V E R N I E R   S O F T W A R E

The Caliper

15th Anniversary

Volume 13 Number 2 Winter 1996-97

A Publication for Users of Vernier Software Products

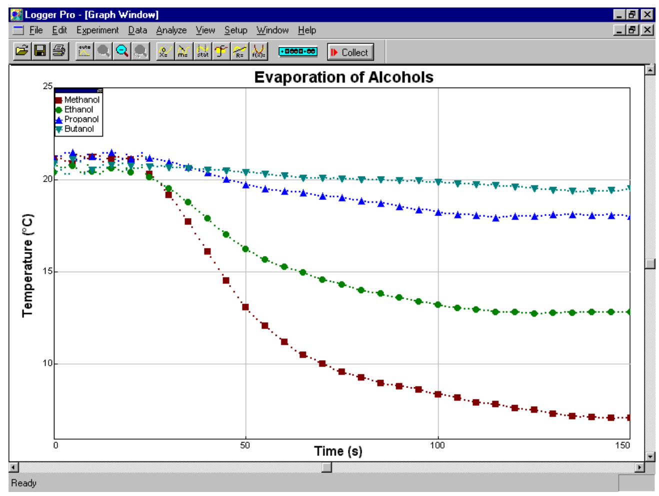
IN THIS ISSUE

New from Vernier Software

We have been so busy working on new products that this newsletter got delayed. As a result, we are combining this edition with our catalog.

New Software

We have been working jointly with Tufts University for almost a year on Logger *Pro*™ Windows software for the ULI and Serial Box Interface. It combines the functionality of our Data Logger, Motion, and Sound programs into one Windows program.



Using four temperature probes to investigate the evaporation of alcohol with Logger Pro.

New Sensors

- 3-Axis Accelerometer
- Exercise Heart Rate Monitor
- Student Radiation Monitor
- CO_2 Gas Sensor
- Dual-Range Force Sensor
- Low-Priced Photogate

New Books

CBL users will be pleased to know that we have two new CBL books, *Biology with CBL* and *Physical Science with CBL*. *Biology with CBL* is co-authored by David Masterman and Scott Holman. It has 30 experiments that support all sensors in our starter and standard packages. It also has experiments for our new CO_2 Gas Sensor and the Exercise Heart Rate Monitor. In *Physical Science with CBL*, Don Volz and Sandy Sapatka have written another outstanding lab manual with 40 experiments for use in middle school, junior high, and high school science. We are also pleased to announce that we have made some significant changes in our popular *Chemistry with CBL* lab manual. The book is now written for use with all four Texas Instruments graphing calculators: TI-82, 83, 85, and 92.

Summer Workshops for Teachers

There seem to be more workshops this summer on MBL and CBL than ever before.

- The popular PHYSLab workshop has expanded to three sites this year. The three-week workshops will be held in Portland, OR (July 7-25), Palo Alto, CA (July 7-25), and Omaha, NB (June 23-July 11). These are great workshops for physics teachers. The deadline for applications is February 15. Contact Lowell Herr, The Catlin Gabel School, 8825 SW Barnes Rd., Portland, OR 97225, herr@catseq.catlin.edu, http://physlab.catlin.edu.

(Contined on next page)

Summer Workshops for Teachers

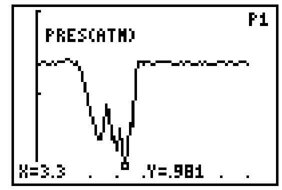
(Continued from page 1)

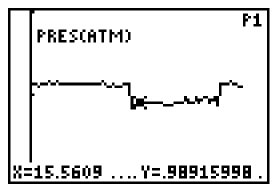
- Three workshops on computer technology and advanced placement biology, chemistry, and physics will be held June 23-27 in San Antonio. The workshops use some of our lab interfaces and software, along with other programs. Contact Carol Leibl, 431 Deer Meadows, Canyon Lake, TX 78133, (210) 899-3923, cmleibl@tenet.edu for further information.
- The Leadership Modeling Workshops for High School Physics Reform are NSF-funded four-week workshops. They are open to high school teachers nationwide who wish to contribute to physics teaching reform. Stipend, travel, housing and meal allowance are provided. Some college teachers may apply. MBL and/or CBL techniques are used extensively. The sites are Arizona State, Univ. of Wisconsin-River Falls, and Univ. of Akron. Applications due March 10. Contact Jane Jackson, Box 871504, Dept. of Physics, Ariz. State Univ., Tempe, AZ 85287, jane.jackson@asu.edu. (602) 965-8438, http://modeling.la.asu.edu/modeling.html.
- AAPT may have a new PTRA program for this summer (NSF funding pending). The new focus is primarily on physics teachers in urban schools. The deadline for applications is March 3, 1997. Call AAPT at (301) 209-3344 for more information.
- A two-week NSF-sponsored summer seminar, Teaching Introductory Physics Using Interactive Teaching Methods and Computers, will be held at Dickinson College in Carlisle, PA. This workshop for high school and college teachers will run from June 15-27. The program will emphasize computer-enhanced interactive approaches to introductory physics teaching. Participants will pay no tuition fees and will have their room and board provided. Travel expenses are not included. For more information or to obtain an application, contact Gail Oliver, Dept. of Physics, Dickinson College, Carlisle, PA 17013, (717) 245-1845, oliver@dickinson.edu.
- The University of Oregon will run an institute for high school science teachers July 20-August 1. Oregon SOS (Summer Outreach in Science) is sponsored by the Howard Hughes Medical Institute and is run jointly by the departments of Biology, Chemistry and Physics. Thirty teachers from the Northwest (Oregon, Washington, Idaho, California, Northwestern Nevada and Western Montana) will be selected to participate—ten teachers in each of the three disciplines: biology, chemistry and physics. Benefits for teachers include stipend and equipment, all expenses paid and graduate credit available. The deadline is March 21. For more information contact David Sokoloff, Dept. of Physics, University of Oregon, Eugene, OR 97403 (541) 346-4755, sokoloff@oregon.uoregon.edu.

CBL Corner

by Rick Sorensen

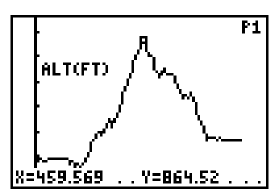
Brian Holmes' article, "My Teacher Is a Blowhard," in the September 1996, issue of *The Physics Teacher* prompted us to try a number of activities with our Barometer (BAR-DIN) and CBL. Brian measured the rise of a column of water as air was blown across a vertical tube. From that he calculated the pressure drop and then used Bernoulli's equation to calculate the speed of the air. The pressure drop he quoted was 1.96 kPa. We repeated the experiment, but used our Barometer instead. When we blew across the Barometer opening, we got comparable results. This graph shows a drop of about 1.3 kPa.





This brought to mind another problem. It seems some people are bothered by the opening and closing of car windows as the car travels down the freeway. We decided to use a CBL and see if this pressure change was measurable. This graph shows pressure data in a car traveling at 60 mph. Initially the windows were closed, but the car vent was open. After 15 seconds a window was opened, and the pressure dropped from 0.991 atm to 0.989 atm. You will notice that the pressure returned to its previous level when the window was raised at the end of the experiment.

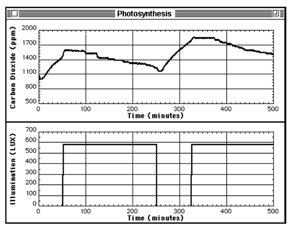
In collecting the above data, we were again reminded of the sensitivity of the Barometer to changes in altitude. To get the data, we had to collect it on a flat road because the Barometer can detect a change as small as 3 meters. As a matter of a fact, in the past we used a Barometer to estimate altitude during automobile trips. We could only get a rough idea of altitude, because the relationship between pressure and altitude is not a simple one. (You might want to refer to "High-Altitude Free Fall" in the October, 1996 issue of *American Journal of Physics*.) To get a relationship near the earth's surface, we used Graphical Analysis to model pressure and altitude data from sea level to 5000 ft. We got a good fit with a quadratic equation. We have taken this one step further and written a CBL program that allows you to use the Barometer as an altimeter. This program is available on our web site or on new versions of our CBL Data Collection disk. This graph shows an altitude vs. time on a trip from work to home. We have compared this CBL program to a $200 hand-held altimeter and obtained similar results.



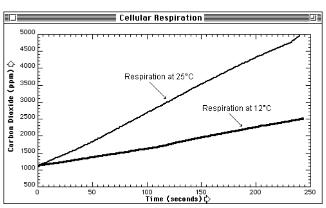
Chemistry/Biology Corner

by Dan Holmquist and Scott Holman

Teachers and students can use our new CO_2 Gas Sensor to monitor changes in gaseous carbon dioxide levels in a variety of biology and chemistry experiments. It is great for measuring small changes in carbon dioxide concentration in photosynthesis and respiration experiments. It measures gaseous carbon dioxide levels in the range of 0 to 5000 ppm by recording the amount of infrared radiation absorbed by carbon dioxide molecules. The CO_2 Gas Sensor is easily calibrated by using its calibration button. A 250-mL chamber that attaches to the sensor is included for running controlled experiments with small plants and animals.

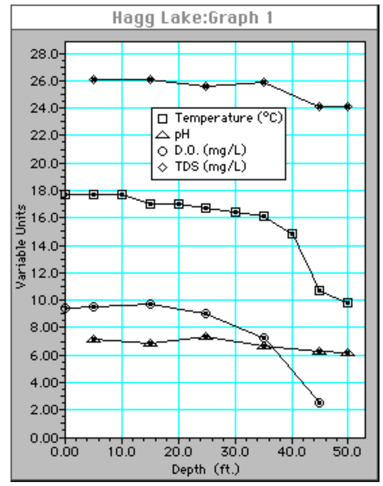


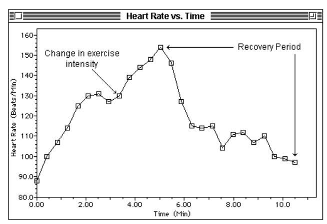
Here are just a few ways to use this sensor. In the graph shown at the right, a CO_2 Gas Sensor and a Light Sensor were both placed in a closed terrarium. Carbon dioxide levels were monitored as a grow light was alternately turned on and off. Notice in the top graph how carbon dioxide concentration slowly decreases when the light is turned on (photosynthesis), or increases when the light is turned off (photorespiration).



In another experiment, bush peas were germinated and placed into the chamber with a CO_2 Gas Sensor. The chamber was placed into water baths of differing temperatures. The top curve represents a trial performed at 25°C, and the bottom curve at 12°C. Students can easily see the effect of temperature on respiration rates of peas or small insects such as crickets.

In answer to many requests by teachers who want to take dissolved oxygen, pH, and conductivity readings at various lake depths, we now have the Water Depth Sampler. This handy device allows you to quickly collect a water sample at a given depth and bring it to the surface to make measurements. We picked a beautiful, fall day to take a CBL, TI-83, sensors, and our canoe to Hagg Lake near Portland to try out this new Vernier product. We collected 1.5-L samples at 5-foot intervals, down to the bottom of the lake (about 55 feet). Along with the Water Depth Sampler, we dropped a Vernier Extra-Long Temperature Probe to take temperature readings. After making readings in the canoe, we returned to the office to download our data into Graphical Analysis. Here is a graph showing the four probes plotted vs. lake depth. The curves are, from top to bottom: total dissolved solids (mg/L), temperature (°C), dissolved oxygen (mg/L), and pH.





One last bit of good news for biology teachers—we now have an Exercise Heart Rate Monitor. This new sensor is ideal for determining the heart rate of moving or active individuals, during or after exercise. The Exercise Heart Rate Monitor consists of a wireless transmitter belt and a receiver module that plugs into a Vernier interface box or CBL. The transmitter belt senses the electrical signals generated by the heart much like an EKG. In the heart rate vs. time data shown here, a high school student jogged at a moderate rate, then at a higher rate, followed by a recovery period.

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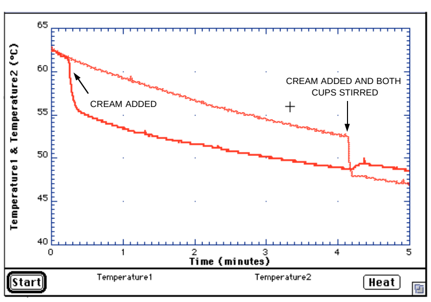
Innovative Uses

Earl Feltyberger (Nicolet HS, Milwaukee, WI) has put his CBLs to a very practical use. His district recently put in a new heating and cooling system that was causing lots of complaints. The complaints were largely ignored until Earl documented the temperature variations with CBL. He distributed graphs to the faculty and administration. The administration has promised to investigate.

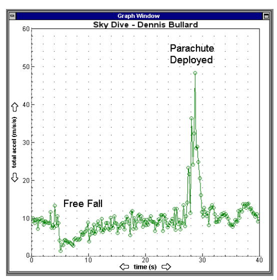
At the MBL II Workshop this fall at Jamestown CC, Paul Marquard (Casper College, WY), Herman Trivilino (College of the Mainland, Texas City, TX), Umesh Pandey (Technical-Vocational Institute, Albuquerque, NM), and Laura Tacheny (Rochester Community & Technical College, Rochester, MN) did an experiment to answer the old question: If you have hot coffee that you will not be able to drink for a while and you want to add cream to it, is it better to add the cream immediately or just before you drink it? The graph below shows the cooling of the two cups. The addition of the cream early reduces the heat loss during the waiting period, due to Newton's law of cooling—that cup stays hotter. Try it with your students.



Pat Maturo and her students at Ocean Lakes HS (Virginia Beach, VA) built and launched a 13-ft rocket with a CBL inside to take data. The CBL collected acceleration and other data during the successful launch. They even sent us a video tape of the launch!

The U.S. Army Corps of Engineers at Mark Twain Lake, MO uses our Serial Box Interface to test entrees in a "Design a Turbine Contest." Students make miniature turbines to turn a generator. The turbine producing the most voltage over a period of one minute is declared the winner.

Dennis Bullard (Lafayette HS, Lafayette, LA) took a CBL and three Low-g Accelerometers mounted at right angles on a sky dive. Here is a graph showing the g-factor during the fall. G-factor is 9.8 m/s/s when you are at rest and should go to zero in true free fall. Notice the large acceleration during parachute deployment.



Merlin W. Passow (UW Oshkosh, WI) has had good results by combining our Low-g Accelerometer and a force sensor to study simple harmonic motion. He mounts the accelerometer on the mass hanging from a spring connected to a force sensor. He then plots force vs. time, acceleration vs. time, and acceleration vs. force. The last of these graphs produces a nice straight line with a slope of 1/mass.

The teachers at the C^3P conference held in Dallas, Texas last summer had a chance to jump from the roof of a building into one of the large air bags that stunt men use. Several teachers jumped, carrying a CBL and our accelerometers. Thanks to Richard Olenick and Carl Rotter for including us in this summer workshop.

The September 1996 issue of the *The Physics Teacher* had an article by F. Schuttinger (Piedmont Hills HS, San Jose, CA) that described a very clever, simple velocity of sound lab. He uses our ULI, microphone and Sound program to capture the sound made when you strike an empty paper towel roll. He has the program do an FFT to determine the frequency and then has the students measure the length of the tube. At resonance, the tube is assumed to be 1/2 wavelength long, in order to calculate the speed of sound. He gets very good results.

Science Humor

A computer science student, an electrical engineering student, and a mechanical engineering student were driving down the road. Suddenly, their car stopped dead. The ME student suggested they examine the fan belt and the cooling system. The EE student thought they should check out all the wiring. The computer science student suggested getting out of the car and then getting back in again.

Bits & Bytes

There was a very favorable review of our Graphical Analysis program in the January issue of *The Science Teacher*. Quoting from the review: "Graphical Analysis 2.0 is excellent software. Its ease of use and power make it a valuable addition to any science classroom."

The 1997 AAPT High School Physics Photo Contest (sponsored by Vernier Software) will be held at the AAPT summer meeting in Denver in August. Contact Ann M. W. Brandon, Joliet West H. S., 401 N. Larkin Ave., Joliet, IL 60435 for details. Photos are due by June 30.

Ten Years Ago in The Caliper . . .

We had a report on using our products on the new Apple IIGS and Laser 128 computers. We also announced Graphical Analysis III for the Apple II.