Physics with Computers

by Ken Appel, John Gastineau, Clarence Bakken, and David Vernier

Physics with Computers is now shipping. This book provides 34 ready-to-use labs for physics teachers using our Universal Lab Interface and Logger *Pro*™ software. The experiments included are

- Graph Matching
- Back and Forth Motion
- Modern Galileo Experiment
- Determining g on an Incline
- Picket Fence Free Fall
- Ball Toss
- Bungee Jump Accelerations
- Projectile Motion
- Newton's Second Law
- Atwood's Machine
- Newton's Third Law
- Static and Kinetic Friction
- Air Resistance
- Pendulum Periods
- Simple Harmonic Motion
- Energy of a Tossed Ball
- Energy in Simple Harmonic Motion
- Work and Energy
- Momentum, Energy and Collisions
- Impulse and Momentum
- Sound Waves and Beats
- Tones, Vowels and Telephones
- Mathematics of Music
- Speed of Sound
- Ohm's Law
- Series and Parallel Circuits
- Capacitors
- The Magnetic Field in a Coil
- The Magnetic Field in a Slinky
- Electrical Energy
- Polarization of Light
- How Light Intensity Varies with Distance
- Newton's Law of Cooling
- The Electronic Thermometer

Like our *Chemistry with Computers, Biology with Computers,* and *Physical Science with Computers* books, this book has a lot of features that should be of help to teachers, including:

- Ready-to-copy lab sheets for student use.
- Experiment files for each lab, with pre-set graphs, data collection parameters, calibrations, and notes for the students.
- Word processing files of the student handouts so that you can edit them for your specific lab situation (Microsoft Word format).
- Teacher's guide with suggestions, sample results, and graphs.
- A free high school or college department site license with each book purchased.

Physics with Computers (includes 280-page book and two disks)
For use with Logger *Pro* (Windows or Power Macintosh) .... PWC-LP $35.00
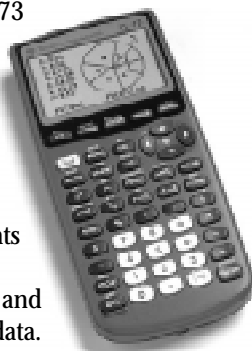
CBL News
by Rick Sorensen

Flash Technology from Texas Instruments

Texas Instruments recently announced a significant improvement in the design of calculators. Until now, TI graphing calculators only contained RAM, which is used to store programs, data collected with a CBL or CBR, variables, and functions. The newest calculators now also contain Flash ROM. Flash ROM is additional memory that is used to store applications, data, and programs. The most important feature of Flash ROM is that it allows you to update the software on your calculator. This means you will be able to electronically upgrade your calculator as new software becomes available.

TI-73

If you teach middle grades, the new TI-73 could be your best choice in graphing calculators. This calculator combines the fraction capabilities of the Math Explorer, and the scientific and trig functions of the Explorer Plus, with the features of a graphing calculator. Since the calculator has a large screen, students can explore patterns, create a variety of charts (including bar charts, pie charts, and pictographs) and analyze CBL or CBR data. The TI-73 is CBL and CBR compatible, and it comes with a basic CBL/CBR program in Flash ROM. This summer we will convert our CHEMBIO and PHYSICS programs to the TI-73. We will also make our *Physical Science with CBL* compatible with the calculator. The TI-73 will be available in July and will sell for $90 (order code TI-73).

TI-92 Plus Module

The TI-92 Plus Module is a plug-in module that replaces the existing memory module in a TI-92. This module provides you with 500K more memory, including an additional 128K RAM and 384K Flash ROM. The module comes with Advanced Mathematics Software, which adds advanced analysis features for college-level math, science, and engineering. These features include numeric differential equation graphing, improvements in symbolic expression formatting, real-time rotation of 3-D surfaces, unit conversions, and support for units in equations. The TI-92 Plus Module will sell for $75 (order code TI-92MOD) and will be available in July.

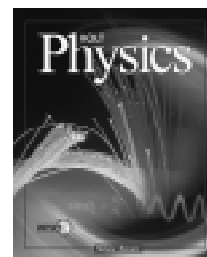## College Physics with the CBL and TI-86
by John E. Gastineau

We now carry a new TI publication called *College Physics with the CBL and TI-86* written by John Gastineau. This set of student laboratory activities uses the TI-86, CBL, Vernier sensors, and our PHYSICS program to collect and analyze data. The book contains 30 activities in mechanics, sound, light, electricity, and magnetism. Even though the book was written for introductory college and university courses, many high school teachers will find it a valuable resource. The book costs $20 (order code TI-CP). As some of you may know, John Gastineau has been working as a consultant for Vernier Software for the past year. He has helped us with our Logger *Pro* software and is a co-author of our new *Physics with Computers* lab manual. His next project for us will be *Physics with CBL.*

Holt Physics
by Dr. Raymond Serway and Dr. Jerry Faughn

This spring, Holt, Rinehart, and Winston announced their new high school physics program, *Holt Physics*, by Serway and Faughn. While developing the labs for the text, Holt decided to incorporate technology in a number of the experiments. In 12 of the 26 labs, teachers can choose between a traditional lab and a lab incorporating graphing-calculator technology. The graphing-calculator experiments use the CBL with the TI-82 or TI-83, along with Vernier sensors and our PHYSICS program. CBL labs appear in chapters on mechanics, gas laws, heat, sound, light, electric circuits, and magnetism. The book also uses the graphing calculator in a series of articles entitled "Technology and Learning." For more information, visit the Holt, Rinehart, and Winston web site at www.hrw.com or call 1-800-HRW-9799.

CBL Programs on the Web

Since our PHYSICS and CHEMBIO programs are being used more and more, we have made it easier to get them from our web site, www.vernier.com. Until now, you would download one file that contained all of our programs for all the calculators. Now you can also be selective and download programs for specific calculators. To check it out, visit our site and click the link to "Free Stuff."
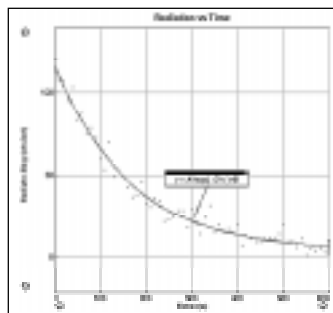
Logger *Pro* Upgrades

If you own Logger *Pro* for a Windows 95 or Windows NT 4.0 machine, you can download a file from our web site that will upgrade your software to the latest version. Before you try to download the upgrade, you need to know which version of Logger *Pro* you are running. The easiest way to determine this is to start the program and note the version number on the splash screen that is displayed during startup. If you are already running Logger *Pro*, you can find the version number by choosing the About Logger Pro option from the Help menu.

To download the update from our web site, click the link to Free Stuff, which can be found in the left column of the main page. The Freebies, Demos, and Program Update page will come up. Click the link to Logger *Pro* Updates. Next, click on the link that corresponds to the exact upgrade you are making; e.g., version 1.0.3 to 1.0.6. A "patch" file will be loaded onto your computer. After downloading the patch file, double click on it. You will be asked to locate the existing Logger *Pro* software. If you used the default settings during the initial installation, your existing software is in the Logger *Pro* folder, which can be found in the Vernier Software folder of My Programs. If you did not use the default settings during installation, you will need to locate the folder in which Logger *Pro* was installed. Once you choose the correct folder, your software will be updated to the newest version.

If you do not have Internet access or if you are running Windows 3.x, contact us to get the upgrade in disk form.
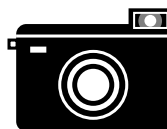

We keep adding features to Logger *Pro*. Last fall, we added support for Rotary Motion Sensors and Photogates. The latest addition is support for Radiation Monitors. You can now do studies of half life, shielding, and the inverse square law using Logger *Pro*. Sample results taken with Logger *Pro*, a ULI, and our Student Radiation Monitor (order code SRM-DG) are shown here.

The Power Macintosh version of Logger *Pro* will be available at the end of May. It will allow Power Mac users to gain some new features over our existing Macintosh programs, including

- using four analog inputs at the same time.
- using two motion detectors at the same time (requires ULI II EPROM 1.2 or newer).

We will continue to support and sell our existing Macintosh programs (Data Logger, MacMotion, Sound, etc).

AAPT Photo Contest

The 1998 AAPT High School Physics Photo Contest is open to any high school student. Photos must be 8x10, in black and white or color. A paragraph (<250 words) describing the physics involved in the photo must be included. Photographs will be judged by physics teachers attending the summer AAPT meeting in Lincoln, NE. Vernier Software supplies the prizes. For more information, contact Ann M.W. Brandon, Joliet West High School, 401 N. Larkin Ave., Joliet, IL 60435.

What's new @ www.vernier.com?

If you haven't seen it lately, you should check out our web site. It has been around since the spring of 1995. As the internet becomes more and more popular, we will continue to add to our site. In addition to all of the information in our 1998 catalog, you will find

- Free CBL data collection programs for all TI calculators.
- Two sample labs from each of our lab manuals.
- The latest info on all of our workshops and conferences.
- Technical specifications on all of our sensors.
- Frequently Asked Questions (FAQs).
- Demo versions of our most popular programs.
- Updated experiment files for all of our programs.
- Free Logger *Pro* upgrades.
- New product announcements.
- Past issues of this newsletter.

We recommend that you put www.vernier.com on your list of favorite sites and check it periodically to keep up to date on our products.

Science Humor

Here is some science-related humor from the annual joke contest from "Prairie Home Companion" on National Public Radio.

- "He is so dense that light bends around him."
- "An optimist sees a glass as half full. A pessimist sees the same glass as half empty. An engineer sees it as a glass that is twice as big as it needs to be."

And here is a really obscure one. (If you do not get it, ask a computer scientist.) "Why is Halloween like Christmas?"

OCT 31 = DEC 25

Using Vernier Sensors for Water-Quality Studies

by Dan Holmquist and Scott Holman

With the introduction of our new Vernier Ion-Selective Electrodes, we decided it was time to do a trial water quality study in the greater Portland, Oregon area. Our choice was the Tualatin River, a medium-sized river that flows about 100 miles from the Coastal Range west of Portland to its eventual confluence with the Willamette River near the center of Portland. We collected water samples at four locations on April 24th at the following locations:
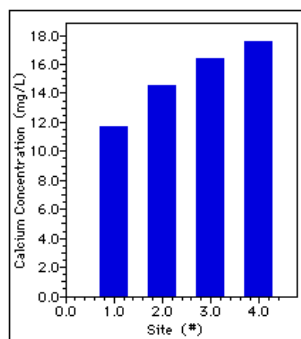
■ Site 1: After the river flows from the heavily-forested Coastal Range

■ Site 2: After the river meanders through agricultural land for 15 miles

■ Site 3: After the river has gone through more agricultural land and residential suburbs

■ Site 4: After the river flows several more miles through populated suburbs of Portland

Measurements were made at each site using a portable CBL and TI graphing calculator. We also made use of a PC laptop computer using a Serial Box Interface (with a Rechargeable Battery Pack). We made other measurements soon after returning from the trip (nitrate, calcium, chloride, ammonium, conductivity). Even though the levels of several of these ions in the Tualatin River water were as low as 1 mg/L (1 part per million), the new ion-selective electrodes provided very stable, reproducible results. Here is a summary of some of the measurements:
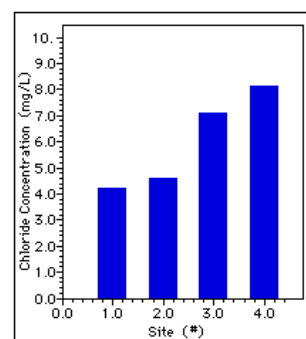
■ As expected, temperature increased from site 1–4 (9.5, 12.1, 13.3, and 13.3° C).

■ The pH values, measured using a Vernier pH System, hovered very close to a value of 7, which is typical for western Oregon water (7.12, 6.99, 7.01, and 7.04).

■ The Conductivity Probe revealed that the level of total dissolved solids (TDS) increased significantly from site 1–4 (32.2, 41.1, 56.0, and 64.6 mg/L TDS, respectively).

Since the conductivity tests showed a steady increase in ion concentration of the stream, we were quite curious to see the results of our tests using our ion-selective electrodes. Because a significant part of total dissolved solids is usually due to either hard-water ions (e.g., Ca^{2+}, Mg^{2+}, Fe^{3+}, or HCO_3^-), or salts dissolved from the stream bed (e.g., Na^+ or Cl^-), we made measurements of the Ca^{2+} and Cl^- concentrations (using the Vernier Calcium ISE and Chloride ISE). Here are the results:
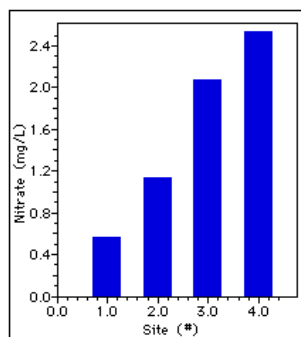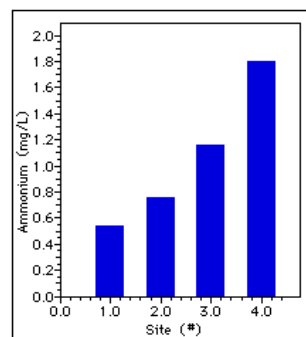

Calcium, Ca^{2+}   *Chloride, Cl^-*

The results indicated a gradual increase in the Ca^{2+} and Cl^- ion concentrations throughout the four sites. As is typical for western Oregon water, water hardness is very low; the highest Ca^{2+} concentration (17.3 mg/L) would correspond to a Calcium Water Hardness value of 44.0 mg/L, a value considered "very soft water." The highest chloride concentration (8.1 mg/L) is far below the EPA chloride drinking water standard of 250 mg/L.

Because the Tualatin River flows through agricultural areas between sites 1 and 3, and flows through populated areas (between sites 3 and 4), we thought it might be interesting to see how nitrate (NO_3^-) and ammonium (NH_4^+) levels were affected. Here are the results of each of these tests:
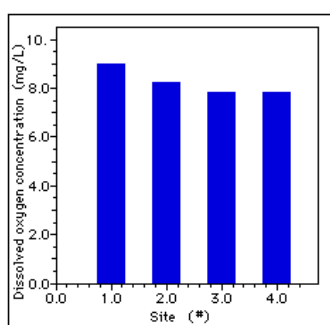

Nitrate, NO_3^-   *Ammonium, NH_4^+*

There is a noticeable increase in both nitrate and ammonium ion concentrations. These may be due to runoff of fertilizers from farm fields between sites 1 and 3. Stream flow drops significantly after site 1, so decomposition of biological matter may contribute to the increased levels of nitrate ions. Water with nitrate levels less than 1 mg/L are generally considered to be "unpolluted," while levels higher than 10 mg/L are unsafe for drinking water. The peak nitrate level of 2.53 mg/L at site 4 is moderately high.

We also made dissolved oxygen measurements using the Vernier Dissolved Oxygen Probe. This small decrease in dissolved oxygen concentration shown below may be due to an increase in biological decomposition in the stream.

Dissolved Oxygen Concentration

The purpose of this article is to show how easily data can be collected using a variety of Vernier sensors and portable data acquisition systems. Your students can experience the same kind of excitement we did while investigating a local lake or stream. The following sensors were used in our experiments:

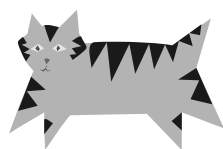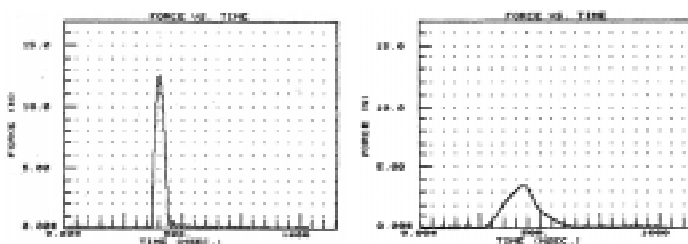| Sensor	Order Code	Price
ISE Amplifier	ISE-DIN	$39
Ammonium ISE	NH4-ISE	$149
Calcium ISE	CA-ISE	$149
Chloride ISE	CL-ISE	$149
Nitrate ISE	NO3-ISE	$149
pH System	PH-DIN	$72
Conductivity Probe	CON-DIN	$79
Extra Long Temperature Probe	TPL-DIN	$68
Dissolved Oxygen Probe	DO-DIN	$189

Ten Years Ago in this Newsletter . . .

We announced our first version of Precision Timer for MS-DOS computers. Also included was a report on Laser 128 compatibility and a review of our book *How to Build a Better Mousetrap and 13 Other Science Projects Using the Apple II.*
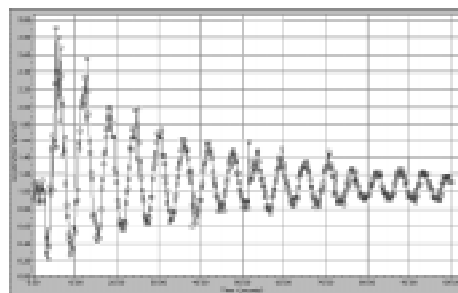

Innovative Uses

Dewey Beadle (Seneca HS, Louisville, KY) has been using our Apple II products for many years. His students are still doing quality science experiments with the Apple IIs. Here are some sample graphs showing force vs. time for collisions between a cart and a mounted force sensor. The left graph is a collision with no padding and the right graph is a collision with a foam bumper.
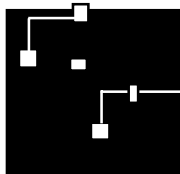

Mary Pat Evans (The Londonerry School, Harrisburg, PA) sent us information about her 8th-grade student, Jessica Lyons, who recently entered a science fair with a project on monitoring the purring of cats. Jessica used a ULI and microphone. Her original hypothesis was that the volume would increase when the cat was petted. In fact, she discovered that the frequency of the purring also increases when the cat is petted.

Jerry Easdon (College of the Ozarks) and his student, Scott Deken, sent us data collected from a ride on the Ozark Mountain Skycoaster. The ride is like the giant swings you may have seen at other amusement parks. The graph above shows the total acceleration calculated as the vector sum of three accelerations measured with our 3-Axis Accelerometer (order code 3D-DIN).

Bits & Bytes

Vernier in Print

There have been a lot of articles in recent physics journals about experiments and demonstrations using our sensors and software. Here are some that you may want to look up:

Measuring the Forces Required for Circular Motion by Charles Henderson (Macalester College), *The Physics Teacher,* Feb 1998. Measures centripetal force using our Dual-Range Force Sensor mounted on an easy-to-build device.

Another Use for the Sonic Ranger by James C. Kernohan (Milton Academy), *The Physics Teacher,* Feb 1998. Students make predictions about what they would expect on energy graphs and then test their predictions with the motion detector.

The 100-Meter Dash: Theory and Experiment by Glenn Wagner (Centre Wellington District HS, Fergus, Ontario), *The Physics Teacher,* Mar 1998. Students use Graphical Analysis to analyze data on sprinter's performances and compare with a mathematical model.

Milkweed Seed Dispersal: A Means for Integrating Biology & Physics by Gregory D. Bisbee and Cheryl A. Kaiser (Arrowhead HS, Hartland, WI), *The American Biology Teacher*, Sept 1997. Students study the range of dispersal of seeds as a function of wind speed and use Graphical Analysis for analysis.

Force Exerted by a Chain by Willem H. van den Berg (State College Area HS, State College, PA), *The Physics Teacher,* Jan 1998. Students use a CBL and force sensor to measure the force exerted and compare it to mathematical models.

Assessing Student Learning of Newton's Laws: The Force and Motion Conceptual Evaluation and the Evaluation of Active Learning Laboratory and Lecture Curricula by Ronald K. Thornton (Tufts University) and David R. Sokoloff (University of Oregon), *American Journal of Physics*, April 1998. Compares student results after traditional physics instruction and after active learning, including the use of MBL. Also includes the complete force and motion conceptual evaluation, which you may want to use with your classes.

Sensing Subtle Tsunamis - The Amateur Scientist by Shawn Carlson, *Scientific American*, May 1998. Our Serial Box Interface is recommended as a low-cost way to log the data on a PC or a Macintosh computer from a microbargraph and other home-made devices.

Logger *Pro* was favorably reviewed in the March, 1998 issue of *Technology and Learning.*

A Microcomputer-Based Phase-Change Experiment by Francis X. Hart, University of the South, Sewanee, TN, *The Physics Teacher,* Feb 1998. In this experiment, students monitor the temperature of a beaker of Crisco shortening as it cools. At the same time, they monitor the light transmission through it. When the phase change occurs, there is a big change in the light transmission.

Graphical Analysis for Windows

Several people have complained about the fact that Graphical Analysis for Windows always tries to use the wrong COM port when importing data from a TI calculator or CBL. Here is the way to permanently change the setting:

- Choose Import from TI calculator from the File menu as usual.
- Click on the option to Select Port.
- Select the proper COM port and click on OK.
- Import some data from a calculator, just to make sure you have the right port.
- Choose Save As from the File menu and save the file with the exact name Startup.dat. This is the file that is automatically loaded each time you start Graphical Analysis.

Grants and Donations

We are often asked for advice on how to find funding for technology. We would like to pass along some of the tips, tricks, and strategies of our loyal *Caliper* readers. Have you recently won a grant for technology in your school? Do you have any advice for others who want to write a grant proposal or inquire about corporate donations? Please send us an e-mail (info@vernier.com), and let us know how you got your grant or donation. We would like to start a new section on our web site with tips, tricks, and links to useful resources for schools in need of funding.

Workshops

Leadership Modeling Workshops

Exceptionally motivated high school physics teachers nationwide who wish to contribute to science-teaching reform are invited to apply for the final series of NSF-funded Leadership Modeling Workshops. Workshops will be held for four weeks in each of the next two summers at Univ. of MD (June 29 - July 24), Univ. of Central FL (June 29 - July 24), or Univ. of CA at Davis (July 6 - 31) in 1998 and 1999. Participants will receive a $1200 stipend, plus travel, housing and meal allowance. Graduate credit is available. Teams okay.

Seventy-five teachers will learn the modeling method of instruction, which corrects weaknesses of the traditional lecture-demonstration method, including the fragmentation of knowledge, student passivity, and the persistence of naive beliefs. MBL and/or CBL techniques are used. For information, contact Reba Wilson, Box 871504, Dept. of Physics, Arizona State University, Tempe, AZ 85287-1504; (602) 727-6199; reba@asu.edu; http://modeling.la.asu.edu/modeling.html.
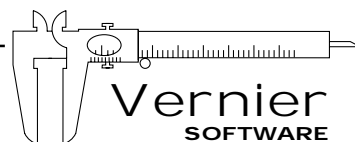
Oceanology for Educators

A three-day workshop titled *Oceanology for Educators* will be offered June 24-26 at Schaefer Oceanology Wet Lab in Marion, MA. Among the workshop activities, they will do water quality testing using our sensors. For information, contact Susan Nourse at 617-628-5000 x 5394, snourse@emerald.tufts.edu.

Workshop Science

Workshop Science is a new physical science course now being developed. It is similar in style to the *Workshop Physics* curriculum that many of you use. The authors would like to do additional classroom testing of the unit on energy. This unit uses several of our sensors, including our CO_2 Gas Sensor. For information, contact Priscilla Laws, Physics Department, Dickinson College, P.O. Box 1773, Carlisle, PA 17013, lawsp@dickinson.edu.

T³–Teachers Teaching with Technology

The Teachers Teaching with Technology (T³) organization provides an excellent way to learn more about the use of graphing calculators in science and math through national conferences and hundreds of summer workshops. Eighteen CHEM/BIO and 32 Connecting Math and Science workshops will be held in various cities across the country. For more information, contact Teachers Teaching with Technology, P.O. Box 650311, MS 3908, Dallas, TX 75265, (888) 2-TCUBED, t-cubed@ti.com.

Vernier SOFTWARE

Evaluation Workshops

We will be demonstrating the use of Vernier hardware and software in the classroom at the following locations during 1998. Join us for an evening in which you can learn how to integrate our data-collection software, interfaces, and sensors into your classroom. These workshops are free of charge.

September 10: Rochester, NY
September 21: Providence, RI
September 24: Philadelphia, PA
September 28: Norfolk, VA
September 29: Cleveland, OH
October 6: Columbia, SC
October 12: Tallahassee, FL
October 22: Baton Rouge, LA
October 27: Houston, TX
October 29: Dallas, TX

Computer or CBL Workshops—Portland, OR

We will be offering five one-day workshops at Vernier Software in Portland, Oregon. Participants will receive intensive training in computer or CBL data collection. Combine this experience with a trip to the scenic Pacific Northwest. The fee for each workshop is $50. At the workshop, you will receive a $50 gift certificate good towards the future purchase of any products in the Vernier Software catalog.

- July 20–*Using the TI-82/83 with the CBL system*

- July 21–*Using the TI-82/83 with the CBL system*

- July 22–*Using the TI-82/83 with the CBL system*

- July 23–*Collecting data using Windows and Macintosh computers*

- July 24–*Collecting data using Windows and Macintosh computers*

■

You may register for our workshops by phone, mail, electronically at www.vernier.com, or by e-mail at workshop@vernier.com. Contact Amy Ring at (503) 297-5317 for more information.

UPCOMING EVENTS

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

National Education Computing Conference .... San Diego, CA ....June 22-24
AAPT Summer Meeting .... Lincoln, NE .... August 3-8
15th Biennial Conference on Chemical Education .... Waterloo, Ontario, Canada .... August 9-13
California Science Teachers Association .... San Jose, CA .... October 8-10
Oregon Science Teachers ....Portland, OR .... October 9
New Jersey Science Teachers .... Somerset, NJ ....October 13-14
Illinois Science Teachers Association .... Rosemont, IL ....October 16-17
NSTA Northwestern Area Convention ....Seattle, WA ....October 29-31
Virginia Association of Science Teachers .... Richmond, VA ....October 30-31
New York Science Teachers ....Ellenville, NY .... November 1-3
North Carolina Science Teachers .... Greensboro, NC .... November 4-6
National Association of Biology Teachers ....Reno, NV .... November 5-7
Science Teachers Association of Ontario .... Toronto, Ontario, Canada ....November 5-7
American Mathematical Association of Two-Year Colleges ....Portland, OR ....November 5-8
Texas Science Teachers, CAST ....Corpus Christi, TX .... November 19-21
NSTA Southern Area Convention .... Birmingham, AL .... November 19-21
NSTA Southwestern Area Convention .... Albuquerque, NM .... December 3-5