



A Publication
for
Users of
Vernier Software
Products

The Caliper

Volume 16 Number 1

Spring 1999



It's Here! *Water Quality with CBL*™

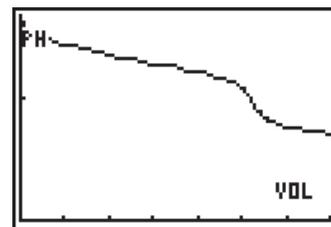


by Robyn L. Johnson, Scott Holman, & Dan D. Holmquist

We are pleased to announce the latest addition to our series of popular CBL lab manuals, *Water Quality with CBL* (order code WQCBL, \$35). This 250-page manual (and accompanying CD) is a complete solution for using the Texas Instruments CBL System and Vernier sensors to determine the water quality of streams, lakes, and seawater. The manual provides students and teachers with easy-to-follow directions for a wide variety of water tests. A comprehensive student introduction is included with each test, so students know why they are making a measurement, and what kind of results to expect. A Data & Calculations sheet is included for each test, on which data for stream sites are recorded and calculations performed.

This manual includes all nine of the tests that are commonly included in the Water Quality Index, or WQI. We did so because many schools and organizations like to use the WQI to obtain a value that reflects their stream's quality. The WQI tests (along with the Vernier sensor that is used) include

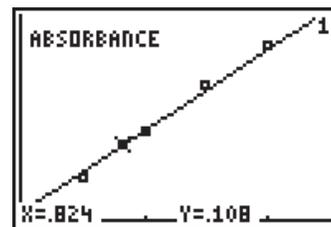
- Temperature Temperature Probe
- pH pH System
- Turbidity Turbidity Sensor (Fall '99)
- Total Solids by evaporation
- Dissolved Oxygen Dissolved Oxygen Probe
- BOD Dissolved Oxygen Probe
- Phosphates, Ortho- and Total Colorimeter
- Fecal Coliform standard fecal coliform test
- Nitrate Nitrate ISE or Colorimeter



Finding Alkalinity of a Sample

In addition, we include a large number of other important water tests:

- Ammonium Nitrogen Ammonium ISE
- Alkalinity pH System
- Total Dissolved Solids Conductivity Probe
- Calcium and Calcium Water Hardness Calcium ISE
- Total Water Hardness EDTA Titration
- Chloride and Salinity Chloride ISE or Conductivity Probe
- Flow Rate Flow Rate Sensor



Finding Phosphate Concentration

Here are some other important features that will make water-quality testing easier than ever for your students!

- **Advanced Information for Instructors or Student Research.** Teachers or students can find in-depth background information about the specie being measured, as well as helpful hints for performing

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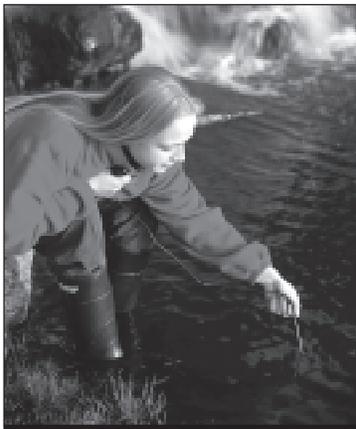
HUMOR

UPCOMING EVENTS

(continued from page 1)

tests, collecting samples, or preparing standard solutions. In the appendix, you will find directions for downloading data onto your computer, analyzing data in our Graphical Analysis program, and running the all-purpose CHEMBIO data collection program.

- **A Complete Resource Manual.** Whether you are testing freshwater or saltwater, lakes or streams, you will find the information you need. We include details for locating or purchasing a wide variety of resource texts, internet web sites, and water-quality organizations. Many of these organizations have web sites where students can contribute and compare the results they obtain with students in other regions of the country.



- **CD Included with Word-Processing Files and Programs.** Our CD contains the word-processing files for each of the tests in the manual (in Macintosh® Word and Word for Windows® format). We have included these files because we know that teachers like to design laboratory methods according to their own teaching style. A free copy of the CHEMBIO program and the popular Vernier resource manual, *CBL Made Easy*, are also on the CD.
- **GPS Methods Provided.** Many schools are now using a GPS (Global Positioning System) and GIS data to help identify and track changes in local and regional watersheds. We include information for using this valuable tool.
- **Extensive USGS Appendix.** U.S. Geological Survey data are documented in our appendix, so your students will be able to compare their results with those found in other parts of the United States. In addition, we provide directions for locating and interpreting USGS data on the internet.

The CBL System and Vernier sensors have greatly improved the ease of use and accuracy of water-quality measurements. Visit our web site to examine our line of water-quality products or to download sample tests from *Water Quality with CBL*.

Coming Soon: Our *Water Quality with Computers* (Macintosh or IBM) lab manual will be available in late summer.



Logger Pro™ for iMac and New G3 Macs

Apple has produced several new computers that do not have serial ports. This has led to many questions about using our products with these new computers. After a lot of testing and revising, here is the report.

Logger Pro works fine with these new computers when used with either the ULI or the Serial Box Interface, but you need to use a USB-to-serial adapter and new versions of our software and Apple's operating system, specifically:

- MacOS 8.5 or newer
- Logger Pro version 1.1 (available now on CD-ROM or disk)
- a Keyspan USB Serial Adapter

Other adapters can probably be used, but we have not tested them. The Keyspan adapter is available from most mail order Macintosh product catalogs or from Keyspan directly at (510) 222-0131, info@keyspan.com, or www.keyspan.com.

If you are using our other software, such as MacMotion, Data Logger or Graphical Analysis, you will be able to use the Keyspan adapter as well. We had success when we connected the interface to Port 1 of the Keyspan adapter and selected the printer port setting in the software.

If you currently own Logger Pro and would like this new version of Logger Pro, you are entitled to a free upgrade. Please indicate "free iMac upgrade" when ordering. Keep in mind that Data Logger is not the same as Logger Pro. If you own Data Logger or MacMotion, you need to purchase Logger Pro (order code LP-MAC or LP-WIN, \$59).



New Version of Logger Pro

Logger Pro version 1.1 for Mac and Windows was recently released. This is our first version available on CD-ROM. In fact, from now on, we will send a CD-ROM version for all Logger Pro orders unless you specify that you want a disk version. If you have already purchased Logger Pro and want a free upgrade, check out "Free Stuff" on our web site or contact our office.

The Caliper is published semiannually by Vernier Software. It is distributed free of charge to Vernier Software customers.

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Flow Rate Sensor



Vernier Software is proud to announce our new Flow Rate Sensor for computers (order code FLO-DIN, \$128) or CBL (order code FLO-CBL, \$129). This is the ideal device for measuring flow in your local stream or creek. The sensor consists of a collapsible rod with an impeller connected to its base. Three riser rods are included to allow easy placement of the sensor at different depths. Each sensor comes equipped with a 5-meter cable to allow use in a stream while maintaining a safe distance between the water and your computer or CBL.

Vernier Software and Wisconsin Fast Plants

If you attended the NSTA National Convention in Boston, MA, you may have noticed the plant light house in our booth that contained Wisconsin Fast Plants. This is the beginning of a collaboration between the Wisconsin Fast Plants program and Vernier Software. Dr. Paul Williams of the Wisconsin Fast Plants program feels that Vernier sensors and Fast Plants are a perfect combination for studying plant development. The Vernier CO₂ Gas Sensor, Light Sensor, and Direct-Connect Temperature Probe are ideally suited for monitoring the Wisconsin Fast Plants in a self-contained environment. This is a great setup to demonstrate both photosynthesis and cellular respiration in action without destroying the plants being studied. The Wisconsin Fast Plants program can be reached at fastplants@calshp.cals.wisc.edu or at fastplants.cals.wisc.edu.



Free Stuff at www.vernier.com

On our web site there is a “Free Stuff” section that has all kinds of goodies for people who use our equipment:

- Demo versions of *Logger Pro* and Graphical Analysis.
- Sample labs from all of our books.
- Data collection programs for TI calculators.
- Technical specifications for our sensors.
- *Logger Pro* updates. Every time we release a new version of *Logger Pro*, anyone who has purchased an older version can upgrade from our web site for free.
- New product announcements.
- Experiment files for new products. When we release new products, we post any needed files to use with the new equipment.
- The latest information on all of our workshops and conferences.
- Past issues of this newsletter. We’ve been at this for over 18 years. Maybe you missed some of our lab ideas from the past!
- Tips on how to use our older MS-DOS programs on Windows computers.

All of this, and more, is available at our web site.

15 Years Ago in This Newsletter . . .

We started this newsletter 15 years ago using an Apple® II computer. It was printed on a modified IBM® Selectric typewriter that could be controlled by the Apple II. We announced our newest programs, Frequency Meter for the Apple II and Precision Timer for the Commodore 64. We also announced our first “hardware” products—our Photogate and Microphone Parts Kits. It was quite a few years before we started selling assembled sensors.

10 Years Ago in This Newsletter . . .

We announced a new MS-DOS version of our Frequency Meter program and a new version of our popular Precision Timer III program for the Apple II. We discussed using pocket telephone dialers as sound sources and analyzing the frequencies of the two tones produced. Much later, we included this idea as a lab in our *Physics with Computers* book.

Logger Pro for MPLI

We have been working on a new version of *Logger Pro* that works with our MultiPurpose Lab Interface (MPLI). If you would like to test a beta version or if you are interested in using *Logger Pro* with your MPLI, visit www.vernier.com/mpli.



CBL News

by Rick Sorensen

TI-83 Plus Calculator

After its introduction in 1993, the TI-82 quickly became the calculator of choice for science and math students. Three years later, Texas Instruments upgraded the TI-82 by introducing the TI-83, which has become their most popular graphing calculator. It has been another three years, and TI has now upgraded the TI-83. They have introduced the TI-83 Plus, and this calculator might be the last one you need for quite a few years.



The TI-83 Plus is basically a supercharged TI-83. It includes all the capabilities of the TI-83 and can be used side by side with the TI-83. The most exciting improvement is the addition of Flash ROM technology. Flash ROM provides many valuable improvements, including:

- **The TI-83 Plus is electronically upgradeable.** If you bought a TI-82 in 1993, you could never take advantage of calculator software maintenance updates that were included on newer calculators. If you wanted new features, like sine regression on the TI-83, you bought a new calculator. That has changed with Flash ROM. Now when TI makes a maintenance update to the calculator software, you can download the update from the TI web site and use TI-GRAPH LINK™ to load it onto your calculator. If TI makes a major revision to the calculator software, you can purchase the new version from the TI web site, and you won't have to buy a new calculator.
- **TI-83 Plus has six times more user memory than the TI-83.** This includes 24K of RAM, but it also includes 160K of data archive memory used to store data, programs, and additional applications. The extra memory makes it easier to collect and analyze data with calculators. For example, if the calculator RAM is full of educational games gathered from the Internet, the programs can be archived, i.e., moved to Flash ROM. The RAM is now free for CBL data.
- **The data archive can be used to store and execute calculator software applications.** Applications are different from programs that you probably used in the past. Applications load into Flash, while programs load into RAM. For example, we have worked with TI to convert our CHEMBIO and PHYSICS programs to applications. Using TI-GRAPH LINK, you will be able to load both of these applications into Flash ROM. (You can have up to 10 applications loaded into Flash ROM.) You then press the APPS button on the

calculator and choose an application. The calculator loads the appropriate part of the program from Flash into RAM and runs the subprogram. This process leaves RAM for data. For more information about the CHEMBIO and PHYSICS applications, check the CBL Programs page of our web site, www.vernier.com/cbl/progs.html. Another example of an application is a powerful periodic table developed by TI. If you are interested in this product or other TI-83 Plus applications, visit www.ti.com/calc/flash/83papps.htm.

- **The Flash ROM allows you to store data runs, since the TI-83 Plus has a Group option.** This feature groups data lists into one file, and the file will be automatically stored in the data archive. Later you can Ungroup the file, which will move the data into RAM.

The TI-83 Plus is now available from Vernier Software (order code TI-83PL, \$98).

TI-92 Plus Calculator

Flash ROM is coming to another calculator—the TI-92. The TI-92 Plus replaces the TI-92. The TI-92 Plus will have 500K of memory, including 188K of RAM and 384K of Flash ROM. The Flash



ROM can be used to store data, programs, and applications. The TI-92 Plus also has an enhanced anti-glare, black-on-gray screen. The TI-92 Plus will contain the Advanced Mathematics Software that is already available on the TI-89 or TI-92 Plus Module. All this is in a package that will sell for the same price as the TI-92, \$175, and will be available in early June. The order code is TI-92PL.

Graphical Analysis Update

We have modified our Graphical Analysis programs to import data from the new TI-83 Plus calculator. Check our web site or contact us for details on upgrading either your Windows or Macintosh version of Graphical Analysis.

Changes to TI Product Line

Effective May 1, we will be lowering prices of two calculators. The TI-82 will sell for \$78, while the TI-86 will sell for \$109.

The contents of the TI-73, TI-82, and TI-83 calculator Teacher Packs is changing. The Teacher Packs used to include rechargeable alkaline batteries and a recharger station. In talking with teachers, TI learned that most teachers use the rechargeable batteries once and then throw them away. From now on, the Teacher Packs will be shipped with standard alkaline batteries, which have a longer life than rechargeable alkalines. A battery recharger will not be included.



Digital Control Unit

Our new Digital Control Unit (DCU) has already led to a lot of creative projects! We recently created an automatic titrator and a mass driver using cow magnets and electromagnets.

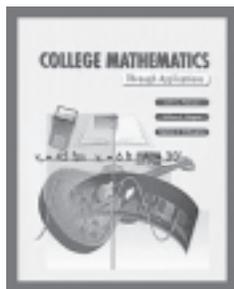
Scott Ausbrooks (Harmony Grove HS, Benton, Arkansas) came up with a clever way to use the DCU to build the classic Monkey Gun physics demonstration. He developed this demo as part of the Arkansas Physics Lending Library Program. A photogate is placed at the end of the barrel of the gun and connected to the CBL. A Digital Control Unit (order code DCU-CBL, \$59) is connected to the same CBL and it powers an electromagnet that holds up the metal-can target. When the photogate is blocked, the DCU cuts the power to the electromagnet. A custom program is available for this demo. It is on our web site at www.vernier.com/cbl/dcu.html.

By the way, we are planning to have a Digital Control Unit project contest this fall. It will involve building interesting projects controlled by a DCU, a CBL, and a calculator. Details will be in our fall newsletter. If you like to have your students do projects, keep this contest in mind.

College Mathematics through Applications

by John C. Peterson, William J. Wagner, Stephen S. Willoughby

If you teach advanced mathematics at the high school or college level, you might be interested in this new textbook. Designed for technical mathematics and precalculus students, this book covers advanced algebra, trigonometry, geometry, and intuitive calculus. The authors make extensive use of the TI-83 calculator enabling students to concentrate on problem-solving skills. The mathematical concepts are put into focus through a "chapter project," presented at the beginning of each chapter. The CBL and sensors are often used to develop solutions to these projects. For information on the text, contact Delmar Publishers at 800-347-7707 or visit their web site, www.cmta.delmar.com.

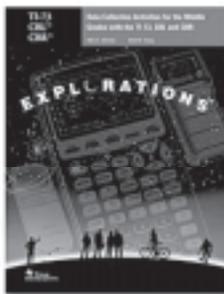


Solar Power for the CBL

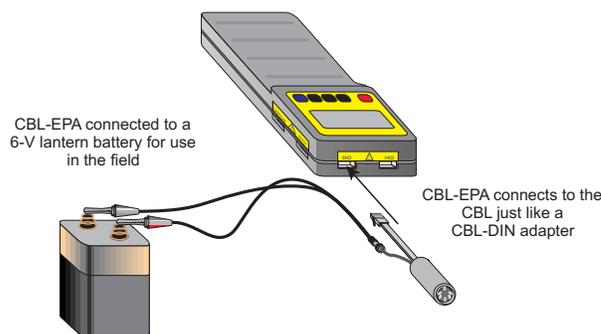
Patrick Technologies Inc., Lisle, Illinois, manufactures a variety of photovoltaic panels. In addition, the company produces a battery pack that can be recharged with their solar panels. Their SolarVerter® F9150 and U9600 panels or rechargeable battery can be used to power the CBL. The solar panels cost between \$45 and \$110, and the battery pack sells for about \$50. You can get information on their products by calling (888) 858-2801 or visiting their web site, www.solarverter.com.

Data Collection Activities for Middle Grades with the TI-73, CBL, and CBR

by Ellen C. Johnson and David A. Young



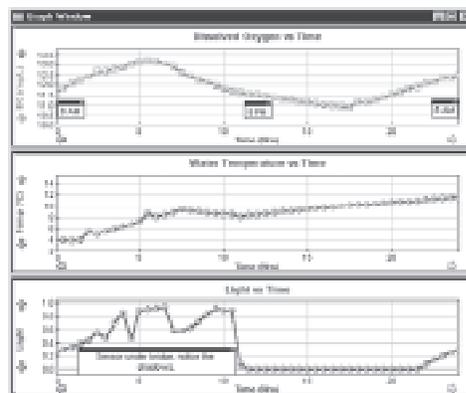
This book is an excellent source of activities to introduce middle school students to data collection technology. The book contains twelve activities that integrate mathematics and science, with an emphasis on data collection and analysis. Each activity presents a problem relevant to the student's everyday experience. Step-by-step instructions take the students through data collection and analysis. Black line masters for student handouts and an extensive set of teacher notes are included. This book is available for \$20 (order code TI-DCA).

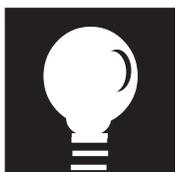


Long-Term Data Collection with the CBL

Long-term, remote data collection with the CBL and water quality sensors has been a challenge in the past. Power management features of the CBL made it difficult to maintain power to sensors such as the pH System and Dissolved Oxygen Probe throughout data collection. The solution is our new External Power Adapter for data collection with the CBL (order code CBL-EPA, \$15). When connected to a 6-V lantern battery, the External Power Adapter provides constant power to the sensor. If you are performing long-term experiments in the lab, the External Power Adapter can also connect to a TI-9201 AC adapter, instead of the 6-V lantern battery.

Dissolved oxygen, water temperature, and light intensity data collected in the field for a 24-hour period using a CBL and TI-83 graphing calculator.

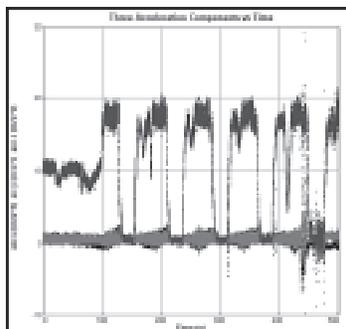




Innovative Uses

Accelerometers on the Vomit Comet

The March 30 issue of *USA Today* featured a story on students of Jim Jordon and George Irwin (Lamar University) flying on the KC-135, known as the "Vomit Comet." This plane flies in a pattern of 40 flight parabolas to produce periods of "weightlessness." It is used to train astronauts and was used for filming *Apollo 13* capsule scenes. The students took along our 3-Axis Accelerometer, a ULI, and a laptop computer to take the data shown here.



The accelerometers that were oriented roughly horizontally show mostly vibrations. The accelerometer that was oriented more or less vertically is the most interesting. For the first 100 seconds, the plane is traveling horizontally at a steady speed. The accelerometer reads approximately 9.8 m/s^2 (1 g). The plane then applies power and climbs, causing an acceleration reading of up to 1.8 g for a few seconds. The engines are then cut and the plane goes into a near free fall for about 25 seconds. The acceleration reading goes to near zero. Notice that the vibration is reduced on all three accelerometers during this period, because the engines are not working as hard. This pattern is repeated several times on this graph. The Lamar students' experiment was designed to simulate the tethered launch of a satellite in zero gravity and to measure the acceleration of the satellite. This is all part of a continuing project that will hopefully lead to the use of our accelerometers on a satellite in the year 2001.

Two recent articles in *Mathematics Teacher* describe the use of the CBL and sensors for classroom data collection and analysis activities. In the December, 1998, issue Brian A. Keller wrote an article called "Shedding Light on a Subject." He uses the CBL and TI light probe to develop Beer-Lambert's law for light absorbance as a function of depth in a liquid. Maria L. Fernandez published "Making Music with Mathematics" in the February, 1999 issue. She describes an activity in which students blow across pop bottles filled with water to generate musical tones. The students use the CBL and our CBL Microphone to collect and analyze waveforms. Each of these articles contains a full description of the activity, including student handouts.

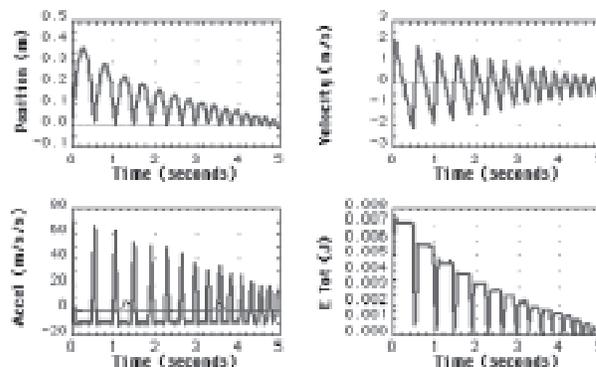


Richard Taylor, Hockaday School, Dallas, TX, wrote an article called "The TI-89 at Six Flags Over Texas" in the Winter, 1999 issue of the *Eightysomething!* newsletter. He describes the use of the TI-89, CBL, Low-g

Accelerometer, and our Graphical Analysis software at an amusement park. If you plan to collect CBL data at an amusement park, you may want to download a copy of this newsletter at www.ti.com/calc/docs/80xthing.htm. Also you can electronically subscribe to *Eightysomething!* at the same web page or send e-mail to ti-cares@ti.com.

We get lots of questions about taking data at amusement parks. Experiment 22: "Accelerations in the Real World" in our new *Physics with CBL* lab manual provides information on using the CBL at amusement parks. You should also check out www.physicsday.org. This is a site set up by Clarence Bakken of Gunn HS (Palo Alto, CA), who has been doing Physics Day at Great America for about a decade.

Barbara Pecori (Bologna University) and Giacomo Torzo (Padova University) wrote the article "The Maxwell Wheel Investigated with MBL" for the September, 1998 issue of *The Physics Teacher*. A Maxwell wheel is similar to a yo-yo. The authors used our ULI and a Motion Detector to study the motion and the complex energy changes of the wheel or a yo-yo. They conclude the article with a study of the bounces of a ping-pong ball. The graph is a classic and we could not resist including it here.



Physics with Computers Gets a Rave Review

We were pleased to see the very favorable review of our *Physics with Computers* book in the January, 1999 issue of *The Physics Teacher*. The reviewer liked that we use ten different sensors, provide lots of teacher tips and suggestions, and "encourage students to think about what they are going to do by estimating or first doing the experiment qualitatively." He also appreciated that we provide the word processing files of the lab handouts, so teachers can edit them.



Bits & Bytes

Workshops

This summer, there are more workshops featuring Vernier products than ever before. Take advantage of these opportunities for hands-on training and interaction with other teachers utilizing technology in their science classrooms. Check our web site or contact the workshop organizer for more information about these workshops.

Vernier Workshops in Portland, Oregon

In July, we will be offering five one-day workshops at Vernier Software. Participants will receive eight hours of intensive, hands-on experience in computer or CBL data collection. Combine this great learning experience with a trip to the beautiful Pacific Northwest!

- Monday, July 19 - CBL
- Tuesday, July 20 - Computer
- Wednesday, July 21 - CBL
- Thursday, July 22 - Computer
- Friday, July 23 - CBL

For more information, check our web site or e-mail us at workshop@vernier.com.

Vernier Workshops in Fairfax, VA

July 27-29 in Fairfax, VA (near Washington, D.C.) Participants will receive eight hours of intensive, hands-on experience in chemistry or biology with computers. For more information, check our web site or e-mail us at workshop@vernier.com.

T³ Summer Institutes

These five-day institutes sponsored by T³, Teachers Teaching with Technology, offer hands-on training using TI Graphing Calculators and the CBL System. Some of the subject-specific institutes include:

- Dealing with Data in Middle School Mathematics and Science (35 sessions)
- Chemistry and Biology (23 sessions)
- Connecting Math and Science (25 sessions)
- Connecting Biology and Algebra (16 sessions)

There are so many sessions of each workshop being held around the country this summer (see above) that we cannot list them all here. Visit the T³ web site at www.ti.com/t3 or call 1-888-2-TCUBED to find an institute in your area.

T³ Discovery Workshops

T³ also offers free, one-day, hands-on CBL workshops for schools that can provide 10 to 40 teachers and a 6-hour block of time. Visit the T³ web site at www.ti.com/t3 or call 1-888-2-TCUBED for an application and more information.

Computer and CBL Technology

June 21-25, San Antonio, TX
Workshops in AP and pre-AP biology, chemistry, environmental science, middle school science, and physics. For more information, contact Carol Leibl at cmleibl@tenet.edu.

ChemEd '99

We are very excited to offer six hands-on chemistry workshops at ChemEd '99 in Fairfield, CT, August 1-5:

- Chemistry with CBL
 - Chemistry with Computers
 - AP and College Chemistry with CBL and Computers
- For more information, visit the ChemEd '99 web site at www.sacredheart.edu/chemed.

Promoting Active Learning in Introductory Physics Courses

- Dickinson College, Carlisle, PA, June 3-5
 - University of Oregon, Eugene, OR, June 17-19
- For more information, contact David Sokoloff at sokoloff@oregon.uoregon.edu.

Promoting Active Learning in Introductory Physics Courses

- Vancouver, British Columbia, Canada, July 19-23
- For more information, visit the web site at www.columbia.college.bc.ca/Physics_Seminar.

We now have several former teachers around the country who are available to conduct Vernier Software workshops, including John Mauch (Boston), David Braunschweig (Madison, WI), Bridget Dube (San Antonio), and John Gastineau (Morgantown, WV). Contact Amy Ring (503-297-5317, workshop@vernier.com) if you want to discuss having one of these experienced teachers do a workshop for your staff.



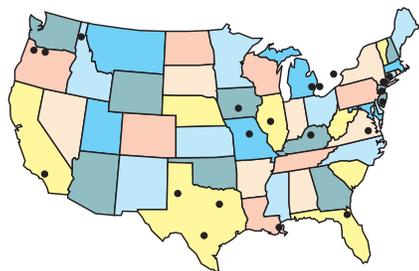
Science Humor

Q: Why did the scientist put a knocker on his door?

A: Because he wanted to win the Nobel prize.

A seventh grade biology teacher arranged a demonstration for his class. The teacher had two earth worms. He dropped the first worm into a beaker of water, where it dropped to the bottom and wriggled about. He dropped the second worm into a beaker of Ethyl alcohol, and it immediately shriveled up and died. He asked the class if anyone knew what this demonstration was intended to show them.

A boy in the second row immediately shot his arm up and, when called on said, "You're showing us that if you drink alcohol, you won't have worms."



UPCOMING EVENTS

We will be exhibiting at all of the following conferences. For an updated list, visit the "Workshops" section of our web site.

- American Chemical Society Northwest Regional Meeting Portland, OR June 20-23
- National Educational Computing Conference Atlantic City, NJ June 22-24
- ChemEd '99 Fairfield, CT August 1-5
- AAPT Summer Meeting San Antonio, TX August 2-7
- American Chemical Society Meeting New Orleans, LA August 23-25
- Illinois Science Teachers Association Springfield, IL October 1-2
- Idaho Science Teachers Association Coeur d'Alene, ID October 7-8
- Northwest Math Conference Portland, OR October 7-9
- California Science Teachers Association Long Beach, CA October 7-10
- Oregon Science Teachers Association Hood River, OR October 8
- Science Teachers of Missouri (STOM) Columbia, MO October 8-9
- New Jersey Science Teachers Association Somerset, NJ October 11-13
- Iowa Science Teachers Section Des Moines, IA October 13-14
- Florida Association of Science Teachers (FAST) Jacksonville, FL October 14-16
- NSTA Midwestern Area Convention Detroit, MI & Windsor, Ontario October 21-23
- National Association of Biology Teachers (NABT) Fort Worth, TX October 27-30
- Texas Science Teachers (CAST) Lubbock, TX October 28-30
- New York Science Teachers (STANYS) Ellenville, NY Oct. 30-Nov. 2
- Virginia Association of Science Teachers (VAST) Richmond, VA November 4-6
- Science Teachers Association of Ontario (STAO) Toronto, Ontario, Canada November 4-6
- Kentucky Science Teachers Association Lexington, KY November 4-6
- Metropolitan Detroit Science Teachers Association Plymouth, MI November 6

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