



A Publication  
for  
Users of  
Vernier Software  
Products

# The Caliper

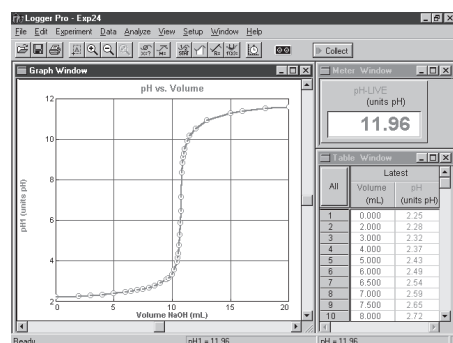
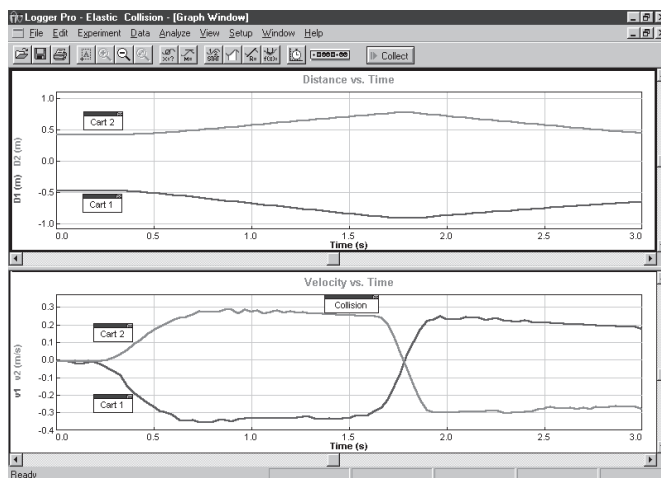
Volume 14 Number 1

Fall 1997

## Logger Pro™ Wins Award!

Our new Logger Pro™ for Windows has been awarded a “Software Award of Excellence” from *Technology and Learning* magazine. Logger Pro is our Windows software for the Universal Lab Interface and Serial Box Interface. It has what you would expect in a Windows program—multiple windows, a toolbar, copy and paste, lots of color, and an easy-to-use graphical interface. Other features include

- Data display in several windows, such as graphs, data tables, meters, histograms, and more.
- Extensive analysis tools, including tangent line, integration, statistics, curve fitting, calculated “spread sheet” columns, examine, and interpolation.
- Multiple data runs.
- Easy sensor and experiment setup with pre-saved experiment files.
- Annotation of graphs and notes in a text window.
- Support for up to four analog sensors simultaneously (with the ULI II).



Logger Pro was developed jointly by Vernier Software and Tufts University. The latest version supports Windows 3.1, as well as Windows 95 and Windows NT. We have integrated the functionality of several different programs into this new program. It can be used with motion detectors, photogates, force sensors, rotary motion sensors, temperature probes, microphones, pressure sensors, EKG sensors, heart rate monitors, light sensors, pH systems, CO<sub>2</sub> gas sensors, and more. If you have a ULI II with a 1.2 or newer EPROM, you can even run two motion detectors at the same time (see sample graph above). ULI II EPROM upgrades are available.

Logger Pro support for radiation monitors will be added soon. A Macintosh version of Logger Pro is under development and will be available early in 1998.

Logger Pro for Windows system requirements: Windows 3.1, Windows 95/98, or Windows NT; 16MB of RAM; an unused serial port; and 5MB of disk space. A Serial Box Interface, original ULI, or ULI II is also required.

**Logger Pro (includes site license) ..... LP-WIN ..... \$49.00**

### IN THIS ISSUE

#### NEW PRODUCTS:

- New Motion Detector
- Instrumentation Amplifier
- Logger Pro Books
- CBR
- TI-86

#### LAB IDEAS

#### WORKSHOPS & CONTESTS

#### BITS & BYTES

#### SCIENCE HUMOR

**NEW!**

# What's New for '97?

## New Motion Detector

We are very excited about our new Motion Detector. We have greatly improved its ease of use by adding a pivoting head, a clamp, interchangeable cable, and rubber feet. Best of all, the new Motion Detector is the same price as the old one. The new Motion Detector is a joint project of Vernier Software and Texas Instruments. The motion detector is available with any of three different connectors:



- For use with the CBL: ..... MD-CBL..... \$64
- For use with the ULI: ..... MD-ULI ..... \$65
- For use with the MPLI: ..... MD-M ..... \$66

While the new motion detector looks like a CBR™ from Texas Instruments, it is not the same thing. See page 8 of this newsletter for information on the CBR.

## Lower-Priced Sensors

We have worked this year to reduce the price of data collection hardware. As a result, we have three new and improved probes with lower prices than the ones they replaced:

### Vernier Photogate (VPG-DG, \$39):

This is the least expensive, assembled photogate ever sold. It comes with a mounting rod for connection to a ring stand. An optional pulley (SPA, \$16) can be added to use it as a Smart Pulley.



**Student Radiation Monitor (SRM-DG, \$138):** We left the display off this radiation sensor to lower the cost. It also features improved beta and gamma sensitivity.



**Dual-Range Force Sensor (DFS-DIN, \$98):** This is our best force sensor yet. It has two ranges:  $\pm 5$  N and  $\pm 50$  N. It is easy to hold in your hand, but it also comes with a bracket, which makes it easy to mount on a PASCO cart.



## Exercise Heart Rate Monitor

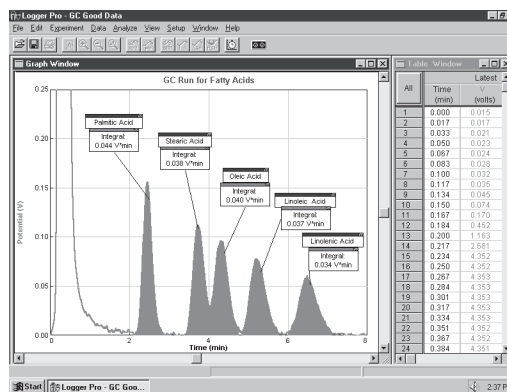
This sensor allows you to monitor your heart rate while you exercise, run, or jump. We have a number of sample graphs made using the Exercise Heart Rate Monitor (EHR-DIN, \$89) on page 5 of this newsletter.



## Instrumentation Amplifier

We get many requests from universities and high schools to amplify analog signals from lab instruments up to the voltage range of our lab interfaces. Now we have the Instrumentation Amplifier to monitor voltages from a few millivolts (DC or AC). It has several switch settings to allow you to select the best gain: 0-20 mV, 0-200 mV, 0-1 V,  $\pm 20$  mV,  $\pm 200$  mV, and  $\pm 1$  V. It can be used with any of our computer lab interfaces, as well as the Texas Instruments CBL. Typical uses would include

- amplifying the chart recorder output of any instrument (such as a Gas Chromatograph) so that its signal can be used with our lab interface.
- building a current (amperage) probe by measuring the voltage drop across a resistor.

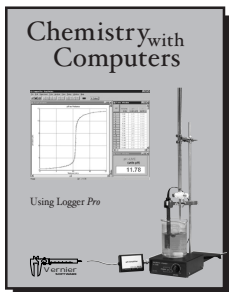


Gillian Gardner of the Lewis and Clark College, Portland, OR, Chemistry Department let us connect the Instrumentation Amplifier to a GOW-Mac Series 350 Gas Chromatograph to collect data using a sample of fatty acids dissolved in toluene solvent. The data were collected using our Serial Box Interface. Following the initial solvent peak, the five fatty acid peaks are identified, and their respective integrals calculated using our *Logger Pro* software.

Instrumentation Amplifier ..... INA-DIN ..... \$49



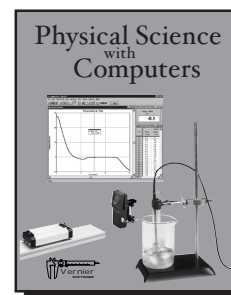
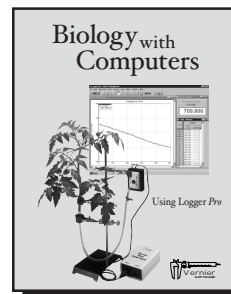
## Logger Pro Versions of Our Books



We have recently revised three of our lab manuals to match the *Logger Pro* software. The new versions have the following order codes:

<i>Biology with Computers</i> .....	BWC-LPW .....	\$35
<i>Chemistry with Computers</i> .....	CWC-LPW .....	\$35
<i>Physical Science with Computers</i> .....	PSC-LPW .....	\$35

Watch for a new book *Physics with Computers* (PWC-LPW, \$35). The authors are Ken Appel, Clarence Bakken, and John Gastineau. We hope to have this book available in our 1998 catalog. It includes labs from many areas of physics and uses a wide variety of sensors. Like all of our "...with Computers" books, it will include disks with experiment files and the word processing files of the student handouts so that you can edit the labs.



### Ion-Selective Electrodes



We are pleased to announce that a new family of ion-selective electrodes will be available in our 1998 catalog (shipping after February 1, 1998). The initial species available will include four electrodes: Nitrate ( $\text{NO}_3^-$ ), Chloride ( $\text{Cl}^-$ ), Calcium ( $\text{Ca}^{2+}$ ), and Ammonium ( $\text{NH}_4^+$ ). We chose these four ions because of their importance in environmental monitoring. We get many requests for nitrate testing in water quality studies. Calcium is very useful as an indicator of hardness of water. Chloride is a good indicator of water salinity, and ammonium is often present as a result of fertilizer in water runoff from fields. These easy-to-use electrodes will be priced at under \$150. An Ion-Selective Electrode Amplifier will be priced at under \$45—one ISE Amplifier can be purchased for use with multiple electrodes. Here are some features of our ISEs:

- Electrodes are stored dry, and have either solid state or PVC membranes.
- Vernier ISEs are a combination-style, non-refillable, gel-filled construction—no messy filling of ISEs. They are ready to use in a matter of minutes.
- Each electrode has a built-in protective guard.
- Other ion-selective electrodes will be available later in 1998.

### Rechargeable Battery Pack for the Serial Box Interface



We have had a battery holder for the Serial Box Interface for several years. It is handy when you are using your Serial Box Interface with a laptop computer in the field. Our new battery pack (Order Code RBP, \$59) contains a set of rechargeable batteries and a complete battery-charging system. When the new battery pack is in the Serial Box Interface, all you have to do is plug in the AC power supply and the batteries will be recharged.

### What's New on our Web Site

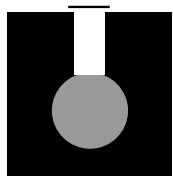
Our web site has been around since early 1995, but it has continued to grow. The new additions include:

- The very latest (free) CBL data collection programs for TI-82, TI-83, TI-85, TI-86, and TI-92. Included are our popular CHEMBIO and PHYSICS groups of programs, along with a new program for use with radiation monitors.
- Two sample labs from each of the following books: *Chemistry with Computers*, *Chemistry with CBL*, *Biology with Computers*, *Biology with CBL*, *Physical Science with Computers*, *Physical Science with CBL*, and even our soon-to-be-released *Physics with Computers*.
- Frequently Asked Questions.
- Articles from all of our recent newsletters (including this one).
- The latest information on upcoming workshops.
- Technical specs on all of our sensors.

Check out our web site at [www.vernier.com](http://www.vernier.com)

### Ten Years Ago in this Newsletter . . .

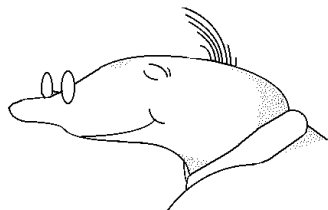
In our Fall 1987 newsletter, we announced our first real chemistry probe — pH. We sold the pH Amplifier in both an assembled version and a parts kit for teachers or students to assemble. Our pH System is still one of our most popular sensors. That newsletter also featured a comparison of the game ports on the various models of Apple IIs and the Laser 128 computer. (Remember that one?)



# Chemistry

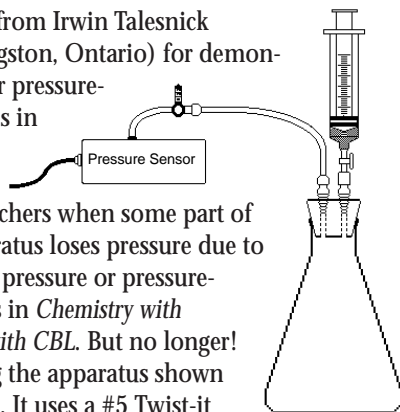
by Dan Holmquist

## Vernier Software Celebrates Mole Day 1997!



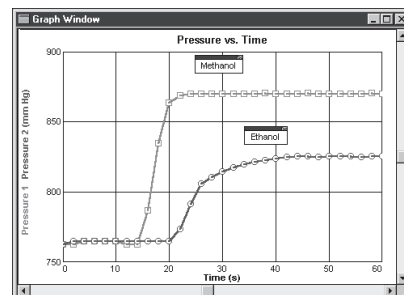
Are you ready for the Mole Day celebrations taking place across America during the early morning hours of October 23rd? Vernier Software is! Set those alarms for 6:02 a.m. and help us celebrate the First Annual Vernier Software Mole Day Contest. How do you enter? Easy! Just have your class (minimum 1 teacher and 5 students) make the *first* phone call to Vernier Software at precisely 6:02 a.m. in your time zone (Eastern, Central, Mountain, and Pacific only...time zones east of Eastern Time use Eastern, west of Pacific Time use Pacific). We realize this imposes a hardship on some dedicated Vernier employees (6:02 a.m. Eastern is 3:02 a.m. Pacific time!). We will have our clock set according to the National Institute of Standards and Technology in Boulder, CO. Their URL is [www.bldrdoc.gov/timefreq/javaclk.htm](http://www.bldrdoc.gov/timefreq/javaclk.htm), or telephone (303) 499-7111. The winning class in each time zone will receive a class set of student versions of Graphical Analysis, Macintosh or Windows (limit 30 per class), and a Vernier Software t-shirt for the teacher. But remember, no fair calling us early. After all, would you accept  $6.01 \times 10^{23}$  for Avogadro's Number?

Here is a great new idea from Irwin Talesnick (Queen's University, Kingston, Ontario) for demonstrating vapor pressure or pressure-temperature relationships in chemistry. We occasionally hear of the frustrations of students and teachers when some part of the rubber stopper apparatus loses pressure due to a poor seal during vapor pressure or pressure-temperature experiments in *Chemistry with Computers* or *Chemistry with CBL*. But no longer! Irwin recommends using the apparatus shown here (for vapor pressure). It uses a #5 Twist-it stopper (with two air-tight tapered valve connectors inserted into it) to ensure a perfect seal. One of the tapered valves has a 2-way valve that allows you to attach your 20-mL syringe with 2 to 3 mL of the liquid to be vaporized.

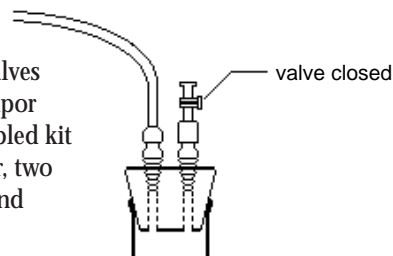


Once the system is closed and you have begun monitoring pressure, simply open the 2-way valve, squirt the liquid into the 125-mL Erlenmeyer flask and close the valve. Vapor pressure data (like that shown in the next column for methanol and ethanol) can easily be collected using any of our

interfaces and data collection programs. Gently swirl the flask. Once the system equilibrates, the flask can be placed in water baths of varying temperature to investigate the relationship between vapor pressure and temperature.

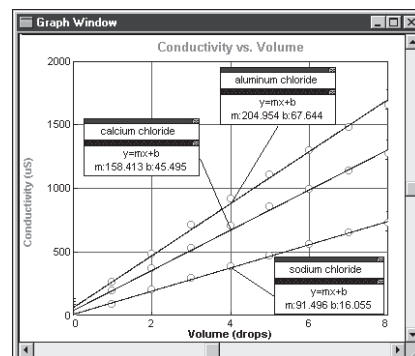


The good news is that we now carry the additional valves shown in this figure in a Vapor Pressure-PT Kit. The assembled kit includes the rubber stopper, two tapered valve connectors, and one Luer-lock connector to the rubber tubing. Note that the syringe, rubber tubing, and one of the Luer-lock connectors are currently shipped with each Pressure Sensor. If the 2-way valve is closed, as shown here, the rubber stopper assembly can also be used in pressure-temperature experiments. The order information is:



Vapor Pressure-PT Kit ..... VP-ACC ..... \$5.00

Andrea Cobb (Chantilly HS, Chantilly, VA) has added a new touch to Experiment 14 in *Chemistry with Computers* and *Chemistry with CBL* (Conductivity of Saltwater). Instead of simply adding 1.0 M NaCl one drop at a time to distilled water and monitoring the increase in conductivity, she has students repeat the procedure using 1.0 M CaCl<sub>2</sub> and 1.0 M AlCl<sub>3</sub>. This way students not only discover the relationship between conductivity and concentration, but also see the increase



in conductivity as they go from NaCl to CaCl<sub>2</sub> to AlCl<sub>3</sub>. The ratio of the slopes shown here corresponds to nearly the dissociated-ion ratio of 2 to 3 to 4 for the three compounds.

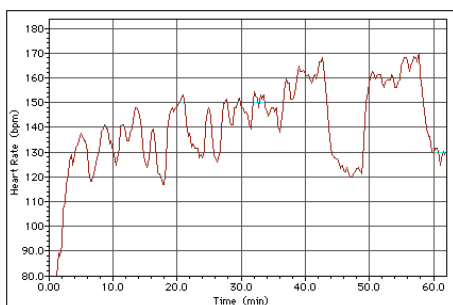


# Biology

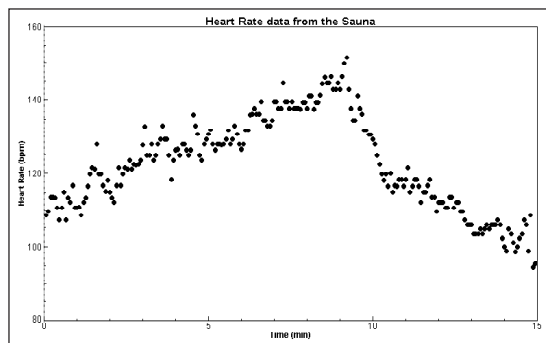
by Scott Holman

## Exercise Heart Rate Monitor

We have found that when used with the CBL, our new Exercise Heart Rate Monitor becomes a portable and effective way of monitoring heart rate in a variety of situations outside of the classroom. Below is a graph of Dave Vernier's heart rate while running. These data were collected with the Exercise Heart Rate Monitor and CBL, and then downloaded into Graphical Analysis.



Do you ever wonder what happens to your heart rate when you get hot? I decided to find out by taking an Exercise Heart Rate Monitor and CBL with me into a sauna. I spent 10 minutes sitting in the sauna while monitoring my heart rate. After 10 minutes, I left the sauna and sat on a bench to cool down. The data were then downloaded into Graphical Analysis. The graph below shows my heart rate increasing as I was subjected to the 200° F (93.33° C) environment. When I returned to an environment of 75° F (24° C), my heart rate steadily decreased.

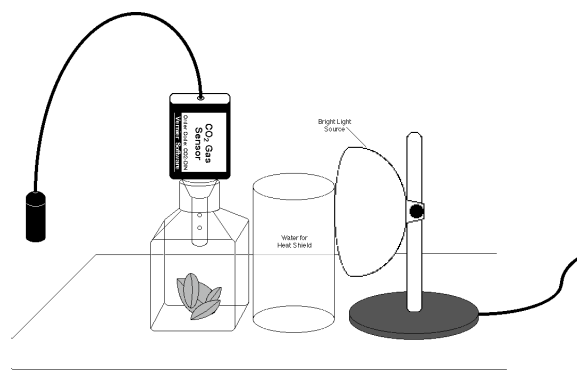


## Biology with Computers for Logger Pro

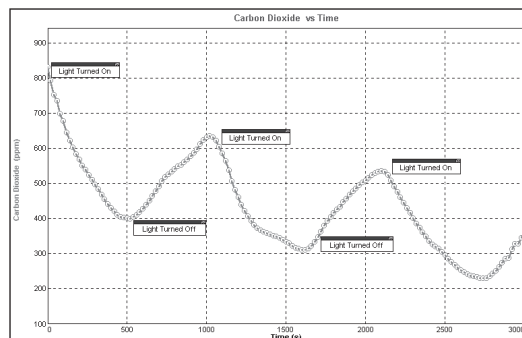
A new version of *Biology with Computers* using the new Logger Pro for Windows software (order code BWC-LPW) has just been released. It includes labs for our newer probes, such as the CO<sub>2</sub> Gas Sensor, EKG Sensor and Exercise Heart Rate Monitor. All of our lab manuals are \$35.

## Photosynthesis Happens!

Dave Masterman of Lakeside School in Seattle, Washington has found an easy way to show photosynthesis in action using our new CO<sub>2</sub> Gas Sensor. When shipped, the sensor includes a 250-mL Nalgene bottle and a slit stopper. The sensor is fitted with a slit stopper that allows a good fit in the opening of the 250-mL bottle.



To perform the experiment, place 3-5 small, freshly picked leaves from a tree or bush into the bottle. Fit the shaft of the CO<sub>2</sub> Gas Sensor into the opening of the bottle and secure with the slit stopper. Collect data at a rate of 1 point every 10 seconds for 10 minutes. Place the bottle with the sensor and leaves in front of a bright light source. Put a beaker filled with room temperature water between the bottle and the light source. The beaker will act as a heat shield. Collect data for 5 minutes with the light on. At 5 minutes, turn off the light while continuing to collect data. In the graph below, data were collected for 50 minutes. Every 8 or 9 minutes the light was turned on or off. The graph shows carbon dioxide being removed from the container when the light was turned on (photosynthesis). The graph also shows carbon dioxide being produced when the light was turned off (respiration).





# Bits & Bytes

Gene Steinruck, Bloomsburg HS, Bloomsburg, PA reports that for safety reasons his district required that all items containing mercury (including thermometers) be removed from the schools. To quote Gene: "Out came the Apple IIe computers with our Vernier Direct-Connect Temperature Probes. They worked super and my calorimetry experiments went better than with the old thermometers!"

## Data Collection Using the New eMate® Computer from Apple

Apple has a new, portable computer called the eMate. We are pleased that our Serial Box Interface and probes are being used for data collection with the eMate. A data collection package called eProbe™, which consists of eMate software, a Serial Box Interface, and Direct-Connect Temperature Probe, Light Sensor, and Voltage Probe, is marketed by Knowledge Revolution. The software was developed entirely by Knowledge Revolution. For information, contact

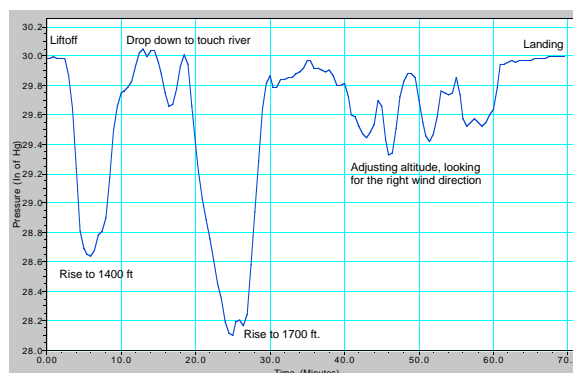
Knowledge Revolution  
66 Bovet Rd. Suite 200  
San Mateo, CA 94402  
800-766-6615  
info@krev.com  
www.krev.com/ed/eprobe

Vernier Software is a distinguished member of the BRAG (Business Recycling Awards Group) in our county for our efforts on recycling and using recycled products.

## Balloon Trip



*David and Christine Vernier had their first hot-air balloon ride this summer. They couldn't resist taking a CBL and a Barometer along to monitor the air pressure changes with altitude. Here are the results. They also monitored the air temperature, but it was not as interesting.*



## We Want Your Ideas!

We welcome all your ideas for labs and demonstrations using Vernier Software products. You may mail or e-mail your ideas to the following Vernier Software technical support people:

- Biology: sholman@vernier.com
- Chemistry: dholmquist@vernier.com
- Physics or Physical Science:  
dvernier@vernier.com or  
jhopkins@vernier.com
- CBL: rsorensen@vernier.com or  
zpartridge@vernier.com

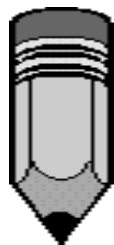
In future newsletters, we will pass on your information to our readers.

Alan Cromer, Northeastern University, has a new book entitled *Connected Knowledge: Science, Philosophy, and Education*. Dr. Cromer has been involved

with using computers for science education since the earliest days.

Chapter 7 of the book, "Of Chalk and Chips," gives his personal perspective on the ever-changing role of computers in education. He tells of purchasing Apple II+ computers with 0.048 Megabyte of RAM memory and 0.12 Megabyte floppy disk drives in 1980 for \$2000. Compare this to what you can purchase today for \$2000. He argues for a simple low-cost student computer that every eighth grader can carry in a book bag. He recognizes that, for the purpose of scientific calculations, data acquisition, and analysis, the graphics calculator is just such a machine. (Oxford University Press, 1997) ISBN 0-19-510240-1 \$25.00

For more information and direct orders: [www.oup-usa.org/docs/0195102401.html](http://www.oup-usa.org/docs/0195102401.html)



## Workshops & Contests

### Teaching Introductory Physics Using Interactive Teaching Methods & Computers

A summer institute for college/university and high school physics faculty will be held June 21- July 3, 1998 at the University of Oregon, Eugene, Oregon. Instructors are Priscilla Laws, David Sokoloff, Ronald Thornton, Pat Cooney, Maxine Willis and John Garrett.

This institute is designed for those interested in making major changes in introductory physics courses through new teaching strategies based on research in physics education and cognition. Strategies include the comprehensive use of Macintosh and MS Windows tools in introductory physics (microcomputer and calculator-based laboratory tools—MBL and CBL, spreadsheet and graphical analysis, mathematical modeling and visualization, digital video analysis, and interactive simulations).

Thirty college/university and 30 high school participants will be selected. The deadline for applications is March 18. For more information or to obtain an application, contact Gail Oliver, Department of Physics and Astronomy, Dickinson College, Box 1773, Carlisle, PA 17013. Phone (717) 245-1845, Fax (717) 245-1642, [oliver@dickinson.edu](mailto:oliver@dickinson.edu).

### Chautauqua Short Courses: Promoting Active Learning in Introductory Physics Courses

When: May 28-30, Dickinson College, Carlisle, Pennsylvania.  
June 11-13, Kapi'olani Community College, Honolulu, Hawaii.

Instructors: Priscilla Laws, David Sokoloff, and Ronald Thornton

These NSF-sponsored Chautauqua courses are designed for those interested in making major changes in introductory physics courses or in other introductory science courses. The focus will be on giving participants direct experience with methods for promoting active student involvement in the learning process.

Open to teachers of undergraduate students in institutions of higher education in the U.S. High school teachers and faculty from outside the U.S. are also admitted if space is available. There is a small application fee, but no tuition. For more information contact David Sokoloff, Department of Physics, 1274 University of Oregon, Eugene, OR 97403-1274, Phone (541) 346-4755, Fax (541) 346-5861, [sokoloff@oregon.uoregon.edu](mailto:sokoloff@oregon.uoregon.edu).

### Project PHYSLab '98

Project PHYSLab will again be held at three sites next summer: Portland, OR; Omaha, NE; and Palo Alto, CA. Last summer's workshops were very popular and successful. These are 3-week workshops involving computer interfacing, spreadsheets, physics software, internet instruction, and low-cost physics equipment. Lodging, food, travel allowance, and a stipend are provided. Graduate credit can be arranged. Project PHYSLab is funded by the NSF, M.J. Murdock Charitable Trust, Tektronix Foundation, and The Catlin Gabel School. Contact Lowell G. Herr, The Catlin Gabel School, 8825 SW Barnes Rd., Portland, OR 97225, [lherr@physlab.catlin.edu](mailto:lherr@physlab.catlin.edu), <http://physlab.catlin.edu>.

### Contests

Here are three contests you may want to consider:

- Duracell/NSTA Scholarship Competition (students design battery-powered device); deadline January 14, 1998; call 888-255-4242.
- ExporaVision Awards (students envision how present technologies could be used 20 years in the future); deadline February 3, 1998; call 800-EXPLOR-9.
- Tapestry (teachers apply for \$10,000 grants); call 800-807-9852.

We had a successful series of one-day workshops this summer here at Vernier Software in Portland, Oregon. On separate days, these hands-on workshops covered CBL, Macintosh, and Windows data collection in the laboratory. We had 115 participants from as far away as Florida. We plan to run a similar series of workshops next summer. Watch for details in our Spring 1998 newsletter, or on our web page at [www.vernier.com](http://www.vernier.com). The workshops are essentially free. (There is a small fee, but you get a gift certificate of equal value, which you can use on your next purchase.)

Vernier Software again sponsored the AAPT Physics Photo Contest. The winning pictures are displayed on the web site [www.aapt.org/aaptgeneral/competitions.html](http://www.aapt.org/aaptgeneral/competitions.html). One of the winners is displayed below. Students are required to write a paragraph explaining the physics illustrated in the photo. Encourage your students to enter next summer's contest. Contact Ann Brandon, Joliet West HS, 401 N. Larkin Ave, IL 60435 for more details.



Photo by Carol Morse  
Ponderosa HS, Parker, CO  
Teacher: Margaret Brinker  
Title: Teeter-Totter/Merry-Go-Round



# CBL News

by Rick Sorensen

## Vernier Software and Texas Instruments Form Alliance

We are very excited about a new partnership between Texas Instruments and Vernier Software to develop and market new data-collection products. This alliance has produced three products so far: a CO<sub>2</sub> Gas Sensor, the Calculator-Based Ranger™ (CBL™), and the new Vernier Motion Detector. Watch for new products from this alliance.

### Calculator-Based Ranger (CBL)

If you teach math, physical science or physics, and don't have a CBL, you may want to consider the new CBL—the least expensive and easiest way to collect motion data in your classroom (order code CBR, \$95). The CBL is unique because it collects distance, velocity, and acceleration data while connected directly to a TI graphing calculator, so you don't need the CBL. Equally important is that the CBL contains built-in programs. You send programs directly from the CBL to the calculator, so you don't need a TI-GRAPH LINK. Other important features include the following:



- The CBL is built with a pivoting head, making it easy to set up experiments.
- It comes with a versatile, detachable clamp.
- A manual trigger button lets you collect data on demand or while detached from the calculator.
- Students can repeat data collection quickly by pressing just one button.
- It works with TI-82, TI-83, TI-85, TI-86, and TI-92 calculators.
- The CBL can also be connected to a CBL (extra cable required).
- The built-in program supports popular activities, such as Distance Match

### CBL Workbooks

The CBL comes with an introductory workbook of five activities. Two additional workbooks are available:

*Math and Science in Motion: Activities for the Middle School* (TI-MCBL, \$14)

This book by Chris Brueningsen, Elisa Brueningsen, and Bill Bower contains twelve activities for the TI-82 or TI-83 with the CBL. Students explore graphs of distance vs. time as they move

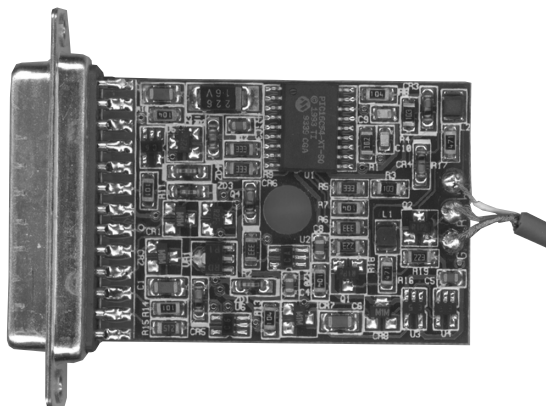
toward and away from the CBL. Students also study bouncing objects, acceleration due to gravity, and pendulum motion.

*Modeling Motion: High School Math Activities with the CBL* (TI-HCBL, \$14)

This book by Linda Antinone, Sam Gough, and Jill Gough contains fifteen activities using the CBL with the TI-82 or TI-83. Activities in algebra, pre-calculus, and physics include linear, quadratic, and exponential regression and projectile motion.

### TI-GRAPH LINK Cable

If you are collecting and analyzing data with the CBL and a TI graphing calculator, you know how important it is to have a TI-GRAPH LINK. The GRAPH LINK is the easiest way to get programs onto the calculator and to get data into the computer. When first starting with CBL, most teachers buy at least one GRAPH LINK. But when it is time to buy another cable or a replacement, we get several questions, such as: "Why does it cost so much (\$55)?" "Can I find a cheap, replacement cable at an electronics store?" "Can I build my own cable?" Let's start with the last two questions. No, Radio Shack doesn't have a replacement. The problem is that the GRAPH LINK is not just a cable, like the cable connecting a VCR and TV. It's actually a "protocol converter"; that is, it's like a modem. It allows the calculator and computer to talk. No, don't try to build one. It's more complex than you would think. When you look at the cable, you'll see a small, flat, rectangular box near the computer end of the cable. This housing contains a circuit board with 54 components. Be forewarned that a homemade cable may burn up your calculator or even damage your computer. Also, the calculator warrantee is void if damaged by a homemade cable. Considering that you are getting a reliable, simple, and safe connection to the computer, the GRAPH LINK is worth the investment.



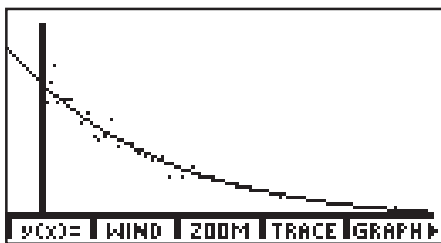
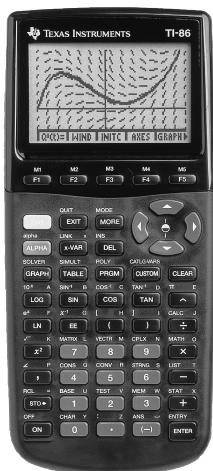
*The insides of a TI-GRAPH LINK cable.*



**NEW** TI-86

The newest addition to the line of CBL-compatible calculators is the TI-86. This calculator has all the functions of a TI-85, but it has been enhanced to make it more versatile and easier to use. Like the TI-85, this calculator was designed primarily for college math, science, and engineering, but it will work well in upper-level high school science and math courses. We like it because it has more than three times the memory of the TI-85. You can store all of our CBL programs on one calculator and have plenty of room to collect data. In addition, data are now displayed in a list editor, like the TI-82 and TI-83. The Trace feature makes it easy to read data directly from a graph.

TI-86 calculator ..... TI-86 ..... \$115

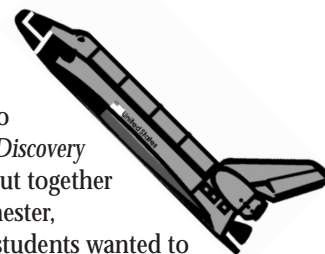


*Radioactive Decay Collected with a TI-86  
(count rate vs. time)*

**Graphical Analysis with TI-92 and TI-86**

It has taken us a while, but now you can import data from TI-92 calculators into our Graphical Analysis programs (Macintosh or Windows). This feature supports importing lists and data set variables from the TI-92. If you have the new TI-86, you'll also be able to import into these two programs. Graphical Analysis for Macintosh 2.0 and Graphical Analysis for Windows now support importing data from TI-82 through TI-92 calculators. Contact us about an upgrade.

**CBL in Space**



A TI-92 and CBL blasted off into space aboard the space shuttle *Discovery* in August with an experiment put together by students at Mayo HS in Rochester, Minnesota. In the experiment, students wanted to see how weightlessness would affect the growth of fava beans. The TI-92 and CBL came into play very early in the experiment when they had to power up and water the beans to start the growing process after the space shuttle passed 50,000 feet. After that, the CBL recorded temperatures in three areas of the container to verify that the heaters worked properly. The heaters were needed to keep the beans around 55° F, where they grow the best.

Everything worked perfectly. The CBL turned on and ran, the valves all opened to water the beans, and the heaters and thermostats all worked to keep the beans warm. The TI-92 retained the temperature recordings until the container made it back to the high school and the data could be downloaded into the computer. At press time, we have not yet seen the final biological results. You might watch for information on the TI web page at [www.ti.com/calc/docs/beans.htm](http://www.ti.com/calc/docs/beans.htm).

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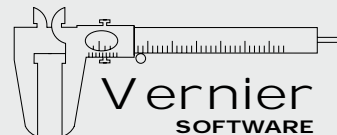
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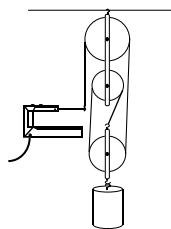
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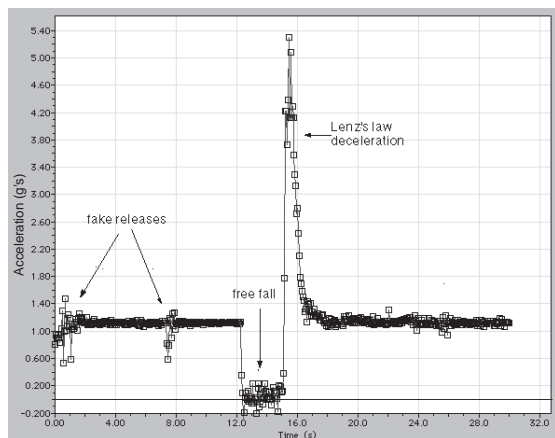
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# Physics

## The Drop Zone

Trips to the amusement park have become very popular for physics classes. CBL has helped make this happen. My favorite ride, from a physics point of view, is the Drop Zone at Great America in Santa Clara, CA. The ride is a free fall of 39.3 m (129 ft), and then during the final 23.8 m of descent, Lenz's law eddy currents are used to slow the chairs to a stop. There are powerful permanent magnets built into the chairs and aluminum fins near where the chairs move. Here is a graph of the vertical acceleration on the ride. One interesting thing is that before the fall, the ride gives the rider two fake releases. Note that these also show up on the graph. Thanks to Clarence Bakken, Gunn HS, Palo Alto, CA for providing this data.



## Using Two Photogates with the CBL

When we developed the new, low-cost Vernier Photogate (VPG-DG, \$39), we made one mistake: it did not work properly when used with a CBL and a two-photogate adapter (CBL-2P). We have revised the CBL-2P adapter so that it now works with the new photogate. If you received CBL-2P adapters *before this summer* and if you use our new photogates, we will revise your adapters so they work properly at no charge.

There is an excellent introduction to Interactive Lecture Demonstrations using MBL by David R. Sokoloff and Ron Thornton in the September 1997 issue of *The Physics Teacher*. We are now distributing David and Ron's Mechanics Interactive Lecture Demonstrations package. Macintosh and IBM versions are available (ILD-MAC or ILD-IBM, \$18).

The September 1996 issue of *The Physics Teacher* had several articles discussing our products:

If you have ever wondered about the polarization of helium-neon lasers and how it changes, check out the article by Edwin R. Jones (University of South Carolina). He had his students do an elaborate study of the polarization using our ULI. The polarization changes in interesting ways that students would not expect.

There also was a note on measuring temperature coefficients of resistors by Paul D. Schulze (Abilene Christian University).

Recently, *Analog Devices* asked us to write an article on our use of accelerometers in their newsletter for engineers. The article gives a brief summary of how we have introduced accelerometers into teaching and includes a lot of sample graphs. Let us know if you would like a copy.

## Science Humor

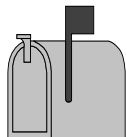


"You cannot be Sirius!" said the astronomer who pointed his telescope in the wrong direction. From the British Physics Journal, *Physics Education*, July 1996.

There were two students who were taking chemistry and who were doing pretty well. In fact, going into the final they had solid A's. These two friends were so confident that the weekend before finals week (even though the Chem final was on Monday), they decided to go away skiing with some friends. They had a great time; in fact, such a good time that they didn't make it back to campus until Monday afternoon. They went to the chemistry professor and explained to him why they missed the final. They told him that they went away for the weekend and had planned to come back in time to study, but that they had a flat tire on the way back. They said that they didn't have a spare and couldn't get help for a long time and so were late getting back to campus. The professor thought this over and then agreed that they could make up the final on the following day. The two were elated and relieved. They studied that night and went in the next day at the appointed time. The professor placed them in separate rooms and handed each of them a test booklet and told them to begin. They looked at the first problem, which was something simple about molarity and solutions and was worth 5 points. "Cool" they thought, "This is going to be easy." They did that problem and then turned the page. They were unprepared, however, for what they saw on the next page. It read:

(95 points) Which tire?

## RENEW AND WIN!!!



It has been three years since we asked you to "renew" your free newsletter subscription. This form should be folded, taped, stamped, and sent back to us. On November 1, we will draw 10 names from the renewals. Those ten people will win a valuable **Vernier Software t-shirt**. (You are eligible to win even if you ask to have your name taken off our mailing list!)

- |  |  |
|--|--|
| <input type="checkbox"/> <b>Yes</b> , I want to stay on your mailing list. Make sure your name and address on your mailing label (on the back of this page) are correct. If there is no mailing label, please write the information below. | <input type="checkbox"/> Please send me your latest catalog.                                       |
| <input type="checkbox"/> Please remove my name from your mailing list.   | <input type="checkbox"/> Please send me more information on the Calculator-Based Laboratory (CBL). |
|  | <input type="checkbox"/> Please add the following name to your mailing list.                       |

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### Vernier Software

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We are very interested in hearing about how you use computers or graphing calculators in your classes. Your plans affect our plans. Please answer the following:

The type(s) of computers that I use most of the time in my classes are:

- Macintosh    Windows    MS-DOS    Apple II    Other (specify) \_\_\_\_\_

Do you use or plan to use either of the following:

- CBL    eMate

What subjects do you teach?

- Chemistry    Physics    Biology/Life Sciences    Earth Science    Math    Other (specify) \_\_\_\_\_

Would you be interested in conducting Vernier Software training sessions in your area?

- Yes    No

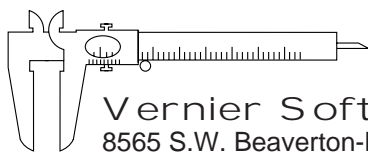
Your comments, questions, jokes are welcome below:



# UPCOMING EVENTS

We will be exhibiting at all of the following conferences. If you attend, stop by and say hello.

New Jersey Science Teachers Convention .....	Somerset, NJ .....	October 7-8
National Association of Biology Teachers National Convention .....	Minneapolis, MN .....	October 8-11
Oregon Science Teachers Association Conference .....	Redmond, OR .....	October 10
Vernier Evaluation Workshop .....	Uniondale, NY .....	October 16
Science Teachers Association of Texas (CAST) .....	Fort Worth, TX .....	October 16-18
Iowa Science Teachers Conference .....	Des Moines, IA .....	October 23
Washington Science Teachers Association Conference .....	Bellevue, WA .....	October 26
NSTA Eastern Area Convention .....	Pittsburgh, PA .....	Oct. 30-Nov. 1
Vernier Evaluation Workshop .....	Schaumburg, IL .....	November 3
Massachusetts Association of Science Teachers .....	Worcester, MA .....	November 5-7
National Council of Teachers of Math Regional Conference .....	Cleveland, OH .....	November 6-8
Kentucky Science Teachers Association .....	Lexington, KY .....	November 6-8
Kansas Math and Science Teachers .....	Wichita, KS .....	November 7
Vernier Evaluation Workshop .....	Tampa, FL .....	November 10
North Carolina Science Teachers Association Conference .....	Greensboro, NC .....	November 12-14
School Science and Math Conference .....	Milwaukee, WI .....	November 13-15
Virginia Association of Science Teachers .....	Virginia Beach, VA .....	November 14-15
NSTA Western Area Convention .....	Denver, CO .....	November 20-22
NSTA Southern Area Convention .....	Nashville, TN .....	December 4-6
AAAPT National Convention .....	New Orleans, LA .....	January 5-7



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