room for Date and Time labels
- Combine class data by choosing File / Import from Logger *Pro* file
- Save custom calibrations to a sensor's internal memory to save setup time
- Create semi-log or log-log graphs to display different types of trends
- Undo the last action to correct any mistakes

Go!Motion *Use this USB Motion Detector to teach important concepts, such as position, velocity, and acceleration*



Logger Lite® *Real-Time Graphing Software included* ***FREE.*** *There is even a FREE Linux version.*

FREE Download all student labs as PDFs for your evaluation

Aligned to science standards, our lab books contain experiments for LabQuest, computers, and more. FREE computer versions available for download.

www.vernier.com/labs

Generous Site License

Logger *Pro* includes a site license for your entire school or college department, including home computers of faculty and students.

Lab Books. Buy one book and duplicate labs for your class. Easily edit and print labs for all versions of the experiments on CD.

NSTA/Vernier Technology Awards

The award, co-sponsored by Vernier and NSTA, is part of the NSTA Teacher Award Program. Each year, educators are recognized for their planned or current innovative use of data-collection technology. Seven awards are available: one elementary, two middle level, three high school, and one college. **The awards, each valued at $3000, include $1000 in cash, $1000 in Vernier technology, and up to $1000 in expenses for attending the NSTA convention**. Below are brief synopses of the 2009 award winning entries.

Elementary Level (Grades K-5)

Sheryl Sotelo, McNeil Canyon Elementary School, Homer, AK
Sheryl plans to add Vernier data-collection technology to her environmental monitoring projects.

Middle School Level (Grades 6-8)

Chris Campbell, Simsboro School, Simsboro, LA
Chris will monitor environmental conditions in aquatic tanks and monitor the effect of nano-sized particles on aquatic species.

Kristy Gollakner, Gwinn Middle School, Gwinn, MI
Kristy will have her students monitor water quality in various water sheds that feed into Lake Michigan.

High School Level (Grades 9-12)

Robert Benedetto, Central Catholic High School, Lawrence, MA
Robert's students will investigate a case study involving decomposition biochemistry by designing an experiment that will measure decomposition rates.

Sarah Southam, Telstar High School, Bethel, ME
Sarah plans to increase her students' science literacy using hands-on activities that utilize data-collection technology.

Eric Walters, Marymount School of NY, New York, NY
Eric will introduce students to different data collection and analysis techniques while developing a better understanding of sources of error using inquiry-based activities.

College Level

Virginia Balke, Delaware Technical & Community College, Newark, DE
Virginia uses Vernier data-collection technology to help prepare her students for careers as technicians for chemical and biotechnology companies, among others.

Detailed descriptions of these projects can be found at **www.vernier.com/nstaawards**

2010 Technology Awards Entry

It's not too early to start thinking about your 2010 entry.

Deadline for entry is November 30, 2009.

www.vernier.com/grants/nsta.html

LabQuest Tips

Did you know that in LabQuest you can...

- Enter your own data directly into the Data Table by tapping the first empty cell, using the popup keypad to enter a number, and tapping the enter key on the keyboard to advance to the next cell.
- Start or stop data collection without tapping the screen by pressing the hard key Collect button (crescent-shaped button right below the screen).
- Keep a data point in events mode without tapping the screen by pressing the hard key OK button.
- Print to an HP printer using a standard USB cable plugged into the back of the printer. See list of compatible printers at www.vernier.com/labqprinters
- Set up most legacy sensors using Sensor Setup on the Sensor menu.
- Collect data using the internal microphone and temperature sensors accessed in the Sensor Setup menu.
- Disregard the plotting of selected data using Strike Through Data on the Graph or Table menu.
- Show two graphs at the same time by using Show Graph on the Graph menu.

Use these hot spots on the LabQuest screen to speed up operations:

- Tap the sensor live monitor to Zero, Change Units, or Calibrate.
- Tap the Mode area to change data-collection parameters.
- Tap each axis label to change the plotted column.
- Tap the area to the right of the graph to see plot details.
- Tap the file cabinet icon next to the Run label to store a run.
- Tap the data set label in the data table to change its name.
- Tap the column name in the data table to change the Column Options.

LabQuest Updates

Now Available: LabQuest App v. 1.2

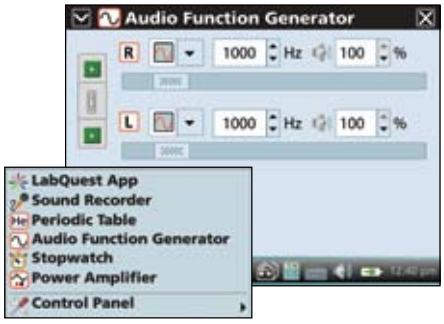
One nice feature of LabQuest is the ability to update its flash memory and firmware through updates, no matter when the device was manufactured. On March 6th, we released our second major update, version 1.2 of LabQuest App. This FREE update is available at **www.vernier.com/labquest/updates**

We strongly recommend that you update your LabQuest App to this new version. Here are some of the features and improvements:

- **Support for the Vernier GPS Sensor**
  Collect data with this new USB sensor (see page 1 for details) at various locations, along with latitude, longitude, and elevation readings. Easily upload your LabQuest data into Logger *Pro*.
- **Support for Garmin GPS**
  The Garmin eTrex Venture HC, and several other Garmin USB models, are supported as sensors.
- **Support for the Vernier Power Amplifier**
  Power Amplifier application
- **Support for the Wide-Range Temperature Probe** (see page 5 for details)
- **Support for Vernier Go!Temp, Go!Link, and Go!Motion USB sensors**
- **LabQuest Function Generator application**
  Generate audio-out sound waves and beats from our internal microphone or external speakers (see below).
- **Delta and FFT analysis tools**
- **Power-saving improvements**
- **Baseline Adjustment analysis tool** (especially for Spirometer)
- **Full scientific notation support**
- **Save custom calibrations**
  Ability to save custom calibrations to many Vernier sensors
- **Increased number of installed labs**
  From 51 to 102. Pick and choose which of our more than 425 labs you want to install on LabQuest, or create your own labs. (See page 9 for details about our new LabQuest Library, Lab Creator, and Lab Organizer.)
- **10 additional international versions**
  Portuguese, Greek, Russian, Danish, Finnish, Netherlands, Swedish, Turkish, Greek, and Japanese (the latter is in a separate Asian release of LabQuest App), for a total of 17 languages.

NEW LabQuest Audio Function Generator

Making Music with LabQuest



LabQuest App v. 1.2 includes a separate application called the Audio Function Generator. This application generates audio signals through the LabQuest internal speaker or through external stereo speakers. To start the application, tap the Home icon in the tool bar and then select Audio Function Generator.

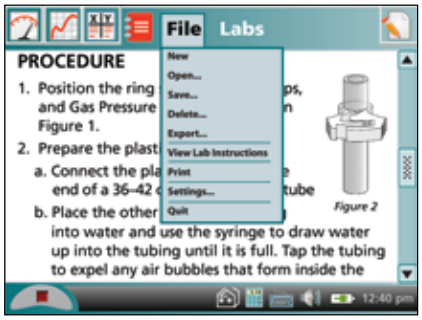
Explore the relationship between frequency and pitch either with the internal speaker or an external speaker. Start the application. Tap the icon that represents the link between the two channels. This allows you to play a single channel. Click the Play button for that channel. Change the frequency of the signal to change the pitch. How are pitch and frequency related?

With this setup, you might want to explore the hearing response of your students. What is the lowest frequency that your students can hear? What about the highest frequency? How does their hearing response compare to yours? If you are much older than your students, you might not hear the high frequencies as well as they do. Setting the frequency to 10 kHz might draw strong criticism from them, while you or others in the classroom may not hear it. This gives you an excellent opportunity to talk about the effects of loud music.

If you use a set of external stereo speakers, you can independently control the left and right speakers. This is an excellent way to demonstrate beats. Set one speaker to 600 Hz and set the other speaker to 610 Hz. Note the beat pattern. As you decrease the frequency of the second speaker down toward 600 Hz, what happens to the beat frequency?

NEW My LabQuest Library
www.vernier.com/mylabquest

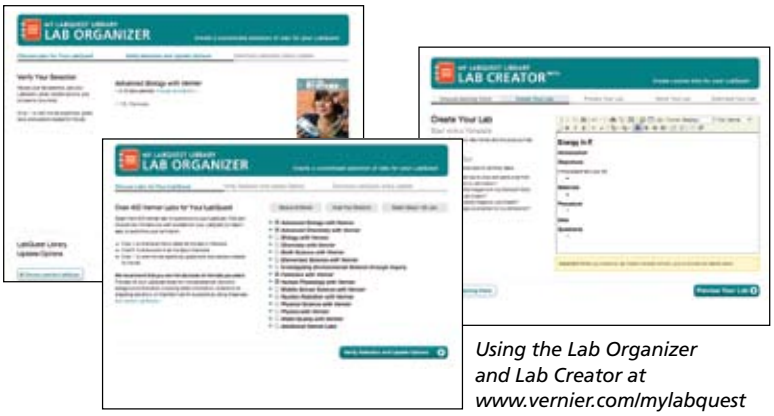
In LabQuest App, v. 1.2 (see previous page), we added 51 additional LabQuest labs to its View Lab Instructions. The total is now 102 built-in labs, including the most popular labs from each subject area. If you update to v. 1.2 of LabQuest App, you will automatically have these new labs on your LabQuest.



LabQuest "Transpiration" lab instructions

Lab Organizer: Customize your LabQuest with more (or all!) labs in your subject area, and remove book folders that you do not want. ALL of the experiments in *Biology with Vernier*, *Chemistry with Vernier*, and *Physics with Vernier* lab books are currently available. By June 30, you will have access to all of our more than 425 Vernier experiments in 14 subject areas! Customize the file structure to meet your own needs; for example, if you teach biology and chemistry, using Lab Organizer, you can

- Remove all folders, except Biology, Advanced Biology, Chemistry, and Advanced Chemistry.
- Choose to add all or some of the 30 to 40 labs from each of these subjects.
- Once you are finished, you can save a file from our web-based Lab Organizer to a USB Flash (thumb) drive, and proceed to update each of your LabQuests (in a few minutes each) with this new file structure.

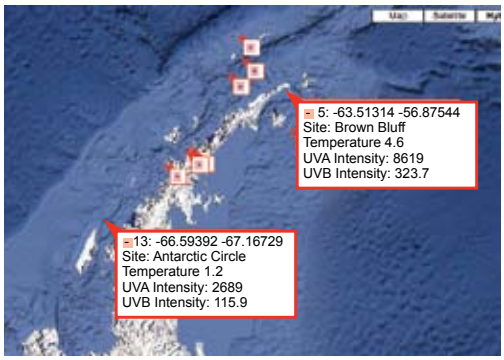


Using the Lab Organizer and Lab Creator at www.vernier.com/mylabquest

Lab Creator: Create your own labs, or edit Vernier labs, and then have those lab instructions installed on your LabQuest. Using this FREE web-based tool, found at **www.vernier.com/mylabquest**, you can

- Start with a template, a blank document, or an existing Vernier lab.
- Edit the lab using the word-processing tools available in Lab Creator.
- Once you are finished, you can save a file from Lab Creator to your USB Flash (thumb) drive, and proceed to update each of your LabQuests to a location called "My Labs."

continued from page 1



along with temperature and UV light intensity data. Transferring the information to Logger *Pro* on my computer back in the cabin, I used the Export as Google Map feature to create the map you see here. This shows all the landings we made, with two of the markers expanded to show details of the data collected at that location.

Brown Bluff was our first stop on the Antarctic mainland. The annotation shows my latitude and longitude in units of decimal degrees. LabQuest can also display units of degrees and minutes, or even in UTM coordinates. Notice they are both negative values, indicating that I am in the Southern Hemisphere and in the Western Hemisphere. The temperature was a balmy 4.6°C (it was summer there, after all), and the UVA and UVB light intensity readings, in units of mW/m^2, were the highest we have ever recorded with our sensors.

The other open annotation is the point at which we crossed the Antarctic Circle. The temperature was down to 1.2°C, but the UV readings were lower than locations farther north. Why would that be? It was a very cloudy day, blocking some, but not all, of the UV radiation.

The photo below shows my LabQuest with the new Vernier GPS Sensor on the ship's bridge just after crossing the Antarctic Circle. A latitude of -66.59133° is surely the farthest south a LabQuest has been so far!

More information at **www.vernier.com/innovate/105**

VERNIER LABQUEST

Where have your scientific explorations taken you and your LabQuest? Antarctica? The Florida Keys? Eastern Europe? Send us a picture and data you have collected to share with science teachers around the world. If we publish your photo, you will receive $100 Vernier gift certificate.

Send an e-mail to quest@vernier.com

Need Extra Storage on Your LabQuest?

You can add storage space on LabQuest by inserting an SD card. Using a card, you can also move files to other LabQuests or to a computer. Not all SD card types are compatible with LabQuest, but you can get one from Vernier. LabQuest 2 GB SD Card, order code LQ-SD2, $12.

Logger *Pro* Updates

Logger *Pro* 3.7

Logger *Pro* 3.7 was released on March 3, 2009. This is a free update to all users of Logger *Pro* 3. In this release, we have added support for two additional operating systems: 64-bit Windows Vista and Ubuntu Linux. We've added two new sensors, the Vernier GPS Sensor and the Wide-Range Temperature Probe. We have also added LabQuest support for the DCU and Heat Pulser.

The interpolation calculator is now more flexible in that you can work either from the x- or y-axes. Time-of-day graphs are now drawn with easier-to-read labels. The exchange of files between LabQuest and Logger *Pro* is more complete, with additional calculated column information moving between the platforms.

While many instructors and students appreciate the automatic setup features in Logger *Pro*, sometimes less automatic behavior is appropriate. There is now a manual configuration mode so that students must set the data-collection rate and duration, graph axes, and graph range manually. (See "Do you teach IB Science" on page 4.)

We recommend that all LabPro and LabQuest users update to this new version of Logger *Pro*.

See **www.vernier.com/lpupdates** for download information.

Logger *Pro* for Linux | **Public Beta Now Available**

Last fall, we released a FREE Linux version of our Logger Lite program. This was done mostly to support the small, Linux netbook computers that are so popular right now. We have now gone the next step with a version of Logger *Pro* for Linux. We are offering this program as a free public beta test program. If you are a Linux computer user, or if you have been interested in trying Linux, download it and give it a try. It works with LabPro, LabQuest, and our Go! devices. It does not support the WDSS, spectrophotometers, Ohaus balances, photos, or movies. To download Logger Lite or Logger *Pro* for Linux , go to **www.vernier.com/linux**

SCIENCE HUMOR

Since this is the 25th anniversary of this newsletter, your newsletter joke editor is going to take this opportunity to once more list his favorite science jokes from 25 years of trying to come up with clean, non-offensive, and funny science jokes. To put another positive spin on it and in keeping with a theme of our company: Vernier is so green it even recycles its jokes!

From our first newsletter, 25 years ago:
After he received his Nobel Physics Award in 1927, Arthur Compton was very much in demand as a speaker at universities and conferences. He wasn't very interested in public speaking, so he developed a standard speech that he repeated whenever necessary. To make these public speaking obligations more tolerable to Compton, he was provided with a chauffeur who drove him to the site, and who then sat in the back of the hall until the speech was over. One night on the way to a talk, Compton was complaining about having to deliver the speech again. The chauffeur responded, "If you think it's boring giving that speech over and over, think about how boring it is for me having to listen to it. I know the whole speech word for word."

Well, that got Compton thinking. It occurred to him that nobody at the lecture hall knew what he looked like. He arranged to trade clothes with the chauffeur and let him give the speech. Compton took a seat at the back of the hall as the chauffeur began to speak. The speech was given flawlessly. Thunderous applause followed. The master of ceremonies then called the speaker back for a short question-and-answer session. The first question was on the kinetic energy of the recoiling electron in X-ray scattering experiments. The chauffeur listened carefully to the question and then responded, "That is a really dumb question. In fact, that question is so dumb, I think I'll have my chauffeur answer it."

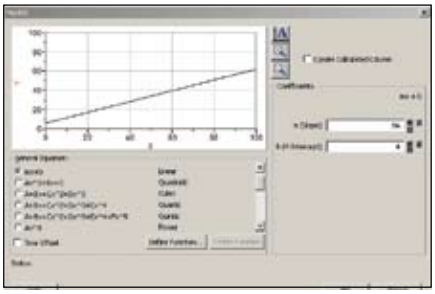
From the Spring 1987 issue:
The museum guard proudly told the visitors that the dinosaur bones on display were "60,000,005 years old." When asked how the age could be known so precisely, the guard said, "I don't know how they do it, but when I started working here five years ago, they told me that the bones were 60 million years old." *(This lesson in significant digits came from John McGervey's book, Probabilities in Everyday Life, 1986, Nelson-Hall, Inc.)*

If you have ideas for good science jokes, please send them to Dave Vernier (dvernier@vernier.com). If we use your joke in the Caliper, you will win a "valuable" prize.

Function Graphing in Logger *Pro*

Did you know that Logger *Pro* plots functions? Even if you have no data in Logger *Pro*, you can insert a function model and adjust parameters to view the result. Here's how:

Launch Logger *Pro* with no sensors attached. Choose Model from the Analyze menu. You will see a dialog much like the general curve fit dialog. Choose a function, such as linear. (You can even choose to define your own function.) The parameters (in this case, slope and intercept) are set to starting values of 1. You can type in new values, or use the up and down arrows to adjust. Click OK to place the model on the main graph of Logger *Pro*.



Graphing a linear function with Logger Pro

You can still adjust parameters, even after closing the modeling dialog. On the main graph, the slope and intercept are shown in a floating box attached to the function line. Click on either parameter. Either type in a new value, or, better still, use the up and down cursor keys to smoothly adjust the value. Right and left keys will increase and decrease the step size.

Function graphing, or modeling, can be used in several ways with your students. First, just use Logger *Pro* to explore the shapes of functions and the effect of changing certain parameters on the shape. Second, use modeling instead of automatic curve fits to analyze sensor data. When there are sensor data on a graph and you then add a model, the discrepancy between the data and model (the root-mean-square error, or RMSE) is shown. This discrepancy is a measure of how far away, on average, the model is from the data. RMSE is in the y-axis. By having your students adjust parameters to optimize the fit, they will see the RMSE get smaller. A computer performs a fit by minimizing the RMSE. They'll also learn the appropriate interpretation of each parameter as they are changed.

2009 Summer Hands-On Workshops

for teachers of science and math

Learn how to integrate Vernier data-collection technology into your chemistry, biology, physics, math, middle school science, physical science, and Earth science curriculum. Use Vernier products with the Vernier LabQuest, computers, or calculators in this six-hour workshop. Register online at **www.vernier.com/workshop** or call 888.837.6437

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6/23/09 - ST. LOUIS, MO
6/24/09 - RALEIGH, NC
6/26/09 - CHICAGO, IL
6/26/09 - NORFOLK, VA

JULY 09

7/8/09 - AMES, IA
7/10/09 - MINNEAPOLIS, MN
7/22/09 - ALBANY, NY
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AUGUST 09

8/7/09- BEAVERTON, OR

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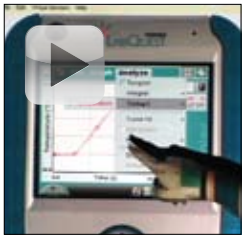
7/22 - 7/23 - SEATTLE, WA
8/12 - 8/13 - BOSTON, MA

PHYSICS
6/26 - 6/27 - DALLAS, TX
7/24 - 7/25 - SEATTLE, WA
8/14 - 8/15 - BOSTON, MA

Video Training

We have over 65 new training videos on our web site. Whether you are new to data collection, helping someone who is, or just need a three-minute refresher before trying out a new sensor, there is something for everyone on the new video section of our web site. Look for new videos from featured activities this fall in the new Video Training section of our web site. Go to **www.vernier.com/videos**

Go Green

Prefer to get an e-mail version of this newsletter or our catalog? Go to our web site and sign up for our digital mailings, up-to-date product announcements, innovative lab ideas using Vernier technology, video training updates, and *more*.

www.vernier.com/green

25 years ago The CALIPER

Our company started in 1981, but our first newsletter was published in 1984. It was printed on an IBM Selectric typewriter controlled by an Apple II computer. In that issue, we announced our new Frequency Meter program for the Apple II and our only Commodore 64 program, Precision Timer.

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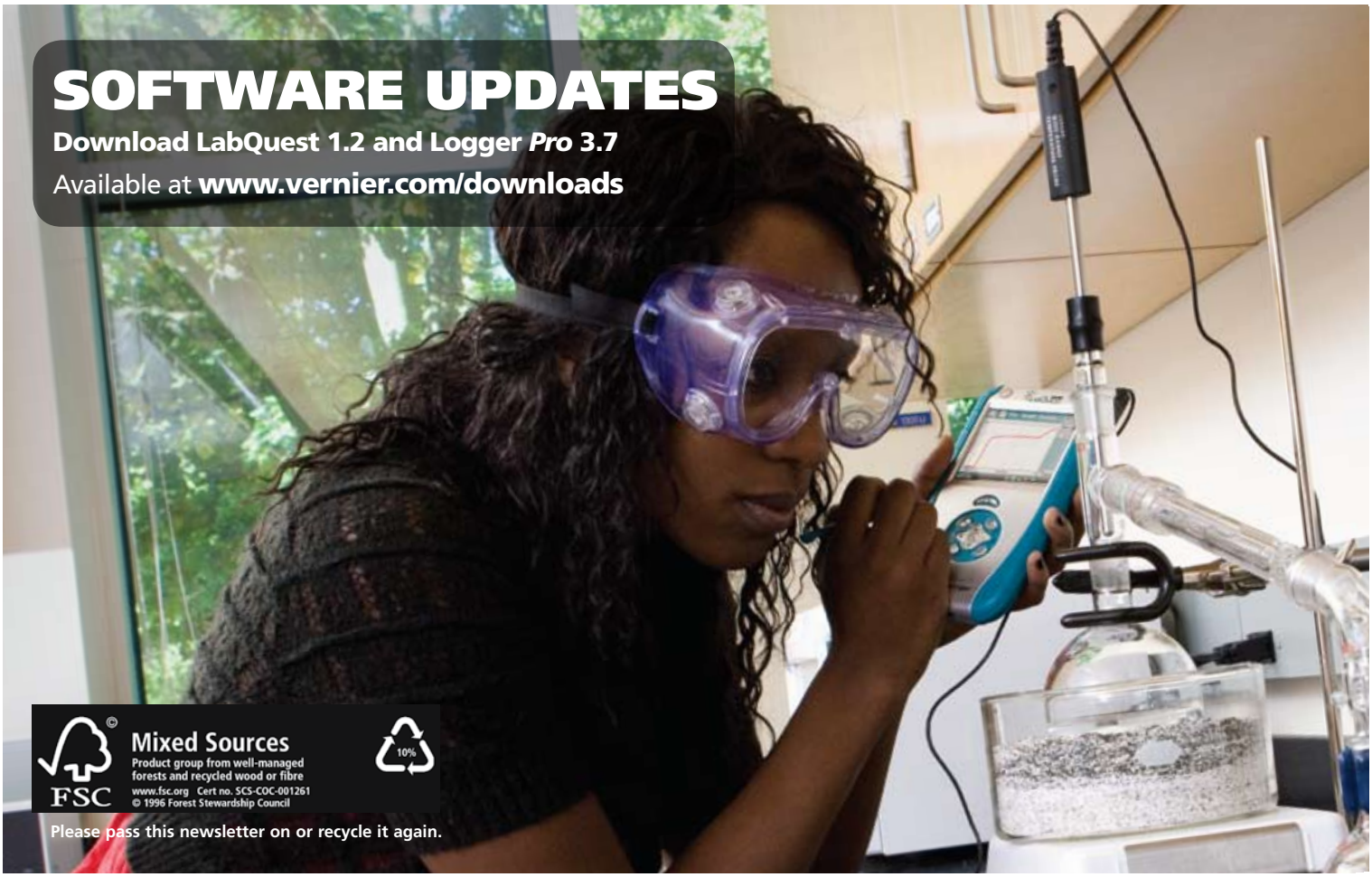
GREEN CODE



*Measuring the temperature of a distillation with the **NEW** Wide-Range Temperature Probe. See page 5.*