VERNIER SOFTWARE & TECHNOLOGY

The *Caliper*

The Caliper is a publication for users of Vernier products

2002 OREGON BUSINESS 100 BEST COMPANIES TO WORK FOR

Volume 19 Number 1 | Spring 2002

NEW! Collect Data with Palm™ Handhelds

Now you have one more way to collect data with Vernier LabPro®. We are pleased to announce Data Pro, a new data-collection program for use with Palm handhelds. Load Data Pro software onto your Palm handheld, connect the handheld to your LabPro (with our Palm-to-LabPro cable and pouch), attach a Vernier sensor, and begin collecting data!

We will be shipping the first Palm handheld data collection packages on May 31. Each package will include the following:

- Data Pro software on CD
- Palm-to-LabPro pouch
- Palm-to-LabPro cable

You can use Data Pro in or out of the classroom. In the classroom, a student lab station can consist of a Palm handheld, LabPro, and a sensor. Outside of the classroom, the handy Palm-to-LabPro pouch provides an all-in-one unit for collecting data at your favorite stream or at a local amusement park.

NEW! Graphical Analysis 3

Graphical Analysis 3 is an inexpensive, easy-to-learn program for presenting, analyzing, and printing data. It has been one of our most popular products for over 10 years, and now it's even better!

This new version has a great new look, improved curve fit and analysis tools, 100% interchangeability between Macintosh® and Windows® files, and much more, including:
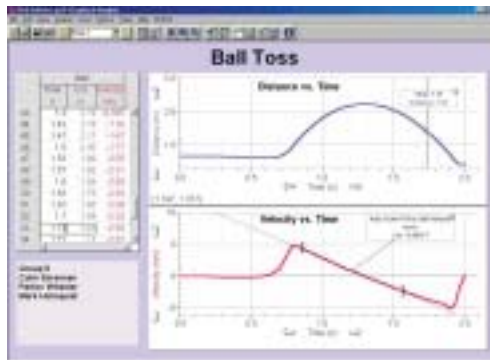
- Calculator users can now use any TI-GRAPH LINK™ cable to send calculator data to a computer.
- Includes a site license for your school or college department AND your students' own computers!
- Ability to create multiple pages within a document
- More color
- Improved features for report-writing
- Support for the newest computer operating systems
- Improved import of other file formats

Once you have purchased Graphical Analysis 3, you are permitted to distribute it to your students for use on their home computers. If you do not want to copy the CD yourself, however, we have 5-Packs of CDs available (order code GA-ST5, $10). Check our web site for a free demo version of Graphical Analysis 3.

Graphical Analysis 3 *(Includes site license for both Windows and Macintosh)* .... GA		$80
Graphical Analysis Upgrade *(for previous purchasers)* .... UGA		$40

*Data Collection with Palm Handhelds* Continued from page 1

Data Pro Software

Data Pro has all of the features you would expect in a Vernier data-collection program:

■ Supports more than 30 Vernier sensors. You can use up to 4 different analog sensors and 2 digital sensors at the same time.

■ Supports Vernier auto-ID sensors. Data Pro is able to identify the sensor, load calibrations, and assign labels and units.

■ With a tap of the Palm stylus, you can quickly navigate between the data table, graphs of data, and analysis tools, or zoom in on regions of data on graphs.
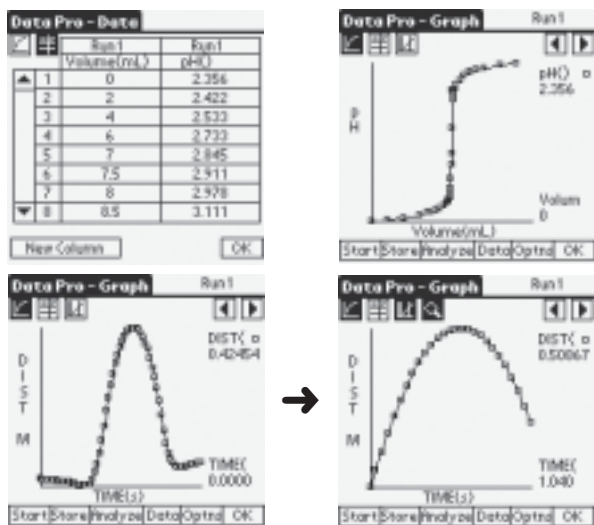
■ Data Pro has an analysis mode that allows students to
   • examine data point-by-point on a plotted graph
   • do a statistical analysis of data (mean, minimum, maximum, standard deviation)
   • perform curve fits (linear, power, quadratic, exponential)
   • integrate data
   • model data with a wide variety of equations.

■ Students can create calculated columns using a variety of mathematical equations, from simple linear equations to first and second derivatives.

■ Data Pro allows manual entry of data. Even when the Palm handheld is not connected to the LabPro interface, students can easily enter numbers into a data table, plot graphs, and use all of Data Pro's extensive analysis and modeling tools.
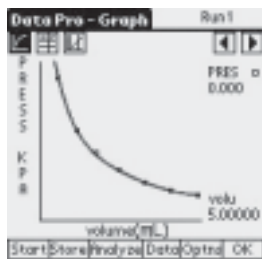
The Palm-to-LabPro Pouch

Included in the Data Pro Package is a handy pouch for attaching your Palm handheld to the LabPro interface. The pouch provides an all-in-one feel for remote data collection.

Palm Models and Cable Support

Data Pro software is designed to run on Palm OS® (version 3.3 or newer recommended). Both Palm series listed below use the same version of Data Pro software. Each series uses a different style of

connector ("universal" and "legacy"). We provide support for the following models and connectors:

Universal-Connector Palm Handhelds: m125, m130, m500, m505, m515, i705

Legacy-Connector Palm Handhelds: m100, m105, III, IIIc, IIIe, IIIx, IIIxe

Transfer of Data to a PC or Macintosh Computer: Graphical Analysis or Microsoft Excel® Support!

Once data have been collected on the Palm handheld, it is easy to transfer the Data Pro data to a PC or Macintosh computer. Students simply place their Palm into the Palm HotSync® Cradle, start up Graphical Analysis software (version 3.1 or newer), and press the HotSync button. Their data will transfer directly to the data table and a graph in Graphical Analysis (shown below). For those not familiar with Vernier Graphical Analysis, this award-winning software includes a school site license and a student site license for only $80!

Data graphed using Data Pro, then transferred and graphed with Graphical Analysis.

If you prefer to use Microsoft Excel or another spreadsheet application, simply place the Palm handheld into the Palm HotSync Cradle and press the HotSync button. The Data Pro data are saved as a text file (.txt) that can easily be loaded into other applications.

Frequently Asked Questions about Handheld Data Collection

Why should I choose Vernier for Palm products and support?
In addition to being the established leader in educational technology, Vernier can provide you with

• an affordable interface (LabPro!) that provides the flexibility to collect data on Palm handhelds, Macs, PCs, and TI graphing calculators. No other company can make this claim!

• the best technical support in the business, which includes 8 former educators with 106 years of teaching experience among them.

Can I purchase Data Pro (or the Palm-to-LabPro cables or pouch) as separate items?
No. These items are sold only as part of the DP-UP or DP-LP packages listed above.

Data Pro Universal Package for Palm Handhelds
Order Code DP-UP $52

Data Pro Legacy Package for Palm Handhelds
Order Code DP-LP $50

NEW! JUMP on our New Force Plate!

There was a recent article in the *American Journal of Physics* (the first article listed below) that described some nice experiments using a custom-built force plate. The author commented that a good physics department should be able to reproduce the setup for about $5000. We've been able to do a little better than that: our new Force Plate is $199, *and* comes with two detachable handles.

About the size of a bathroom scale, the Vernier Force Plate measures forces of stepping, jumping, and other human-scale actions. For example, you can observe the change in normal force during an elevator ride, or measure the impulse delivered by the floor when you jump. You can use the Force Plate with any of our interfaces, along with Logger *Pro* for computers, DataMate for TI calculators, and Data Pro for Palm OS.

Here are some things you can do with the Force Plate:

1. Analyze a crouched jump.
2. Do expensive running shoes measurably reduce heel strike force?
3. Compare the measured impulse to the mechanical work done when lifting a large weight.
4. Investigate the forces involved during the technique known as "unweighting" during ski or snowboard turns.
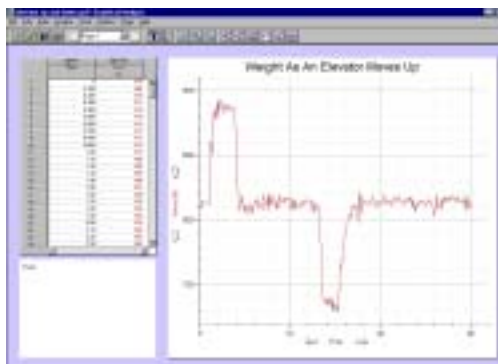
5. Hang the Force Plate on the wall and measure the reaction force as you lean on the plate. Does the wall push back on you?

Check out these physics journal articles and additional activities that can be done with our new Force Plate:

N. P. Linthorne, "Analysis of Standing Vertical Jumps Using a Force Platform," *Am. J. Phys.* 69 (November 2001), 1198-1204.

Ole Anton Haugland, "Physics Measurements for Sports," *The Physics Teacher* 39 (Sept 2001), 350-353.

Ron Cross, "Standing, Walking, Running, and Jumping on a Force Plate," *Am. J. Phys.* 67 (April 1999), 304-309.

Force Plate
Order Code FP-BTA **$199**
Order Code FP-DIN **$202**

NEW! Real-World Math Books

Real-World Math with Computers

by John Gastineau, Chris Bruningsen, Bill Bower, Linda Antinone, and Elisa Kerner

Real-World Math with CBL 2™ and LabPro

by John Gastineau, Chris Bruningsen, Bill Bower, Linda Antinone, Elisa Kerner, and Will Cortez

These lab books contain 29 activities that explore real-world applications of math concepts. Concepts from algebra through calculus are covered. Activities cover a wide variety of topics, including linear, quadratic, and periodic functions, statistics, systems of equations, and many more. A variety of sensors are used, including motion detectors, temperature sensors, force sensors, and microphones.

Check out our web site or our 2002 catalog for our new math packages!

Real-World Math with Computers .... RWC-LP **$45**
Real-World Math with CBL 2™ and LabPro .... RWCALC **$25**

Proper Sensor Storage

We are often asked if any of our sensors require special storage. There are a few sensors that need to be stored properly in order to stay in good condition:

- Oxygen Gas Sensors should be stored upright. This is easily done by storing them in the bottle in which they were shipped.
- Dissolved Oxygen Probes should have the filling solution emptied and rinsed out, then stored dry.
- pH Sensors should be stored in the storage solution provided. Replacement solution can be made (10 g KCl in 100 mL pH 4 buffer solution) or purchased (order code PH-SS, 500 mL for $12).
- Ion Selective Electrodes should be stored in the humid environment of the storage bottles in which they are shipped. If the sponge at the bottom of the storage bottle dries out, simply add a few drops of distilled water.

This is just one of the many items that can be found in our new Vernier Technical Information Library (TIL) on the Support page of www.vernier.com.

Current Probe and Differential Voltage Probe

We recently changed the way we handle what used to be called our Current & Voltage Probe System. We have replaced this system with two separate sensors, with all the electronics built into them:

Current Probe (order code DCP-BTA, $37)
Measures currents of –600 to +600 mA. This sensor is electrically the same as the current sensor in the Current & Voltage Probe System.

Differential Voltage Probe (order code DVP-BTA, $35)
Measures potentials between –6 and +6 volts. The leads on this sensor are isolated from ground. This sensor is the same as the voltage probe part of the Current & Voltage Probe System, except that the input impedance has been increased to 10 MΩ.

Voyage™ 200 Personal Learning Tool

(available June, 2002)

The TI-92 Plus is being replaced by the Voyage 200. In addition to having all of the features of the TI-92 Plus, the Voyage 200 has three times the Flash ROM of the TI-92 Plus. It comes preloaded with all of these Apps: Cabri Geometry, CellSheet™, Finance, The Geometer's Sketchpad®, Polynomial Root Finder, Simultaneous Equation Solver Statistics with List Editor, and StudyCards™. A new icon desktop makes it easy to navigate and organize your Apps. A real-time clock on the Voyage 200 keeps track of time. A USB TI-GRAPH LINK™ cable is included for computer connectivity. All this for the same price as the TI-92 Plus. (Order Code TI-VOYAGE, $175)

Analog Out – A Free Function Generator with every LabPro!

One of the best features of LabPro is that it has flash memory, so its operating system can be updated to add new features. We are excited about the recent addition of analog output and a function generator. The frequency range of the function generator is 0.5 to 200 Hz. The current output is limited to 100 mA, but you can do some great experiments with this analog-output line. Here are some things we have tried:
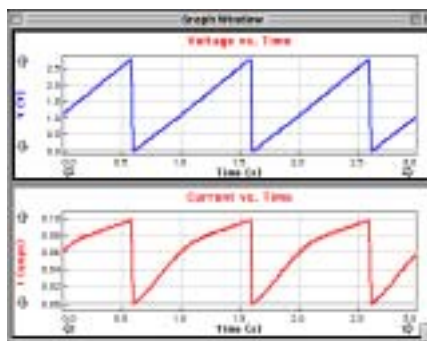
- Drive a spring on a mass hanging from a hook glued on to a small speaker. You can explore resonance.
- Drive a stretched string from a hook glued onto a small speaker. When LabPro produces the right frequencies, you can produce a number of standing wave patterns.
- Study RLC circuits.
- Work with a sonometer to study vibrations in strings.
- Study the current in a small lamp driven by a varying voltage. See the sample graph below as one example.
- Control the DC voltage level as part of an experiment.

All of these experiments can be done using the analog-out signal directly from CH4 of LabPro (no amplifier is required). You can add an amplifier if you want to increase the current beyond 100 mA.

You need two things to use the analog-output feature of LabPro, and both are free:

- LabPro operating system 6.22 or newer. This is a free download from our web site.
- A program to generate the analog-output pattern. There are several options (all available on our web site):
  - calculator program for all of the TI graphing calculators
  - a simple Macintosh or Windows program that emulates a function generator
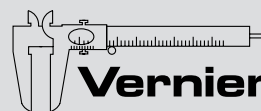 - a LabVIEW™ VI (with source code) that you can use and modify

Future versions of Logger *Pro* software will have analog-output control included.

*Voltage and current in a small lamp.*

Innovative Uses

If you use ultrasonic motion detectors, you should definitely read the article "Physics and Technical Characteristics of Ultrasonic Sonar Systems," in the January 2002 issue of *The Physics Teacher.* Dan MacIsaac (Northern Arizona University) and Ari Hamalainen (University of Finland) do a great job explaining how these complex sensors work. Understanding how the sensor works can help you avoid some of the pitfalls of using it.

———————————————

Speaking of motion detectors, the December 2001 issue of *The Physics Teacher* described a unique way to use them. In "Obtaining the Length and Width of a Rotating Box with a Motion Detector," Tom Lough (Murray State University, Murray, KY) describes placing a cardboard box on a turntable and having it rotate. Aim a motion detector at it and then graph distance *vs.* time as the box rotates. You get some interesting results, and there is a lot of geometry and trigonometry to be learned in the process of determining the box's dimensions from these graphs.

———————————————

Marvin Giesting (Connersville HS, IN) arranged to have one of his former students, Rusty Ammerman (who works for "Jumpin' Indiana") skydive with our LabPro, 3-Axis Accelerometer, and Barometer. Graphs of a sample jump are shown below.

———————————————
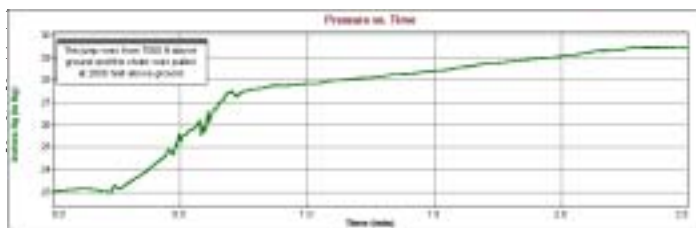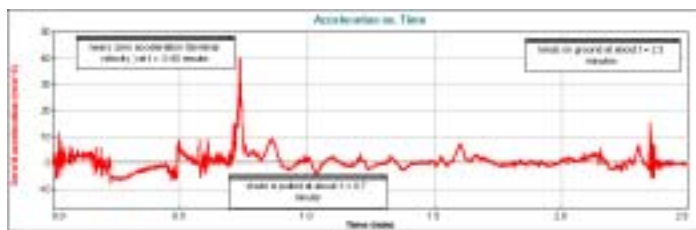
In "Simple-Pendulum Lab with a Twist" in the March 2002 issue of *The Physics Teacher,* Ben Szapiro, University of the South (Sewanee, TN) uses our force sensor to do a different study of a pendulum. Instead of just measuring the vertical pull on the pendulum string, he measures the horizontal force.

———————————————

The use of LabVIEW in physics teaching is gaining in popularity. The January 2002 issue of *American Journal of Physics* included an article by T.D. Usher and P.K. Dixon (California State University San Bernardino) entitled "Physics Goes Practical," in which they discuss using LabVIEW as part of a new applied physics course. Check our web site at www.vernier.com/labview/index.html for more details and free programs for using LabPro with LabVIEW.

Internet Data Collection

Kyle Forinash and Raymond Wisman (Indiana University Southeast, New Albany, IN) describe their use of LabPro and other interfaces in the article "Simple Internet Data Collection for Physics Laboratories" in the April 2002 issue of *The American Journal of Physics.* The web site for their software is http://Physics.ius.edu/~kyle/K/DataCollect/LabPro.html We borrowed their Linux C++ code and have been experimenting with data collection over the internet. If this is of interest to you, open a Telnet session to host www1.vernier.com and port 1088. This will display the data streaming out of the LabPro in our classroom that is reading the light level, air temperature, barometric pressure, and relative humidity at half-second intervals.

We have also been experimenting with LabVIEW 6.1, which supports Remote Panels. Remote Panels makes sharing data, and even controlling data collection, over the internet very easy. For more details on remote data collection with LabPro, go to www.vernier.com/labproremote.

———————————————

Stevie Steiner, a former student of Earl Feltyberger (Nicolet HS, WI) and currently a sophomore at the University of Wisconsin, has been studying the
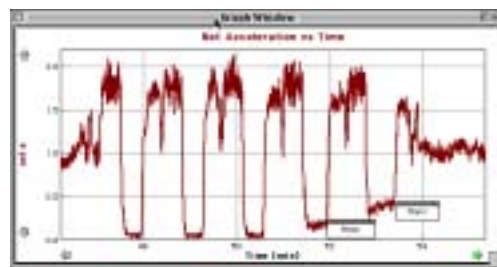
formation of aerogels in microgravity conditions. He has been able to get NASA to fly him and his equipment, including our 3-Axis Accelerometer, aboard the "vomit comet." Here is a sample graph showing acceleration during several parabolic flight paths. A typical parabola is 23-30 seconds of 0 g followed by 45-90 seconds of 1.8 g. (They say too many people pass out at 2 g.) The last two parabola were done to get lunar gravity (1/6 g) and Martian gravity (1/3 g). You can see these on the graph.

———————————————

Jake Niemand, a high school student from Montevideo, MN, has used LabPro and some of our sensors for some remarkable data collection. He constructed TOTO (TOtable Tornado Observatory) II. TOTO II is loaded into a pick-up truck and driven to a location where severe weather is approaching. It can be left at the location to record data and then picked up after the storm. Jake hopes the data collected will help engineers and architects design houses with a "tornado-proof" room for safety and help give meteorologists an idea of the complexity of a storm. Here is a photo of TOTO II. For more info on this project and sample data, go to www.kramfm.com/samlab.

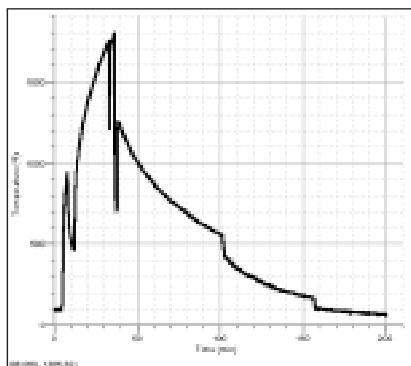*TOTO II*

Temperature in a Kiln

What teacher hasn't heard the age-old complaint, "I'm going to be an artist. Why do I need to know science?" Whether the medium used is film, ceramics, paint, or glass, science actually plays an important role in the outcome of the piece. Glass artists, for example, use kilns to bring glass to temperatures exceeding 1300° F. Glass has unusual characteristics at varying temperatures which the artist can utilize to produce beautiful products. The artist is confined by the laws of nature and must be aware of heating and cooling rates, as well as soaking temperatures. Violation of these laws results in shattered glass, frustration, and loss of time and money.

It is easy to record the temperature of a kiln using a thermocouple. A thermocouple is a device that measures temperatures over a wide range. A simple thermocouple has two wires made of different metal alloys: chromium-nickel and aluminum-nickel. They are jointed together at two junctions. Whenever these two junctions are at different temperatures, a small voltage is produced between them. This phenomenon is called the Seebeck Effect. The voltage produced is proportional to the difference in the temperatures of the two junctions. By placing one wire inside the kiln and one in an ice bath, the kiln temperature can be easily monitored.

The production of stable glass requires a cooling rate that allows particles to arrange themselves with minimal stress. Since glass is considered to be a supercooled liquid, it has no specific melting point. It makes a transition from being more solid-like to more liquid-like. Soda-lime glass (used for windows and bottles) has a glass transition of around 550° C. Glass used for test tubes and ovenware contains boro-silicates and has a higher glass-transition temperature, making it withstand heat better.

Mike Ferrance, a physics instructor from Rhode Island, is a hobbyist glass artist. He used a LabPro and our Thermocouple (order code TCA-BTA, $37) to produce this graph of the temperatures inside his kiln. The sharp drops in temperature occur during venting — opening the kiln to check the status of the glass. The areas of relatively constant increases and decreases in

Kiln temperatures measured with a LabPro and our Thermocouple.

temperature are called ramps. Notice that the rate of heating is much greater than the rate of cooling. When glass is cooled too rapidly, stresses occur. If the outside cools much faster than the inside, the outside contracts at a different rate, causing stress and possibly breakage. Some pieces take weeks to make and cost thousands of dollars, making it crucial for glass artists to watch the ramps carefully. You can find out more about glass art and its science connections by e-mailing Mike at Michael_Ferrance@brown.edu.

Bits and Bytes

Free 24-Hour Technical Support On-Line!
The Vernier Technical Information Library (TIL) is a new resource to help you find answers to your technical questions. Simply click on the Support button at www.vernier.com and you will see the TIL search field. Type in the key word(s) you are looking for, and all of the relevant entries will be displayed. Also found on this Support page are the specifications and calibrations for all of our sensors, free downloads of sensor booklets, and the e-mail addresses of our Technical Support staff, should you prefer personal assistance.

———————————————

Media & Methods Award for LabPro
Vernier LabPro will be featured in the *Media & Methods* magazine Awards Portfolio issue (May/June 2002). Vernier Software & Technology is recognized "for commitment and creativity in the production of outstanding educational materials and services for educators worldwide."

———————————————

Best Places to Work in Oregon Award
Vernier Software & Technology was selected as one of the 100 Best Places to Work in Oregon for 2002. This is the third year in a row we have received this award. This rating was based on surveys completed by both management and employees.

———————————————

Vernier Electronic Newsletter
We recently e-mailed our first electronic newsletter. We will send these out a few times a year announcing new products, updates, and workshops. If you did not receive it, but want to, please e-mail info@vernier.com. On the other hand, if you do not want to be on this list, simply let us know. We do not want to send unwanted e-mail.

———————————————

Web Site Updates
Faster downloads from the Vernier web site! We recently upgraded the speed of the downloads from our web site. If you haven't tried out Graphical Analysis 3 yet, download a demo copy for free!

### *Fifteen Years Ago in this Newsletter…*

In the spring of 1987, we included a compatibility report about using our products on the new Apple® IIGS and Laser 128 computers. We also mentioned that we were going to convert some of our programs to the IBM PC.

**A new experiment idea for your Gas Pressure Sensor!**

Fun with Balloon Pressure

Do you know how the pressure inside a balloon changes as it is blown up? The more air you blow in, the higher the pressure, right? Not exactly. We have found that many students (and sometimes teachers!) have misconceptions when it comes to the pressure inside a balloon. Here is one way it can be measured:

Assemble the apparatus shown here. We use the rubber stopper that comes with our Gas Pressure Sensor. Pull the two tapered valve stems out of the large end of the stopper and insert them into the small end. Attach the balloon to the large end of the stopper. Connect the Gas Pressure Sensor to one of the stems. The figure shows the end of a bicycle pump connected to the other valve, but you can inflate the balloon by blowing directly into this valve as well. Begin data collection, then start blowing into the valve (or pumping with the bicycle pump).
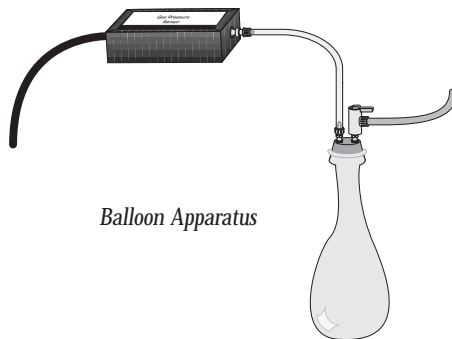
Balloon Apparatus
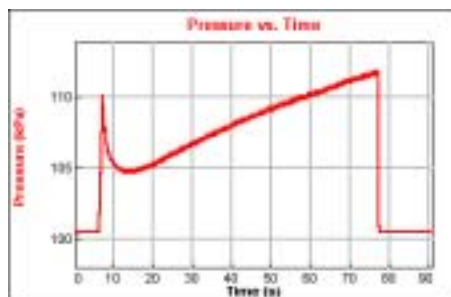
Graph of pressure as balloon is inflated

Our results are shown in this graph. Notice that the pressure increases quickly at first, but once the initial stretching of the balloon occurs, the pressure drops back down. As the balloon gets larger and tighter, the pressure begins to rise again until it eventually pops. (If you are blowing into the balloon, you may not be able to blow hard enough to pop it.)

An interesting demo can be done using this information. Two balloons, one fully inflated and one partially inflated, are connected via a tube with a valve in it, as demonstrated by Dave Vernier at right. When the valve is opened, most people expect both balloons to reach the same size. Instead, the small balloon gets smaller. Why? The graph provides the answer. The smaller balloon is behaving like our balloon did in the 7- to 8-second section of the graph. The larger balloon is like the 15- to 20-second section. The smaller balloon, with a higher pressure, will force its air into the larger balloon.

Tombstone Science

Here lies Isaac Newton - A body at rest tends to stay at rest.
Here lies Euclid - or at least his elements.
Here lies Fermat - There isn't enough room for a proper epitaph.
Here lies Heisenberg - maybe. If we indeed knew precisely where he was, we would not know where he is going.

Contributed by John L. Hubisz, Physics Department, North Carolina State University

Science Humor

TI Connectivity Kit USB for Windows/Mac

The TI Connectivity Kit USB is replacing the TI-GRAPH LINK for USB. This kit includes a USB TI-GRAPH LINK cable that works on Windows or Macintosh computers. The Graph Link cable is your connection between a TI graphing calculator and our Graphical Analysis 3 software or TI software. (Order Code GLC-USB, $17)

P.S. For a short time only, Texas Instruments is including a $15 rebate coupon in the package. What a deal!

TI-Presenter

The TI-Presenter video interface is used to project the screen of a ViewScreen™ calculator directly through the video input of any conventional TV, VCR, or projector. The price of the TI-Presenter has just been reduced from $297 to $235.

Workshops

There are a number of spaces still available in the Chautauqua Courses on active physics learning coming up in this spring and summer. Priscilla Laws, Ron Thornton and David Sokoloff are offering these courses May 9-11 at Dickinson College and June 6-8 at University of Oregon. See http://www.engr.pitt.edu/chautauqua to register or for more information.

Modeling Workshops for high school and junior high teachers will be held this summer in Arizona, California, Hawaii, Kansas, Missouri, Wisconsin, Arkansas, Florida, North Carolina, and Pennsylvania. Workshops range in duration from 1-week (usually focusing on kinematics) to 4-week workshops that thoroughly treat the pedagogy and content for the mechanics portion of a physics course. For detailed information, visit http://modeling.asu.edu.

LabVIEW Workshops

We will be offering a free, all-day workshop on using LabVIEW with Vernier LabPro on May 21 at our office. Also, we will be presenting a session on LabVIEW with LabPro at the AAPT meeting in August. Contact Dave Vernier at dvernier@vernier.com for details.

VERNIER SOFTWARE & TECHNOLOGY

Summer Workshop for Computers and Handhelds

Join us for one of our one-day, summer workshops to learn how to integrate our data-collection technology into your chemistry, biology, physics, math, middle school science, physical science, and earth science curriculum. Our products can be used with computers, TI graphing calculators, and Palm handhelds. You will have an opportunity to collect data on all of these platforms.

All workshops are from 8:00 a.m.–3:30 p.m. and include a light breakfast, lunch, and lab handouts.

The cost of the workshop is $50 for the training only or $250 for the training package. The $250 training package includes training, Vernier LabPro®, Logger *Pro*®, and a Temperature Probe (a $364 value!).

You will also have the opportunity to earn one credit hour through the Portland State University Center for Science Education (approximate cost $70, payable to PSU). The credit hour will be awarded to participants who attend the workshop and elect to complete a follow-up project using electronic sensors. A brief lesson plan and a description of how you plan to integrate this project into your curriculum will be required.

Here's where we'll be this summer:

June 11—Embassy Suites Hotel, Denver South—Denver, CO
June 13—Fort Collins Marriott—Fort Collins, CO
June 18 & 20—Vernier Software & Technology—Portland, OR
June 25—Sheraton Nashua Hotel—Nashua, NH
June 27—Newton Marriott Hotel—Boston, MA
July 9—Crowne Plaza Hotel-Westshore—Tampa, FL
July 11—Sheraton Suites Hotel, Cypress Creek—Fort Lauderdale, FL
August 1—Doubletree Hotel Boise Riverside—Boise, ID
August 5—University of Montana—Missoula, MT
August 13—Embassy Suites Hotel-San Diego Bay—San Diego, CA
August 15—Embassy Suites Buena Park—Anaheim, CA
August 20 & 22—Vernier Software & Technology—Portland, OR

Our workshops fill up fast, so sign up today to secure your spot! The first three teachers from any one school may register; others will be placed on a waiting list. Sign up on-line at www.vernier.com/workshop
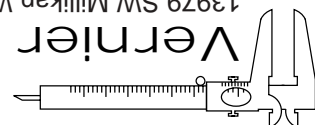
Applications must be received no later than one week prior to the scheduled workshop date.

Printed on Recycled Paper