THE CALIPER

Vernier
CELEBRATING 30 YEARS

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*in this issue*



# Congratulations Grant Winners!

## Vernier Awards Thirty $10,000 Technology Grants to Celebrate Company's 30th Anniversary

**FIND THE NAMES OF ALL THE GRANT WINNERS AT www.vernier.com/30years**

After three decades of serving STEM education, Vernier is honoring the recipients of its 30th Anniversary Technology Grants by providing each grantee with their choice of $10,000 worth of Vernier technology. The 30 grantees shared inspiring stories about how they will use the technology and outlined concrete plans for implementation, while demonstrating financial need. With nearly 2,000 applications in total, Vernier was thrilled with the overall innovation, creativity, and dedication to the improvement of STEM education demonstrated by all applicants.

### College

The ten grantees at the college level represent diverse disciplines encompassed under the STEM spectrum, from mathematics to engineering to astronomy, at higher education institutions in nine different states. Saint Joseph's College in Indiana will enhance quantitative literacy through student-developed interactive projects. The Science and Mathematics Education Center at the University of North Carolina Wilmington will provide equipment for teacher professional development. And the Southern Illinois University of Edwardsville Center for STEM Research, Education and Outreach will use Vernier tools as an integral part of the center's summer camps for youth.


### High School

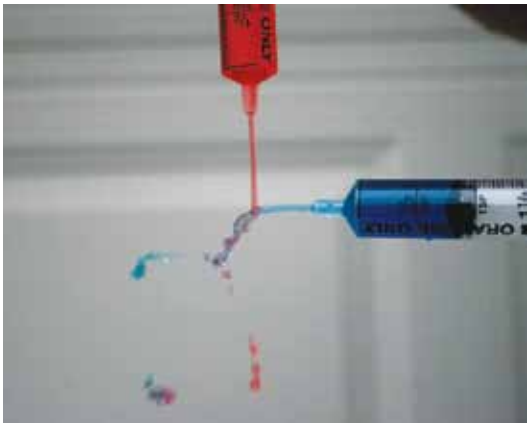
From physics to biology and chemistry to AP science courses, the ten selected high-school grantees will use Vernier technology in a variety of STEM programs across multiple disciplines. Menominee Indian High School, located on a rural Indian reservation; Manhattan Center for Science and Math; and Discovery High School, an alternative school that works closely with the Northern Oregon Regional Detention Facility, are among the high schools that will help numerous students from diverse backgrounds learn by using engaging science tools.

*K-8 winners: see page 13*

# PHYSICS

## AAPT Photo Contest

Once again, the AAPT Photo Contest sponsored by Vernier was held at the summer meeting of the American Association of Physics Teachers. Students submitted photos that demonstrated physics concepts, along with an explanation of the physics involved. Meeting attendees voted on the entries. We are always amazed at the quality of the work submitted by students. For details about the contest and to see the photo winners for 2011, visit www.aapt.org/Programs/contests/winners.cfm?theyear=2011



*1st Place–Contrived Category, "Purple Rain"*
*Jason Daniel Connell, The Walker School*
*Teacher: Sandra Rhoades*

*1st Place–Natural Category, "Picture in a Puddle"*
*Irene Eugenie Wehrwein, Cherry Creek High School*
*Teacher: Jessica Olsen*

## NEW! Experiments for Optics Expansion Kit and Color Mixer Kit

Our Optics Expansion Kit and Color Mixer Kit expand the capabilities of the Vernier Dynamics System. Use the precision markings and convenient fixtures to explore the inverse-square law of light brightness, real and virtual images, the optics of telescopes and cameras, additive and subtractive color mixing, and more. Download five new optics experiments at www.vernier.com/oek

## PHYSICS PUZZLE by Matt Anthes-Washburn

### Can Angry Birds Help Teach Physics?

**Teachers Share Video Analysis Ideas via Twitter**

Students always have a lot of fun analyzing motion in their own videos using Vernier Video Physics (http://bit.ly/videophysics) or Logger *Pro* 3. Another way to encourage interesting discussion of the nature of motion is to analyze movies that appear to defy the laws of physics, such as viral videos and video gameplay. Teachers have been seizing these teachable moments to engage their students in rich problems and analysis.

Frank Noschese (@fnoschese), a teacher at John Jay High School in Cross River, NY, maintains a collection he calls "Win? Fail? Physics!" According to Noschese, his students are engaged when they investigate a video to find evidence to "support or refute their immediate, visceral reaction." He believes that incorporating video analysis "strips the problem to its core: Win or Fail? Students do the cognitive weightlifting." You can learn more about Noschese's approach and use videos he has collected at his blog. (See resources link below.)

Rhett Allain (@rjallain), author of the Wired blog, Dot Physics, has long been a proponent of using video analysis technology to help students judge whether viral movies are real or fake. Last fall, he wrote an article about the physics of Angry Birds that motivated excited users to run the popular video game through its physical paces. Noschese also posted Angry Birds videos on his blog that are ideal for video analysis. John Burk (@occam98), of The Westminster Schools in Atlanta, GA, added to the discussion with his approach to teaching projectile motion through the use of Angry Birds video analysis.

A great place to start is with the seemingly simple question: What is the gravitational acceleration in the world of Angry Birds? Noschese and another physics teacher, Michael Magnuson, have posed additional tricky questions such as whether momentum is conserved when birds split into three or drop an egg. See more at the resources link below.

Do you have viral videos you want to share and analyze? Surprising video analysis results? Stories of using video analysis with your students? Let's share resources and discuss at: www.vernier.com/p25171. Or tweet with the hashtag: #videoanalysis

PHYSICS

## How to Make a Derivative Machine

By John Gastineau, Ph.D

How would you make a derivative machine? Here's an unexpected way:

Faraday's law states that there is an induced emf in a coil, proportional to the time rate of change of the magnetic flux Φ through that coil, or

$$|\varepsilon| = N\frac{d\Phi_B}{dt},$$

where N is the number of turns in the coil.

You can do this experiment with a LabQuest, a Power Amplifier, an Instrumentation Amplifier, and a set of nesting coils. We used a common coil set that is often used with galvanometer experiments.

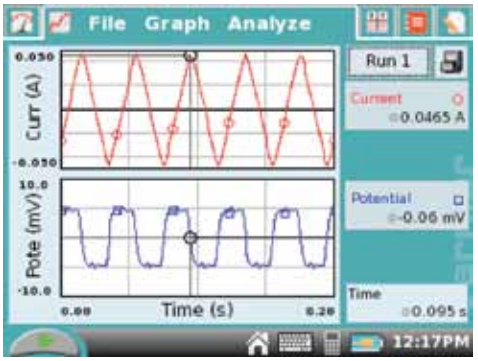
The Vernier Power Amplifier steps up low-current and low-voltage signals from the LabQuest for driving larger loads. In particular, to create magnetic fields large enough to easily detect, currents on the order of hundreds of milliamps are required. The Power Amplifier is perfect for this application.

The Power Amplifier App on the LabQuest is used to set the output. For example, one can select a triangle wave at 1 V peak-to-peak amplitude with a frequency of 25 Hz. This can be applied to a primary coil. A smaller, secondary coil resides inside the primary coil.

The Instrumentation Amplifier is a voltage sensor for signals as small as 20 mV. In this experiment, it is used to detect the induced emf in the secondary coil.

In the spirit of modeling good classroom technique, let's make a prediction. The current flowing in the primary is in the form of a triangle wave. The time derivative of a triangle wave, with constant positive and negative slopes, is a square wave. The frequency would be the same as the driving triangle wave.

What really happens? Here are some sample data.




*As expected, the induced emf, shown in the lower graph, is a square wave.*

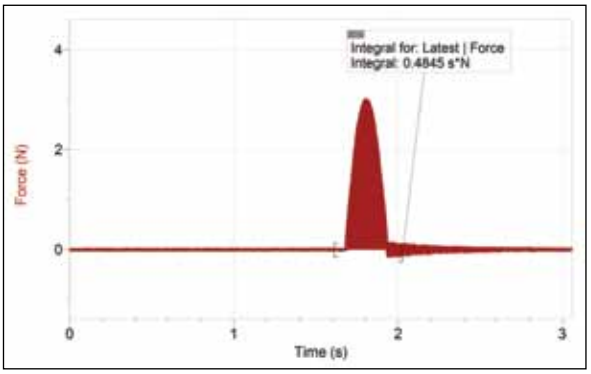
Some questions to have your students consider: What will happen if the drive frequency is increased? What will happen if the drive amplitude is changed? What will happen if the drive waveform is changed to a sine wave?

## Momentum Impulse Experiments with a Photogate

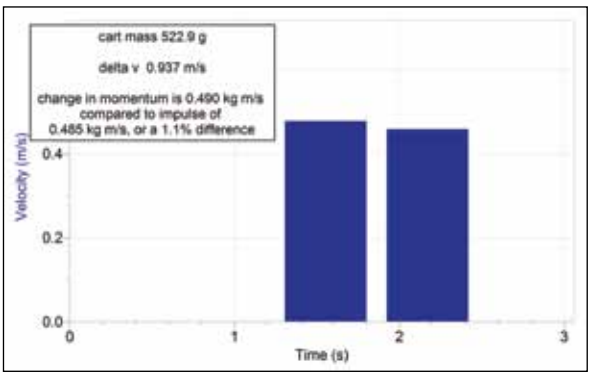
Lots of physics instructors use photogates, but did you know that you can use other sensors at the same time as photogates? For example, you can use a force sensor along with a photogate. You can use this sensor combination in the standard momentum-impulse experiment where one measures the velocity of a dynamics cart before and after a force impulse.

We set this up with the following equipment: a Vernier Dynamics System with a track, a cart, a Bumper-Launcher Kit (BLK), a Vernier Photogate, and Dual-Range Force Sensor. The BLK includes a variety of magnets and bumpers that can be used to create different impacts. The force sensor is fixed to the track, using the BLK, with a soft, highly Hookian hoop bumper extending the duration of the impulse.

Using either a LabQuest alone or an interface with a computer running Logger *Pro*, connect the sensors and change the photogate to gate mode, with a flag width corresponding to the flag on your cart. If you use a Vernier Cart Picket Fence (PF-CART) it will be 5 cm.




*On sending a cart into the hoop bumper, we got these data.*




*The integral of the force impulse is 0.485 kg m/s, and the change in momentum is 0.490 kg m/s.*

This experiment can also be done with a Motion Detector, but since you only need the velocities before and after the collision, the extra velocity detail it provides is not needed. The photogate gives just the information you need, with a very simple and reliable setup.

# PHYSICS

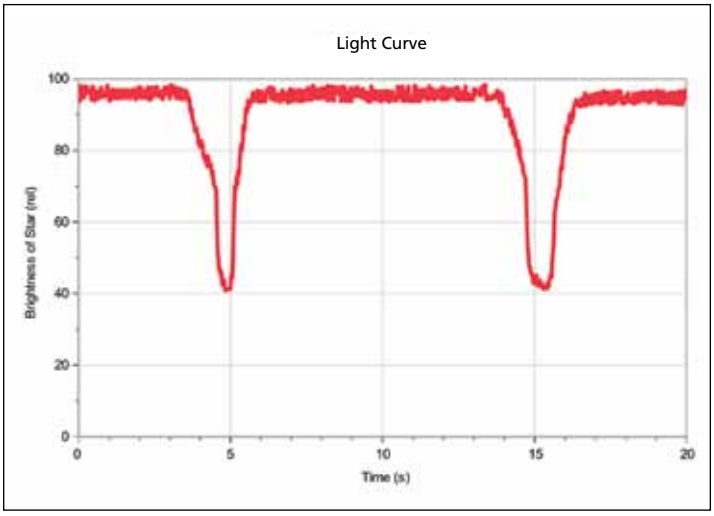
## Modeling the Study of Extrasolar Planets with the Vernier Light Sensor

In the search for life beyond our planet, astronomers are particularly interested in planets outside our solar system (extrasolar planets). Since these planets are too far away to be visible, finding and studying them can be a challenge. One way to locate and study extrasolar planets is to observe the light from a star as an orbiting planet passes in front of the star (transits). By observing the variation in the intensity of light from the star, it is possible to determine the presence of a planet, its diameter, and the size of its orbit. Combining this information, it is possible to determine whether life might be possible on the planet. Astronomers refer to the "Goldilocks region," where it is neither too hot nor too cold for liquid water to be present but is "just right."

Peter Newbury, through the Carl Wieman Science Education Initiative at the University of British Columbia, developed an interesting way of modeling the transit technique in the classroom or laboratory. He recently presented his work at a meeting of the Astronomical Society of the Pacific. Using a Vernier Light Sensor, interface and Logger *Pro*, students pass a "planet" in front of a light source representing the central star of another solar system. The data collected from the Light Sensor in Logger *Pro* closely model the data produced by the Microvariability and Oscillations of Stars (MOST) microsatellite, a space telescope project based out of the University of British Columbia. Students then compare their collected data to real-life data collected by the probe.

For instructions and student handouts of the activity, including actual Kepler data, visit Newbury's blog, Science Edventures: http://bit.ly/planetactivity

NASA's Kepler space probe uses the transit method, and the project web site includes many related educational resources: http://kepler.nasa.gov




*Students use the Vernier Light Sensor to model the light curve of a star as a planet transits.*

## A New Face in Our Physics Department

Dara Easley is a new Vernier Technical Support Specialist and Publications Assistant. She holds a Masters degree in physics from Oregon State University, and completed post-graduate work in physics at the University of New Mexico. Dara's physics research interests are in statistical thermodynamics. As a lifelong 4-H'er, Dara enjoys volunteering with the 4-H Youth program at the county and state levels. Dara has worked in various technical writing positions, and we are very happy to have her left-brain organizational skills to help balance out Dave Vernier's right-brained physics creativity.

## Hydroelectric Power Lab

Inspired to instruct students about renewable energy, Professor Richard G. Born, from Northern Illinois University, developed a lab to investigate the relationship between hydroelectric power and the volume of water that moves a turbine in a given amount of time. Born connected a small water wheel and dynamo to a Vernier Circuit Board and added resistors. A Vernier Differential Voltage Probe and a Current Probe were used to collect voltage and current during the experiment.

The water from a faucet enters a turbine, spins the water wheel, and exits into a 2-liter bucket. The time required to fill the bucket was recorded for various faucet water pressures (see link below). After calculating and graphing the electric power for each of the water pressures and the volume of water moved per unit time, students could see that the amount of electric power produced is proportional to the volume of water moved over time.

To see Born's results or for a full lab description, visit www.vernier.com/p25157

*Vernier Circuit Board*

$89 ORDER CODE VCB

*Current Probe*

$39 ORDER CODE DCP-BTA

*Differential Voltage Probe*

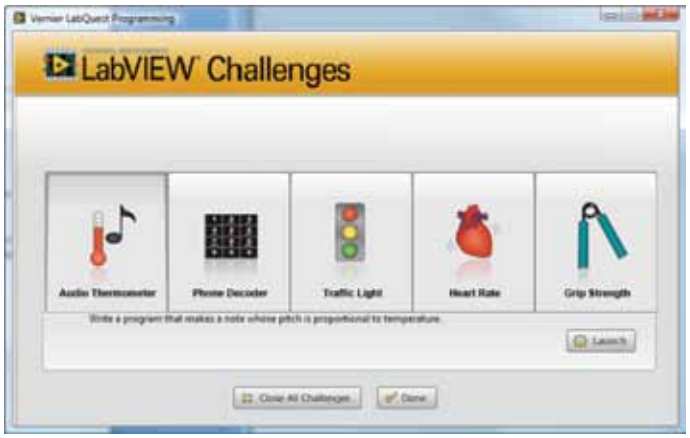
$39 ORDER CODE DVP-BTA

# PHYSICS & ENGINEERING

## NEW! LabVIEW™ for Education

A new version of National Instruments (NI) LabVIEW™ software for high school, called LabVIEW for Education, has just been released. Now, you can leverage your Vernier technology to incorporate STEM activities into your curriculum.

The LabQuest, LabQuest Mini, SensorDAQ, Go! Devices, and our NXT Sensor Adapter are all integrated within LabVIEW for Education. From day one, students will have the power to use Vernier sensors to design creative engineering projects, control and automate hardware, perform custom analysis on waveforms, or build sensor-controlled NXT robots.




LabVIEW for Education includes instructional videos, tutorials, and teaching resources built directly into the software. In addition, a series of interactive challenges is included with integrated instructions and solutions. Five of these challenges incorporate Vernier sensors with LabQuest, LabQuest Mini, or SensorDAQ.

- Output a sound proportional to the temperature
- Determine which button has been pressed on a cell phone
- Build a traffic light with 3 LEDs, and control the lighting sequence
- Calculate heart rate from the waveform of an EKG Sensor
- Sound a buzzer when grip strength exceeds a user-defined threshold value

These challenges will not only provide students with an introduction to LabVIEW, the same technology used by scientists and professional engineers, but they will also introduce digital output, signal analysis, peak detection, and more. When you click on a challenge, a window appears with a series of tabs. You can then click on any tab to get information, along with tips to help complete the challenge. This may include an overview, information on the hardware, programming tips, and data-collection tips. At any point, the student may click a button to try the challenge. The final tab provides a sample solution.

The built-in LabVIEW challenges, as well as our two LabVIEW books, Hands-On Introduction to NI LabVIEW™ with Vernier and Engineering Projects with NI LabVIEW™ and Vernier, provide the resources and projects that allow teachers and students to start using Vernier technology with LabVIEW for hands-on STEM activities.

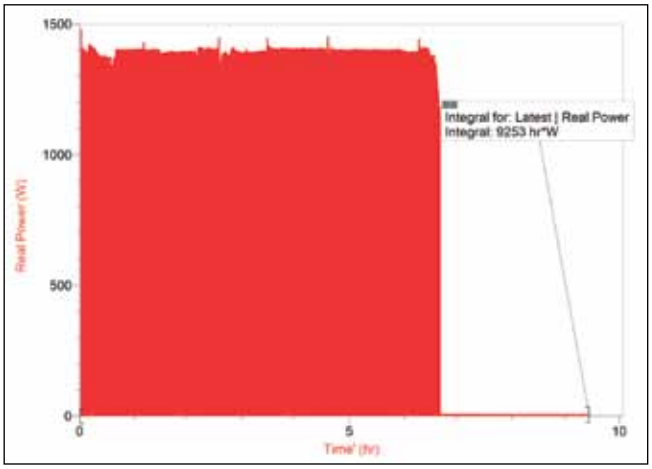
For more information go to www.vernier.com/products/labview
For more STEM resources from National Instruments go to www.K12lab.com

**NI LabView for Education:**
Single User, LV4E-1, **$129**
10-User, LV4E-10, **$799**
Site License, LV4E-SITE **$1,499**

**Lab Books:**
*Hands-On Introduction to NI LabVIEW with Vernier*, LWV, **$25**
*Engineering Projects with NI LabVIEW*, EPV, **$48**

## Chevrolet Volt Charging

Richard Taylor (physics teacher at Hockaday School, Dallas, TX), recently bought an all-electric Chevrolet Volt. He quickly used our Watts Up Pro to monitor the charging cycle. Here is a graph of charging power *vs.* time for the Volt after Richard drove it 26.7 miles (40.0 km).




*The charging at a fairly constant current and voltage drawing about 1.3 kW for over 6 hours. The integral shows that this is 9.25 KwH, which would cost about a dollar in most parts of the U.S.*

## Vernier and the Last Space Shuttle Launch

Dave and Christine Vernier were partial sponsors of a Student Spaceflight Experiments Program experiment that was taken on the last space shuttle. Parkridge Elementary of Peoria, AZ proposed a very clever experiment that was selected for the Atlantis mission. The experiment was to study how yeast behaves in space. The students made the case that if we are ever to send humans to Mars or beyond, they will need to make bread, so we had better start learning how yeast acts in microgravity. For more information, see www.nasa.gov/audience/foreducators/peoria-ariz.html

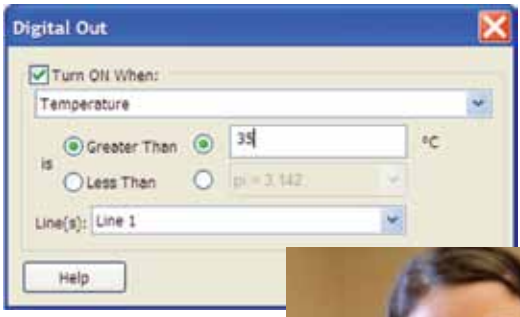
# PHYSICS & ENGINEERING

## NEW! STEM Extensions with Vernier

With the Race to the Top initiative, teachers have been asking us, "How can I incorporate STEM into my science labs?" With some simple low-cost electronics, you can leverage your existing Vernier products into STEM activities that will address national and state educational standards.

In a traditional science lab, students analyze a set of data to verify a scientific principle or their own hypothesis. A STEM extension takes the lab one step further by requiring students to DO something with their data. For example, many teachers start off the school year with the "Hot Hands" experiment, because it's an easy way to introduce data collection with Logger *Pro*. A Vernier Stainless Steel Temperature Probe is passed around the room to determine which student has the hottest hands. But what do you want to do when you're too warm? Cool off, right? A simple STEM extension is to blow a fan on those students with the hottest hands.

Turning on small fans or other DC electronics from your local hobby store is easy with the Vernier Digital Control Unit (DCU) and Logger *Pro* software. The DCU connects to any Vernier interface with a DIG1 channel. The DCU comes with a cable having six output lines (D1-D6), two ground lines, and one power line. Simply connect the positive and negative leads (red and black wires) on the fan to the D1 and GND lines and start Logger *Pro*.




From the Experiment menu, choose Set Up Sensors. Drag the Digital Control Unit icon to the DIG/SONIC1 button. Click on the DIG/SONIC1 button and select Digital Out (the temperature probe must be plugged into the interface for this option to be available). In the popup window, check the box next to Turn On When, and then check the radio button next to Greater Than and enter a threshold value of 35°C. You don't have to click the Collect button; your fan will automatically turn on whenever the temperature probe exceeds 35°C.

The world is full of sensor-based systems that you can adapt as simple STEM extensions for your science experiments. You can find instructions for these and other STEM ideas at www.vernier.com/engineering/stem

## Vernier in the Science Journals

The September 2010 issue of *The Physics Teacher* included the article "Using a Force Probe to Study Transverse Pulses and Reflections on a Plucked Elastic Cord" by Ari Hamalainen, (University of Helsinki) and David Abbott (SUNY-Buffalo State College, NY). In this article, the authors use our Wireless Dynamics Sensor System (WDSS) to study transverse waves on an elastic string and determine their speed. To quote from the article "This experiment also affords the opportunity to explore frequency spectrum, natural frequencies, and resonance."

*Classroom Astronomer* is a journal for teachers who use astronomy in their teaching. The summer 2011 issue includes an extensive article on the use of our SpectroVis Plus in astronomy. The article is found at http://classroomastronomer.toteachthestars.net/resources/spectra.pdf.

The May 2011 issue of *The Physics Teacher* had two good articles showing innovative ways to use Logger *Pro*:

"Pressure Oscillations in Adiabatic Compression" by Roland Stout (University of NC, Pembroke, NC) explains how pressure oscillations can be set up and measured using our Gas Pressure Sensor when doing in a simple adiabatic compression experiment.

"A Teachable Moment Uncovered by Video Analysis" by Joshua Gates (Tatnall School, Wilmington, DE; JHU Center for Talented Youth, Baltimore, MD), explains how the video analysis feature of Logger *Pro* can be give students a better understanding the details of the collision of a ball with a wall and give them a chance to do some meaningful error analysis.

The September 2011 issue of *The Physics Teacher* included the article "High-Speed Video Analysis in a Conceptual Physics Classroom" by Dwain M. Desbien, (Estrella Mountain CC, Avondale, AZ). Dwain describes how he uses the new, inexpensive high-speed cameras and Logger *Pro* to determine velocities and accelerations in rocket launches.

## Cooking with Quadratics

In her article, "Cooking with Quadratics," published in the November 2010 issue of *Mathematics Teacher*, Luajean Bryan examines the math behind solar cookers. Bryan's students at Walker Valley High School in Cleveland, TN, designed solar cookers and analyzed their properties using Vernier sensors. The cookers are three-dimensional parabolic dishes designed through the understanding of quadratic equations. After the cooker was built, the students inserted a temperature probe into a marshmallow. They then placed the marshmallow at the focus and collected temperature data as the marshmallow cooks. Students used EasyTemp temperature probes with TI graphing calculators to collect the data. They then imported the data into Logger *Pro* for further analysis. Luajean finds that the activity is very valuable because it "requires students to analyze nonroutine situations using algebra, analytical thinking, technology, and teamwork."

www.nctm.org/eresources/view_media.asp?article_id=9482

# 30 Years of Vernier Software & Technology

By David Vernier

In 1981, the hot new computer for science educators was the Apple II with up to 64K of memory, running at 1 MHz. Today, technology has changed, but Vernier's commitment to teachers remains. We thank our loyal customers for allowing us 30 great years in business. As you can see below, data-collection technology for science has come a long way.

## 1980s

### Game-Port Interfacing with Apple II and MS-DOS Computers

In the 80s, if you wanted to collect data with a computer, you probably did it with homemade sensors that you built from a kit. We first showed people how to build the kits and finally, after getting many teacher requests, we started selling assembled units.

## 1990s

### Data Collection for Macintosh and Windows

We used a lot of acronyms for the interfaces we sold in the 90s: ULI, MPLI, CBL, and my favorite name, "Serial Box Interface," SBI.

## 2000s

In the last decade, we have introduced lots of new data-collection options. These interfaces and USB-direct sensors provide for data collection with a computer, in the field, or using a TI calculator. We have added both advanced sensors and low-cost solutions that work with cash-strapped budgets.

To support these new interfaces, we keep improving Logger *Pro*. Some of the major additions have been video analysis, exporting data to maps, gel electrophoresis analysis, and a Linux version. We have also introduced new software products: LabQuest App, Logger Lite, DataQuest (for TI Nspire handhelds), and Video Physics for iOS.

In addition to these great new interfaces and software, we have developed a lot of science equipment to support data collection, including

- Centripetal Force Apparatus
- Vernier Dynamics System/ Optical Bench
- Transilluminators
- Stir Station

We have also expanded into new areas, including engineering education, elementary education, human physiology, agricultural science, biotechnology, and organic chemistry.

Thanks for your encouragement, suggestions, feedback, and purchases over the past 30 years. We have lots of new things coming.

## Data Collection Options

**2000**

LABPRO

**2004**

THE GO! USB DIRECT SENSORS

**2006**

WIRELESS DYNAMICS SENSOR SYSTEM (WDSS)

**2007**

LABQUEST

**2008**

SPECTROVIS


**2009**

MINI GAS CHROMATOGRAPH

**2010**

LABQUEST MINI

**2011**

MELT STATION

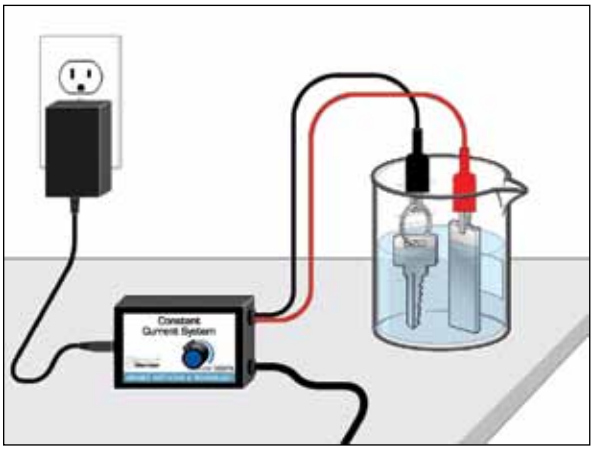
# CHEMISTRY

## NEW! Constant Current System

By Elaine Nam, Ph.D.

Setting up an electroplating experiment is now easier using the Vernier Constant Current System. The Constant Current System is a combination current sensor and power supply delivering a constant current set by the user. Simply connect the Constant Current System to a powered electrical outlet and a Vernier interface, secure the alligator clips to the metal electrode and item to be plated, turn the knob to the optimal current, and begin collecting data. With only two wires to connect, it will be the easiest electroplating setup you've ever done.

The new Constant Current System connects to a Vernier interface, allowing you to collect data with Logger *Pro* or LabQuest App. The figure below shows the constant current while electroplating copper onto a key, as performed in Experiment 21 from *Advanced Chemistry with Vernier*.




*Electroplating using the Constant Current System*

Want to demonstrate the electrolysis of water? The Constant Current System can do that too! Set up your electrolysis apparatus and use the Constant Current System as the DC power source.

Key features:

- 0–0.6 A
- Voltage adjusts automatically (max 5 V) to keep constant current
- Built-in auto-ID current probe
- Simplified wiring for electroplating and electrolysis

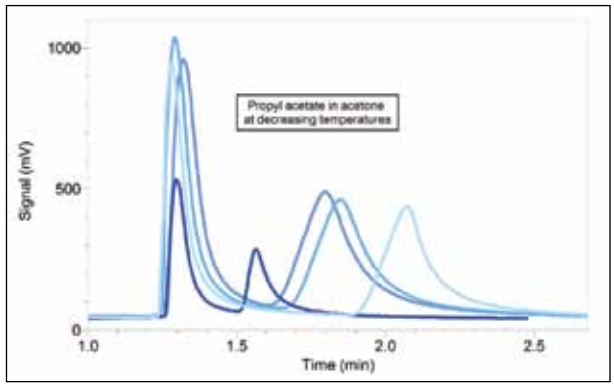
For more information, go to www.vernier.com/ccs-bta


$49 ORDER CODE CCS-BTA

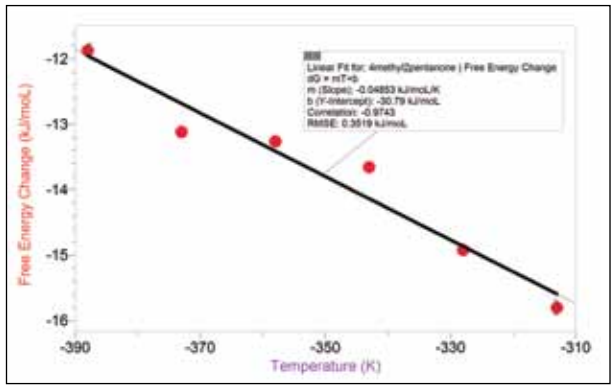
## Spotlight on New Mini GC Experiment for College Chemistry

By Melissa Hill, Ph.D.

Are you looking for more advanced experiments to run on your Vernier Mini GC? Then you are in luck! We've recently written a new experiment entitled "Investigating Thermodynamic Relationships of Substituted Hydrocarbons" that will help students understand a very challenging concept in college chemistry—chemical equilibrium and its relationship to thermodynamics. After students become familiar with the basic operation of a gas chromatograph, they can begin to understand the equilibrium chemistry occurring between the stationary phase and the mobile phase. It is this chemical reaction that is the basis for our experiment. The equilibrium between the mass of the analyte in the stationary phase and the mass of the analyte in the mobile phase can be determined from the ratio between retention times of a non-retained compound (such as acetone) and the compound of interest. Completing several runs where the only variable changed is the temperature of the column, students calculate the standard free energy, enthalpy, and entropy changes for the reaction between the mobile phase and the stationary phase. Students also observe the differences in the resultant Gibb's free energy as samples with increasing numbers of carbon atoms are compared. Download the entire experiment, as well as other more advanced Mini GC experiments, at www.vernier.com/chemistry/organic




*Gas Chromatograms of propyl acetate in acetone at different temperatures*




*Gibb's free energy analysis of 4-methyl-2-pentanone in acetone*

# CHEMISTRY & BIOLOGY

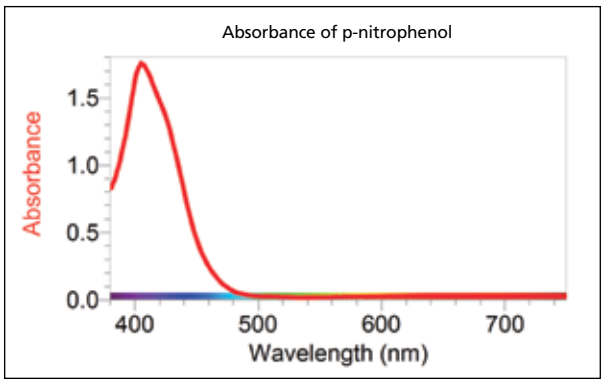
## Biofuel Investigation Using SpectroVis® Plus

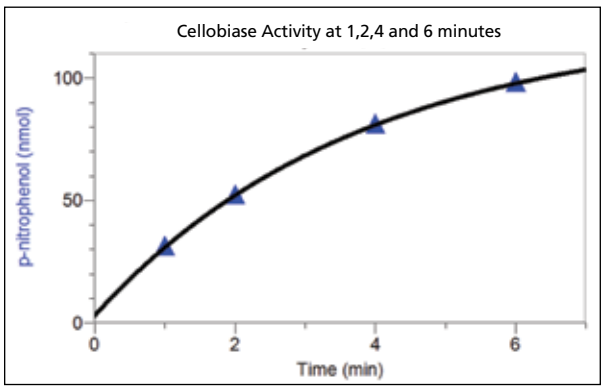
By John Melville, Ph.D.

Bio-Rad Laboratories has developed an exciting new kit for investigating enzyme action as part of making biofuels that can be used with our SpectroVis Plus spectrophotometer. This is an excellent investigation for AP biology and college biology courses.

The BioFuel Enzyme Kit measures the enzymatic activity of cellobiase. The reaction of the enzyme, cellobiase, breaking down a sugar, cellobiose, is important in the process of making cellulosic ethanol. Cellulosic ethanol is an efficient, more sustainable fuel that could potentially replace petroleum.

The BioFuel Enzyme kit uses a colorimetric assay to measure the activity of cellobiase. In this kit, the sugar (p-nitrophenyl glucopyranoside) is used as a substrate for the cellobiase. The enzyme cleaves the sugar into the compounds p-nitrophenol and glucose. P-nitrophenol is a yellow-colored compound with a peak absorbance between 405–410 nm, as shown. The rate that p-nitrophenol is produced is a function of enzyme activity.




The kit contains a series of experiments that are perfect for inquiry. As shown in the second graph, students can calculate the conversion rate of the sugar substrate from p-nitrophenyl glucopyranoside to p-nitrophenol and glucose using a known set of standards. The kit also contains instructions on how to determine the ideal conditions (e.g., pH, temperature) for this enzyme. In addition, there is an appendix on quantitative enzyme analysis. This is an excellent resource for the instructor.

Instructions on how to use the SpectroVis Plus spectrophotometer with the BioFuels Enzyme Kit can be found in Appendix D of the kit's instruction manual. You can find more information about Vernier products and other Bio-Rad kits at www.vernier.com/biotechnology

If you have any questions about this exercise please contact our Biology Staff Scientist, John Melville at jmelville@vernier.com

Biofuel Enzyme Kit (Bio-Rad Catalog # 166-5035EDU) sold by Bio-Rad Laboratories, explorer.bio-rad.com

SpectroVis Plus Spectrophotometer, SVIS-PL, **$449**

## Exploring Redox Reactions

The Vernier Oxidation-Reduction Potential Sensor is an ideal tool for exploring redox reactions in chemistry. Experiment 19, "Oxidation-Reduction Titrations" from our *Investigating Chemistry through Inquiry* lab manual offers several interesting reactions that your students can explore with measurements taken by our ORP Sensor. The experiment takes advantage of readily available substances by suggesting the student begin the investigation with a reaction between two common household products – bleach and hydrogen peroxide. Optional reactions between bleach and hydrochloric acid, and solutions of hydrogen peroxide and potassium permanganate, are also presented.

$79 ORDER CODE **ORP-BTA**

As increasingly more emphasis on inquiry-based lab experimentation unfolds in chemistry, we are sure you'll find that Experiment 19 and many others in *Investigating Chemistry through Inquiry* provide your students with the guidance and practice they need to pursue successful inquiry experiments.

To view and/or download this experiment, visit www.vernier.com/experiments/chem-i/19

## NEW! Turbidity Bottles

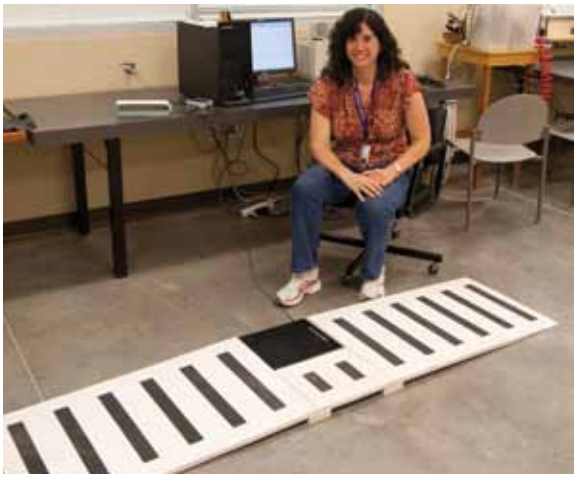
The Vernier Turbidity Sensor comes with one sample bottle, so having extras can be convenient. We now offer a box of six glass sample bottles for use with the Turbidity Sensor. Use them for additional samples or to replace broken or scratched bottles.

Turbidity Bottles, TRB-BOT, **$27/box of 6**

# BIOLOGY

## Walking Biomechanics Using a Force Plate

We recently visited Dr. Deborah Schenberger's biomechanics research lab at the University of Portland in Portland, OR. She has designed some experiments to look at issues related to barefoot running, a running trend popularized by Christopher McDougall's book *Born to Run*. Without the padding provided by traditional running shoes, barefoot runners minimize their heel strike, thus changing their gait.

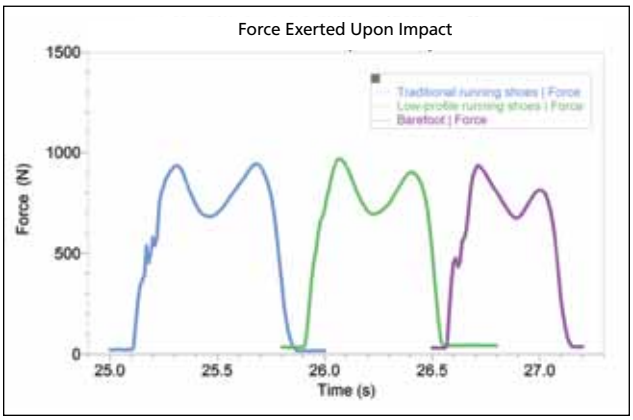


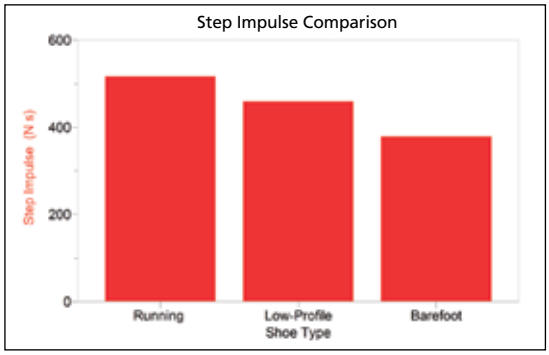
*Dr. Deborah Schenberger in her biomechanics lab*

Using a wooden ramp fitted with a Vernier Force Plate, Dr. Schenberger's students collected force data using LabQuest Mini and Logger *Pro* software. Through analysis in Logger *Pro*, her students investigated the effects of various types of shoes on walking force profiles.

During our visit, we collected walking data in traditional running shoes, low-profile running shoes, and barefoot. We found that all profiles exhibit peaks associated with the heel strike and toe-off of the walker. We were interested to see that when barefoot, the toe strike is relatively lower in magnitude than the heel strike.

We integrated the force profiles over time in Logger *Pro* to calculate the impulse for each shoe type. A comparison of these




step impulses suggests that reducing the padding in the shoes also reduces the step impulse.

Dr. Schenberger is currently working with Vernier Biology Staff Scientist, John Melville, PhD, to implement a similar experiment for analyzing running. For more details on this innovative use, see www.vernier.com/p25163

Force Plate, FP-BTA, **$215**

## Do you Need Inquiry-Based Investigations for Your AP* Biology Class?

If you are an AP Biology teacher, you already know that the College Board is making several changes to the AP Biology curriculum. One significant change is the requirement of inquiry-based, student-directed lab investigations. Inquiry-based investigations are much more open-ended than traditional laboratory exercises. Students are encouraged to investigate different questions and to design their own experiments. Due to these changes, many teachers have been asking us where they can find inquiry-based investigations for biology. You may be surprised to learn that many ideas for inquiry can already be found in the teacher's information section of our revised *Advanced Biology with Vernier* lab book.

You can also find several inquiry-based investigations appropriate for biology in our lab book, *Investigating Environmental Science through Inquiry*. Our *Investigating Chemistry through Inquiry* book also contains one investigation appropriate for biology on the topic of enzyme activity.

If you would like free training on how to conduct inquiry-based investigations using Vernier products, attend one of our inquiry-based workshops at the National Association of Biology Teachers Conference in Anaheim, CA. Our free hands-on workshops will be held on Thursday and Friday, October 13–14. Information on this conference can be found at www.nabt.org

*Advanced Biology with Vernier*, BIO-A, **$48**
*Investigating Environmental Science through Inquiry*, ESI, **$48**
*Investigating Chemistry through Inquiry,* CHEM-I, **$48**

* AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

# BIOLOGY

## Enter to Win the Bio-Rad and Vernier Technology Package—a $1,664 Value!

Take a short survey to be entered to win this biotechnology package. Vernier provides a suite of analytical tools that complement Bio-Rad's Biotechnology Explorer™ kits. Integrate more technology into your course with Vernier's award-winning, intuitive Logger *Pro*® software.

**From Bio-Rad:**

1 Forensic DNA Fingerprinting kit
1 Mini-Sub® Cell GT cell with tray and combs
1 PowerPac™ Basic Power Supply
1 Classroom Digital Micropipet, (2-20 µl)
1 TBR-35 Pipet tips, Pkg of 1,000, (2-200 µl)

**$858.60 value**

**From Vernier:**

1 White Digital Bioimaging System
1 LP Logger *Pro*® 3 Software
1 *Advanced Biology with Vernier* Lab Manual

**$806 value**

ENTER TO WIN BY OCTOBER 17, 2011

www.surveymonkey.com/s/vernierandbioradsweepstakes

## NEW! $O_2$ Gas Sensor to Spirometer Adapter

Laura Cerletty, an anatomy and physiology teacher at Whitnall High School in Greenfield, WI, and her students modified our $CO_2$ to $O_2$ Tee for improved performance when connecting the Oxygen Gas Sensor to the Spirometer. We were inspired to create the new $O_2$ Gas Sensor to Spirometer Adapter that will replace the $CO_2$ to $O_2$ Tee.

This combination of sensors is used in Experiment 22 "Oxygen and Aerobic Metabolism," found in our *Human Physiology with Vernier* lab book. In this experiment, respiratory volumes and oxygen concentrations of inhaled and exhaled air can be recorded simultaneously. As shown in the figure, the bacterial filter that comes with the Spirometer is attached to the inlet of the adapter to keep the system sterile.

The modified lab instructions for this lab can be found at www.vernier.com/p25165

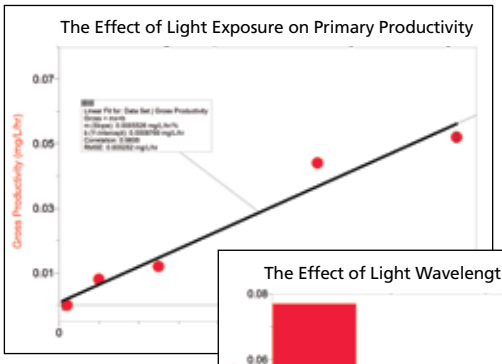
We would like to thank Laura Cerletty and her students for all of their hard work and inspiration for this new product.

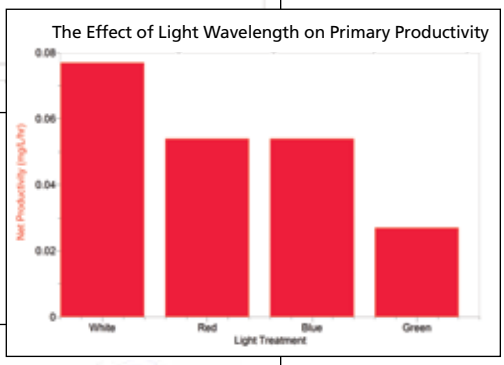
$O_2$ Gas Sensor to Spirometer Adapter, O2-SPR, **$8**

## NEW! Primary Productivity Kit

Collecting data to calculate the primary productivity of an aquatic sample just got easier with our new Primary Productivity Kit. This kit contains seven bottles and stoppers designed for measuring dissolved oxygen (DO) in dark and light environments. The special shape of the bottles prevents air entrapment and makes it easy to collect data with the Vernier Dissolved Oxygen Probe.

The Primary Productivity Kit also includes four screens of varying length that wrap around the bottles, providing different light exposures for students to sample and compare to a bottle placed in the dark. This makes it easy to conduct the classic Primary Productivity lab found in our *Advanced Biology with Vernier*, *Biology with Vernier*, and *Investigating Environmental Science through Inquiry* lab books.





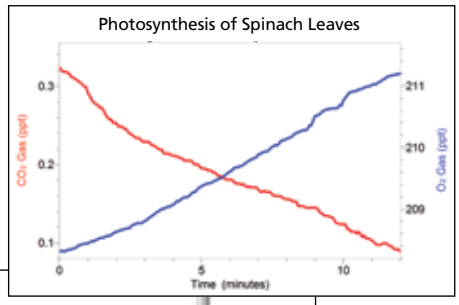
The Primary Productivity Kit also works well for inquiry-based labs; for example, a student can look at the effect of different nutrients on DO levels, or measure the primary productivity of different eutrophic samples. We have developed several inquiry-based labs using the Primary Productivity Kit. One that you might consider is an investigation of the effect of light of different wavelengths on the primary production of green algae. Students expose samples of algae to white, red, blue, and green light for 24 hours. Sample results are provided above. Students can observe the utilization of blue and red wavelengths over green wavelengths by the green algae and investigate further by mixing different wavelengths together to encourage an increase in primary production. For lab instructions, go to www.vernier.com/ppk

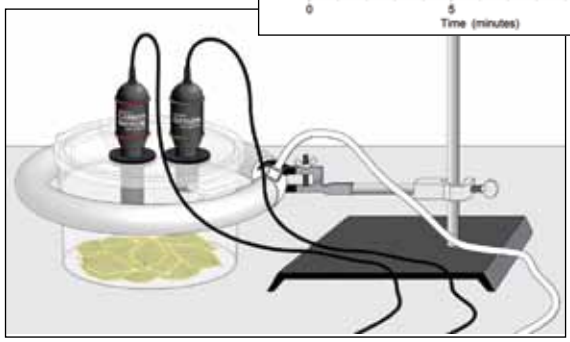
# BIOLOGY

## Tips and Tricks for Success with Photosynthesis

Photosynthesis and respiration of plants are fundamental concepts in biology and agricultural science. Our $CO_2$ and $O_2$ Gas Sensors make it easy for your students to study these concepts, producing beautiful data as shown here. However, you can't just place one leaf in a chamber with a light bulb and expect great results. Our resident biologists have revisited this experiment recently to provide you with the following tips and tricks for consistently good results.

- Use fresh, turgid spinach leaves. Using plant tissue that is old or using outdoor plants that have slowed down for the winter will not work well.



- Rinse the leaves with water and store in a cooler until the time they are used.
- Use the BioChamber 2000 as the sample chamber, and fully line the bottom with leaves to maximize surface area. The $O_2$ Gas Sensor needs plenty of leaf surface area to register a change in oxygen concentration.
- Use a 12-inch fluorescent ring lamp for maximum light in the photosynthetically active radiation (PAR) wavelength range, but with minimal heat emission. Insufficient light and/or excessive heat can contribute to poor results.
- Be patient. Plants require a several minute lag time shifting between photosynthesis and respiration.

By following these suggestions, you and your students should get good results every time.

To download updated instructions for our Photosynthesis and Respiration labs (Lab 31 in *Biology with Vernier* and Lab 12 in *Agricultural Science with Vernier*), visit www.vernier.com/p25169

$CO_2$ Gas Sensor, CO2-BTA, **$249**
$O_2$ Gas Sensor O2-BTA, **$188**
BioChamber 2000 BC-2000, **$19**

## A New Face in Our Biology Department

*Kristen Nelson*

Kristen Nelson joins Technical Support with experience teaching science, language arts, and advanced mathematics in Beaverton, Forest Grove, Oregon City, and Portland, OR, districts. She earned her B.S. in Ecology/Evolution and her M.A.T. from Pacific University. Her research included studying population dynamics in reefs off the coast of Belize. During her teaching career, Kristen utilized Vernier probeware for Oregon's first One-to-One high school laptop program. Kristen is a member of the Oregon City Service Learning Academy school board and volunteers for the Forest Grove School District sponsored non-profit, Adventures Without Limits, as a kayak/snowshoe guide.

*"My science department always remains impressed with Vernier. In this high tech world where things go out of date so quickly, your probes stay current with software upgrades. Keeps us coming back!"*

– Kevin Postma, Manistee HS, Manistee, MI

### VERNIER AWARDS

Vernier is proud to be recognized for its philanthropic commitment, steady growth, and as one of the Best 100 Companies to Work For in Oregon—for 12 years in a row.

*INTERNATIONAL AWARD FOR LABQUEST*

*FASTEST GROWING PRIVATE COMPANIES*

*PLACED 10TH OF 100 BEST GREEN COMPANIES IN OREGON*

*HEALTHIEST EMPLOYERS OF OREGON 2011*

*OREGON BUSINESS AWARD*

# SOFTWARE & HARDWARE

## Software Updates

Have you updated your Vernier applications recently? We regularly release updates to support new devices and add new features. Keeping up to date with software releases is one way to keep things running smoothly in your classroom or lab.

**LOGGER *PRO* 3.8.4** – Logger *Pro* 3.8.4 was released in February, 2011. This update is free to all users of any previous version of Logger *Pro* 3, and is available at **www.vernier.com/lpupdates**

Version 3.8.4 adds data marks and data tags, allowing you to attach notes to particular data points. Data marks were developed to support the Melt Station. Video analysis acquired several new features, including the ability to automatically skip frames and to calculate the center of mass for multiple objects.

The next release for Logger *Pro* is planned for January, 2012.

**LABQUEST 1.5** – LabQuest 1.5.1 was released in March, 2011. Version 1.5 adds data marks and tags, as well as the new Data Matrix. The Matrix is ideal for water quality testing with multiple sensors on multiple sites and days. LabQuest now supports the WDSS with the addition of a Bluetooth radio dongle. New sensor support includes the Melt Station and the Anemometer. This free update for LabQuest is available at **www.vernier.com/labquest/updates**

The next major release for LabQuest is planned for January, 2012. A minor patch for Constant Current System and Power Amplifier users is available now.

**GRAPHICAL ANALYSIS 3.8.4** – Graphical Analysis 3.8.4 was released on May 2011. This is a free update for users of any prevision version of Graphical Analysis 3.

The 3.8.4 release of Graphical Analysis is based on Logger *Pro* 3.8.4, and adds support for modern operating systems such as Windows 7. The Graphical Analysis update is available at **www.vernier.com/support/updates/graphical-analysis**

Graphical Analysis is updated infrequently, and no new release is planned at this time.

**LOGGER LITE 1.5** – Logger Lite 1.5.1 was released in March 2010, to support LabQuest Mini and Windows 7 (including 64-bit machines) and also adds linear fits. This free update is available at **www.vernier.com/llupdates**

We will release an update to Logger Lite in January, 2012.

**VIDEO PHYSICS FOR iOS** – The current version of Video Physics is 1.1.3, released in March, 2011. Updates to Video Physics are always free and are available in the Apple App Store.

Purchasing apps for iOS devices can be a challenge for schools. Did you know that your school or department can purchase vouchers to distribute apps such as Vernier Video Physics to multiple devices? This is a way to distribute iOS apps to both school-owned and student devices. You can use purchase orders or credit card. You receive a 50% discount when purchasing 20 or more copies of Vernier Video Physics. Learn more at **www.apple.com/itunes/education**

### K-8

*(Congratulations Grant Winners continued from page 1)*

In the K-8 category, the ten grantees truly showed how Vernier's technology would enrich the educational experience for their young students. For example, the grant will afford Gratigny Elementary, a Title I school in Miami, FL with a high ELL population, the opportunity to meet their School Improvement Plan's science goals, while helping to implement a science club, a science camp, and a science center for students who have traditionally had very limited science experiences outside of the classroom. Other innovative initiatives include Jefferson Middle School of Olympia, WA plan to use Vernier sensors as part of their STEM Robotics course for 7th and 8th grade students, and Berkley Middle School's multi-disciplinary, inquiry-based study of local water quality in Williamsburg, VA using a variety of Vernier technology.

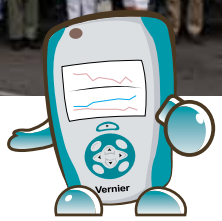
To learn more about all of Vernier's 30th anniversary technology grant winners, visit www.vernier.com/30years

## Talking LabQuest for Blind and Low-Vision Students

Independence Science has been working with us for several years on ways to make data collection work for blind and low-vision students. They helped us add new features to the regular version of Logger *Pro* (see the Spring 2011 issue of this newsletter for more details) and they provide scripts so that popular screen readers can make Logger *Pro* "talk."

Now, they have added speech to LabQuest. Any LabQuest can be upgraded to add the speech capability. The LabQuest will announce sensor readings and read off data from its data table. Contact Independence Science (www.independencescience.com) for information or to purchase Talking LabQuest.

## Vernier Around the Globe




**Did you know?**

This summer, 42 international representatives from 25 countries and six continents visited Vernier headquarters in Beaverton, Oregon. The three days they were here were spent learning more about Vernier products, learning how other countries market Vernier products, and seeing some of Oregon!

The LabQuest mascot above was created by our South Korean representative.

Vernier products can be found in 138 countries around the world. For more information, go to www.vernier-intl.com

## Home Energy Challenge

Want to encourage your students to explore energy efficiency? Participate in America's Home Energy Education Challenge (AHEEC) sponsored by NSTA and the U.S. Department of Energy. Registration is open until October 7, 2011 at: www.homeenergychallenge.org

Compete for over $200,000 in prizes with fellow teachers and students to reduce home energy use in the Home Energy Challenge. Or, have students investigate their individual role in energy efficiency by competing for an Energy Fitness Award. Modeled after the President's Physical Fitness Test, this award asks students to complete specific tasks and then demonstrate their learning and proficiency.

Need ideas for monitoring real-time electricity usage and cost? Try the Watts Up Pro with Logger *Pro* or a LabQuest in stand-alone mode. For suggested experiments, see: www.vernier.com/wu-pro

## Vernier Goes Backpacking

On September 6th, 20 Vernier employees packed backpacks with school supplies for Schoolhouse Supplies. Our eager team packed 427 backpacks with pouches, folders, rulers, spiral notebooks, pencils, and crayons donated by Vernier Software & Technology.

All the backpacks then were delivered to Creston Elementary in Portland, Oregon to start the students off to a new year with the supplies they'll use to learn, grow, and succeed.

## 25 years ago in THE CALIPER

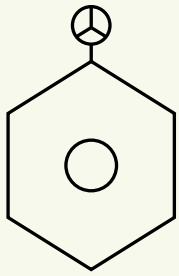
**25 Years Ago in *The Caliper*:**

We announced Graphical Analysis III, the third version of the program that has been sold continuously since 1982. There have been versions for Apple II, MS-DOS, Macintosh, and Windows. Is there any other computer program that has been actively used for more consecutive years?

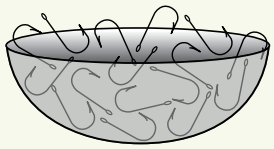
## SCIENCE HUMOR

This time we have a challenge for you. Identify the word or phrase represented by these graphics:

A.



B.



C. $\frac{NaCl}{NaOH}$ (HINT: This is a warning a commander might give out.)

A. Mercedes-Benzene
B. Hooks slaw (Hooke's Law)
C. The base is under assault!

# PROFESSIONAL DEVELOPMENT

## Free Hands-On, Data-Collection Workshops

Join us for one of our free, four-hour, hands-on workshops to learn how to integrate our computer and handheld data-collection technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. The workshops include lunch or dinner and lab handouts. Visit our web site for up-to-date information and registration.

| 2011 DATE | LOCATION |
|---|---|
| September 12 | Dallas, TX |
| September 13 | Dallas, TX |
| September 13 | Tulsa, OK |
| September 14 | Austin, TX |
| September 14 | Oklahoma City, OK |
| September 15 | San Antonio, TX |
| September 15 | Wichita, KS |
| September 17 | San Antonio, TX |
| September 17 | Topeka, KS |
| September 19 | Houston, TX |
| September 19 | Kansas City, MO |
| September 20 | Houston, TX |
| September 28 | Minneapolis, MN |
| September 29 | Minneapolis, MN |
| October 1 | Des Moines, IA |
| October 1 | Charleston, WV |
| October 3 | Omaha, NE |
| October 3 | Columbus, OH |
| October 4 | Cincinnati, OH |

| 2011 DATE | LOCATION |
|---|---|
| October 5 | Lexington, KY |
| October 6 | Louisville, KY |
| October 15 | Detroit, MI |
| October 17 | Cleveland, OH |
| October 19 | Erie, PA |
| October 20 | Pittsburgh, PA |
| October 22 | Madison, WI |
| October 24 | Milwaukee, WI |
| October 25 | Chicago, IL |
| October 26 | Chicago, IL |
| November 1 | Providence, RI |
| November 2 | Boston, MA |
| November 3 | Boston, MA |
| November 5 | Nashua, NH |
| November 7 | Portsmouth, NH |
| November 14 | Buffalo, NY |
| November 15 | Rochester, NY |
| November 16 | Albany, NY |
| | |

## Vernier Webinars

**NO TRAVEL REQUIRED!** Vernier holds free, one-hour training events online. The presenter will give a tour of Vernier products and answer questions. All you need is a broadband internet connection and a phone line. Recorded versions will also be available for download. You can follow along with your own equipment or simply watch and learn.

**LabQuest 101**
September 22, 29; October 10, 12, 24, 28; November 18, 22, 29

**Determining the Concentration of a Solution: Beer's Law**
September 22; October 28; November 18

**Physics with Video Analysis: Velocity and Speed**
October 12, 24; November 29

**NEW! Biology: Cell Respiration**
September 29; October 10; November 22

For more information and registration for these training opportunities, go to www.vernier.com/workshops

## For Our Canadian Customers

### CANADIAN WORKSHOPS

**Presented by Merlan Scientific**

Let us customize a Vernier workshop for your school! We know that opportunities for teacher PD are limited, and we can help you make the most efficient use of your valuable time. Our experienced presenter has used Vernier hardware and software in his own classroom for 20+ years and will prepare a full-day, part-day, or after-school workshop customized to the needs of any group of science teachers.

All workshops feature hands-on exploration using LabQuest, Vernier's "point and touch" handheld solution to collecting data, and Logger *Pro*, Vernier's award-winning flagship data-collection application and the most popular software of its kind.

Or, incorporate your curriculum priorities:

- Biology, with a focus on human physiology, field work in environmental science, and using Logger *Pro* for gel analysis
- Focus on inquiry-based labs, or how to meet the IT requirements of the IB program using Logger *Pro*
- Chemistry, including the care of pH probes, getting those perfect titration curves, and observing absorption and emission spectra with the SpectroVis Plus
- Elementary and Middle School labs for young, inquiring minds, using the features of Logger Lite and the cost-efficient line of Go! products
- Physics, using the video analysis feature of Logger *Pro* (or the iOS app), using animated displays, and data collection with the Wireless Dynamics Sensor System (WDSS)

Request a customized workshop quote today! Contact us at:
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www.merlan.ca

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*Scan this QR code with your mobile device to go to vernier.com*

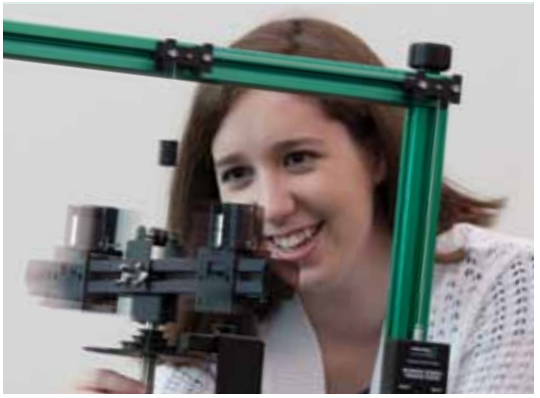
## Vernier's Centripetal Force Apparatus

ONLY $299

*Scan this QR code to read the full review.*

"As an experimental physicist who teaches introductory physics, I strongly recommend Vernier's new Centripetal Force Apparatus. It is extremely well thought out and engineered. Vernier's Centripetal Force Apparatus is simple and clever and provides even more versatility by allowing torque, angular acceleration, and moment of inertia to be studied as well—one apparatus that can be used for investigating rotational motion in general." *– Dr. Mark Rosen, Physics Instructor, Gloucester County College*

To read the detailed review go to www.vernier.com/p25147





**Please pass this newsletter on or recycle it again.**