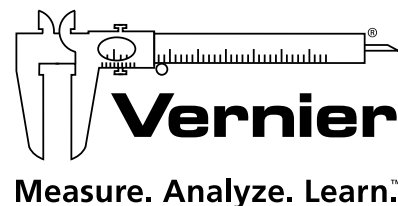


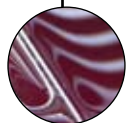
# The CALIPER



THE CALIPER IS A PUBLICATION FOR USERS OF VERNIER PRODUCTS

**IN THIS ISSUE**

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3 | NEW Video Training Downloads



5 | Measuring Emissions of the Flame Test



6 | Netbooks and Vernier Data-Collection Software



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11 | Professional Development



## Vernier Used Around the GLOBE

Is the heat given off by 500 people enough to change the temperature inside a large auditorium? How does the temperature and salinity of a tide pool compare to that of the nearby ocean water? These were just two of the questions posed to about 250 students from 52 countries who gathered in Cape Town, South Africa, this summer for the GLOBE Learning Expedition (GLE). And of course, Vernier equipment was used to investigate the answers to those questions.

GLOBE is a worldwide community of students, teachers, scientists, and citizens working together to better understand, sustain, and improve the Earth's environment. Every few years, these groups of people converge at the GLE to share their projects and their love of science. During the opening ceremonies at the University of Cape Town, Chief Scientist Dr. Peggy LeMone asked the audience whether they thought the 500 people in the auditorium were enough to warm the air and, if so, by how much. She then revealed that a Vernier Go!Temp had been collecting data on her computer for the past hour and she projected the resulting graph shown in Figure 1.

The conference had barely started and everyone was already doing science!

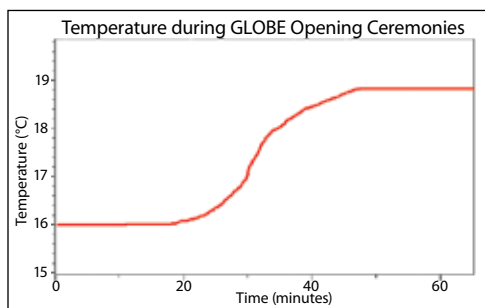


Fig. 1 Warming of the auditorium as people entered

Over the next few days, teams of students presented the GLOBE-related projects they had been working on in their own countries. Between sessions, they had time to relax and enjoy using some of the Vernier equipment, such as this group from South Africa having fun with LabQuest and an Infrared Thermometer.



Using the Infrared Thermometer to measure temperature

The final two days were spent on field expeditions to various locations around Cape Town. The Vernier field location was at a set of tide pools on beautiful Dias Beach, adjacent to the Cape of Good Hope.

Approximately 250 students used Vernier LabQuests and sensors to measure temperature, salinity, dissolved oxygen, and pH of the tide pools, and compared the results to the nearby ocean water.



Dias Beach and the Cape of Good Hope

When asked to predict the differences in temperature and salinity between the two, the students invariably predicted that the tide pools would be warmer and more saline than the ocean water.

continued on page 8

## Vernier Sponsors AAPT Physics Photo Contest

Each year, the American Association of Physics Teachers (AAPT) conducts a high school physics photo contest. The contest is open to high school students in grades 9–12. Students submit photographs, along with a description of the physics displayed in the photograph. Winners are judged on the quality of the photo and the accuracy of the physics.

Winning students receive a cash award, and winning schools receive a plaque and a gift certificate from Vernier. Check out the AAPT web site at [www.aapt.org/Contests/photocontest.cfm](http://www.aapt.org/Contests/photocontest.cfm) to learn more about the contest. The web link also contains a scientific explanation of the photos.



**Paperclip Peculiarity**  
1st place: Contrived Category  
Shilpa Hampole, San Jose, CA



**A Scattered Sun**  
1st place: Natural Category  
Alexis Blanch, New Orleans, LA  
Teacher: Stephen Collins

## Anscombe's Quartet

Have you ever wondered about how much outlier points influence the curve fits you do in software like *Logger Pro*? Or, how much you can rely on measures like the slope uncertainty or the correlation coefficient as a judge of how good a line fits your data?

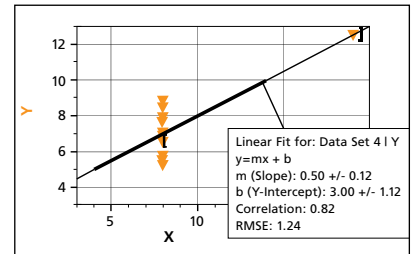
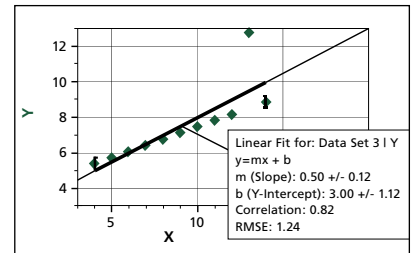
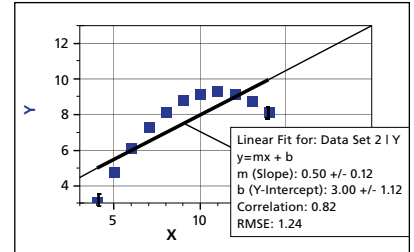
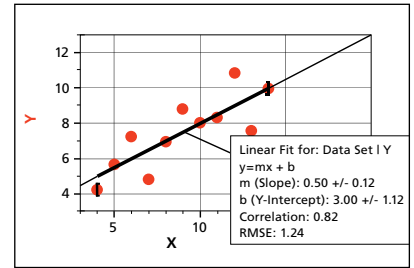
Way back in 1973, a statistician named Anscombe wrote a paper about the importance of actually graphing your data, and not just depending on statistical analysis. He created four sets of XY data pairs, each with identical average X, average Y, variance in X and Y, mean X and Y, linear regression slope and intercept, and even correlation coefficients and RMSE values. In other words, these data sets seemed to be about the same—until they are graphed.

Here's what the four data sets look like, graphed in *Logger Pro*. We've added linear fits to each graph, complete with uncertainties of the slope and intercept, and correlation coefficients and RMSE values. The fit statistics are all the same, but the underlying data sets are far from the same.

The take-home lesson: Inspect a plot of your data, and then decide if your fit means anything.

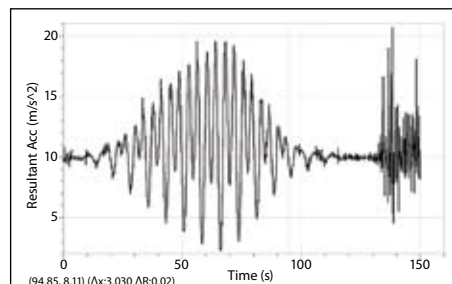
F.J. Anscombe, "Graphs in Statistical Analysis," *American Statistician*, 27 (February 1973), 17-21.

Wikipedia entry on Anscombe's Quartet: [tinyurl.com/6jwpgop](http://tinyurl.com/6jwpgop)



## Studying Acceleration at Amusement Parks

Richard DeLombard of NASA's Glenn Research Center in Cleveland has come up with a unique way to get students to analyze acceleration graphs from amusement park rides. Over the past six years, he has had a booth during Physics Day events at a couple of amusement parks. In the booth, he displays a poster that challenges students and teachers to match the graphs of the 3-axis acceleration data to various rides. The poster contains eight graphs that show the three independent axes and the scalar sum of the accelerations, along with a description of the eight rides. The activity is very challenging. You might want to check out this NASA web site, which includes an educator guide, a microgravity demonstrator, articles, and links to other web sites: [http://exploration.grc.nasa.gov/outreach/appd/appd\\_resources.html](http://exploration.grc.nasa.gov/outreach/appd/appd_resources.html)



*Ocean Motion* — The *Ocean Motion* is a pendulum ride with a large boat, holding about 50 riders, that is suspended below its horizontal axis. Motors push the boat back and forth until it is swinging at about 90 degrees end-to-end.

## Balloon Launch Uses Vernier Technology

The FIRST LEGO® League Team from Reston, VA recently took part in the High Altitude LEGO Extravaganza (HALE) balloon launch. Their payload included a LEGO NXT Robotics System with a Vernier NXT Adapter and two Vernier sensors—a UVB Sensor and a Surface Temperature Sensor. They measured UV radiation as a function of altitude as the balloon rose to almost 100,000 ft. over Nevada. The NXT controlled a rotating pinwheel that moves different materials in front of a Vernier UVB Sensor. A Vernier Surface Temperature Sensor was used to control the temperature inside the payload area.

They recovered their payload after the flight and retrieved the data. The experiment seems to have worked quite well.



*UV pinwheel filter (sunglass lens, cotton shirt, denim, and no filter)*

The team's mentor was David Levy. See a video of the launch and get more information at [www.unr.edu/nevadasat/hale/](http://www.unr.edu/nevadasat/hale/)

## LEGO® NXT Adapter



**\$39** ORDER CODE **BTA-NXT**

Incorporate science, control, and engineering into your NXT projects using this adapter and Vernier sensors. The NXT Sensor Adapter can be used with LEGO® Mindstorms® NXT robots and over 30 Vernier sensors for sensor-based control systems.



NXT robot projects with Vernier sensors are available online at [www.vernier.com/nxt](http://www.vernier.com/nxt)



## Force Plate Used to Test Wing Spar

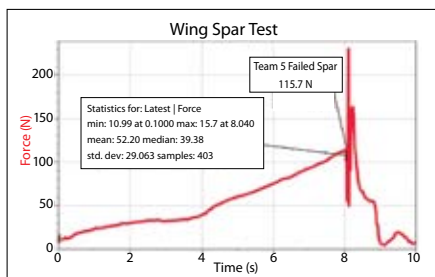
Ron Bowerman at St. Wendelin High School, Fostoria, Ohio knows how to motivate students: competition. In his physics class, students compete for a simulated high stakes contract with an airline. Physics and engineering skills are put to the test as students work in engineering teams that try to design the lightest and strongest wing spar for an airplane.

Bowerman's students use a Vernier Force Plate to stress test each spar. The real-time graphs help build the competition's tension in the room as each group's test results are displayed for everyone, while more and more stress is applied until each spar breaks.

Mr. Bowerman explains Boeing aircraft wings must hold five times the weight of the airplane. For the assignment, students assume their model airplane weighs one kilogram, so spars that hold the equivalent of five kilograms or more receive an "A."

(Boeing's target for the 777 was that the wing should be able to withstand up to 150% greater force than ever realistically would ever be exerted on it and, to put this into start perspective, this entails an astounding wing deflection of over 24 feet.)

Several of his students were quoted in a school newspaper story about the project, saying things like "Physics is a lot easier to understand if you visualize the concepts" and "It's better than learning out of a book."



*Force data during wing spar test*



More details at [www.vernier.com/innovate/innovativeuse99.html](http://www.vernier.com/innovate/innovativeuse99.html)

## NEW Video Training



*Attaching a friction pad*

Teaching dynamics this fall? Spend a couple of minutes with our Staff Scientist, John Gastineau, Ph.D., as he guides you through the fundamentals of setup for the Vernier Dynamics System.

Watch this and other helpful videos at [www.vernier.com/videos](http://www.vernier.com/videos)

engineering & physics





## NSTA Hosts Conference in Portland

### Visit Vernier Headquarters and OMSI Event

NSTA is hosting a regional conference in our hometown, Portland, Oregon, from November 20-22.

#### Tour Vernier Headquarters

Join us for a tour of Vernier Software & Technology with co-founder Dave Vernier. Along with seeing how Vernier works behind the scenes, you'll have a chance to tour our LEED Gold green building, with 126 solar panels. You'll also have the opportunity to see what's new at Vernier during product demonstrations, and have a chance to take a ride on a Segway®! *Thursday, November 20, 12:45–3:45 PM.*

#### Sustain Your Brain: An Evening at OMSI

Science is cool—especially at OMSI (the Oregon Museum of Science and Industry)! On Friday evening, OMSI and Vernier Software & Technology invite you to explore all the museum has to offer. Join us for a pasta dinner, complete with salad and dessert, explore OMSI's newest exhibit, Mindbender Mansion, and attend live demonstrations in OMSI's labs. Relax and enjoy a show in the Planetarium and shop in the OMSI Science Store, where you will receive a 10% educators' discount. Tour the USS Blueback, a real decommissioned military submarine. Discuss with OMSI educators how to connect your classroom to the museum using reserved labs, field trips, and distance learning. Get inspired with wonder. *Friday, November 21, 6:00–9:00 PM.*

These are ticketed events. Purchase tickets when you register with NSTA.

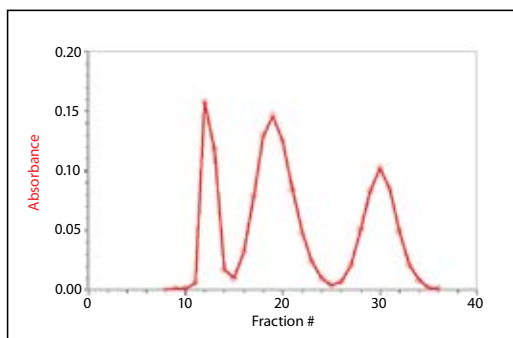
## Drop Counter as Fraction Collector

Although the Drop Counter was developed to record drops during titration, attaching the Luer-lock stopcock to the outlet of a chromatography column adapts it for use as an inexpensive fraction collector for column chromatography. Although column chromatography is an essential part of the undergraduate biochemistry laboratory curriculum, most undergraduate programs cannot afford to purchase a class set of fraction collectors, and many protocols call for the students to collect each fraction into a graduated cylinder.

An article published in the September 2008 issue of the *Journal of Chemical Education*, (Nash, B.T. (2008) *J. Chem. Ed.* 85:1260), describes the use of the Vernier Drop Counter as a fraction collector. Although test tubes containing the fractions must be moved manually, this protocol gives students the opportunity to learn the essential skills needed to operate a computer-interfaced fraction collector (aligning the sensor with the column outlet and test tube, calibrating the drop size, and operating software).

You can download a file created for this experiment at [www.vernier.com/innovate/innovativeuse100.html](http://www.vernier.com/innovate/innovativeuse100.html). Although the experiment file was written for a non-interfaced spectrophotometer, PC users can perform this experiment with an Ocean Optics spectrophotometer by opening two Logger Pro windows.

Supporting material, including student handouts, notes for the instructor, and answers to a post-lab problem set are available for download at JCE Online at <http://www.jce.divched.org/Journal/Issues/2008/Sep/abs1260.html>



Profile for gel filtration chromatography

## NEW Cuvette Rack

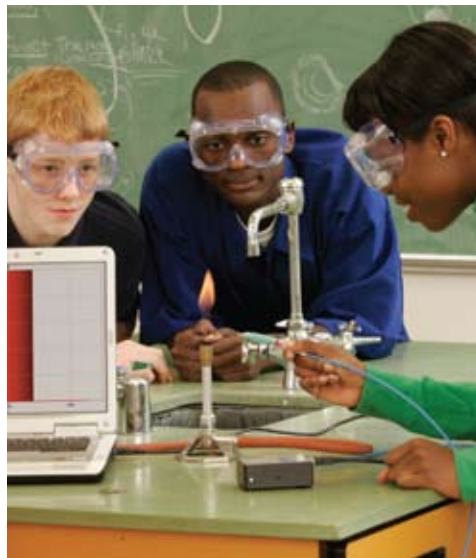
### Small Footprint, Easy Storage

Many of the participants in this summer's workshops at Vernier were introduced to our new Cuvette Rack. The new Vernier Cuvette Rack has slots for ten 1-cm pathlength cuvettes. There may be a cuvette out there that won't fit in the rack, but we couldn't find one. We chose a small size to save space on your lab bench. We made them so they are stackable for easier storage. We put guides along the corners of the slots so the outer walls of your cuvettes aren't scratched by the Rack. We beveled the base of the Cuvette Rack to help make it more stable.

It's a simple, thoughtfully-designed accessory for your colorimetry or spectroscopy experiments.

\$9 ORDER CODE CUV-RACK

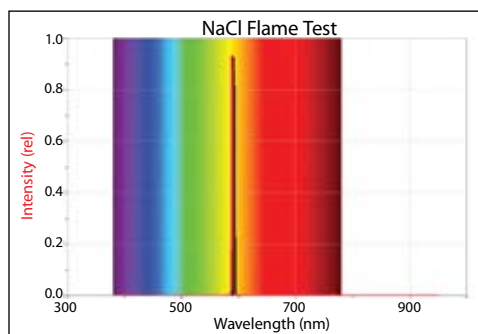




## Flame Testing Salts Using Vernier Spectrometers

One of the more popular chemistry lab experiments is the flame test. This experiment has many variations, but the major goal is to observe the color of a salt as it is energized in a lab burner flame, the color being characteristic of the cation (the positively charged species) in the salt. While it is relatively simple to see the flash of red or green or purple from a salt of strontium or barium or potassium as it leaps within a lab burner flame, it is not so easy to measure—until now.

Visit the spectroscopy section of our web site and download the experiment entitled “The Flame Test.” This experiment will show you how to set up a Vernier SpectroVis, Vernier Spectrometer, or Ocean Optics Spectrometer, and measure emissions with the spectrometer and a fiber optic cable accessory. Your students will see the emission from an element not only as visible color but as a set of lines at specific wavelengths, bringing this simple test to life in a new and more scientifically satisfying way. [www.vernier.com/spectroscopy](http://www.vernier.com/spectroscopy)



## Featured Activity for Biology

from Experiment 11  
*Biology with Vernier*

All organisms, including plants and animals, oxidize glucose for energy. Often, this energy is used to convert ADP and phosphate into ATP. It is known that peas undergo cell respiration during germination. Do peas undergo cell respiration before germination? Using collected data, your students will be able to answer this question concerning respiration and non-germinated peas.

Using the O<sub>2</sub> Gas Sensor, students will monitor the oxygen consumed by peas during cell respiration. Both germinated and non-germinated peas will be tested. Additionally, cell respiration of germinating peas at two different temperatures will be tested.

Watch the video from this popular Biology lab using Vernier technology.



### Objectives

In this experiment, you will

- Use an O<sub>2</sub> Gas Sensor to measure concentrations of oxygen gas during cell respiration.
- Study the effect of temperature on cell respiration rate.
- Determine whether germinating peas and non-germinating peas respire.
- Compare the rates of cell respiration in germinating and non-germinating peas.



### more online

Watch the video online and download the free activity  
[www.vernier.com/videos](http://www.vernier.com/videos)

biology & chemistry

# FREE Data-Collection

We offer free graphing and analysis software for the latest in compact computers. Try any one of these netbooks, or sub-notebook computers with our Go! Link USB interface. You can use your favorite Vernier sensors, backed by legendary support and teacher-tested experiments. Not only will you get a bigger screen, you'll have a fully-functional computer at a budget-minded price.



## OLPC XO LAPTOP

Targeted at undeveloped nations, this lightweight laptop has a screen that pivots 360 degrees. It has preinstalled applications to promote creativity and collaboration, a built-in digital still/video camera, automatic mesh networking, built-in WiFi, and a long battery life.

Cost: Approximately \$200-\$300



Screen size available in 7.5 inches  
1200 x 900 resolution

## ASUS EEE PC

All Asus Eee PCs come pre-loaded with the Linux OS, weigh about two pounds, include WiFi, 3 USB ports, and have a built-in card reader, speakers, and a microphone. Some models include a camera.

Cost: Approximately \$300 to \$500, depending upon the model



# Software FOR LOW-COST NETBOOKS



## Looking for a Linux version of Logger Lite?

We now support Logger Lite for Linux, Ubuntu 8.04. Use it with these mini-notebooks, as well as standard size PCs. Logger Lite is award-winning software that provides fundamental graphing and analysis tools for K-8 science students.

**FREE Vernier Software** download at  
**[www.vernier.com/netbooks](http://www.vernier.com/netbooks)**



Screen size available in 7 inches  
800 x 480 resolution

## INTEL-POWERED CLASSMATE PC

Intel designed this rugged computer specifically for students grades K-6. Available with either Windows XP or Linux, it also comes with WiFi, a water-resistant keyboard, and a built-in microphone. An optional digital camera and digital pen are also available.

Cost: Approximately \$350



Screen size available  
in either 7 inches or 9 inches  
800 x 600 resolution

continued from page 1



Students from four countries measure temperature and salinity

The results, however, showed the opposite to be true (see Fig. 2). Students reevaluated the environment and realized that these tide pools were in constant shade, nestled in cold rock (the IR Thermometer showed the rock to be 12°C), and there had been rain since the last high tide, diluting the salt water with fresh water.

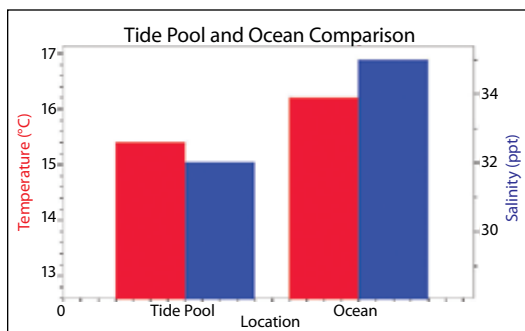


Fig. 2 Temperature and salinity comparisons near the Cape of Good Hope

Vernier enjoyed bringing hands-on science to the GLOBE Learning Expedition, and we look forward to next time!



For more information on GLOBE visit [www.globe.gov](http://www.globe.gov)



## Logger Pro

3.6.1 FREE update is now available

Logger Pro is under continuous development, as we add new features and support for new sensors, devices, and operating systems.

We've just released version 3.6.1 for both Macintosh and Windows. This version is recommended for all Logger Pro users with computers running Windows XP or Vista, or Mac OS X 10.3.9 and newer.

Logger Pro 3.6.1 adds support for rotary motion sensors and radiation monitors when used with LabQuest, and it enables the internal microphone in LabQuest. The document and application icons are refreshed to match new icons used in Logger Lite. Also, Logger Pro now works with more videos imported from other applications. The experiment files have been updated to match the numbering of the latest edition of the many Vernier lab books.

### Share Logger Pro with your students

Every copy of Logger Pro includes a site license. This license allows you to install Logger Pro on any computer in your department (college or university) or school (K-12). Faculty and students are also allowed to install Logger Pro on their personal computers.

You can share Logger Pro with students in a variety of ways. The easiest is to use the Logger Pro CD itself; we have a five-pack of CDs available (LP-ST5, \$10) for current licensers of Logger Pro. You can also copy the Logger Pro CD yourself, but take care to use a disc-copy utility, such as Easy CD Creator (Windows) or Disk Utility (free with

If you haven't updated Logger Pro in a year or two, you'll discover new functions, such as log graphs, video capture and analysis, gel analysis, modeling, and many other cool features.

This is a free update for purchasers of Logger Pro 3 in any previous 3.x version.

For download information, see [www.vernier.com/lpupdates](http://www.vernier.com/lpupdates)

### Logger Pro is available in:

- Spanish
- French
- Italian
- German
- Korean
- Simplified Chinese
- Traditional Chinese

all Macs), so that the entire disc contents are copied.

You can also post downloadable installers on your own school network for student access, as long as the installers are not accessible to the public. Contact us for access to these installers.

When students have wider access to Logger Pro, they can easily use it for special projects or to complete lab work not done within class time. Graphs and other objects from Logger Pro can be pasted into a word processor for report preparation. If you make it easy for students, they may surprise you with the quality of their work!

HA!  
HA!  
HA!  
SCIENCE  
HUMOR

"I don't like numbers that can't be written as a fraction. It's an irrational fear."

—Unknown author

"I don't like electrons; they've always had a negative influence on society."

—Chris Lipe

"An expert is a man who has made all the mistakes that can be made, in a very narrow field."

—Niels Henrik David Bohr (1885-1962)

from <http://www.gdargaud.net/Humor/QuotesScience.html>

**NEW**

## Video Training

Look for new videos from featured activities this fall in the NEW Video Training Corner of our web site.

[www.vernier.com/videos](http://www.vernier.com/videos)





## Display LabQuest to Your Entire Class for FREE

We are often asked if there is a way to project the LabQuest screen. There is—it's called the LabQuest Emulator (LQE). Instructors sometimes want to project the LabQuest screen in order to demonstrate certain procedures to students.

The LQE looks just like a LabQuest, even down to the hardware keys. If you connect a LabQuest to your computer, you can even take data with the LQE. Project the computer screen as usual, and run LQE. Using LQE with an interactive whiteboard is a kick, because you can tap on the projected screen just like you would tap on the LabQuest screen.

You've now got two projection options for live data collection with LabQuest: use *Logger Pro* with LabQuest and get all the features of our computer software, or use the LabQuest Emulator to show students exactly what they will see on their own LabQuest devices.

LQE is free and runs on Windows XP and Vista, and on Macs running Windows XP or Vista.

Check out a video of the LabQuest projected on a touch-sensitive, interactive white board and download the LQE FREE at [www.vernier.com/labquest/emulator](http://www.vernier.com/labquest/emulator)

### Languages now supported by LabQuest:

|         |        |                     |
|---------|--------|---------------------|
| Spanish | German | Simplified Chinese  |
| French  | Korean | Traditional Chinese |
| Italian |        |                     |



## Solar Energy Activities

If you have students interested in solar energy or doing reports on solar energy, check out [www.vernier.com/solar](http://www.vernier.com/solar). On that web site we have live data on our building's 126 photovoltaic panels, a camera view of many of the panels, and weather data. They can also see graphs showing the energy production from our panels on any particular day or week. There is also an 11-page document they can download with details of our solar project, including costs,

energy production data from the first year, and background information. Students can compare the energy production from the two types of photovoltaic panels we have, or do their own determination of the "pay back period" for our panels. This document includes many questions for students to investigate.



Solar information and activities on [www.vernier.com/solar](http://www.vernier.com/solar)

## NEW Updated Correlations to State and National Standards

We have partnered with Academic Benchmarks to provide you with correlations to the latest state and national standards for science, math, and technology. Our correlations include alignment to state curriculum and testing standards, the National Science Education Standards, the NCTM Principles and Standards, and the National Educational Technology Standards for students. To view the alignments for your state, visit [www.vernier.com/standards](http://www.vernier.com/standards)



OREGON BUSINESS AWARD



2005 PHILANTHROPY AWARD



FOR OUTSTANDING CONTRIBUTION IN SUPPORT OF EDUCATIONAL EXCELLENCE



INTERNATIONAL AWARD FOR LOGGER PRO SOFTWARE

Logger Pro, Vernier LabPro, Vernier and caliper design, Go!, Logger Lite, Vernier EasyTemp, Vernier EasyLink, Vernier EasyData and Data Pro are our registered trademarks in the United States.

Vernier Software & Technology, vernier.com, Vernier LabQuest, DataMate, and Graphical Analysis are our trademarks or trade dress.

All other marks not owned by us that appear herein are the property of their respective owners.

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 9 YEARS IN A ROW.



\$45 ORDER CODE ESI

## NSTA Recommends *Investigating Environmental Science through Inquiry*

The Vernier lab book, *Investigating Environmental Science through Inquiry*, recently received a favorable review from NSTA Recommends. Products recommended by NSTA Recommends are considered among the best available supplements for science teaching. The book was reviewed by Donald Logsdon Jr., and he says, "With media attention on species extinction and global warming, environmental science has an intrinsic interest for students. The best way to study the environment (the air, water, and soil) and the interactions among biological organisms in the environment, is by performing good experiments using the inquiry model of learning.... The book's objective is to present a large number of environmental experiments that can be done by students as part of a course in environmental science. It begins by describing the inquiry approach, tells how to plan and organize the experiments, and gives suggestions about how the student work can be effectively assessed...."



For the complete review or to download free sample labs, go to [www.vernier.com/cmat/esi.html](http://www.vernier.com/cmat/esi.html)

## Toyota Tapestry Awards

Fifty one-year grants of up to \$10,000 each will be awarded for the 2009 Toyota tapestry competition. A minimum of 20 "mini-grants" of up to \$2,500 each will be awarded, as well. Proposals must be submitted by January 21, 2009.

For details, information on past winners and FAQs, see <http://www.nsta.org/pd/tapestry/>

## Best Buy Teach Awards

The Best Buy Teach Award program was created to specifically recognize and reward schools that "are using interactive technology in the classroom to engage students and make learning fun." Best Buy will award up to \$2 million to K-12 schools in the U.S. and Puerto Rico. Awards will range from \$1,000 to \$5,000, based on specific school needs. \$10,000 will be awarded to up to 15 applications supporting 9th grade programs. Educators must submit applications online by October 12, 2008. For information, see [www.bestbuyinc.com/community\\_relations/teach\\_awards.htm](http://www.bestbuyinc.com/community_relations/teach_awards.htm)



## LabQuest is Teachers' Choice

LabQuest just received recognition in Learning Magazine's Teachers' Choice Awards, strictly judged by classroom teachers. The Teachers' Choice Awards recognize the very best in classroom-tested, teacher-approved products. It is terrific to receive recognition from front-line educators.



MultiMedia & Internet@Schools



Learning Magazine's Teachers' Choice Award 2008



**DEADLINE EXTENDED**  
to November 30, 2008

## 2009 NSTA/Vernier Technology Award

The Vernier Technology Award is your opportunity to be honored for innovative uses of data-collection technology with your students. Seven awards are offered annually: three high school (grades 9-12), two middle school (grades 6-8), one elementary (grades K-5), and one college. The award consists of \$1,000 in cash, \$1,000 in Vernier data-collection technology, and up to \$1,000 in expenses to attend the 2009 NSTA conference in New Orleans.

*It's not too late to submit your 2009 entry.*

[www.vernier.com/grants/nsta.html](http://www.vernier.com/grants/nsta.html)

## 2008 Fall Hands-On Workshops for teachers of science and math

Join us for one of our **FREE**, 4-hour, hands-on workshops to learn how to integrate our computer and handheld data-collection technology into your chemistry, biology, physics, math, middle school science, physical science, and Earth science curriculum. The workshops include lunch or dinner and lab handouts. Contact us or visit our web site for up-to-date information and registration.

LABQUEST • LABPRO • TI GRAPHING CALCULATORS • COMPUTER DATA COLLECTION • GO! LINK DATA COLLECTION

**SEPTEMBER '08**

- 9/10/08 - TULSA, OK
- 9/11/08 - OKLAHOMA CITY, OK
- 9/13/08 - WICHITA, KS
- 9/15/08 - TOPEKA, KS
- 9/15/08 - FORT WORTH, TX
- 9/16/08 - KANSAS CITY, MO
- 9/16/08 - DALLAS, TX
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- 9/27/08 - DULUTH, MN

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- 10/6/08 - CHICAGO, IL
- 10/7/08 - MILWAUKEE, WI
- 10/8/08 - MADISON, WI
- 10/11/08 - GREEN BAY, WI
- 10/22/08 - BUFFALO, NY
- 10/23/08 - ROCHESTER, NY
- 10/25/08 - SYRACUSE, NY
- 10/25/08 - LOUISVILLE, KY
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- 10/27/08 - LEXINGTON, KY
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- 11/5/08 - CLEVELAND, OH
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- 11/10/08 - GRAND RAPIDS, MI

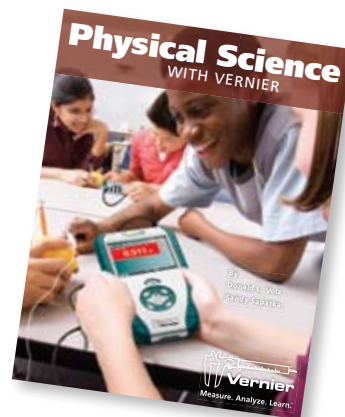


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## Featured Activity for Middle School Science

from Experiment 40 in *Physical Science with Vernier*

Galileo tried to prove that all falling objects accelerate downward at the same rate. Falling objects do accelerate downward at the same rate in a vacuum. Air resistance, however, can cause objects to fall at different rates in air. Air resistance enables a skydiver's parachute to slow his or her fall. Because of air resistance, falling objects can reach a maximum velocity or terminal velocity. In this experiment, you will study the velocities of two different falling objects.



### Objectives

- Use a LabQuest and a Motion Detector to measure distance and velocity.
- Produce position vs. time and velocity vs. time graphs.
- Analyze and explain the results.




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