



The CALIPER

THE CALIPER IS A PUBLICATION FOR USERS OF VERNIER PRODUCTS

WIRELESS DYNAMICS SENSOR SYSTEM

FORCE • ACCELERATION • ALTITUDE

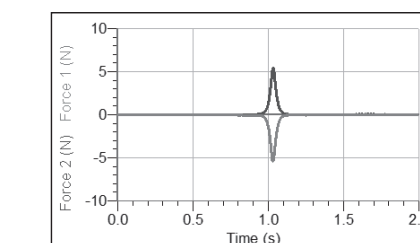


Use for Amusement Park Field Trips
Your students can take a WDSS on a roller coaster and analyze the accelerations. The altimeter makes it clear where on a ride a given acceleration value took place. Students can take multiple runs before downloading data wirelessly to a computer using the Start/Stop button. An indicator shows when a run is in progress.

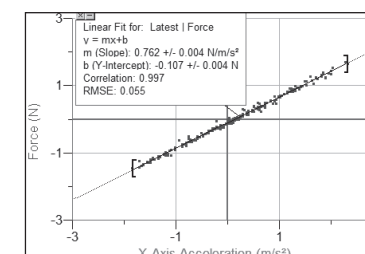
Using the WDSS is easy. You can use multiple units in a classroom. Rechargeable batteries last for days of typical use, and the 1000 samples/second data rate is more than enough for dynamics experiments. On-board data storage of up to 100,000 points means you can collect many runs before downloading to a computer.

Requires Logger Pro 3.4.5; Windows XP SP2, Microsoft-compatible Bluetooth radio; or Mac OS X 10.3 or newer. Available May 2006.

Wireless Dynamics Sensor System
Order code **WDSS** | \$249



Newton's 3rd law experiment with two carts and two WDSS



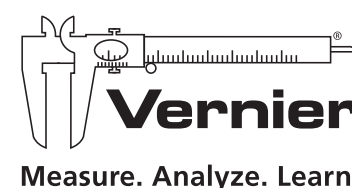
Newton's 2nd law experiment with WDSS

You asked for a wireless sensor system. We created one for you. We didn't want to just get rid of the wire between the computer and the interface—we wanted to get rid of all the wires. So we took it one step further and created a remarkable product, the new Wireless Dynamics Sensor System (WDSS). The WDSS measures forces up to 50 N, accelerations up to 50 m/s² in three directions, and altitude changes of ±200 m. The data from these five sensors can be streamed wirelessly to a Bluetooth-equipped computer. Even better, if your experiment takes you outside the 10 m range of Bluetooth, the WDSS can store multiple runs of data internally for download to Logger Pro 3.

No More Dragging Wires
The WDSS can be used for any physics experiment where a force sensor or accelerometer is used, but with the significant advantage that there are no wires interfering with the motion. For example, you might attach the WDSS to a Vernier Dynamics Cart (all required hardware is included) and study Newton's 2nd law by measuring the applied force and resulting acceleration. No longer will you have to hope that the wires won't push or pull on the cart. Or, you might look at reaction forces in Newton's 3rd law by colliding two carts with units attached.

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Vernier Summer Workshops
These are 1-day, general data-collection workshops that feature a wide variety of activities in chemistry, biology, physics, math, middle school science, physical science, and Earth science. The \$50 fee includes training, lunch or dinner, and lab handouts.

June 12: Fargo, ND
June 14: Sioux Falls, SD
June 20: Lincoln, NE
June 22: Des Moines, IA
June 28: Kansas City, MO
June 30: Wichita, KS

July 10: Little Rock, AR
July 12: Memphis, TN
July 24: Pittsburgh, PA
July 26: Buffalo, NY
Aug 14: Boise, ID
Aug 17: Beaverton, OR

AP* Biology Workshops with Vernier, TI, and Wards
At these 2-day summer workshops, teachers will receive hands-on training on seven of the AP Biology lab activities recommended by The College Board. The \$99 registration fee includes a copy of our *Biology with Computers* lab book.

June 28-29: Miami, FL
July 12-13: Worcester, MA
July 24-25: Chicago, IL
August 8-9: Los Angeles, CA

* 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.

AP* Chemistry Workshops with Vernier and Flinn
During these 2-day summer workshops, teachers will do many of the 22 experiments recommended by The College Board. The \$99 registration fee includes a copy of our *Advanced Chemistry with Vernier* lab book.

June 19-20: Atlanta, GA
July 27-28: Chicago, IL
August 10-11: Los Angeles, CA

Physics Workshops with Vernier and AAPT/PTRA
These 2-day summer workshops feature hands-on training for teachers of physics and physical science. Teachers will become more highly qualified through training in content, teaching techniques, and technology. The \$99 registration fee includes a copy of our *Physics with Computers* lab book.

June 17-18: Georgia College and State University, Milledgeville, GA
June 23-24: Metropolitan State College, Denver, CO
July 13-14: Lee College, Baytown, TX

Workshop registration and details can be found at www.vernier.com/workshop

Summer Workshops

Hands-On Training with Science Technology Experts

Printed on Recycled Paper

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Studying Beer's law

NEW Vernier Spectrometer

Imagine taking less than five minutes to set up and calibrate a spectrophotometer. Imagine measuring the absorbance of a solution and viewing a graph of the absorbance spectrum in a fraction of a second. Imagine preparing to conduct a Beer's law lab, a kinetics experiment, or measuring the emission spectra of discharge tubes with a click of a button. Intriguing, right? The new Vernier Spectrometer, powered by Ocean Optics™, can do all this and more. This truly portable spectrometer offers one-step calibration over its entire range of sensitivity (380 – 950 nm), eliminating the need to continually insert blanks. The 2 nm resolution is perfect for measuring

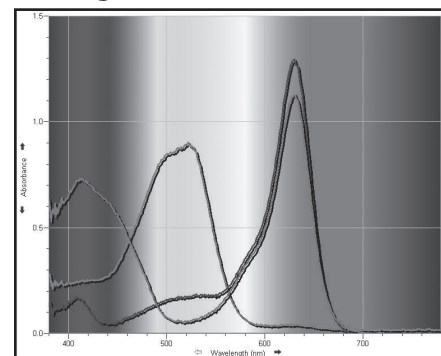


the absorption spectrum of an aqueous solution over the visible spectrum, and can do it in a fraction of a second. The Vernier Spectrometer comes with an open cuvette holder with a built-in light source, allowing access to the sample during testing. It is powered through a USB connection to your computer and is controlled by our award-winning Logger Pro 3 software (version 3.4.5 required).

Vernier Spectrometer Order Code V-SPEC | \$1199

Visible Spectra of Chemical Dyes

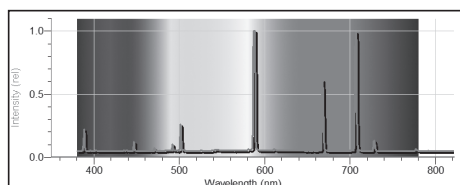
Creating the absorption spectrum of an aqueous sample is easy and fast with the new Vernier Spectrometer. In this experiment, *Visible Spectra of Chemical Dyes*, students measure and analyze the visible light absorbance spectrum of various samples of aqueous food dye mixtures. This activity is a great way to introduce spectral analysis, because it helps students understand the relationship between the color of the solution and the ideal wavelength they should use to measure variations in absorption. To download this free sample activity, visit our web site at www.vernier.com/innovate/innovativeuse53.html



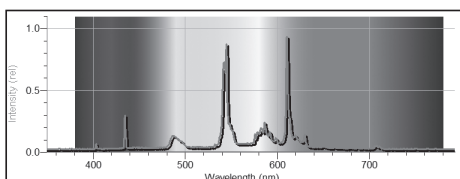
Spectra of various food dyes

Physics Instructors Record Emission Spectra of Common Light Sources

Our new Red Tide Emissions Spectrometer offers much of interest to physics instructors. This unit records the emission spectrum of many common light sources with 1 nm resolution. For example, if you direct the Spectrometer at the light from a common gas discharge source, such as helium, you'll see the emission lines as sharp peaks on an intensity vs. wavelength graph. It's convenient to use the optical fiber assembly (sold separately) to direct light into the Spectrometer. Since the spectrum is acquired in less than a second, analyzing the light from many sources is quick and fascinating. Here are two samples:



Helium emission spectrum



Fluorescent light emission spectrum

You can also use the Red Tide Emissions Spectrometer to do remote detective work. At the last AAPT meeting in Anchorage, we had a small mercury discharge tube in the booth. The exhibit hall had intense lights on the ceiling, and by directing the fiber at the lights and comparing to the known mercury spectrum, it was clear that the hall was illuminated by mercury discharge lamps.

Red Tide Emissions Spectrometer Order Code ESRT-VIS | \$999

(Does not include light source and cuvette holder)

Optical Fiber Order code VIS-NIR | \$120

Around the World with LabPro



Physics teacher, Ute Kaden, collects data at the North Pole

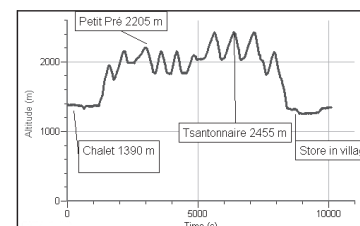
Ute Kaden is the first teacher in Brownsville ISD, Texas, to teach AP Physics. To keep the interest of her students at Hanna High School, she literally spans the globe in search of new and exciting ways to bring real-world data into the classroom. Recently she took her Vernier LabPro and sensors to the North Pole! At a latitude of 89° 58.5' she measured salinity, temperature, barometric pressure, and acceleration due to gravity. Her results? $g = 9.801 \text{ m/s}^2$

Skiing with LabPro

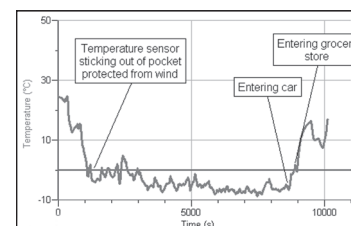
Jean-Jacques Rochat spent a few days skiing near his chalet in Ovronnaz, Switzerland. Even though he is no longer a science teacher (now a principal), he could not resist collecting data. Here is a photo and a day's data from a temperature probe and a pressure sensor, used to calculate approximate altitude. Note that you can see each run, his (short) waits in lift lines, and his visit to the store. The altitude data nicely matches the labeled altitudes of the tops of the chair lifts.



Ovronnaz, Switzerland



Altitude for a day of skiing



Temperature for a day of skiing



More innovative uses at www.vernier.com/innovate

Innovative Uses

Several education journals have recently published articles about great uses of Vernier products. Here are some examples:

"The Indirect Measurement of Biomechanical Forces in the Moving Human Body" by Melanie Cluss, Kenneth Laws, Natalie Martin, T. Scott Nowicki, and Allan Mira, Dickinson College, Carlisle, PA, in the February 2006 issue of the *American Journal of Physics*, used both video analysis and a Force Plate to examine the forces on a jumping ballet dancer.

"Using a Force Plate to Correct Student Misconceptions" by Edward P. Wyrembeck, Howards Grove HS, Howards Grove, WI, in the September 2005 issue of *The Physics Teacher*, provided a great way to measure the impulse of a basketball vs. a dough ball.

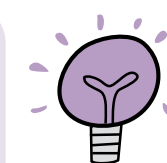
"Using an Authentic Radioisotope to Teach Half-Life" by Scott Liddicoat and John Sebranek, Green Bay Southwest High School, in the December 2005 issue of *The Science Teacher*, used a Vernier Radiation Monitor connected to a computer or TI calculator to allow students to accurately determine the half-life of Barium 137.

"Simplifying the Motion of Coupled Oscillators Using the FFT" by Don Easton, Lacombe, AB, Canada in the January 2006 article of *The Physics Teacher*, used a Motion Detector and Logger Pro to analyze the harmonic motion of two coupled masses.

"Steel Wool and Oxygen: A Look at Kinetics" by James Gordon and Katherine Chancy, Central Methodist University, in the July 2005 issue of *The Journal of Chemical Education*, used our Oxygen Gas Sensor to determine the rate law for the reaction of iron with oxygen.

"Simple and Inexpensive Computer Interface to a Durrum Stopped-Flow Apparatus Tested Using the Iron(III)-Thiocyanate Reaction" by Craig M. Hoag, SUNY-Plattsburgh, in the December 2005 issue of *The Journal of Chemical Education*, used our Voltage Probe, Temperature Probe, pH Sensor, and Logger Pro software to determine rate constants and the equilibrium constant for this reaction.

"Using a CBL Unit, a Temperature Sensor, and a Graphing Calculator To Model the Kinetics of Consecutive First-Order Reactions as a Safe In-Class Demonstration" by Deborah A. Moore-Russo, State University of New York, Buffalo, NY and José E. Cortés-Figueroa, University of Puerto Rico, in the January 2006 issue of the *Journal of Chemical Education*, used temperature probes and the heating of cooling of water to model the behavior of consecutive, bi-phasic, first-order reactions.



innovative uses

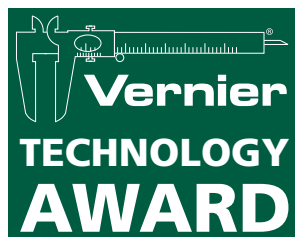
15 Years Ago in The CALIPER

We introduced two books: our first version of *Chemistry with Computers* and *Chaos in the Laboratory (Science Projects for Use with the Apple II)*.

10 Years Ago in *The Caliper*:

- The TI-83 calculator was introduced.
- We started a "Biology Corner" to explain some of the great biology experiments you can do with our products.

Six Educators Receive NSTA/Vernier Technology Award



At the recent NSTA National Convention in Anaheim, California, six educators were honored as the 2006 Vernier Technology

Award recipients. The six winning entries were judged by a panel of experts, appointed by NSTA, to be the most innovative in their use of data-collection technology in their respective categories. David and Christine Vernier presented each of the winners with a trophy, a check for \$1,000, and a \$1,000 gift certificate for Vernier technology. Each recipient also received a one-year membership to NSTA and \$1,000 towards expenses for attending the Anaheim convention.

Below are brief synopses of the winning entries. For more information about the winning entries and the 2007 NSTA/Vernier Technology Awards, visit www.vernier.com/grants/nsta.html

College Level

"Interactive Learning Experiments" Marina Milner-Bolton, from the University of British Columbia, has turned "show-and-tell" demonstrations into Interactive Learning Experiments by collecting data during lectures and making them available for analysis outside of class.

High School Level (Grades 9 – 12)

"Heart Rate Measures in Crayfish" Heidi Anderson, from Paul Laurence Dunbar High School in Lexington, KY, in collaboration with researchers from the University of Kentucky, developed an inquiry-based activity designed to measure the heart rate of crayfish.

"Air Toxics Under the Big Sky" David Jones, from Big Sky High School in Missoula, MT, got his students involved with research studying links between incidence of asthma and the levels of different groups of air pollutants.

"Rocketry" Stephen Potashnik, from Chesapeake Bay Governor's School in Tappahannock, VA, has students measure engine thrust in model rockets to predict maximum launch height and compare the results to an actual launch.

Middle School Level (Grades 6 – 8)

"Soil on the Horizon in Stanly County" Jamie Mabry from New London Choice Middle School in North Carolina, has his students bring in soil samples from farms throughout Stanly County to measure soil pH as an indicator of soil fertility.

Elementary Level (Grades K – 5)

"The Power of the A.P.P.L.E. Bus" Deborah Wickerham from Chamberlin Hill Intermediate in Findlay, OH, lead the development of a mobile science technology laboratory used to provide inquiry-based field studies.



Investigating terminal velocity

NABT Ecology/Environmental Science Teaching Award

It's never too early to start working on your application for the Vernier sponsored NABT Ecology/Environmental Teaching Award that will be given to a secondary school teacher who has successfully developed and demonstrated an innovative approach in the teaching of ecology/environmental science and has carried his/her commitment to the environment into the community. Our sponsorship of this award includes \$500 toward travel to the NABT National Convention, a check for \$500, and \$500 of Vernier equipment. The recipient also receives a plaque to be presented at the NABT National Convention, and a one-year complimentary NABT membership. Download an application from the NABT web site at <http://nabt.org/sub/pdf/awards.pdf>



Find out more about the NSTA Awards at www.vernier.com/nstaawards

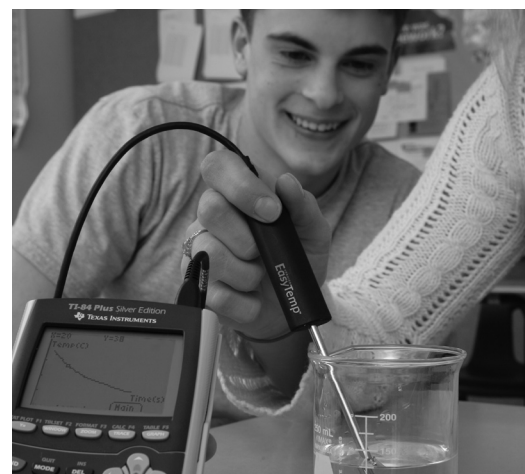
New Online Purchasing Guide

Create a personalized recommendation of lab books, sensors, interfaces, software, and accessories to fit your needs. This interactive purchasing guide lets you customize your options according to the subject you teach, your budget, and curriculum. You can print your recommendation, request a formal quote, or order online.



Try the new Online Purchasing Guide at www.vernier.com/guide

EasyData Versions of Vernier Labs



Studying exponential decay with the Vernier EasyTemp

If you have been waiting to make the move to EasyData because your Vernier lab book activities are all written for DataMate, your wait is nearly over. We have been diligently working to update all of our activities for EasyData, and these new versions will be available in June. All Vernier lab books purchased after June will contain the updated labs on the CD in the back of each book. If you already own a copy of one of our popular lab books, simply contact us after June, and we will be glad to send you an updated CD.

EasyData International Versions

EasyData version 2.0 is now available in 11 different languages. International versions of EasyData can be downloaded from our web site at www.vernier.com/easydata



EasyData is a **FREE** download from our web site at www.vernier.com/easydata

NEW Lab Books from Texas Instruments



Forensics: Connecting Science Investigations with TI Data Collection Activities (order code TI-FOR, \$25)

This new lab manual from Texas Instruments is designed for high school teachers who wish to introduce students to forensics. The manual is written for the TI-84 Plus line of graphing calculators, using the new EasyData calculator application. Twelve of the 14 activities use Vernier sensors in the investigations. If forensics interests you, request a trial set of equipment from Texas Instruments at www.tiforensics.com. You can even enter to win a classroom set of equipment.



EasyData Activities: Modeling Algebraic Functions with Data Collection (order code TI-MAF, \$15)

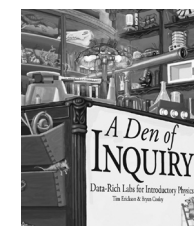
This book is designed for high school teachers who want to introduce their students to data collection, data analysis, interpreting and predicting graphs, and statistical analysis with engaging and realistic activities using the TI-84 Plus family of calculators. It contains 15 activities that deal with various aspects of discrete mathematics and analytical geometry. Nine of the 15 activities use sensors, such as the CBR 2, Vernier EasyTemp, and Vernier Voltage Probe.

DISCOVER TI NEIGHBORHOOD WORKSHOPS

Join TI at a FREE Discover TI Neighborhood Workshop to get a hands-on, beginner introduction to TI graphing technology! In just three hours, learn how to utilize graphing calculators to make understanding science a fun, engaging

journey. This hands-on workshop will explore data collection and problem solving activities, with an emphasis on chemistry. You'll take home classroom-ready activities to WOW your students.

<http://education.ti.com/us/discoverscience>



A Den of Inquiry

We are pleased to announce a new book, *Den of Inquiry, Data-Rich*

Labs for Introductory Physics, by Tim Erickson and Bryan Cooley. This book has 15 labs that can be done with our Logger Pro software. The labs do not involve sensors for data collection. Instead, the emphasis is on data analysis and modeling. The book combination includes student pages with space for data analysis, predictions, and background information. It also includes teacher pages with prerequisite information, notes, pitfalls to avoid, sample results, and suggested discussion questions. Like most of our lab manuals, *A Den of Inquiry* includes a CD with the word-processing files for the student pages, so you can edit them for your classroom situation.

SCIENCE HUMOR

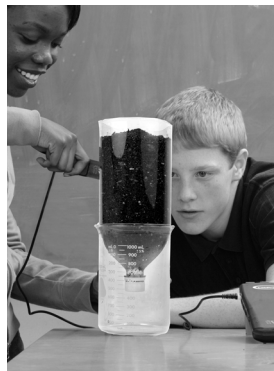
HA!
HA!
HA!

A physicist, biologist, and a chemist were going to the ocean for the first time.

The physicist saw the ocean and was fascinated by the waves. He said he wanted to do some research on the fluid dynamics of the waves and walked into the ocean. He drowned and never returned.

The biologist said he wanted to do research on the ocean flora and fauna and walked into the ocean. He too never returned.

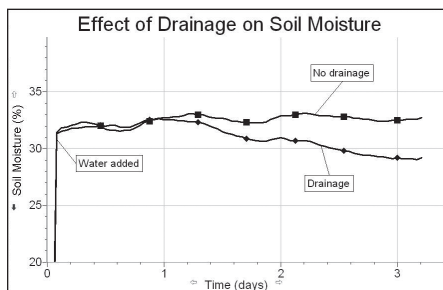
The chemist waited for a long time and afterwards wrote the observation: "The physicist and the biologist are soluble in ocean water."



Time to Water? A Study Using the Soil Moisture Sensor

Here's an idea for an experiment with the new Vernier Soil Moisture Sensor. We wondered how much influence drainage holes had on soil moisture when a house plant is watered. Our setup consisted of two 2 L soda bottles with the bottoms removed. A hole was cut in the side of each bottle to accommodate the Soil Moisture Sensor, and the opening was sealed with tape after insertion. The bottles were then placed neck down into two

1 L beakers. One bottle had the cap removed to facilitate drainage, while the other was left on. A piece of screen was placed in the neck of each bottle to prevent the soil from falling out of the bottom. Equal amounts of soil were added to each bottle and the Soil Moisture Sensors were inserted. Data collection was started, one sample per hour for 80 hours, then equal amounts of water were added to the bottles. As the graph indicates, it took more than one day for any difference to appear, but the bottle with drainage slowly began to dry out, while the soil moisture content of the other bottle remained relatively constant. These results lead to many more questions. What influence would a plant have on the soil moisture content? Why didn't the bottle with drainage show a change for this long? Do different plant species prefer different water contents? Does drainage vary with different soil types? The possibilities for experimentation with this sensor are endless!



Soil moisture data

Soil Moisture Sensor
Order Code SMS-BTA | \$89



Data Pro 1.7 Now Supports Palm T|X

The latest handheld model from Palm is the Palm T|X. A new version of Data Pro, released last December, continues our support for data collection on Palm Powered™ handhelds. The most recent Palm models supported are the Tungsten™ T5, Tungsten™ E2, and Palm® T|X.

The updated version of Data Pro includes improvements in performing sensor calibration, better scaling of the graph during data collection, easier monitoring of sensor data during data collection with the GPS-enabled Garmin® iQue™ handheld, and better printing with an update of the PrintBoy™ drivers. Also, the quick key for starting and stopping data collection is now moved to the right-most key at the base of the handheld.

If you are currently using Data Pro on a version of Palm OS® 4 and above, you may download the Data Pro 1.7 update from our web site at www.vernier.com/downloads/dpupdates.html



NEW Use Garmin GPS with Logger Pro

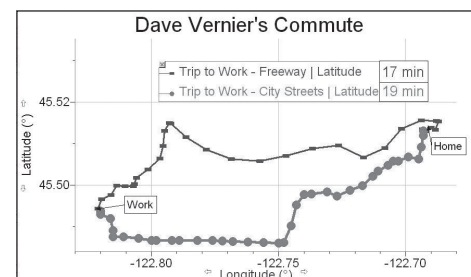


Garmin eTrex Venture

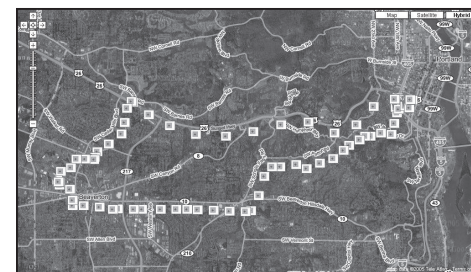
Order Code GAR-VENTURE | \$149

In Logger Pro 3.4.5 (available in May), we are adding support for some models of GPS (Global Positioning System) units. Environmental data collection is a great application for use of a GPS in conjunction with Logger Pro. With the GPS unit attached to a laptop, Logger Pro will read the GPS coordinates and position stamp your data as you take it. If you are not taking a laptop, you can simply mark all your collection sites

as waypoints and then import them to your laptop when you are back in the lab. We have also found some great uses for GPS units in physics. A track can be set up so that the GPS latitude and longitude are noted at even time intervals. The distance between points is a measure of velocity, and it is a fun way to introduce the subject. This use was inspired by J.B. Sharma, of Gainesville State College, GA, who has been doing this kind of exercise using three programs to get the job done. Now Logger Pro does it all. The graph to the right shows a trip from Dave Vernier's home to the office, taking two different routes. The GPS unit noted the car position every 30 seconds. Note the higher speeds on the freeway. Logger Pro 3.4.5 can now launch Google Maps and place the data on a map, as shown. These data were taken with a Garmin eTrex Venture.



Dave Vernier's commute in Logger Pro



A Logger Pro export of the data to Google Maps

NEW Biology ProScope Kit

Make Visual Documentation Part of the Biology Classroom

Vernier presents a new offering this spring that is sure to enhance every life science and biology classroom. In collaboration with Bodelin Technologies, Vernier is pleased to announce a ProScope kit specific to the needs of biology teachers. The Biology ProScope Kit features a USB handheld digital microscope and accessories that students can use to observe and document specimens. With this premier package, students can now study life from the microbial world to the macro level.

The Biology ProScope Kit includes a backlit 50X lens, a 1-to-10X variable focus lens, a lens tube adapter, a C-mount for use with a microscope, and a flexible, sturdy stand.



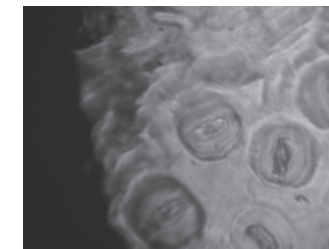
The ability to use the optics of a microscope or dissecting scope greatly broadens the utility of the ProScope, allowing images to be projected on a screen or captured and used in documents and presentations.

The Biology ProScope Kit comes with USB Shot software, making it compatible with both current Windows and Macintosh operating systems.

As a final bonus, remember that the ProScope can be fully integrated into Vernier's award-winning Logger Pro software, and will work in concert with data collection. Just think, a student can now visually document both the conditions surrounding and the actual germination of a seed over several days.



Use the ProScope as a dissecting scope to study crickets



Leaf stomata



Aphid



Biology ProScope Kit
Order code BD-BIO | \$549



Find out more about the Biology ProScope Kit at www.vernier.com/proscope



OREGON BUSINESS AWARD



2005 PHILANTHROPY AWARD



FOR OUTSTANDING CONTRIBUTION IN SUPPORT OF EDUCATIONAL EXCELLENCE



INTERNATIONAL AWARD FOR LOGGER PRO SOFTWARE

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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.