



# THE Caliper

A Publication for Users of Vernier Products

FALL 2018

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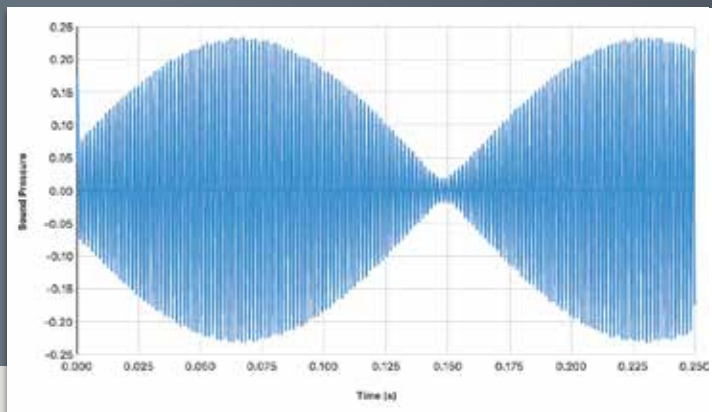
## NEW Go Direct Sound

GDX-SND \$89



Collect sound data wirelessly with the snap of your fingers. With sound-triggered data collection, Go Direct® Sound provides students with an easy way to capture and evaluate waveforms.

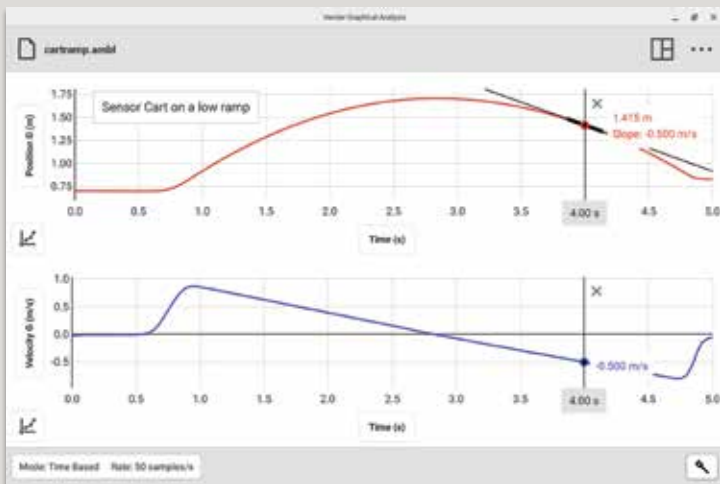
Measure wave amplitude and sound intensity level at the same time to investigate the decibel scale, or take the sensor outside the classroom to discover sounds in their natural environment. Learn more about Go Direct Sound at [www.vernier.com/r1822](http://www.vernier.com/r1822)



Go Direct Sound can capture the beats produced by two sound waves.

## The All-New Graphical Analysis 4 is Better Than Ever!

Graphical Analysis™ 4 app keeps getting better. New in the last several releases is support for photogates, which means you can now use your Vernier photogates with a Chromebook™. The much-requested photogate feature is part of a project to give physics instructors more tools in our free Graphical Analysis app, including support for the Motion Encoder Cart, Rotary Motion Sensors (Go Direct Rotary Motion Sensor and Rotary Motion Sensor versions), the Projectile Launcher, and the novel new Go Direct Sound, which combines waveform and sound intensity measurements.



In addition, with new tablet versions now available, Graphical Analysis has the same core feature set and appearance on Windows®, macOS®, ChromeOS™, Android™, and iOS. You can have a mixed set of devices in a classroom, and everyone can do a full spectrum of experiments, regardless of device. Procedures learned on one platform work everywhere. Files saved on one device can be opened on another, even if it is a different platform. Because device screen sizes vary widely, there is now an option to increase the size of text and other labels so that graphs are more readable on large screens.

Read more about how Graphical Analysis 4 is ready for physics—and chemistry and biology at [www.vernier.com/r1823](http://www.vernier.com/r1823)



The tangent function in Graphical Analysis allows students to compare instantaneous velocity on a position graph with the velocity value at a given time.



## Go Direct Sensors Can Be Used With LabQuest 2!

You already know that Go Direct® sensors are the most versatile sensors around—they can be used via USB or Bluetooth® wireless technology on Chromebooks™, computers, iOS®, and Android™ devices. But did you know that they can now be used with LabQuest® 2?

Imagine studying motion with Go Direct Sensor Carts, testing acids and bases with Go Direct pH, or wading into a stream with Go Direct Optical Dissolved Oxygen, all without wires. You can even mix and match Go Direct sensors and LabQuest sensors on LabQuest 2 for maximum flexibility. Just update your LabQuest App to version 2.8.3 or newer, and your students can connect Go Direct sensors wirelessly or by USB. (Some older LabQuest 2 interfaces require additional hardware to communicate with Go Direct sensors wirelessly.)

Download the latest LabQuest update at [www.vernier.com/r1824](http://www.vernier.com/r1824)

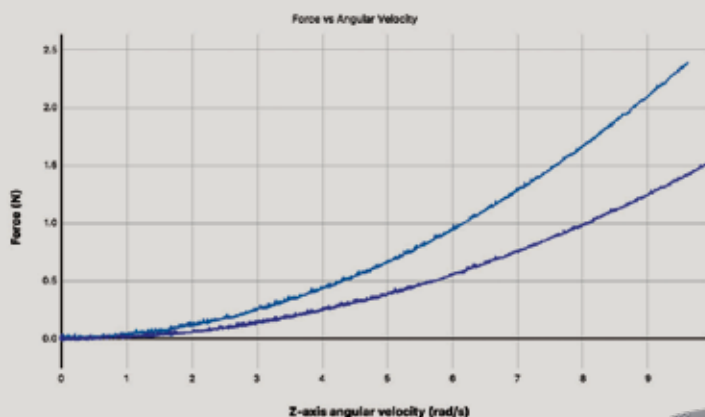
Students gather data along a transect in their schoolyard.

## The Centripetal Force Apparatus Goes Wireless

The new Go Direct Centripetal Force Apparatus makes it easier than ever to investigate rotational dynamics. To investigate the relationships among force, mass, and radius wirelessly, all you need is the Centripetal Force Apparatus, a Go Direct Force and Acceleration Sensor, and a device running our free Graphical Analysis™ 4 app.

With Go Direct Force and Acceleration mounted on the apparatus' beam, you are ready to investigate centripetal acceleration. Attach the mass carriage, and you can explore Newton's second law as it applies to rotational dynamics—no tangled wires to worry about.

Learn more about the Go Direct Centripetal Force Apparatus at [www.vernier.com/r1827](http://www.vernier.com/r1827)



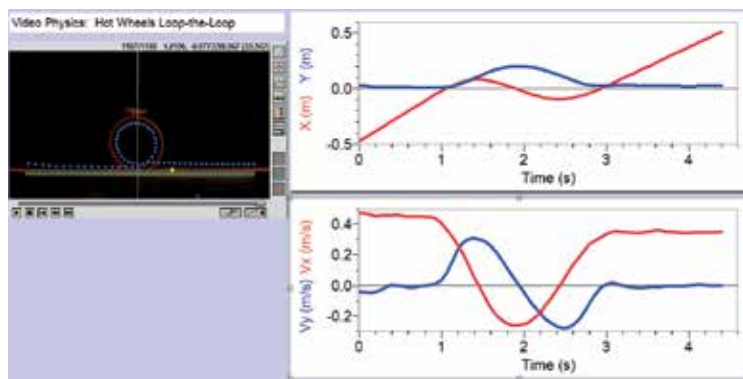
Applying a curve fit to the raw data will provide students with clues to the nature of this relationship.



## Video Analysis of Loop-the-Loop

Richard Born, from DeKalb, Illinois, has written another great experiment that uses data taken with Video Physics™ on iOS and then analyzes it with Logger Pro. He mounts an inexpensive flashing LED on a Hot Wheels® toy car and sends it through a loop-the-loop. After video analysis, you get some interesting graphs.

Download the complete experiment with sample videos at [www.vernier.com/r1825](http://www.vernier.com/r1825)



## Olympic Gold Medal Experiment

Jessie Diggins, who won a gold medal in the recent Winter Olympics, allowed Pivot Interactives to use the medal in a version of the Archimedes experiment. A new activity challenges students to identify the real gold medal from an inexpensive copy and to determine if an Olympic gold medal is actually made of gold.

Give it a try at [www.vernier.com/r1826](http://www.vernier.com/r1826)



## Did you know?

Log in or sign up for an account at [www.vernier.com/account](http://www.vernier.com/account) and take advantage of all the new features:



- Download the latest version of your software.
- Send download links to your students or IT department.
- Access electronic versions of your lab books.
- Create wish lists to use when funding becomes available.
- Find workshops in your area.
- Sign up for free web-based professional development.

## AAPT Photo Contest

The 2018 AAPT Photo Contest, sponsored by Vernier, was held at the summer meeting of the American Association of Physics Teachers in Washington, D.C. 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 Nicolas Gonzalez for the photo "Finger Pickin' Good."



Yining Lu won the Natural Category with the photo "Magic Light."

For details about the contest and to see all the photo winners for 2018, go to [www.vernier.com/r1828](http://www.vernier.com/r1828)

# Why Teach Coding in the Classroom?



22 STEM activities included with purchase of mBot



You don't have to spend much time on education websites, blogs, or social media before you run into the term coding. Why is coding, or computer programming, getting so much attention right now? Coding engages students in new ways, providing practical applications for math and science skills.

The act of coding—an iterative process of building, testing, and refining a program—parallels the scientific method in many respects. Students must construct detailed models, plan carefully, anticipate sources of error, analyze data, and document their

work. Additionally, many programming projects require the application of specific science knowledge, such as understanding the motion of a uniformly accelerating object, in order to successfully accomplish a task.

Programmable robots, such as mBot™ and mBot Ranger from Makeblock®, are a great, hands-on way to introduce coding to students because robots take abstract code from the screen and translate it into actions in the real world. The newest member of the Makeblock family of robots is Codey Rocky, perfect for elementary- and middle-school students who are new to coding. Codey Rocky does not require any construction

and can be programmed through a free app on computers, tablets, or smartphones.

See more about what we offer for coding at [www.vernier.com/r1829](http://www.vernier.com/r1829)

### Robots and Grade Level

- mBot, K–8 and High School
- mBot Ranger, Middle and High School
- Codey Rocky, K–8
- Neuron Inventor Kit, K–8

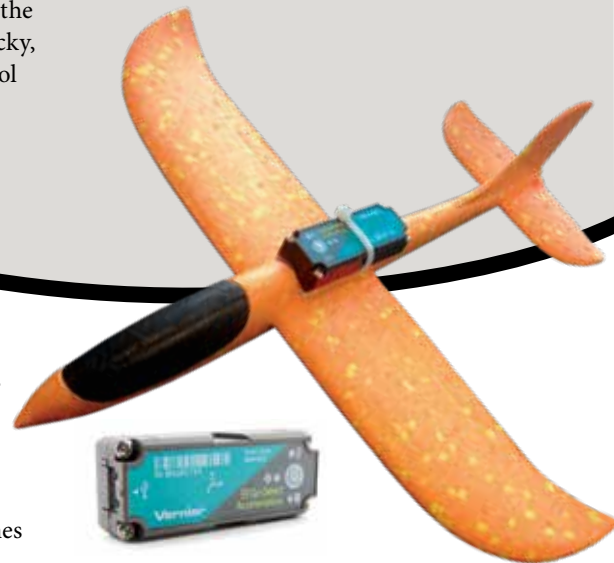
## INNOVATIVE USE

### Determine Pitch and Roll with LabVIEW and Go Direct Acceleration

Combining the power of LabVIEW™ software with the flexibility of our wireless Go Direct® sensors opens the door to engaging coding projects and unique monitoring applications. On our website, you can find free LabVIEW code that can help you and your students incorporate Go Direct sensors into custom LabVIEW programs.

A nice example of combining LabVIEW with Go Direct sensors is a program that determines the pitch and roll of a toy airplane using the readings from Go Direct Acceleration.

Find out how at [www.vernier.com/r1830](http://www.vernier.com/r1830)



GDX-ACC \$99

## Taking Project-Based Learning to New Levels with Vernier



**By George Hademenos,  
Richardson High School**

In my 17-plus years of teaching, I have found that project-based learning is one of the most effective instructional approaches to engaging students in STEM education. Students really start to understand—and master—the concepts being taught in class when they are given the opportunity to collect, display, and analyze data in an interesting, relative, and hands-on way.

The ROAVEE (Remotely Operated Amphibious Vehicle for Environmental Exploration) project is a great example of effective project-based learning in action. Students are challenged to design, model, construct, test, and navigate a robotic vehicle. The goal is for the ROAVEE to collect environmental data from areas not easily or safely accessible to students, such as in a lake and inside a drainage tunnel. More details about this project, including a video, are available at [www.vernier.com/r1831](http://www.vernier.com/r1831)

## Vernier Structures & Materials Tester Used in Nashville Bridge Competition

By Janey Camp, Vanderbilt Engineering Faculty Member



On March 3, 2018, the Nashville Branch of the American Society of Civil Engineers (ASCE) hosted its 10th Music City Bridge Competition with 54 bridges submitted for qualifications testing and 38 bridges tested to failure. The competition is open to any and all high school students in Middle Tennessee and serves as a qualifying competition for the Illinois Institute of Technology's International Bridge Building Contest. Winners of the Music City Bridge Competition are based upon a calculated efficiency of how much mass the bridge holds divided by the mass of the bridge.

For the past two years students have used the Vernier Structures & Materials Tester (VSMT) to test their bridges. The VSMT allows students to test bridges faster and easily display the results of bridge performance.

Learn about this year's winners at [www.vernier.com/r1832](http://www.vernier.com/r1832)

## Vernier Engineering Award

### Win a \$5,500 Award from Vernier

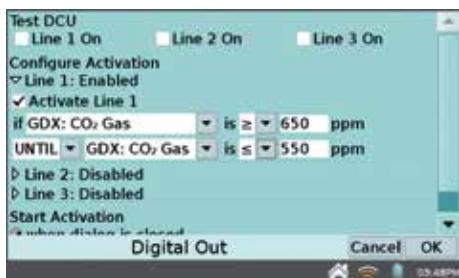
Are you using Vernier sensors to introduce engineering concepts or engineering practices to your middle school, high school, or college students? If so, you could win a \$5,500 award.

Maybe you are reading Vernier sensor data with Scratch to introduce coding, controlling digital outputs with Logger Pro software, integrating NGSS engineering practices, or using your Vernier sensors with a robotics platform such as LEGO, VEX, or Arduino. Tell us about your project, and you might win!

The award consists of an award trophy, \$1,000 in cash, \$3,000 in Vernier technology, and \$1,500 toward expenses to attend either the annual NSTA STEM conference or the annual ASEE conference.

For complete rules, to view videos from past winners, and to submit an online application and video showcasing your entry, go to [www.vernier.com/r1834](http://www.vernier.com/r1834)

## What's New with the DCU?



You can now use our wireless Go Direct sensors with the Digital Control Unit (DCU) to control small electronic devices (e.g., motors, LEDs, and lights). Last year, you may recall, we added the capability to control the DCU from LabQuest<sup>®</sup> 2. This year, when LabQuest 2 gained the ability to connect with Go Direct sensors, we

once again expanded the DCU's capability. Wirelessly connect your Go Direct sensor(s) to LabQuest 2, connect the DCU to LabQuest 2, and program the DCU to turn on components based on the sensor values.

With Go Direct sensors and the DCU, you can use output from a heart rate monitor to light up LEDs that help test subjects maintain a target heart rate. Or, if your students struggle to stay awake, you can have them create an alarm that triggers when carbon dioxide levels get too high in your classroom. You could even program a fan to turn on and bring in some fresh air!

Learn more at [www.vernier.com/r1833](http://www.vernier.com/r1833)

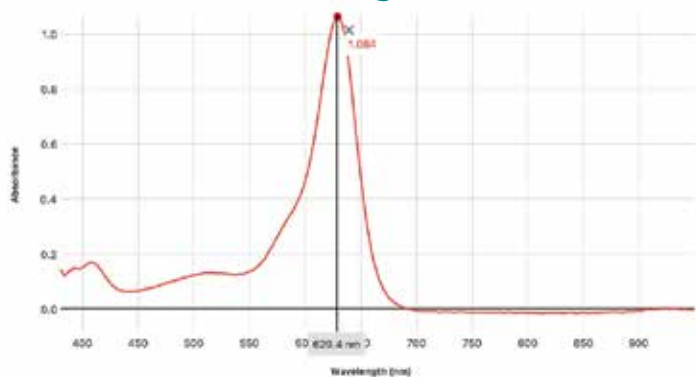
## Robotic Hand Project

We have had a lot of fun with the Robotic Hand project, which we discovered in the Hacking STEM Library from Microsoft. Using our Low-g Accelerometer, an Arduino, and our Vernier Arduino Interface Shield, we modified the project to create an easier control system.

See this robotic hand in action at [www.vernier.com/r1835](http://www.vernier.com/r1835)



## Discover the Wavelength



*Absorbance vs. wavelength of a blue solution with wavelength of maximum absorbance selected*

When conducting Beer's law and kinetics experiments, students must choose a specific wavelength to conduct the experiment. Students are expected to understand and explain why they would choose one wavelength over another. A spectrophotometer, such as Go Direct SpectroVis Plus, is just the tool for this. Unfortunately, many schools can't afford a class set of spectrophotometers. So how can you use a single spectrophotometer and a class set of Colorimeters to have your students discover the best wavelength of light to use?

We've written an experiment that allows you to do just that. Using a colored solution, your students will test each wavelength on their Colorimeter, then record and compare the absorbance at each wavelength. You will capture an absorbance spectrum with a spectrophotometer for the same solution that the students are using. The discussion that follows should help your students understand why they would choose one wavelength,  $\lambda_{\max}$ , over another for a particular solution and also for a specific experiment.

Download this experiment at [www.vernier.com/r1836](http://www.vernier.com/r1836)

## Pivot Interactives Adds Chemistry

Have you ever done an experiment that you wish you could repeat with different chemicals or concentrations but lacked the time and materials? This is where Pivot Interactives new activities for chemistry can become a valuable teaching tool.

Pivot Interactives is a browser-based collection of videos and analysis tools that enable students to control real results—not simulations. The videos come with appropriate tools for measuring



*Students use Beer's law to measure the concentration of solutions.*

volume, mass, temperature, time, and even color intensity. There are additional tools to carefully control the progression of the video and experiment. Online tables and graphs are used for students to graph relationships between the variables being studied. Calculated columns can be built and graphed.

Learn more at [www.vernier.com/r1837](http://www.vernier.com/r1837)

## The Vernier Advantage for College Chemistry

Whether you are teaching general or upper-level college chemistry courses, our affordable sensors and instrumentation make it possible for every student to participate in hands-on learning. Our combination of sensors, software, college-level experiments, and instructional resources engage students and instructors in scientific discovery. We have assembled a collection of products and experiments for commonly taught college chemistry courses.



- **General Chemistry:** Complete an acid-base titration with our pH probes that have 0.1 pH unit accuracy and a drop counter that accurately converts drops to volume.
- **Organic Chemistry:** Measure and analyze the GC retention times of a Fischer esterification reaction mixture using the Mini GC Plus Gas Chromatograph with room air as the carrier gas.
- **Biochemistry:** The Vernier UV-VIS Spectrophotometer can be used to measure the 260/280 nm ratio when purifying proteins and DNA. Its range, 220 nm to 850 nm and 3 nm optical resolution, makes it ideal for biological applications.
- **Analytical Chemistry:** Investigate redox reactions with a potentiometric titration using an ORP (oxidation-reduction potential) sensor.
- **Physical Chemistry:** Explore excited-state dynamics with one of our free experiments that walks students through the heavy-atom quenching of quinine fluorescence using the Vernier Fluorescence/UV-VIS Spectrophotometer.

A full list of recommendations for college chemistry is available at [www.vernier.com/r1838](http://www.vernier.com/r1838)

# Vernier in the Science Journals

## Heat Evolution and Electrical Work of Batteries as a Function of Discharge Rate: Spontaneous and Reversible Processes and Maximum Work

Robert J. Noll and Jason M. Hughes;  
*J. Chem. Educ.*, 2018, 95, pp 852–857.

This article describes an experiment in which students compare the enthalpy change of the useful electrical work to the heat lost from the electrochemical reaction in batteries.

Featured products: Current Probe, Voltage Probe, Stainless Steel Temperature Probe

## Measuring the Force between Magnets as an Analogy for Coulomb's Law

Samuel P. Hendrix and Stephen G. Prilliman; *J. Chem. Educ.*, 2018, 95, pp 833–836.

The authors describe a simple demonstration to illustrate the relationship between charged particles as described by Coulomb's law. They use a Dual-Range Force Sensor mounted on a LEGO® platform.

Featured products: Dual-Range Force Sensor

## Flexible Experiment Introducing Factorial Experimental Design

Penny Snetsinger and Eid Alkhatib;  
*J. Chem. Educ.*, 2018, 95, pp 636–640.

The goal of this activity is to provide students with the opportunity to design

an experiment that studies the effect of activated carbon on dyes.

Featured product: Go Direct® SpectroVis® Plus Spectrophotometer

## Physicians as the First Analytical Chemists: Gall Nut Extract Determination of Iron Ion (Fe<sup>2+</sup>) Concentration

Mary T. van Opstal, Philip Nahlik, Patrick L. Daubenmire, and Alanah Fitch;  
*J. Chem. Educ.*, 2018, 95, pp 456–462.

This article describes a guided inquiry activity that measures the iron in drinking water, using oak gall nut extract. This activity is geared toward students who are interested in medical careers.

Featured product: Go Direct SpectroVis Plus Spectrophotometer

## Physics Meets Art in the General Education Core

Marta L. Dark and Derrick J. Hylton;  
*Journal of College Science Teaching*, 2018, (47) 3.

If you take the Physics and the Arts course at Spelman College in Atlanta, Georgia, you will be exposed to many applications of a traditional physics class as they apply to various areas in the arts.

Featured product: Go Direct SpectroVis Plus Spectrophotometer

## Enhancing a Scientific Inquiry Lesson Through Computer-Supported Collaborative Learning

Kathleen Koenig, Janet Mannheimer Zydney, Doug Behr, and Lei Bao;  
*Science Scope*, September, 2017.

In this guided inquiry activity, students learn about energy transformations as they apply to renewable energy.

Featured product: KidWind Basic Wind Experiment Kit

## Where Does The Energy Go?

Marta R. Stoeckel (Tartan High School, Oakdale, MN); *The Science Teacher*, Vol. 85, No. 1, January, 2018.

This article explains how to use evidence-based reasoning to study the bounce of a ball. It is linked to NGSS standards and the authors use *Logger Pro 3* video analysis to plot a ball's position.

Featured product: *Logger Pro* software

## Burst Mode Composite Photography for Dynamic Physics Demonstrations

James Lincoln; *The Physics Teacher*, May, 2018.

Many cell phone cameras support burst mode. This allows them to take a series of photos in rapid succession. This article explains how to use this feature to create interesting composite photos, which can be analyzed using our photo analysis in *Logger Pro*.

Featured product: *Logger Pro* software

For more articles, visit [www.vernier.com/r1839](http://www.vernier.com/r1839)

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Chris Lenius  
@LeniusC

Follow

I think @VernierST is probably the best customer service company there is. Not just in education, but that I've ever experienced, period.

Chris Lenius (@LeniusC) of Chaska High School, Chaska, Minnesota

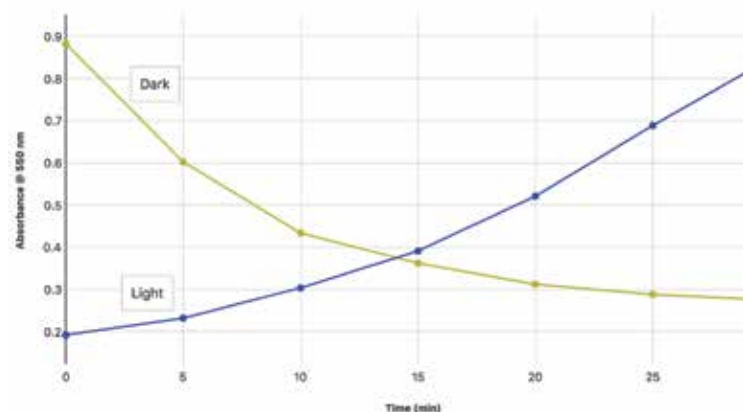
Subscribe to @verniervideo on YouTube



Algae beads, along with the Go Direct® SpectroVis® Plus Spectrophotometer, provide a great way to study photosynthesis and respiration. Algae beads consist of freshwater algal cells suspended in sodium alginate and hardened in calcium chloride solution. In this suspension, the algal cells can still undergo cellular respiration and photosynthesis, exchanging gases with the liquid around them. Traditionally, a CO<sub>2</sub> indicator solution is used to qualitatively observe that dissolved CO<sub>2</sub> increases during cellular respiration and decreases during photosynthesis. However, in an experiment we've adapted from the Bio-Rad Explorer™ Program, students use a Go Direct SpectroVis Plus Spectrophotometer to quantify these changes.

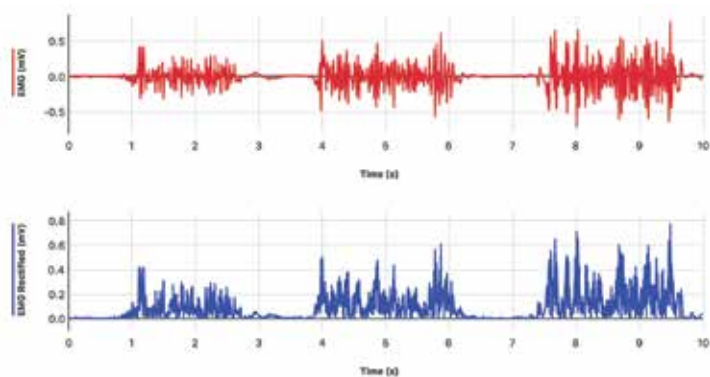
In the experiment, algae beads are placed in cuvettes containing CO<sub>2</sub> indicator solution and incubated either in the dark or the light. Students measure the absorbance once every 5 minutes using Go Direct SpectroVis Plus Spectrophotometer and our free Spectral Analysis™ app.

Download the experiment at [www.vernier.com/r1840](http://www.vernier.com/r1840)



Sample data illustrate the inverse relationship between dissolved CO<sub>2</sub> concentration and exposure to light.

## Easily Record and Analyze EMGs with Go Direct EKG



Normal and rectified EMGs recorded from the forearm

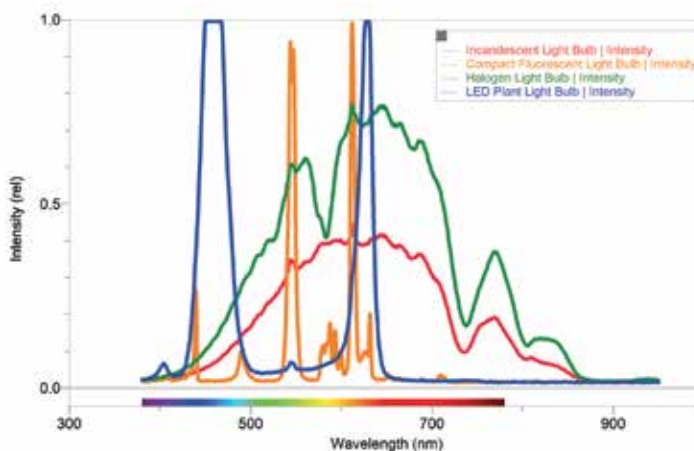
Many teachers are interested in using our EKG sensors to record an electromyogram (EMG), the electrical activity produced from muscle contractions. Recording an EMG is straightforward, but there are multiple ways that an EMG can be analyzed. The most robust technique is to measure the integral of the rectified EMG signal, which can easily be done using Go Direct EKG.

A normal EMG has both positive and negative deflections. A rectified EMG uses a function that makes all of the EMG deflections positive. In the past, we have offered special Logger Pro and LabQuest files that provide the proper filtering and calculated column support to record and analyze rectified EMGs. But, Go Direct EKG makes recording rectified EMGs much simpler. No special files or filter settings are required—just change the channel to EMG Rectified and start collecting data. Then simply measure the integral of the signal in Graphical Analysis.

Find out how at [www.vernier.com/r1841](http://www.vernier.com/r1841)

## What Are the Best Light Sources For Photosynthesis?

Photosynthetic organisms such as plants and algae use electromagnetic radiation from the visible spectrum to drive the synthesis of sugar molecules. Special pigments in chloroplasts of plant cells absorb the energy of certain wavelengths of light, causing a molecular chain reaction known as the light-dependent reactions of photosynthesis. The best wavelengths of visible light for photosynthesis fall within the blue range (425–450 nm) and red range (600–700 nm). Therefore, the best light sources for photosynthesis should ideally emit light in the blue and red ranges. In this study, we used a Go Direct SpectroVis Plus



Relative light intensity of four light bulbs across the visible spectrum

Spectrophotometer with a Vernier Spectrophotometer Optical Fiber and LabQuest® 2 to collect spectra from four different light sources. This allowed us to determine the wavelengths emitted by each source and to determine which ones would be the best for photosynthesis.

Learn more at [www.vernier.com/r1842](http://www.vernier.com/r1842)





# KidWind<sup>®</sup> CHALLENGE

## Vernier Sponsors the 2018 KidWind Challenge

To inspire students to learn about renewable energy and hone their engineering skills, Vernier supported the 2018 KidWind Challenge, hosted by the KidWind Project. The challenge consists of dozens of local and regional competitions across the country, called KidWind Challenges, during which teams of students test the energy output of wind turbines they design and build. Students also present their design processes to a panel of judges and participate in short design or problem-solving tasks called “Instant Challenges.”

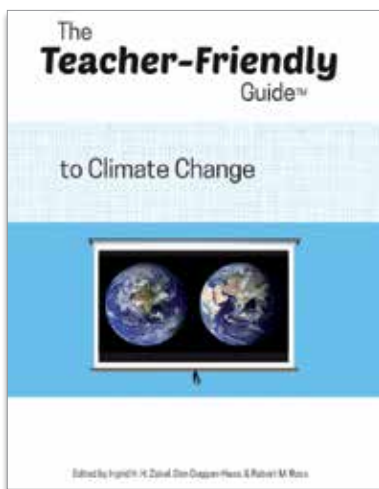
Learn about this year’s winners at [www.vernier.com/r1843](http://www.vernier.com/r1843)

## INNOVATIVE USE

### Vernier Sensors Used in NASA Inquiry Labs

Dan Rosales at American Canyon High School in Napa County, California, was recently featured on KQED Education for teaching a series of six NASA inquiry labs about the science of climate change. The labs use Vernier sensors across the school curriculum in Anatomy/Physiology, AP Environmental Science, AP Chemistry, and STEM Club.

See all six activities about climate change at [www.vernier.com/r1844](http://www.vernier.com/r1844)



## Free Climate Change Resource

The Paleontological Research Institution in Ithaca, NY, has produced its latest book in the Teacher-Friendly Guides™ series, *The Teacher-Friendly Guide™ to Climate Change*.

This guide has many useful resources for incorporating climate change lessons into science programs and has been mailed to science teachers at every school in seven states. It is also available as a free download at [www.vernier.com/r1845](http://www.vernier.com/r1845)

## GLOBE Takes Go Direct to the Field

In July, more than 100 students from 35 countries used our Go Direct sensors to test the water in Ireland’s Killarney National Park as part of the 2018 GLOBE Learning Expedition (GLE). This event is part of the



Students from Croatia and Japan use Go Direct sensors in Killarney National Park.

GLOBE Program and is held every few years in different locations around the world. The GLE brings together students, teachers, and scientists for a week of sharing and learning about science, the environment, and each other’s cultures. As part of this year’s student field experience, Go Direct sensors were used to measure temperature, pH, conductivity, and dissolved oxygen levels along the Deenagh River. This beautiful river runs along the edge of the park, near the town of Killarney. The students’ sensor data, along with a survey of macroinvertebrates, indicated that the Deenagh is in excellent health.

Learn more at [www.vernier.com/r1846](http://www.vernier.com/r1846)

## Vernier Sponsors NABT Ecology/Environmental Science Teaching Award

Once again, Vernier is sponsoring the NABT Ecology/Environmental Science Teaching Award. The award includes \$500 toward travel to the NABT Professional Development Conference and \$1,000 in Vernier equipment. Applications for the 2019 award will be available on the NABT website soon after the November conference, and the deadline for submission is March 15, 2019. Details are available at [www.vernier.com/grants](http://www.vernier.com/grants)

## Our CEO Celebrates His 25<sup>th</sup> Anniversary at Vernier



John discusses the benefits of our Go Direct family of sensors. See the interview at [TeachWithVernier.com](http://TeachWithVernier.com)

John Wheeler with Dave and Christine Vernier and the rest of the Vernier staff in the late 1990s.



John Wheeler, our CEO, first worked for Vernier as a consultant. For his first project he designed a photogate timing device, for which we paid him with one Macintosh computer. In 1993, he became a full-time employee, when we had fewer than 10 employees. John handled our parts purchasing, but he also continued to design products. Over the years, John has designed the Serial Box Interface, the LabPro interface, LabQuest, LabQuest 2, and most of our sensors. In 2015, he took on the overall leadership role at Vernier.

Read more about his experiences at [www.vernier.com/r1847](http://www.vernier.com/r1847)

“While we have grown significantly since when I first started, the amazing thing is that we have been able to grow and keep our company culture. David and Christine Vernier started something really special and have nurtured it for 37 years to get to where we are now. We have kept our company values, and we continue to serve educators and impact student learning.”

—John Wheeler, CEO

## 25 Years Ago in this Newsletter

In the Fall 1993 issue of *The Caliper*, we introduced our Serial Box Interface (Dave Vernier's favorite product name ever. Get it? Cereal Box). It was an inexpensive way to connect analog sensors like temperature probes and pH probes to the serial port of an MS-DOS or Mac computer. We were also starting to do more in chemistry and introduced our first colorimeter in that issue.

## Science Humor

**A dung beetle walks into a bar and says,**

“Excuse me, is this stool taken?”

**Teenager #1:**

Did you hear Oxygen and Magnesium got together?

**Teenager #2:**

OMG!

**Wind Turbine #1:**

What kind of music do you like?

**Wind Turbine #2:**

I'm a big metal fan



## 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 keep things running smoothly in your classroom or lab. Have you updated your Vernier applications in the last few months? Updates are free, and with the shipping of new Go Direct® sensors, we've released updates for nearly all our software.

- For updates to Logger Pro for macOS and Windows, as well as for LabQuest App, visit [www.vernier.com/downloads](http://www.vernier.com/downloads)
- Graphical Analysis™ 4 for macOS and Windows detects the availability of an update and notifies you with a red dot on the overflow menu, found under the three dots in the upper right.
- 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.

Special note for iOS and Android users: We are transitioning from our original Graphical Analysis app to a new version that shares features and appearance across all platforms. The transition requires that we have two versions of the apps available simultaneously in the stores. If you installed Graphical Analysis before July 2018, the app will not update to the new version. Instead, search the appropriate app store and freshly install the new app called Graphical Analysis (the older app will automatically update and be renamed GraphicalGW). When we release updates of Graphical Analysis in the future, the app will automatically update as expected. Additional information can be found at [www.vernier.com/til/4177](http://www.vernier.com/til/4177)

## Professional Development Workshops



Calling all science educators! Step out of your classrooms, roll up your sleeves, and join us for a free four-hour, hands-on exploration of the latest and greatest in probeware and data-collection technology, including our new Go Direct® sensors with multiple options for connectivity. Learn how to integrate Vernier technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curricula.

### Perfect for science educators interested in

- Evaluating our award-winning data-collection technology
- Getting started with probeware and data collection
- Refreshing their knowledge of Vernier equipment
- Learning from the experts

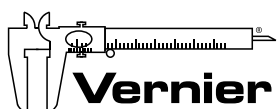
### Attendees receive

- Four hours of free training
- Light lunch or dinner
- Workshop Training Manual download
- Option to purchase a discounted training package

Learn more at [www.vernier.com/workshops](http://www.vernier.com/workshops)

## Applications Open for Annual Vernier/NSTA Technology Awards

Vernier Software & Technology and the National Science Teachers Association (NSTA) are now accepting applications for the annual Vernier/NSTA Technology Awards. The 2019 awards program will recognize up to seven educators—one elementary teacher, two middle school teachers, three high school teachers, and one college-level educator—who promote the innovative use of data-collection technology. Prizes include \$1,000 in cash, \$3,000 in Vernier products, and up to \$1,500 toward expenses to attend the 2019 NSTA National Conference in St. Louis, Missouri. Award recipients are chosen based on their application, which is judged by a panel of NSTA-appointed experts. All applications must be submitted by December 17, 2018. For more information about the award and to read about this year's winners, visit [www.vernier.com/grants](http://www.vernier.com/grants)



State	City and Date
IA	Quad Cities 10/1
IL	Chicago 10/11 • Chicago 10/13 Quad Cities 10/1 • Springfield 10/15
IN	Fort Wayne 10/8 • Indianapolis 10/9
KS	Topeka 9/25 • Wichita 9/24
MA	Boston 9/25 • Boston 9/26
MI	Detroit 10/6
MN	Minneapolis 10/3 • Minneapolis 10/6
MO	Kansas City 9/26 • St Louis 10/16 • St Louis 10/17
NE	Omaha 9/29
NH	Portsmouth 9/24
NY	Albany 9/27 • Buffalo 10/1 • Syracuse 9/29
OH	Cincinnati 10/10 • Cleveland 10/3 Columbus 10/11 • Toledo 10/4
OK	Oklahoma City 9/20 • Tulsa 9/22
PA	Pittsburgh 10/13
TX	Austin 9/17 • Corpus Christi 9/12 • Dallas 9/19 Fort Worth 9/18 • Houston 9/10 • Houston 9/11 San Antonio 9/13 • San Antonio 9/15
WI	Madison 10/8 • Milwaukee 10/9



## Vernier is in the Top 10 of the 100 Best Green Workplaces in Oregon

Community cleanups, renewable energy, and public transportation benefits are just a few examples of our commitment to the environment. This year, Vernier ranked 8<sup>th</sup> on the list of the 100 Best Green Workplaces in Oregon, and we received recognition for having been on the list for the past 10 years.



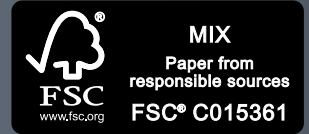
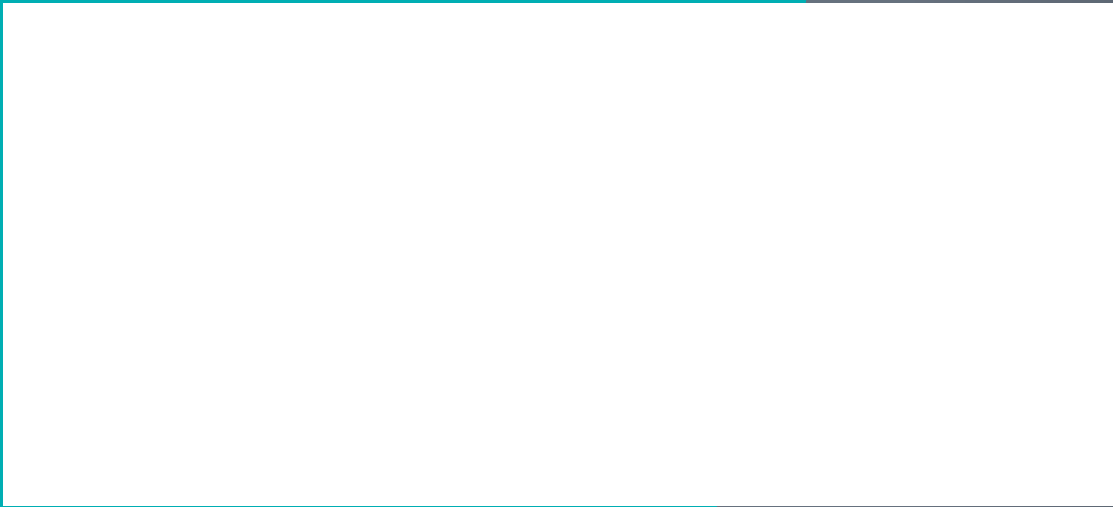
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Learn more at [TeachwithVernier.com](http://TeachwithVernier.com)

