Vernier

K–12 Edition

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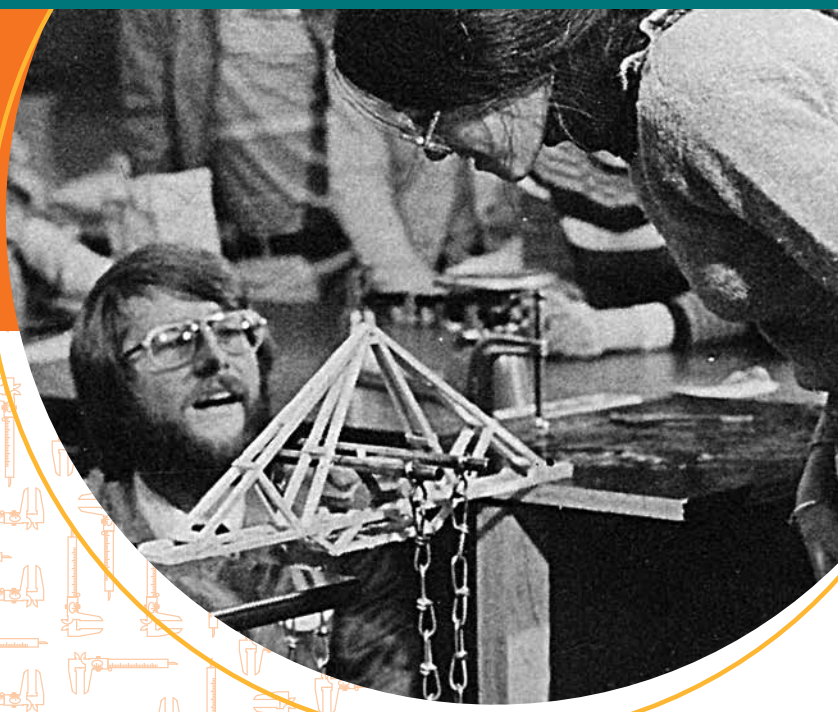
THE Caliper NEWSLETTER



Celebrating Dave Vernier's 50 Years in Education

Dave Vernier's bridge-building contest in 1981

This fall will mark Dave Vernier's 50th year in education. From starting his career as a physics teacher, first at an inner-city school in Cleveland and later in Oregon, to ultimately co-founding Vernier Software & Technology, science education and technology have always been passions for Dave.

Over the past 38 years, Vernier Software & Technology has supported thousands of science educators through the use of reliable hands-on technology. We asked Dave about science education and the changes he's seen in edtech over his years in the business.

Q 50 years is a long time in education. During that time, how did the use of technology in schools get started? How has it changed and evolved?

A When I started teaching, there was not very much of what you would call "technology" being used. Thankfully, there is a lot more and better-quality equipment now.

During my teaching, I loved to do experiments, and the students did a good job taking data, but then they had to graph the data by hand on paper. This often took them a long time to complete. By the time they had the graph completed, they saw very little connection between the graph and the experiment they had done 15 minutes earlier. It was just "busy work" to them. Having a computer graph the data as they are taken makes all the difference in having students understand graphs.

The computer speeds up every aspect of the experimental process—the data collection, the graphing, the data analysis, and even the write-up. Now, students can do an experiment and repeat it with varying conditions to look for patterns, as well as even design their own experiments.

Dave Vernier demonstrates Go Direct® support with Raspberry Pi

Q Throughout this time, what has surprised you most about the use of technology in science education?

A Over the years, I've been surprised at how many people have resisted changing their style of teaching to incorporate technology into their instruction, but I hope this is changing. Today, there is certainly a lot of evidence that hands-on science education is more effective for most students.

I know firsthand how integrating technology can transform instruction. When I was a beginning science teacher, I loved to do demonstrations, but it was difficult to do anything quantitative. I had no way to display a temperature reading or display a "stopwatch time" to the whole class. When I came up with a simple large number display on an Apple II screen, it was a major breakthrough for doing demonstrations.

To learn more about Dave's experience, visit **www.vernier.com/r1916**

Enhance Student Investigations with Data-Collection Technology

Three-dimensional learning is at the core of the Next Generation Science Standards. Finding field-tested lessons that support three-dimensional learning for your elementary and middle school curriculum can be challenging. Fortunately, some great open-source resources are available, one of which is Going 3D with GRC. Going 3D with GRC is a student-centered model that employs the Gather, Reason, Communicate (GRC) instructional framework. GRC lessons use phenomena to engage students and encourage them to ask questions, plan and carry out investigations, and obtain information, so students can develop and use models to explain the phenomena. By incorporating sensor data collection, students can gather reliable, repeatable evidence that they can use to recognize patterns and reinforce explanations.

Two Going 3D with GRC lessons that can easily be enhanced with data-collection technology include So Salty, a 5th grade lesson studying ocean salinity, and Slippery When Wet, a middle school lesson investigating frictional forces.

For more information on incorporating Vernier technology in lessons that support three-dimensional learning, see **www.vernier.com/r1917**

AAPT Photo Contest Winners

The 2019 AAPT Photo Contest, sponsored by Vernier, was held at the summer meeting of the American Association of Physics Teachers in Provo, Utah. Students submitted photos that demonstrate physics concepts, along with essays that explain them. AAPT members voted on the entries. Each year, we are impressed by the creativity of the students who enter this contest. The eye-drawing composition of these images reminds us that art has both an important role in our lives and a valuable connection to science.

The winner of the Contrived Category is Christopher Martin Olson for the photo "Penumbra."

Floria Gu won the Natural Category with the photo "Needle Ice."

For details about the contest and to see all the photo winners for 2019, go to **www.vernier.com/r1927**

Exploring Moments of Inertia with a Centripetal Force Apparatus

Go Direct Centripetal Force Apparatus

Add another layer to your investigation of rotational motion by integrating this activity designed for advanced high school and college physics.

The Centripetal Force Apparatus Moment of Inertia Accessory Kit is an excellent tool to expand the range of experiments and investigations with the Centripetal Force Apparatus or the Go Direct® Centripetal Force Apparatus. This accessory kit includes objects that can attach in different configurations to explore how the distribution of mass affects angular acceleration. It includes a ring and two disks, in addition to the beam that is included with our centripetal force apparatus.

We have created an activity for students to determine the moment of inertia of the various mass configurations.

The initial slope of the angular velocity is used to determine angular acceleration.

The Moment of Inertia experiment provides instructions for setting up the equipment and then collecting and analyzing data. Students are guided through pre-lab activities designed to develop conceptual understanding that students use to make predictions. After conducting their investigations, the students compare the theoretical moments of inertia to their experimental values.

Download this activity for free at **www.vernier.com/r1918**

Self-Driving Vehicles E-book Updated for mBlock 5

We recently revised our *Coding with mBot: Self-Driving Vehicles* e-book to support mBlock™ 5 on Chromebooks and computers (Windows® and macOS®). In the nine coding activities, students are challenged to recreate many of the tasks performed by vehicles in the real world: avoiding obstacles, driving within the lines, autonomous parking, and more. Working programs for all of the challenges are provided.

Learn more about *Coding with mBot: Self-Driving Vehicles* at **www.vernier.com/mbot-msdv-e**

Reactivity of the Alkaline Earth Metals

It can be challenging to find a safe wet lab activity that demonstrates the periodicity of commonly studied properties of the periodic table. In this International Year of the Periodic Table, consider an experiment that incorporates a conductivity probe, such as our versatile Go Direct Conductivity Probe, to help students visualize their data.

For the experiment, have students react alkaline earth metal salts with potassium sulfate (K_2SO_4), and then measure the conductivity of the resulting solution. After data collection, facilitate a student discussion about the relationship between the amount of precipitate in each test tube, the conductivity of the solution, and the position of each alkaline earth metal on the periodic table.

A nice extension is to ask students if other salts besides K_2SO_4 would produce similar results.

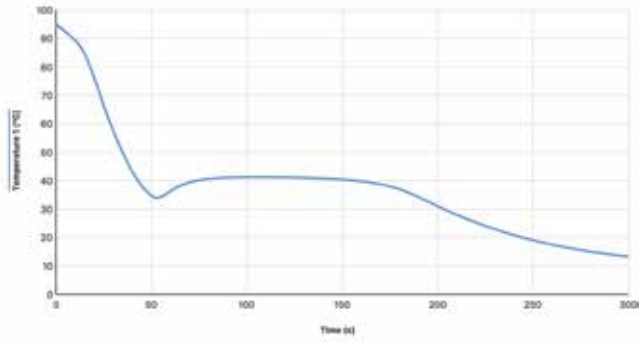
Learn more about this experiment at **www.vernier.com/r1920**

Supercooling to the Max

By Nüsret Hisim

Water is an obvious choice when studying phase change because students regularly encounter phenomena that involve water. While data-collection technology helps students visualize what is happening to the temperature as water cools, the process occurs through a blurry, ice-filled beaker. For my students, the temperature increase of the ice/water mixture in the test tube as it was stirred relative to the external ice water/salt bath was the most surprising aspect of supercooling. This is an interesting aspect of the experiment but doesn't get to the heart of understanding phase change.

Recently, a colleague and I were pondering alternative ways of doing a phase change experiment. We rejected common alternative solutions such as para-dichlorobenzene and acetamide because of safety concerns, and I vaguely recalled the long-past ChemStudy movies that used phenyl salicylate in a variety of demonstrations. Phenyl salicylate is an attractive alternative because it is relatively inexpensive, there are fewer safety concerns, and the freezing temperature is 41.5°C (106.7°F).



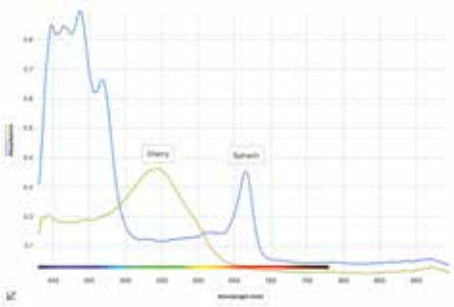
Cooling curve for phenyl salicylate

Learn more about this experiment at **www.vernier.com/r1922**

Investigate Plant Pigments and Olive Oil

Two of our most popular spectroscopy experiments can now be done with Vernier Spectral Analysis® and are available for free.

Spectral Analysis, our free, spectroscopy app, works on Windows, macOS, Chromebook™, iOS, and Android™ devices. You can use this app while collecting data with our SpectroVis® Plus Spectrophotometer and Go Direct SpectroVis Plus Spectrophotometer.



Absorbance of plant pigments from spinach and cherry

Download these experiments for free at **www.vernier.com/r1921**

NEW Go Direct Spirometer

Use our new Go Direct Spirometer to wirelessly record human respiratory flow rate and volume. Students can measure ventilation (the movement of air in and out of the lungs during inhalation and exhalation) while connecting this sensor to a variety of devices via USB or Bluetooth® wireless technology. The wireless capabilities minimize cables getting tangled during human physiology experiments.

As a multi-channel sensor, Go Direct Spirometer can also measure air pressure and respiration rate. With built-in baseline correction, this human physiology sensor makes spirometry a breeze.

You can find free experiments and learn more about Go Direct Spirometer at **www.vernier.com/gdx-spr**

NEW Go Direct Blood Pressure

Record blood pressure parameters on a Chromebook, or any compatible device, with our new Go Direct Blood Pressure Sensor. This versatile human physiology sensor connects to a variety of devices via USB or Bluetooth® wireless technology and uses the oscillometric method to calculate blood pressure non-invasively.

Without any wires or cables to trip you up, you and your students can now measure blood pressure anywhere you want. Simply attach the cuff to the subject and connect the sensor to a device running Graphical Analysis™ 4. Pump up the cuff and, as the cuff pressure decreases, the student's blood pressure parameters, including mean arterial blood pressure, systolic and diastolic blood pressure, and pulse rate, are automatically reported.

You can find free experiments for Go Direct Blood Pressure and sample data at **www.vernier.com/gdx-bp**

Instructing with Relevant, Real-World Applications: Evaluating Plastic Waste in the Environment

By Sara Tallarovic

Plastics in the environment are prominent in the news lately. As plastic waste finds its way into the environment, it seemingly turns up everywhere—from the deepest ocean trench to high mountain tops, and even in the digestive tracts of seabirds and marine mammals. Categorized by size, microplastics are pieces of plastic waste that are smaller than 0.5 cm in size. In contrast, mesoplastics are between 0.5 cm and 10 cm, and macroplastics are the largest at over 10 cm in size. Microplastics are currently in the spotlight, mainly because of their widespread distribution and potential impact on marine ecosystems, including fish nurseries.

If you live or teach near a coastline, it is easy to investigate this phenomenon with your students using our digital microscopes, such as the USB Digital Microscope and the 5 Megapixel Celestron® Digital Imager. Our samples from the beach revealed both primary microplastics (i.e., small pieces of plastic released directly into the environment) and secondary microplastics (i.e., particles that result from the breakdown of larger pieces). Depending on your time and resources, there are two different collection methods that can be an effective way of finding plastics to examine with your students.

Learn more about these collection methods and how to filter the samples at **www.vernier.com/r1923**

NEW Go Direct Sensor Clamp

The Go Direct® Sensor Clamp is an accessory for wand-style Go Direct sensors that helps reduce the chances of accidental drops or submersion in water by students. Ideal for field work, the Sensor Clamp securely holds a sensor, such as Go Direct Optical Dissolved Oxygen, while using it to measure water quality parameters. Using the included lanyard, you can also hang Go Direct Temperature from a bush or tree to measure air temperature.

Learn more about the Go Direct Clamp at **www.vernier.com/gdx-clamp**

Why Use Two Probes When You Only Need One?

Vernier helps you keep experiments simple. Using our multi-channel Go Direct Optical Dissolved Oxygen Probe, students can simultaneously measure dissolved oxygen concentration (mg/L), percent saturation (%), and water temperature. Students normally need to use both a dissolved oxygen probe and a temperature probe to learn how the dissolved oxygen content of water depends on the water temperature. This is an important ecological concept, as some organisms, such as salmon, require high concentrations of dissolved oxygen in their water. Your students no longer need an additional probe to measure temperature when they use a Go Direct Optical Dissolved Oxygen Probe.

We have updated Experiment 19, "Dissolved Oxygen in Water," from *Biology with Vernier*, to include instructions for collecting data more efficiently using this probe.

Simultaneously view three data channels while collecting data with Go Direct Optical Dissolved Oxygen.

This experiment is available as a free download at **www.vernier.com/r1924**

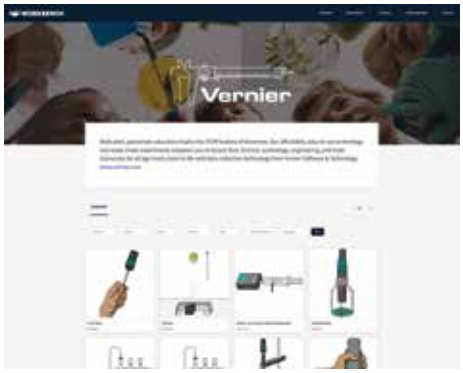
Vernier Sponsors the 2020 KidWind Challenge

We believe in strengthening students' critical thinking skills by encouraging them to create solutions to real-world problems. That's one reason we are a sponsor of the 2020 KidWind Challenge, hosted by the KidWind Project. In addition, a portion of all sales of KidWind products supports the KidWind Challenges held throughout the United States.

The challenges consist of dozens of local and regional competitions across the country during which teams of students test the energy output of wind turbines they design and build.

Learn about this year's winners at **www.vernier.com/r1925**

Experiments Available through Google Workbench



At Vernier, we recognize that educators partner with dependable providers that they have come to know and love. We strive to do the same, which is why we work closely with providers like Google Workbench.

Track progress, access lessons, and keep a living record of work for students through Google Workbench. Free student-ready experiments from Vernier that explore chemistry, biology, physiology, and physics are available through Google Workbench.

Check out our channel on Google Workbench at **www.vernier.com/r1926**

Engineering Contest Now Accepting Entries

Are you using Vernier sensors to introduce engineering concepts or practices to your middle school or high school students? If so, enter the Vernier Engineering Contest for the chance to win a $5,500 award.

For complete rules and to submit an online application and video showcasing your entry, visit **www.vernier.com/grants/engineering**

Vernier Sponsors NABT Ecology/Environmental Science Teaching Award

Vernier is sponsoring the NABT Ecology/Environmental Science Teaching Award, which is given to a secondary school teacher who has successfully developed and demonstrated an innovative approach in the teaching of ecology/environmental science and has carried his/her commitment to the environment into the community.

The award includes $500 toward travel to the NABT Professional Development Conference and $1,000 in Vernier equipment. Applications for the 2020 award will be available on the NABT website soon after the November conference, and the deadline for submission is March 15, 2020. Details are available at **www.vernier.com/grants/nabt**

20 Years Ago in this Newsletter

Twenty years ago, we introduced the LabPro® interface. LabPro was created as a joint project between Vernier and Texas Instruments, and it was a huge hit—partly because it could work with either computers or TI calculators. (This was a time when computers were so expensive that most schools could only afford very few.) We still support LabPro, and thousands of students are still using them 20 years later. Nearly all sensors made for LabPro can still be used today with our newer interfaces, such as LabQuest® 2.

Applications Open for Annual Vernier/ NSTA Technology Awards

Vernier Software & Technology and the National Science Teaching Association (NSTA) are now accepting applications for the annual Vernier/NSTA Technology Awards. The 2020 awards program will recognize educators who promote the innovative use of data-collection technology.

For more information about the awards and to read about this year's winners, visit **www.vernier.com/grants/nsta**

Science Humor

Since we are celebrating the 150th anniversary of the Periodic Table, Dave Vernier went through more than 30 years of newsletters to pull out the best humor. We have used chemistry jokes periodically in other issues.

What do you do with a sick chemist?

If you can't 

or 

then you 

Chemist's laughing gas:

Vernier in the Journals

Effective and Inexpensive HPLC Analogue for First-Year Students: Buret Chromatography of Food Dyes in Drinks

Brian Stankus, Rosemary White, and Binyomin Abrams (Boston University, Massachusetts); *J. Chem. Educ.*, 96, 2019, pp 739–744.

The authors describe how to demonstrate HPLC using a chromatography column constructed from a buret and silica gel. A sample of grape drink mix is separated. A Vernier spectrophotometer is an option when measuring the components of the mixture by spectrophotometry.

Escape the Lab: An Interactive Escape-Room Game as a Laboratory Experiment

Matthew J. Vergne, Joshua D. Simmons, and Ryan S. Bowen (Lipscomb University, Tennessee); *J. Chem. Educ.*, 96, 2019, pp 985–991.

Students run through a variety of laboratory techniques to solve puzzles and identify an unknown compound in order to escape from the laboratory. A Vernier UV-VIS Spectrophotometer (VSP-UV) is used in this activity.

Sound Propagation, Reflection, and Its Relevance to Ultrasound Imaging

Thomas Allen (Portland State University, Oregon), Alex Chally (Portland State University, Oregon), Bradley Moser (University of New England, Maine), and Ralf Widenhorn (Portland State University, Oregon); *The Physics Teacher,* 57, March, 2019, page 134.

This activity uses a Vernier Microphone and LabQuest 2 to study sound reflections in a tube that is closed on one end. The new idea is that one or more partially reflecting surfaces are included in the pipe, making the reflection more complex and modeling a medical ultrasound.

What a Metal Pipe Can Teach You About Magnetism

Maarij Syed, and N. Nuessle (Rose-Hulman Institute of Technology, Illinois); *The Physics Teacher,* 57, May, 2019, page 330.

This series of experiments uses our Rotary Motion Sensor with a Vernier interface to study the motion of an Atwood machine with one side consisting of a magnet moving inside a metal tube. The eddy current damping of the motion is studied.

Software Updates

We regularly release software updates to support new sensors, add new features, and fix the occasional bug. Keeping up to date with software releases is one way to help things run smoothly in your classroom or lab. Have you updated your Vernier applications in the last few months? Updates are free, and with the release of new Go Direct® sensors, we've updated nearly all our software.

For updates to Logger *Pro*® 3 for macOS® and Windows®, as well as for LabQuest® App, visit **www.vernier.com/downloads**

Graphical Analysis™ 4 on macOS and Windows detects the availability of an update and notifies you with a red dot on the overflow menu.

To update Chrome™, iOS, and Android™ applications, including Graphical Analysis 4 app, search the appropriate app store. Updates will eventually be applied automatically, but you can be sure of the current version by deleting and reinstalling the app.

Changes in macOS Catalina 10.15, to be released by Apple in the fall of 2019, will disable video analysis features in Logger *Pro*. Vernier plans to release an updated version of Logger *Pro* to restore video features. To avoid a temporary loss of functionality, macOS users who want to continue using video analysis features should delay updating to macOS 10.15 until Logger *Pro* has been updated.

Hands-On STEM Professional Development Workshops

Education is in our company DNA. For nearly four decades, we have been pioneering technologies and sharing our passion for STEM education to give teachers and students around the world more enriching and relevant classroom experiences.

Join us for a comprehensive four-hour workshop where you will get hands-on experience with our award-winning line of probeware and data-collection technology. Learn how to integrate our solutions into your classroom.

For more information and to register, visit **www.vernier.com/workshops**

Each attendee will receive one free Go Direct Temperature

State	Workshop
CA	Los Angeles 10/1; Palo Alto 10/3
DC	Washington 9/18
IN	Indianapolis 9/23
KY	Louisville 9/25
MN	Minneapolis (St. Paul) 10/9
MO	Kansas City 9/19; St. Louis 9/21
NC	Raleigh 9/16
NY	Buffalo 9/23; Rochester 9/24; Albany 9/26
OH	Cincinnati 9/24
OK	Oklahoma City 9/17
TX	Houston 9/9; San Antonio 9/11; Austin 9/12; Dallas 9/14
VA	Richmond 9/17
WI	Madison 10/7

Follow @VernierST on Twitter

Vernier Software & Technology
13979 SW Millikan Way
Beaverton, OR 97005-2886

888-VERNIER (888-837-6437)
fax 503-277-2440

www.vernier.com
info@vernier.com

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Please send updates to updates@vernier.com

Using an Inquiry-Based Approach to Teach Lab Safety

by Doug Balmer, Warwick High School, Lititz, Pennsylvania

It is imperative that students are taught about lab safety at the beginning of each school year. When it comes to safety, I want to go beyond just guidance and provide something that really sticks with students.

In addition to going over the important guidelines and procedures they need to follow, I created an inquiry-based investigation, titled "What Happened to My Eye? Oh My!", to help my students *really* understand the importance of accident prevention and safe experimentation. This experiment also teaches about experimental design and the scientific method, which is a good beginning-of-the-year refresher.

Learn more at **www.vernier.com/r1928**

> ***"I have found that using a hands-on, inquiry-based investigation, such as the one I use with my own students, successfully reinforces safe lab procedures and engages students in the learning process."***

Share Your Experiments With Us

How are you using Vernier technology in your classroom or laboratory? Share with us at innovativeuses@vernier.com and, if your article is published in our newsletter, you'll receive a $100 gift certificate.