



The Caliper is a publication for users of Vernier products



The Caliper

Volume 21 Number 2

Fall 2004

New! Salinity Sensor Enhances Water Quality Testing

We are pleased to announce the Salinity Sensor as the latest in our outstanding line of water-quality sensors. This sensor easily and accurately measures the total-dissolved salt content in water. Salinity is an important measurement in seawater or in estuaries where freshwater from rivers and streams mixes with salty ocean water. The salinity level in seawater is fairly constant, at about 35 ppt (35,000 mg/L), while brackish estuaries may have salinity levels between 1 and 10 ppt.

Salinity is of interest in bodies of water where seawater mixes with freshwater, since aquatic organisms have varying abilities to survive and thrive at different salinity levels. Saltwater organisms survive in salinity levels up to 40 ppt, yet many freshwater organisms cannot live in salinity levels above 1 ppt.

The new Vernier Salinity Sensor has a range of 0 to 50 ppt. This means it can be used to measure water with a wide variety of salinities, from freshwater to ocean water, and even hyper-saline environments.

The Salinity Sensor measures the ability of a solution to conduct an electric current between two platinum electrodes.

In solution, the current flows by ion transport; therefore, an increasing concentration of ions in the solution will result in higher salinity values. The new Salinity Sensor is an "auto-ID" sensor, which means that it is automatically identified by the software and a calibration is automatically loaded. The calibration that comes stored on the sensor is excellent, due to our new process of individual factory calibrations.

Salinity Sensor | order code SAL-BTA | **\$88**



Collecting salinity data of brackish water with the Salinity Sensor

Lights! Camera! ACTION!

Using Videos in Logger Pro®

One of the most exciting features of Logger Pro 3 is the ability to incorporate digital video within the program. Two significant uses of this feature are

- 1) A movie can be recorded while sensor-based data are collected. The movie can then be inserted into Logger Pro, synchronized with the data, and replayed for further analysis.
- 2) A movie can be recorded and inserted into Logger Pro for direct video analysis. This use is independent of any data-collection equipment, with data being collected directly from the movie itself.



Ball-toss experiment using a Motion Detector

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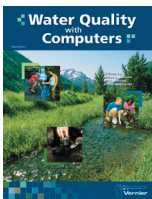
Elementary Corner

Does a Gas Have Mass?

More for Measuring Water Quality

Water-Quality Lab Manuals

Our water-quality lab manuals have been extremely popular since they were first published five years ago. *Water Quality with Computers* and *Water Quality with Calculators* versions are available. A Palm OS® handheld version can also be obtained on CD by purchasing either *Science with Handhelds* or either of the water-quality books previously mentioned.



Map Your Data Using GIS

Environmental data, such as water-quality measurements, come to life when viewed in the context of their geography using GIS (geographic information systems) software. *Logger Pro* facilitates the data transfer using its “Export in GIS format” feature. Whether you use a laptop, TI graphing calculator, or Palm handheld, *Logger Pro* can format your field data for importing into GIS software.

GLOBE Certification

Several of our water-quality sensors (Stainless Steel Temperature Probe, Conductivity Probe, pH Sensor, Dissolved Oxygen Probe) have been certified for use with the GLOBE program. This exceptional program for student-collected data is worth checking out at www.globe.gov.

Individual Factory Calibrations

Many Vernier sensors, including the new Salinity Sensor, are now individually calibrated before they are shipped. This custom calibration is then saved on the sensor and loaded automatically by the software. You can still perform your own calibrations if you wish, but this new feature makes it unnecessary in many cases.

User-Saved Calibrations

We know that many people like to calibrate their sensors themselves for the utmost confidence in their measurements. Now, with *Logger Pro 3*, when you perform your own calibration, you can choose to save it directly on your auto-ID sensor. Your new calibration is automatically loaded by the software, even if you use the sensor with another computer, calculator, or Palm OS® handheld.



New Science CSI Kit

We have teamed up with Apple Computer and Bodelin Technologies to create a new Concentrated Science Investigation (CSI) Kit. This is a starter kit for data collection that includes a ProScope USB microscope, Go!Link interface, three Vernier sensors, and investigation-themed activities. Students are challenged to solve mysteries including “The Case of the Falling Gargoyles,” “The Case of the Bad Lunch,” and more. For more information, see www.apple.com/education/k12/curriculum/solutions/science/cskit.html.

New at www.vernier.com

Are you trying to explain to one of your colleagues just how cool data collection is? Well, we have the tool for you. Try our new animated demos that show how to use Vernier products! If you’ve never used probeware before, these demos are a perfect place to get started! Details at www.vernier.com/getstarted/.

Focus on Educators: Tracy Jackson



Beginning her 6th year of teaching this fall, Tracy Jackson exemplifies all the best qualities of the talented teachers that are just entering the profession. In her five years of teaching biology at Neville High School in Monroe, LA, Tracy has incorporated a number of technologies into her lesson plans, including the use of Vernier data-collection equipment.

Tracy (who is a National Board Certified Teacher in Adolescent/Young Adult Science) has won a number of teaching awards, including the 2002 Louisiana Public Broadcasting National Teacher Training Institute “Technology in Education Award,” and the 2004 RadioShack® National Teacher Award. She has also been named the 2004-2005 Teacher of the Year at Neville High School. What is her secret for success?

Tracy’s approach is to give her students a brief, directed, hands-on introduction to data-collection equipment. Following this experience, they are asked to design and carry out an experiment using one or more sensors. After participating in this inquiry-based approach to training, students have enjoyed great success using the probes to conduct subsequent investigations.

We wish Tracy continued success in the years to come, and look forward to watching her as she achieves it.

New for JASON Teachers!



Two new books of JASON curricula for TI calculators and Vernier probeware will be available this fall. Both of these books will be available at <http://store.jason.org>.

Disappearing Wetlands Texas Instruments Activity Book & CD (\$19.95)

Students use the TI-73 Explorer graphing calculator and Vernier probeware to conduct five different hands-on experiments.

JASON Science Adventure: Aquatic Field Study (\$95)

Topics include: water quality, density, salinity, and invertebrate populations. These multimedia supplemental instructional guides cover key middle grade science topics, and complement most science textbooks and curricula.

Interested in trying out two of these activities?

Borrow a JASON Loaner Kit through the TI Workshop Loan Program. The kit contains a TI-73 Explorer calculator, CBL 2, and two hands-on activities. See <http://education.ti.com/jason> to learn more about this offer.

Texas Instruments and the JASON Foundation for Education, in cooperation with Vernier, have created a series of hands-on activities that engage students in real world, inquiry-based learning. These sample lessons extend the JASON curriculum, bringing out the math in science and giving students opportunities to explore key concepts with powerful, but simple, TI and Vernier products.

Using Videos in Logger Pro

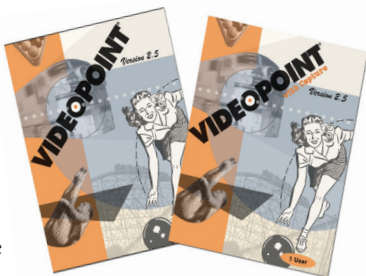
(Continued from page 1)

Both of these uses are very exciting, and lead to numerous educational opportunities. Logger Pro comes with an extensive series of videos, which we hope will inspire you and your students to collect your own videos. However, since most science and math teachers have little experience taking and importing movies into a computer, we are asked many questions about this process.

To answer these questions, we have prepared a booklet called "Video and Logger Pro—A Guide to Getting Started," which is free from the "downloads" page on our web site at www.vernier.com/downloads.

Using VideoPoint® and VideoPoint® Capture

As mentioned above, video analysis is a process in which position and time data are collected from digital videos. Logger Pro software has basic video analysis, but advanced video-analysis capabilities are available in VideoPoint software, which is now available from Vernier.



VideoPoint Capture

If you decide to record and analyze your own movies, VideoPoint Capture software simplifies capturing video from digital sources and converting them into analyzable movies. VideoPoint Capture is compatible with most video-capture hardware on both the Macintosh® and Windows® platforms. With this powerful software tool, real-world movies can be captured by your students, and then analyzed using Logger Pro or VideoPoint.

VideoPoint and VideoPoint Capture can be purchased separately or in combination. The order codes and pricing for various combinations are below. For more details about VideoPoint and VideoPoint Capture, go to www.vernier.com/soft/vepoint.html.

License	VideoPoint only (order code/price)	VideoPoint Capture only (order code/price)	VideoPoint with VideoPoint Capture (order code/price)
Single-user	L-VP / \$198	L-CAP / \$99	L-VPCAP / \$225
5-user	L-VP5 / \$414	L-CAP5 / \$299	L-VPCAP5 / \$513
10-user	L-VP10 / \$738	L-CAP10 / \$495	L-VPCAP10 / \$990
30-user	L-VP30 / \$1,530	L-CAP30 / \$900	L-VPCAP30 / \$1,800

Are You a "Power User"? Want to Become a Power User?

Many teachers have told us how much they are enjoying our e-mail updates. In fact, we have had requests for more frequent updates than our promised maximum of 5 per year. If you would like to stay in the know on the latest news, updates, and announcements, sign up for our new Power User list. Power Users get notified as soon as new versions of our products are available and get more Vernier news more often. To respect everyone's privacy, the only way to get on the Power User list is to sign up on our web site at www.vernier.com/poweruser.

Vernier and the College Board®

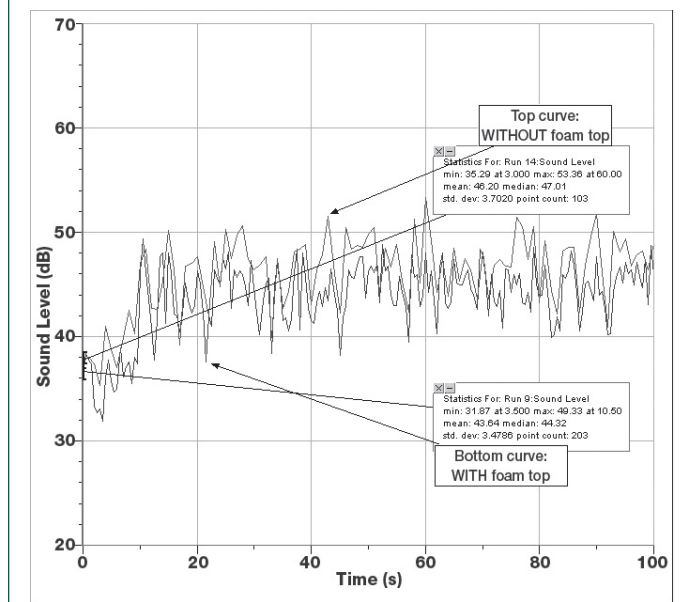
Vernier Software & Technology and the College Board®—two long-time supporters of excellence in education—will collaborate in a joint sponsorship program to improve support for innovative teaching practices, including the use of technology in science and math classrooms. The College Board is a not-for-profit membership association whose mission is to connect students to college success and opportunity. Among its best-known programs are the SAT®, the PSAT/NMSQT®, and the Advanced Placement Program® (AP®).

The College Board is committed to the principles of excellence and equity, and that commitment is embodied in all of its programs, services, activities, and concerns. Education professionals will find teaching resources and information about the College Board's professional development resources at AP Central (apcentral.collegeboard.com).

Through our association, we will be exploring ways to improve teachers' access to and training in the use of technology, so that all middle and high school students can enjoy high quality, successful laboratory experiences that enhance their understanding of science and math concepts.

Hospital Sound Levels

William Church's students at Littleton High School, Littleton, NH, used our Sound Level Meter and LabPro as tools to help them reduce levels of sound transmitted between cubicles in hospital offices. They experimented with sound damping and masking the sound with background music and came up with a solution that improved the situation. Here is one of their graphs of the change in sound level with additional sound damping.



Elementary Corner

Easy-to-use, fun, educational, and inexpensive—that's what elementary teachers are saying about the new Vernier Go!Temp and Go!Link.

Innovative Use

Tracy Kraus of John Osborn Elementary in Leavenworth, Washington raves about using Go!Temp with her students.

“What a great and easy-to-use product! One of the more interesting things that my elementary students have tried was testing a bath gel that claims to keep your bath water warmer four times longer. A student's mother bought the gel and wanted us to see if it indeed keeps your water warmer. Amazingly enough—it did! It kept the water temperature from dropping as low as regular water in the four minutes that we tested it. However, I wouldn't want to take a bath in this stuff because it turns the water into a gel that reminded me of runny jello! It was very fun to test a product claim using Go!Temp and Logger Lite, and see that there was some truth!”

Check out elementary.vernier.com

- Get free sample labs from *Let's Go! Investigating Temperature*
- Online demo of Go!Temp and Go!Link
- Hands-on workshops at conferences around the country

Go!Temp Receives 5-Star Rating

In a recent review published in *Multimedia & Internet@Schools*, Vernier's newest products for elementary school teachers received straight A's and an overall rating of 5 stars—the highest rating possible.

★★★★★ | Report Card

Installation	A
Content/Features	A
Ease of Use	A
Product Support	A

The reviewer, Sally Finley from Country Hills Elementary, Coral Springs, FL, looked at the *Let's Go! Investigating Temperature* Lab Book, Go!Temp, and Go!Link and asked first graders to participate in one of the experiments.

“I used this program with a small group of first graders who reacted with enthusiasm. They were enthralled watching the computer graph their results as they measured the body temperature of their hands. One experiment led to another and another—the students begged me to keep going and not to quit the lesson.”

The full, two-page review may be found in the September/October 2004 issue of *Multimedia & Internet@Schools*.

A Very Unusual Use of LabPro

Probably one of the most unusual uses of our products we have heard of appeared in the August 2004 issue of *Outdoor Life*, a magazine about hunting and fishing. They used our Sound Level Meter and our 25-g Accelerometer to do a comparative study of hunting bows.

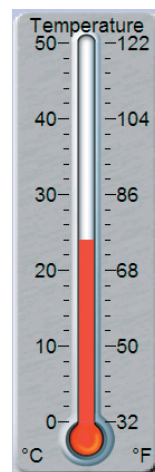
Logger Pro® Keeps Getting Better!

Lots of new features added to Logger Pro 3.3

We're always working to add new features to Logger Pro while guarding against making things too complicated. The new 3.3 version, released in May, adds support for Go!Temp and Go!Link, as well as the Ohaus® Scout Pro balances. You can even use several LabPros, or an assortment of these devices, all at once! Logger Pro, with its ability to import calculator and Palm data, is truly “data central.”

Here are some of the new features to make data collection and analysis easier:

- Collect data from multiple LabPros, Go!Temp, Go!Link, and Ohaus balances simultaneously.
- Continuous detection of auto-ID sensors. This means that you can add and remove sensors after opening files, and Logger Pro will keep up with the changes.
- Keyboard triggering. Now you can start data collection with no delay, simply by hitting the space bar.
- Optional live readouts for the Motion Detector.
- New toolbar icons are clearer than before.
- Single-point calibration option.
- Improved Sensor Confirmation dialog box. When Logger Pro doesn't find the sensors used in an experiment file, you are prompted to connect the missing sensors. When the indicated auto-ID sensors are detected, the dialog box closes automatically.
- Thermometer and gauge meters give you a new way to view data values.
- Optional larger and simplified toolbar buttons.



The update is free for users of any version of Logger Pro 3. Go to www.vernier.com/tech/lpupdates.html to download an updater to Logger Pro 3.3, or call us for a CD. If you are still using Logger Pro or Logger Pro 2, the upgrade to Logger Pro 3.3 is \$50.



Science Humor

Q: If a bear in Yosemite and a bear from Alaska fall into the water, which one dissolves faster?

A: The one in Alaska, because it is Polar.

Q: Two cats are on a roof. Which slides off first?

A: The one with the smaller μ .

Did you know that a radioactive cat has 18 half-lives?

Logger Lite™ 1.2

Logger Lite 1.2 is now shipping with all Go! Temp or Go! Link devices. Logger Lite is a simplified data-collection program designed for younger students. Compared to *Logger Pro*, the toolbar buttons are larger, and shorter menus are easier to navigate. Version 1.2 adds the Events with Entry data-collection mode, which expands the experiments you can do with Logger Lite. Version 1.2 also adds support for Macintosh OS 9.2, in addition to the existing support for OS X and Windows 98, Me, 2000, and XP. Give us a call if you need an upgrade to Logger Lite 1.2.

Finding the Funding

We've revamped the grant portion of our web site, www.vernier.com/grants, to include information on current grant opportunities and the Vernier /NSTA Technology Awards. The grant site is now database driven, which means it can be updated regularly to include upcoming grant opportunities with approaching deadlines. In addition to funding opportunities, you can also find tips for writing a successful proposal and pointers for following up on your grant applications. This site is updated frequently, so check early and check often!

Vernier Technology Awards



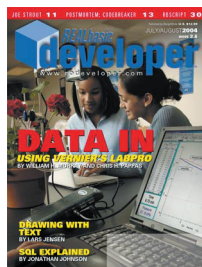
If you are looking for funds to turn your technology dreams into reality, apply for a Vernier Technology Award. Now in its second year, these awards acknowledge the creative use of data-collection technology using a computer, graphing calculator, or other handheld in the science classroom.

Seven teachers (one elementary, two middle school, three high school, and one college educator) will receive an expense-paid trip to the NSTA National

Convention (expenses not to exceed \$1000), a check for \$1000, and \$1000 in Vernier products. Awards will be presented during the Awards Banquet at the NSTA National Convention in Dallas in April, 2005. The deadline for 2005 award applications is October 15, 2004. Go to www.vernier.com/grants/nsta.html for guidelines, a grant application, and profiles of last year's winners.

LabPro Covered in REALbasic Developer

The July/August 2004 issue of *REALbasic Developer* magazine featured an article by William H Murray and Chris H. Pappas entitled, "Data In. Using Vernier's LabPro to collect data from probes." Vernier's data-collection technology was featured on the front cover. This article is a detailed look at how to program LabPro for data collection in the programming language REALbasic. A follow-up article will be in the next issue of *REALbasic Developer*. Check out <http://www.rbdeveloper.com/>. We have sample REALbasic programs at www.vernier.com/realbasic.



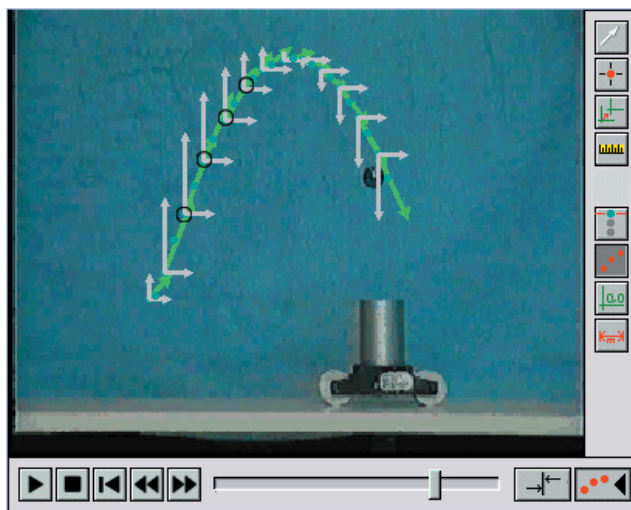
Animated Displays

Have you ever wanted to add velocity vectors to video analysis, or represent a changing temperature or pressure with a moving dot on screen? How about making a barometer screen that includes an arrow that shows the rising or falling trend? The new Animated Display feature of *Logger Pro* 3.3 lets you do these things and more.

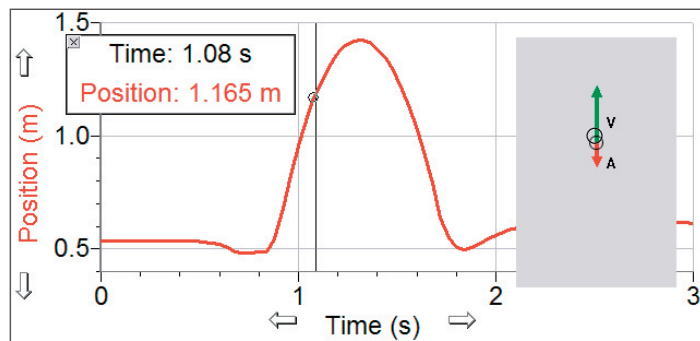
Here are some more things you can do with an Animated Display

- In a ball-toss experiment, you toss a ball over a Motion Detector. The Animated Display can be set to move up and down with the position readings, and have velocity and acceleration vectors superimposed on the moving display.
- Illustrate simple harmonic motion from Motion Detector data.
- Animate a point showing the position of the center of mass along a board as calculated from two Force Plate readings.

You will find examples of animated displays in the Sample Data/Physics folder in *Logger Pro* 3.3.



Velocity vectors with components in *Logger Pro* video analysis



Animated ball-toss experiment with velocity and acceleration vectors

20 Years Ago in *The Caliper*...

We announced our newest program for Apple II: Temperature Plotter, and we discussed compatibility issues with the new Apple IIc. We also announced our first (and only) Commodore 64 program, Precision Timer.



Innovative Uses

At our workshop at the Summer AAPT meeting, teachers did some of the following experiments. You may want to try some of these with your classes.

- Use two Vernier Photogates to measure the velocity of a golf swing. To make a wider gate, shine a laser pointer into the outer sensor of the Photogate.
- Sew a 3-Axis Accelerometer to the back of a bike glove to analyze a badminton serve. Use *Logger Pro 3.3's* new animated meters to show real-time vector motion.
- Mount a Dual-Range Force Sensor, TI graphing calculator, and LabPro onto a bicycle wheel to investigate centripetal force. A Magnetic Field Sensor and a magnet can be used to measure the angular velocity of the wheel.
- Wrap a dowel rod in aluminum foil to use as a battery replacement slug for a toy car. Analyze the reduction in the car's velocity when using the slug in place of one battery.
- Use the video-analysis feature of *Logger Pro 3.3* to investigate the flight path of a ping-pong ball launched from a catapult made from spare LEGO™ parts. A ping-pong ball is light enough to exhibit measurable air resistance.
- Remove the hook from a Dual-Range Force Sensor, and attach a small, wooden platform for measuring the liftoff force of a toy popper.
- Support a 2 m board between two Force Plates to determine a student's center of mass. You can animate the motion of the center of mass using the new animated display feature. Try standing, sitting, and laying down with arms and legs extended into the air.

See www.vernier.com/physics for complete instructions, as well as sample data for these labs.

New Way to Do Egg-Drop Contests!

Danielle Spaete (Pleasant Valley HS, IA) came up with a great new way to do egg-drop contests using our Force Plate.

Students are given a 5-gallon bucket to be placed on a Force Plate. They then drop a basketball from a height of 1.5 meters into the bucket. After observing the forces applied by the basketball, students are challenged to build an "air bag" out of newspaper to help cushion the fall.

In a traditional egg-drop experiment, there isn't any measurement; the egg either breaks or it doesn't, and you only get one chance. With Danielle's method, students get quantitative results, and they can do the experiment over and over again. As an added bonus, the cleanup is a cinch!

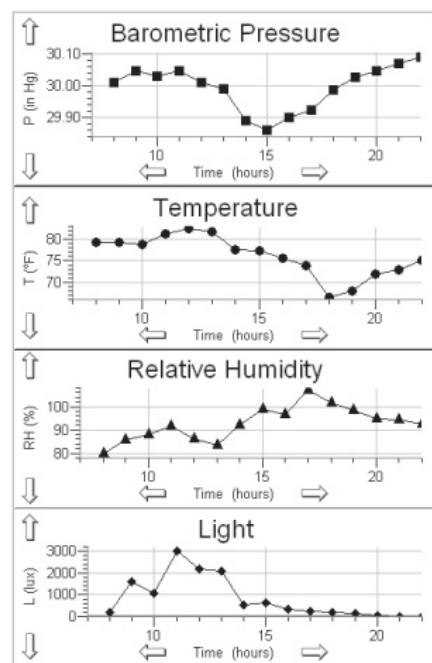


Hurricane Charley

Curt Witthoff, Secondary Math/Science Specialist for Collier County Public Schools in Naples, FL, recorded these data as Hurricane Charley pounded the coastline near his house. He used Vernier sensors with a LabPro and TI graphing calculator. The equipment was placed in a box with the sensors exposed, and left on his patio.

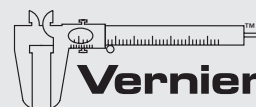
The times on the x-axis correspond to the 24-hour clock on August 13, 2004. The pressure data tells us that the eye of the hurricane passed closest to Naples around 3 p.m. The temperature decreased as the storm approached and continued to drop until 6 p.m. Relative humidity changed inversely with temperature, as expected. The relative humidity readings exceeding 100% were most likely caused by condensation on the electronics. When the temperature increased and the condensation evaporated, the readings came back into range. Light levels dropped as Charley approached and stayed fairly dark until the sun set around 8 p.m.

Thanks for the interesting data, Curt. We are very glad you and your equipment survived the storm!



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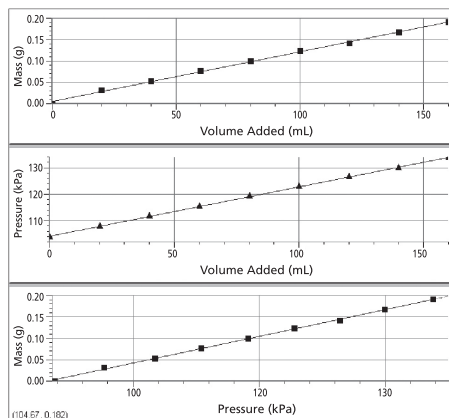
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Does a Gas Have Mass?

“Of course,” you will say. But what do your students think when you first tell them about Avogadro’s law? In many cases, it is quite difficult for them to perceive that equal volumes of gases, at the same temperature and pressure, contain the same number of molecules. Do these invisible molecules really have appreciable masses that they could measure? What happens if you squeeze additional volumes of gases into a container? Does the mass increase? What happens to the pressure of the gases? Is the increase in mass related to the increase in pressure? Here is a simple experiment that can answer these questions, and help students hypothesize about this very abstract concept.

This experiment uses a Vernier Gas Pressure Sensor and its accessories, *Logger Pro 3*, an Ohaus Scout Pro balance, LabPro, and a plastic bottle. In the first trial, students measure the mass of a plastic bottle as more and more air is added to the bottle using a syringe. Students add air in 20 mL increments. They use the Events with Entry mode of *Logger Pro* to record the mass and enter the corresponding volume of air present in the container. In the second trial, students repeat the experiment using a Gas Pressure Sensor. They add air to the bottle using the same techniques used in Trial 1, and then record pressure readings and corresponding volumes of air. Go to www.vernier.com/chemistry for complete instructions for this experiment.

Conclusion By examining the plot of Mass vs. Volume Added, students can see that adding equal volumes of gases to the same container appears to increase the mass by equal increments (due to the linear relationship between mass and volume). For at least one gas composition (air), these data are certainly consistent with the assumption, attributed to Avogadro, that equal volumes of gases, at the same temperature and pressure (before compressing), contain equal numbers of molecules. It should also be noted that these data enable students to easily calculate the density of air from the slope of the linear fit of the plot.



Mass, pressure, and volume data

The second run is interesting because it has a similar linear relationship, but this time between Pressure and Volume Added. This behavior is consistent with kinetic molecular theory, since greater numbers of molecules should result in proportionally greater numbers of collisions (and therefore, increased pressure).

Finally, since the two trials were run using precisely the same procedure of adding 20 mL volumes, students might find it interesting to view a plot of Pressure vs. Mass. They can do this by adding a new graph in *Logger Pro*, and then choosing to plot Pressure on the y-axis, and Mass on the x-axis. These data show a linear relationship between Mass and Pressure.

There are many possible extensions of this experiment. If, instead of using air samples in the syringe, you were to substitute other pure gases, say oxygen or carbon dioxide, students could see that the ratio of slopes is related to the ratio of molecular weights of gases. Note that because the gases are compressed into the same container each time, it is not necessary to take buoyancy of the gases into account (normally a cumbersome step).

Vernier Sensors Get on the Bus



Ron Bowerman introducing teachers to the A.P.P.L.E bus

The A.P.P.L.E. Bus (Awesome Practical Powerful Learning Experience) is a project that Deb Wickerham, Barb Tidd, Ron Bowerman (Department Chair, St. Wendelin Catholic HS), and Mike Eier designed to aid instructional water-quality studies in the field. The bus is equipped with a Vernier Water Quality Deluxe sensor package, Data Pro Palm software, and *Logger Pro 3* software. All of this equipment is used for the study of forest, meadow, stream, and lake ecosystems.

The bus is based at Van Buren State Park near Van Buren, Ohio, where Ron Bowerman is a natural history and technology aide. Ron will assist other schools in Hancock and surrounding counties, home-school students, youth organizations, and even senior citizens to use the bus. Vernier sent an experienced teacher/consultant, Jackie Bonneau, to train the 40 teachers, home-school parents, Ohio EPA water personnel, school technology coordinators, and university interns in a water-testing technology session on August 3rd at the park.

Immediate plans are to take the bus to local schools to make use of school grounds or land labs. Ron says that this will be a tremendous savings to schools in transportation costs and technology expenses. Schools can also use the bus at Van Buren State Park and benefit from the park’s natural history.



Nationwide, Free, Hands-On Evaluation Workshops

Join us for one of our free, 4-hour, hands-on workshops to learn how to integrate our computer and handheld data-collection technology into your chemistry, biology, physics, math, middle school science, physical science, and Earth science curricula.

The workshops include lunch or dinner and lab handouts. For up-to-date information and registration, dates, times, and locations, visit www.vernier.com/workshop/evaluation.html.

No time to attend a course this fall?

Try our online course

No time or travel funding to attend a face-to-face course this fall? Try an online course! Vernier and T³ have produced an online course based on our popular lab books.

Vernier/T³ Introduction to Scientific Data Collection and Analysis Online

- Earn continuing education units or graduate credit
- 25 modules
- 2 to 8 lessons per module
- \$225 per course per participant


A full course outline and registration information is available at <http://education.ti.com/onlinecourses>.



2004 Award-Winning Year for Logger Pro

Logger Pro won the Worlddidac Award for 2004 and the 2004 Media & Methods magazine Portfolio Award. The Worlddidac Award is the most recognized international prize given to innovative and pedagogically valuable educational products that enhance the quality of learning and teaching.



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