Vernier

THE Caliper

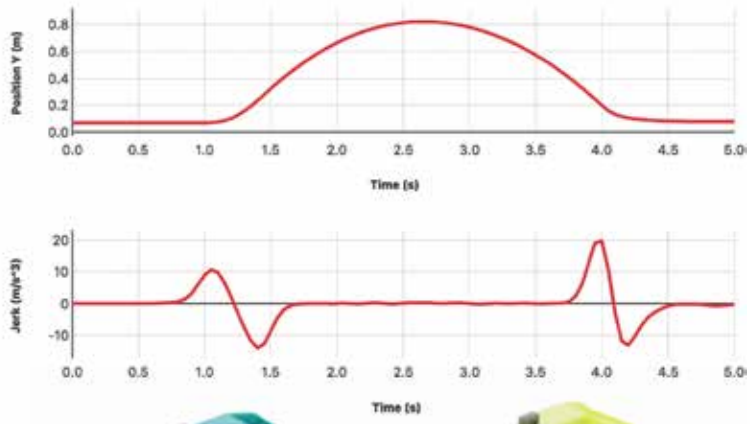
A Publication for Users of Vernier Products
SPRING 2018
Vol. 35 • No. 1

Simple Experiments with Go Direct® Sensor Cart

What may be most striking about the new Go Direct Sensor Cart is that students can obtain excellent kinematic data with minimal lab setup.

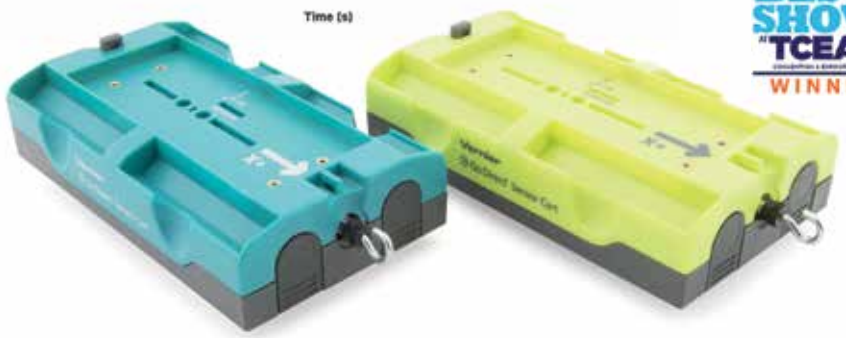
When performing a simple cart-on-a-ramp experiment, only a track, a Sensor Cart, and a device running Graphical Analysis™4 app is required. No additional detectors or interfaces are needed. The cart has an integrated encoder wheel that records changes in position. Because of this wheel, and unlike ultrasonic motion detectors, there is no possibility of spiking or noise from other objects affecting the data. The simple constant-acceleration phenomenon can easily be observed and graphed. Graphical Analysis 4 performs the derivative calculations needed to get velocity, acceleration, and even jerk.

Check out simple experiments and sample data at **www.vernier.com/r181**



Kinematic data from a cart rolling freely up and then back down a ramp

TECH&LEARNING BEST SHOW AT TCEA 2018 WINNER



GDX-CART-G $169

GDX-CART-Y $169

NEW *Coding with mBot: Self-Driving Vehicles* Module

The topic of self-driving vehicles is one that combines diverse issues ranging from engineering to federal regulations. While it may be years before you have a self-driving car in your driveway, you can use mBot™ in your classroom today! Equipped with ultrasonic distance, line-following, and light-level sensors, mBot is an affordable, easy-to-program robot designed to bring coding and computer science education into the real world. With our new *Coding with mBot: Self-Driving Vehicles* module, a set of nine guided coding activities that build upon each other, you and your students can successfully learn to program mBot to mimic many self-driving car actions.

In *Coding with mBot: Self-Driving Vehicles*, students write programs to make mBot perform activities such as following a line, avoiding an obstacle, and parallel parking. Along the way, students learn basic coding and troubleshooting skills.

The activities are aligned with the Computer Science Teachers Association's K–12 Computer Science Standards, and require only an mBot, the free mBlock™ software (based on the popular block-based programming language Scratch), and some patience for the occasional traffic jam. *Coding with mBot: Self-Driving Vehicles* is a free download for customers who purchased mBot from Vernier.

Download Activity 1, "Driving mBot," as a free preview at **www.vernier.com/mbot-msdv-e**

MBOT-P $94.99

Also available in blue

GDX-MD $99

Go Direct® Motion Detector Makes a New Class of Experiments Possible

With a wireless motion detector, you can easily explore relative velocities, allowing students to confirm the validity of the Galilean transformation at non-relativistic speeds in the classroom. Combining the Go Direct Sensor Carts with the Go Direct Motion Detector makes this type of experiment possible.

Try a short relative velocity experiment using two Go Direct Sensor Carts, each measuring its own position relative to a track, and a Go Direct Motion Detector mounted on one of the carts to measure its position relative to the other cart.

Free experiment download available at **www.vernier.com/r184**

Follow-Up on The Great American Eclipse

We enjoyed the eclipse and were pleased that so many people sent us great data collected during the event. Leading up to the eclipse, we encouraged science teachers to experience the eclipse from the path of totality, using the slogan, "The difference between a total eclipse and a partial eclipse is night and day." Our employees were even given the day off to travel to the path of totality, as our office was only at 99% totality. We distributed and sold tens of thousands of eclipse glasses to ensure people could safely view the eclipse. In our previous newsletter (published just before the eclipse), we asked teachers to record and share their data on the physical parameters (light level, UV intensity, temperature, etc.) observed during the eclipse.

See all the data from the solar eclipse at **www.vernier.com/eclipse**

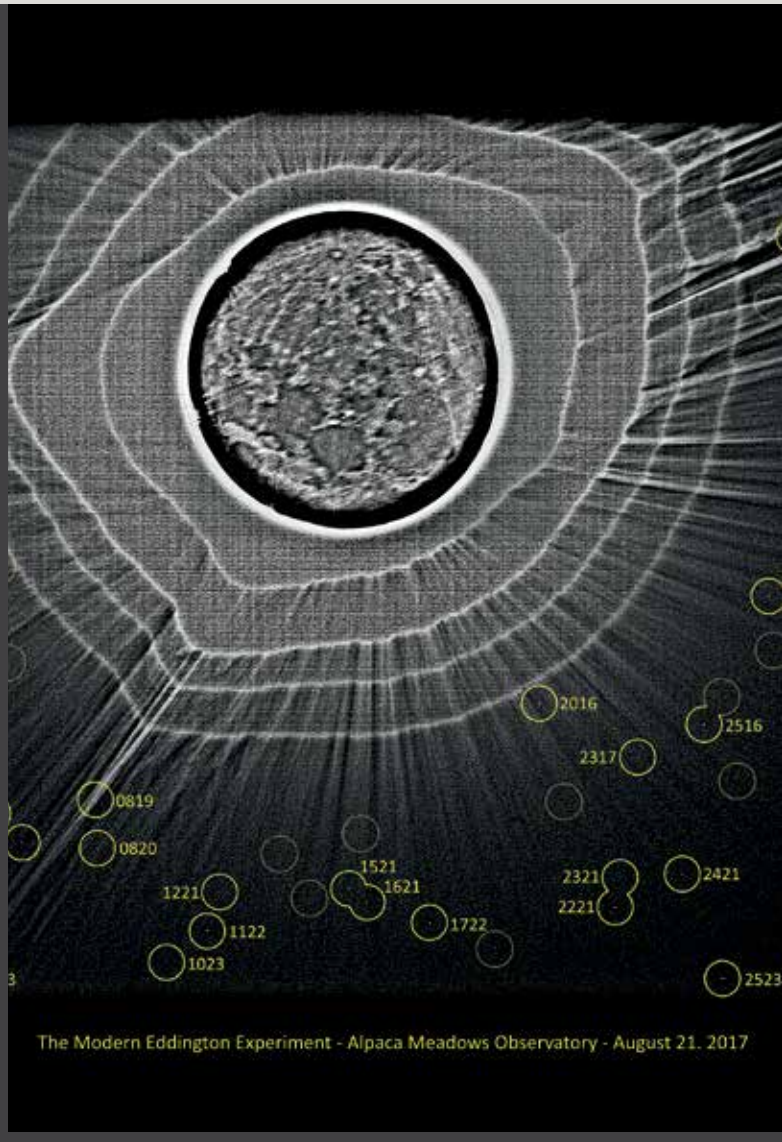
Dave Vernier's article in the December, 2017 issue of *The Physics Teacher* includes data collected by many teachers around the country and by Vernier employees. Our extensive eclipse campaign also won an excellence award from One Planet.

Read more about the 2017 One Planet Best in Business and Professional Excellence Award at **www.vernier.com/r1821**

Vernier helped sponsor a project to reproduce the Eddington experiment, which was an important verification of Einstein's theory of general relativity. This group was headed up by Toby Dittrich of Portland Community College. While the preliminary results of this experiment are promising, the final analysis is not yet complete, and we will provide further follow up in a later newsletter.

As part of this experiment, here is a photo with several overlapping exposures of different lengths. It includes marks around stars that are visible near the sun. The bending of light waves is what the Eddington experiment measured and can be seen in the very tiny changes in the positions of these stars.

Mark your calendar for the next total solar eclipse in the United States on April 8, 2024!



Multiple exposure of the sun during totality with nearby stars marked (photo by Richard Berry)

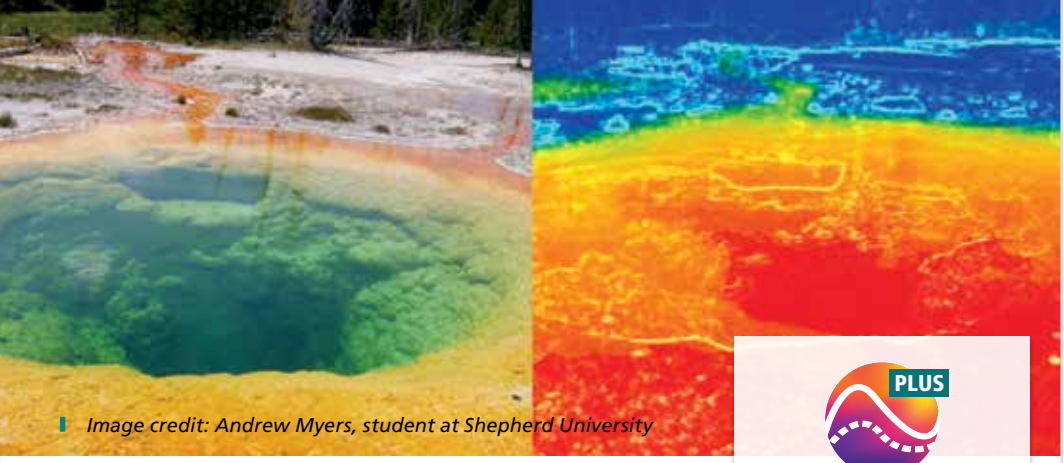


Image credit: Andrew Myers, student at Shepherd University

INNOVATIVE USE

Thermal Imaging of Yellowstone's Hydrothermal Features

By Jeff Groff, Shepherd University

During the summer of 2017, I taught a course on the ecology, geology, and cultural significance of the greater Yellowstone area. My students and I took a FLIR ONE® thermal camera and an iPad® loaded with the Vernier Thermal Analysis® Plus app on a field excursion to Yellowstone to record thermal imagery of hydrothermal features. Above, a true-color image and a pseudocolor thermal image of one of Yellowstone's most famous hot springs, Morning Glory Pool, are shown side by side. The thermal image clearly reveals a higher temperature near the center of the pool, where the water is deeper and fed beneath the surface by superheated water, and a lower temperature near the shallower edges of the pool. The true-color image reveals a pattern of colors that correlates with the temperature gradient. The different colors are different species of thermophilic (heat-loving) bacteria that form thick mats and streamers in the pool.

These thermophiles flourish in hot water, even water over 80°C. One such thermophile is the bacteria *Thermus aquaticus*, which was discovered in Yellowstone in 1969 by Thomas D. Brock and Hudson Freeze. *Thermus aquaticus* is the source of a heat-resistant form of the enzyme responsible for synthesizing DNA called *Taq* polymerase. Discovery of *Taq* polymerase allowed development of polymerase chain reaction (PCR) DNA amplification technology, a cornerstone of modern molecular biology. Taken together, the thermal and true-color images reveal that each species of bacteria prefers a specific temperature band, which determines how close to the edge of the pool each species establishes itself.

For more, visit **www.vernier.com/r185**

PLUS

Thermal Analysis Plus
New app version supports FLIR ONE PRO and FLIR ONE Gen 3 cameras.

NEW Introducing *Physics Explorations and Projects*

Electronic Version

PEP-E $40

Printed Lab Book

PEP $48

Physics Explorations and Projects is our new NGSS-aligned experiment manual for physics that can be used at all levels of introductory physics courses. The format is guided inquiry. You are provided with ideas for introductory observations designed to engage the students' curiosity. Brief student instructions are accompanied by additional extensive instructor information, including suggestions for class discussion and example student results. Each unit culminates in a challenge or project, such as building a Rube Goldberg machine or an egg protection device.

The experiments are written for use with any Vernier software platform, whether you use Logger *Pro*® 3, Graphical Analysis™ 4, or LabQuest® App. Because each student group will solve these inquiry-based tasks differently, no step-by-step instructions in procedure or software use are possible or desirable.

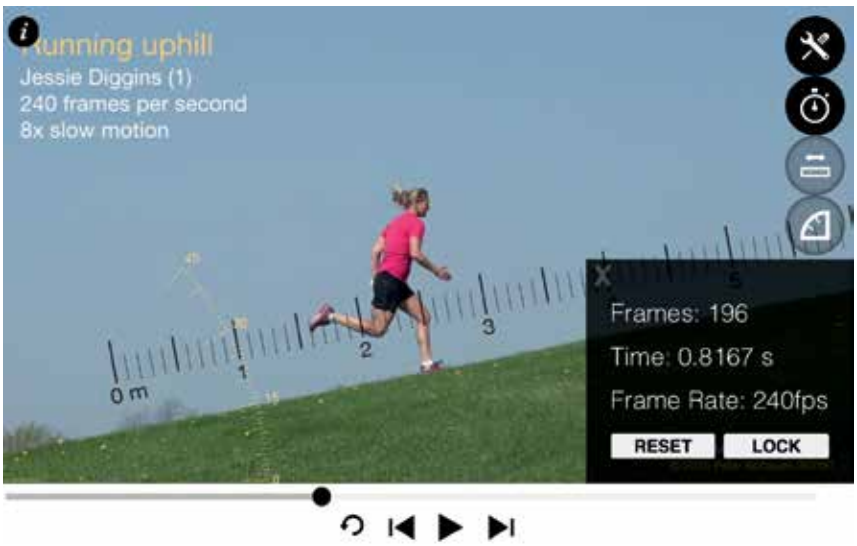
Learn more at **www.vernier.com/pep**

Pivot Interactives Olympian

Jessie Diggins is the runner in one of our Pivot Interactives series of videos. She is a cross-country skier and competed in the 2018 Winter Olympic Games, in PyeongChang, South Korea. She and her teammate, Kikkan Randall, made history when they won gold medals in the team sprint freestyle race and became the first American women to win Olympic medals in cross-country skiing.

Jessie also participated in five other Olympic events and finished in the top seven in each of them. She was even selected to carry the US flag during the Winter Olympics closing ceremony. Congratulations, Jessie!

Sign up for a free trial of Pivot Interactives at **www.vernier.com/pivot**



Vernier in the Physics Journals

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* 3

Incorporating a Farm into Our Science Curriculum—An Innovative Twist

Carrie Herndon; *Science Scope*, Summer 2017.

Herndon's classes monitor chicken growth using our Force Plate, use robots with the chickens, and monitor temperature inside a beehive.

Featured Product: Force Plate, Temperature Probe

Letting Students Discover the Power, and the Limits, of Simple Models: Coulomb's Law

Peter Bohacek, Joseph Dill and Emma Boehm (Henry Sibley High School), and Matthew Vonk (University of Wisconsin River Falls); *The Physics Teacher*, Vol. 55, No. 6, November, 2017.

This article examines a Coulomb's law experiment using Pivot Interactives. Students are confronted with explaining why unexpected results occur in some situations.

Featured Product: Pivot Interactives

A New Take on Exploding Carts

Darren Broder (Siena College), James Burleigh (Schuylerville High School) Matthew Christian (Berlin Central High School). Shawn Mowry (Bethlehem High School), George E. Hassel (Siena College); *The Physics Teacher*, Vol. 55, No. 8, November, 2017.

The authors use our Dynamics Cart and Track System and Logger *Pro* 3 software, but they modify the standard "exploding carts" experiment by replacing one of the carts with a hanging mass. This allows a wider range of variation in the masses and a different type of analysis.

Featured Products: Dynamics Cart and Track System, Logger *Pro* 3

Math Machines: Using Actuators in Physics Classes

Frederick J. Thomas (Learning with Math Machines, Inc.), Robery A. Chaney, Marta Gruesbeck (Sinclair Community College, Dayton, OH); *The Physics Teacher*, Vol. 56, No. 1, January, 2018.

We have worked with Math Machines for a long time; and they use motors, LEDs, and other devices for interesting projects. You can use their software to enter mathematical functions to control the output, and the results are often then plotted with Logger *Pro* 3 software. It is a great way to connect physics, mathematical functions, and models.

Featured Product: Logger *Pro* 3

2018 Winners of the Vernier $5,500 Engineering Grant

Vernier Software & Technology sponsors a contest for educators who innovatively use Vernier sensors to introduce engineering concepts or engineering practices to their students. The prizes for the winners include $1,000 in cash, $3,000 in Vernier technology, and $1,500 toward expenses to attend either the NSTA STEM conference or the ASEE conference.

Congratulations to the 2018 Winners!

Chris Berg, a science, engineering, and math teacher at Montgomery High School in Santa Rosa, California, created a framework to investigate collisions using our Dual-Range Force Sensor, a cart and track system, and student-designed 3D-printed bumpers. Berg aligned the activity with NGSS HS-PS2-3 (Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.).

Tate Rector, an engineering and Project Lead The Way teacher at Beebe Junior High in Beebe, Arkansas, had his students define a problem facing their school or community, and determine a solution. The students used the engineering design process to develop an automated lighting system that activates when someone enters a crosswalk in a dark portion of the school's parking lot.

Honorable Mention

Jen Rushing, a teacher at Central Coast New Tech High in Nipomo, California, had her physics students incorporate the Digital Control Unit and Vernier sensors into the design of their Rube Goldberg machines.

To see details about the contest and videos of the winning entries, visit **www.vernier.com/r189**

Add Coding to Your Curriculum Using Scratch and Vernier Sensors

It is now easier than ever to connect Vernier sensors and Scratch. Both are powerful and simple to use, and they make it easy to incorporate coding into your curriculum.

Our new Go! Link extension for Scratch allows you to connect your Scratch project to a wide variety of sensors, ranging from our Sound Level Sensor to our Light Sensor. The extension allows students to use Vernier sensors in new and engaging ways, such as using a Low-g Accelerometer to control the motion of a spaceship.

Learn more at **www.vernier.com/r1810**

myVitals: A Student Engineering Project

Inspired to help his grandmother receive medical treatment at home rather than in the hospital, Mikolaj (Nick) Mroszczak, a mechanical engineering student at Cardiff University, developed a web-connected medical monitor using Vernier sensors during his internship at National Instruments. (While Vernier sensors are not intended for medical applications, they can easily connect to a variety of software platforms like NI LabVIEW, making them perfect for prototyping.)

The goal of Nick's engineering project was to develop a proof-of-concept model for a low-cost medical monitor that would be able to publish data to the cloud. Nick envisioned that his device might allow medical professionals to remotely monitor health data for any potential emergencies, while patients remain in the comfort of their home.

Read more about Nick's project at **www.vernier.com/r1811**

INNOVATIVE USE

Design-It-Clean Challenge

Alejandra Guzman, a Secondary Science Strategist for Los Fresnos CISD in Texas, shared her recent experience with Project Based Learning (PBL) in the Design-It-Clean Challenge. In this dynamic end-of-year project, students are challenged to create a water-filtration device that is efficient, affordable, and sustainable. Students also create websites and marketing materials in order to promote their product at a school showcase that is open to the public.

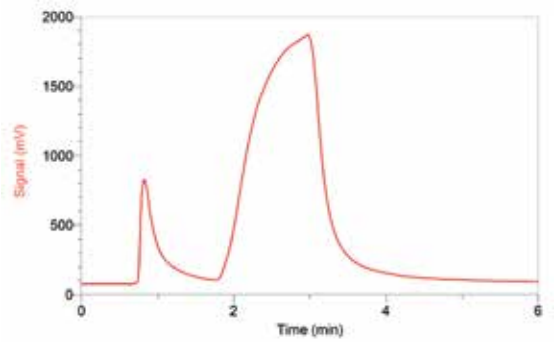
Teachers, district employees, and community members attend the event and act as judges and stakeholders.

This challenge takes approximately two and a half weeks to complete and is a great way for chemistry teachers to cover and review topics such as matter, wavelength, physical and chemical changes, solutions, and acid and base reactions. Throughout a prototyping process, students use Vernier technology to collect data from their water samples.

Learn more at **www.vernier.com/r1812**

INNOVATIVE USE

Investigating Intermolecular Forces Using the Mini GC Plus

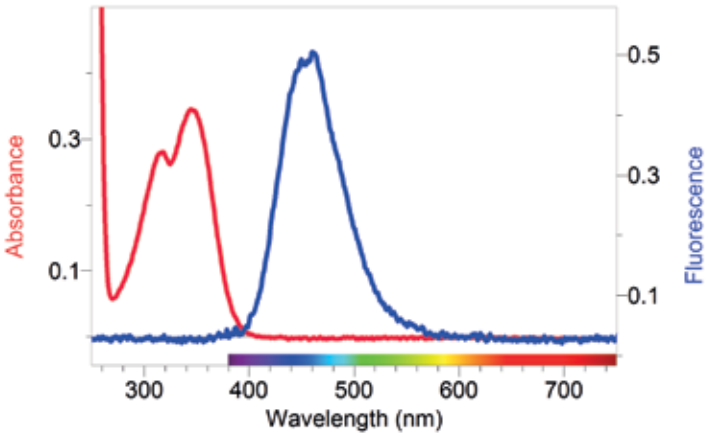


Chromatogram of an equimolar ethanol and n-butanol mixture

Taking full advantage of the Vernier Mini GC Plus, William Patrick Cunningham, from Claudia Taylor Johnson High School in San Antonio, Texas, designed an innovative experiment in which students study intermolecular forces. The experiment uses different alcohols to demonstrate how variations in molecular structure and molecular mass affect the speed at which a molecule's vapor passes through the chromatography column. Students investigate the effect of intermolecular forces on boiling point by testing a mixture of the two alcohols, n-butanol and ethanol. At the end of the experiment, students apply their understanding of intermolecular forces to provide an explanation for the differences in the boiling points and use data to support their answers. William recently published this laboratory experiment in his article "Studying Intermolecular Forces with a Dual Gas Chromatography and Boiling Point Investigation" (William Patrick Cunningham et. al., *J. Chem. Educ.*, 2018, 95 (2), pp 300–304). Detailed lab procedure and sample data are available in the Supporting Information through the *Journal of Chemical Education*.

Spotlight on a New Inquiry-Based Experiment for Spectroscopy

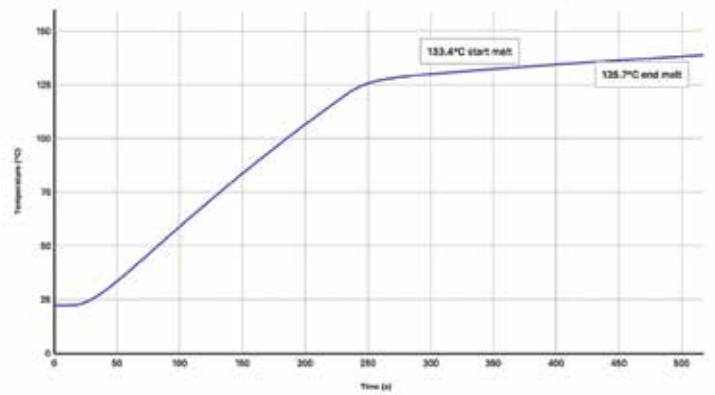
Are you interested in spectroscopy but don't know where to begin? You are in luck! We've recently designed a new experiment, "A Guided Inquiry Approach to Understanding Fluorescence Spectroscopy," to help students understand what goes on inside the "black box" of a spectrophotometer. This experiment, which can be done with either a Go Direct® SpectroVis® Plus Spectrophotometer or our Vernier Fluorescence/UV-VIS Spectrophotometer, has four parts that build upon each other. This allows you to decide what level is right for your students and lets students learn at their own pace. The design also helps to break down spectrometer data collection into manageable chunks, so students are able to gain confidence with the use of the instrument and then quickly move on to focusing on the science.



This experiment is available as a free download at **www.vernier.com/r1813**

Forensic Chemistry: Analysis of a Mystery Powder

As part of the investigation of a crime scene, detectives note that a white powder is found at the location. Even though they have their suspicions, chemical and physical analyses must be performed to determine the identity of the powder. That's where the crime scene technicians take over.



Melting graph for unknown mystery powder from a crime scene

In this experiment, students analyze a white power by employing laboratory techniques similar to those practiced by forensic scientists. Students use Vernier technology to analyze the physical and chemical properties of the powder in order to determine its composition. They measure the melting point of the powder with the Go Direct Melt Station and the pH and conductivity of solutions of the white powder using the Go Direct pH Sensor and Go Direct Conductivity Probe. Students also observe chemical reactions of the powder with iodine and acidified iron(III) ion solutions. After comparing the physical and chemical properties of the mystery powder to known chemicals provided by the teacher, students report their observations and conclusions. Note that this experiment can also be done with LabQuest versions of the sensors.

Download the experiment at **www.vernier.com/r1814**

Vernier in the Chemistry Journals

Open-Source Low-Cost Wireless Potentiometric Instrument for pH Determination Experiments

Hao Jin, Yiheng Qin, Si Pan, Arif U. Alam, Shurong Dong, Raja Ghosh, and M. Jamal Deen; *J. Chem. Educ.*, 2018, 95 (2), pp 326–330.

The authors describe how to build a low cost pH probe from readily available, off-the-shelf parts. Their system uses an Arduino® board to process the data from a glass pH electrode. They also incorporate a temperature sensor and Bluetooth® wireless technology. They program their system using the Arduino Sketch programing language. The authors hope that by building this system their students will better understand how a pH meter works. A Go! Link and Voltage Probe were used to measure the voltage produced by the glass pH electrode.

Featured Products: Go! Link, Voltage Probe

Erasing the Glow in the Dark: Controlling the Trap and Release of Electrons in Phosphorescent Materials

William A. Getz, Dannielle A. Wentzel, Max J. Palmer, and Dean J. Campbell; *J. Chem. Educ.*, 2018, 95 (2), pp 295–299.

The authors use fluorescence spectroscopy to demonstrate the darkening effect using lower energy wavelengths on the intensity of the fluorescent light and the time until the emission is quenched.

Featured Products:
Vernier SpectroVis Plus Spectrophotometer, SpectroVis Optical Fiber

Demonstrations of Magnetism and Oxidation by Combustion of Iron Supplement Tablets

Max J. Palmer, Keri A. Martinez, Mayuresh G. Gadgil, and Dean J. Campbell; *J. Chem. Educ.*, 2018, 95 (3), pp 423–427.

The authors demonstrate the conversion of iron(II) ion in iron nutrient supplements to hematite by first heating a sample with a torch.

Featured Product: Magnetic Field Sensor, LabQuest 2

Nanoparticle Synthesis, Characterization, and Ecotoxicity: A Research-Based Set of Laboratory Experiments for a General Chemistry Course

Zoe N. Amaris, Daniel N. Freitas, Karen Mac, Kyle T. Gerner, Catherine Nameth, and Korin E. Wheeler; *J. Chem. Educ.*, 2017, 94 (12), pp 1939–1945.

Students learn to synthesize silver nanoparticles and then characterize them using UV-VIS spectroscopy and dynamic light scattering.

Featured Product: Vernier UV-VIS Spectrophotometer

Speciation and Determination of Low Concentration of Iron in Beer Samples by Cloud Point Extraction

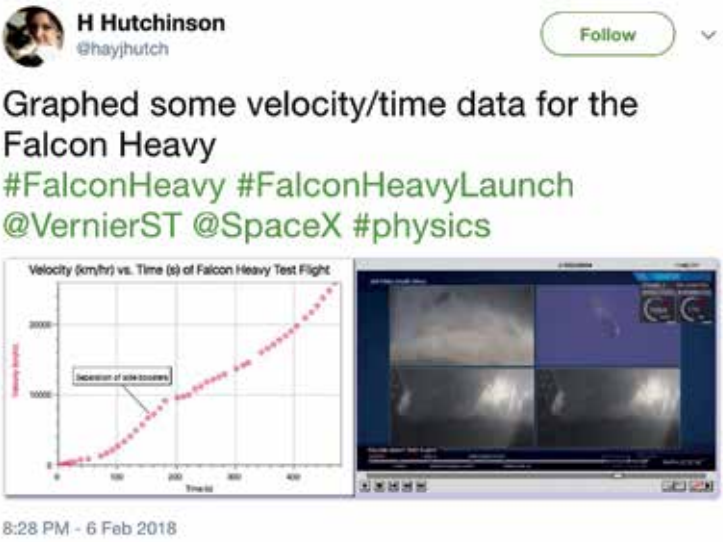
Lida Khalafi, Pamela Doolittle, and John Wright; *J. Chem. Educ.*, 2018, 95 (3), pp 463–467.

Students determine the concentration of iron in beer samples.

Featured Product: Vernier SpectroVis Plus Spectrophotometer

For more articles, visit **www.vernier.com/r1815**

Follow @VernierST on Twitter



*Hayley Hutchinson (**@hayjhutch**) of Derby High School, Derby, Kansas*

Science Humor

One tectonic plate bumped into another and said, "Sorry, my fault."

I poured my root beer in a square mug. Now it's just beer.

Q: **What is another name for a very small group of crows?**
A: **Attempted Murder**

Complete Biology Solution Using Go Direct® Sensors

With the release of new Go Direct sensors, biology instructors now have an easy solution for their ever-changing technology needs in the classroom. The versatility, ease of use, and cost of Go Direct sensors make them an ideal fit for any biology or life science course.

Go Direct sensors connect directly via USB or Bluetooth® wireless technology to Windows® and macOS® computers, Chromebook,™ and iOS and Android™ devices. The sensors are supported by our free Graphical Analysis™4 app and can be used in more than 30 biology experiments from our updated lab book, *Biology with Vernier*, 4th Edition—now available electronically, in addition to the traditional print format.

To see the full list of sensors and to download a free sample experiment, visit **www.vernier.com/r1816**

2017 CASE Award Winners

(left to right) Dan Jansen, CASE Project Director; Brooklyn Bush, CASE awardee; Matthew Eddy, CASE awardee; David Carter, Vernier STEM Training Director

Two agricultural science teachers were honored recently by the Curriculum for Agricultural Science Education (CASE).

Brooklyn Bush of Tillamook High School, Tillamook, Oregon, received the CASE Innovation Award. Bush uses the Food Science and Safety curriculum to develop industry partnerships with the Tillamook County Creamery Association, Tillamook Smoker, Pacific Seafood, and Werner Meats. These partnerships inform students of employment opportunities in the agriculture industry and foster a network of support between students and members of the community.

Matthew Eddy of Southeast Polk High School, Pleasant Hill, Iowa, received the inaugural CASE Model School Award. Through the agriculture program at Southeast Polk, he was able to field test many CASE courses. By offering a pathway for his students and engaging them through technology, including the implementation of CASE Online, Southeast Polk High School's agriculture program ensures students are college and career ready with their knowledge of STEM.

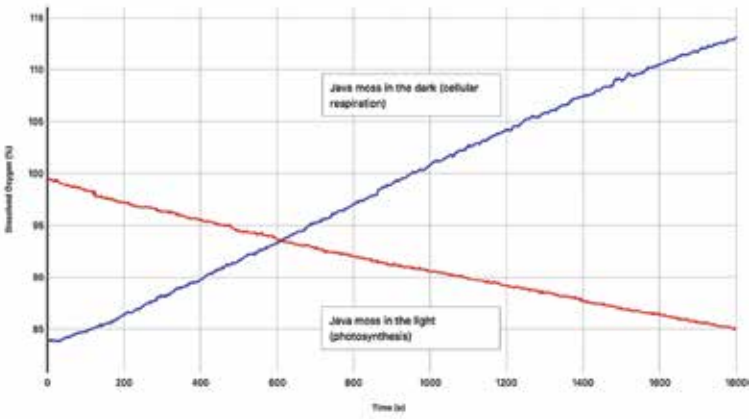
Each award included $1,000 worth of Vernier Software & Technology products, registration to the National Association of Agricultural Educators (NAAE) convention, and a $500 travel stipend.

Read more about these awards at **www.vernier.com/r1817**

Aquatic Photosynthesis and Cellular Respiration

Aquatic plants undergo photosynthesis and cellular respiration much like terrestrial plants. Oxygen dissolves into water when aquatic autotrophs release oxygen as a byproduct of photosynthesis. Dissolved oxygen can be measured directly to determine if aquatic plants undergo photosynthesis or cellular respiration in different conditions.

In this experiment, students use a Vernier Optical Dissolved Oxygen Probe or Go Direct® Optical Dissolved Oxygen Probe to measure the dissolved oxygen produced by aquatic moss. Aged tap water and a golf-ball-sized ball of moss are added to a 250 mL Nalgene® bottle. The bottle is then exposed to a high-intensity plant light or wrapped in aluminum foil to prevent light from reaching the plants. Students can see results in 15 minutes, allowing this activity to be completed in a single 45-minute class period. After data collection, students calculate and compare the rates of oxygen production (or consumption) in each condition.



Download the experiments at **www.vernier.com/r1818**

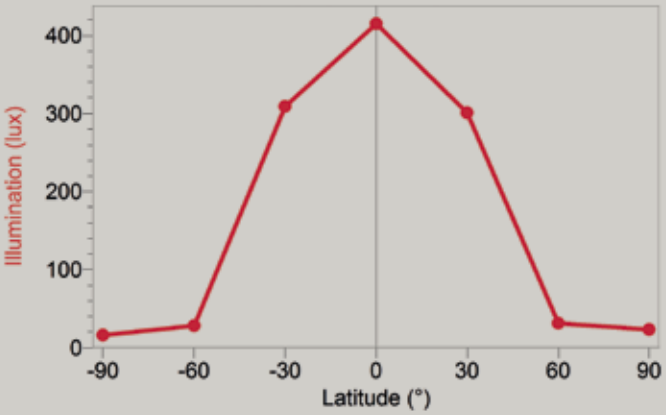
INNOVATIVE USE

A New Take on Angle of Insolation

Paul Osuna, science teacher at Rancho Del Rey Middle School in Chula Vista, California, sent us a new take on the "Angle of Insolation" experiment found in several of our lab books. His intent is to eliminate the concept of Earth's tilt from the experiment and focus solely on the effect of latitude. In his variation, a Light Sensor is placed at various angles in relation to a lamp, simulating the angle of the surface of the Earth at various latitudes in relation to the sun. A Go Direct® Light and Color Sensor could also be used.

Sample data from Osuna's experiment illustrate the intensity of the sun at the equator, 0°, and how quickly intensity drops off near the poles, 90° and –90°. Both incandescent bulbs and LEDs were tested.

In Osuna's version of the experiment, students also use a Voltage Probe to measure the output of a small solar panel placed at these same angles and get similar results. A Go Direct® Voltage Probe could be used in the same way.



Effect of angle on illumination, simulating the angle of insolation

Download the free experiment at **www.vernier.com/r1819**

2017 Ecology/Environmental Science Teaching Award Winner Announced

Robert Hodgdon of Richmond Hill Middle School in Richmond Hill, Georgia, was the 2017 recipient of the National Association of Biology Teachers' NABT Ecology/Environmental Science Teaching Award. This award, sponsored by Vernier, was presented at the 2017 NABT Professional Development Conference in St. Louis, Missouri.

Robert, a 7th grade Advanced Content Life Science teacher, developed an ecological studies program that provides students, parents, and staff with opportunities to participate in real-world ecological surveys in partnership with state and federal wildlife agencies. Hodgdon's work has been recognized by numerous local, state, and national organizations, including the United States Environmental Protection Agency and the White House Council on Environmental Quality. For more information, visit **www.nabt.org**

Over 30 Years Ago in This Newsletter

In our Spring 1987 issue of *The Caliper*, we introduced our first IBM-compatible program, Precision Timer (MS-DOS version). After Apple II and Commodore 64, this was the third platform we supported with Precision Timer. It was a major breakthrough for our company; some college physics professors considered the IBM-PC to be the first "real computer" and the program became a big hit. In the same issue we explained how to use our Voltage Plotter program for Apple II to monitor the output of a Spectronic 20 spectrophotometer. This was our first work with any kind of spectrophotometer.

Ira Flatow at Vernier

Last fall, we were pleased to host Ira Flatow, host of Science Friday, at our office for a fundraiser for our local public broadcasting station. Ira talked about the many guests he has interviewed and his views of how science and the media have changed. He even autographed a LabQuest 2 for us.

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**

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.

2018 Vernier/NSTA Technology Award Winners

The annual Vernier/NSTA Technology Awards recognize seven educators—one elementary teacher, two middle school teachers, three high school teachers, and one college-level educator—for their innovative use of data-collection technology in the science classroom. Chosen by a panel of NSTA-appointed experts, winners receive $1,000 in cash, $3,000 in Vernier products, and up to $1,500 toward expenses to attend the annual NSTA National Conference. For more information and to apply for the 2019 awards program, visit **www.vernier.com/grants/nsta**

ELEMENTARY SCHOOL

Rachel Hallett-Njuguna

Goldsboro Elementary Magnet School
Sanford, FL

Goldsboro Elementary Magnet School's Space Lab engages students in thinking about space science and working as scientists, astronauts, and engineers. Space Lab teacher Rachel Hallett-Njuguna will have students in grades K–5 model complex systems, such as a Mars habitat, using LabQuest 2 devices and an assortment of Vernier sensors to collect authentic data.

MIDDLE SCHOOL

Robert Hodgdon

Richmond Hill Middle School
Richmond Hill, GA

Science teacher Robert Hodgdon engages students in real-world ecological investigations to help them develop STEM career readiness skills. An example of this includes students using Vernier data-collection technology, such as a pH sensor, to understand the biotic and abiotic factors relevant to their local habitats such as tidal marshes, ephemeral wetlands, and relic forests.

Leah LaCrosse

McCormick Junior High School
Huron, OH

Leah LaCrosse believes it is important for students to understand the short- and long-term implications of being responsible citizen scientists in the community. As such, 8th graders will participate in a year-long project that involves the use of Vernier technology to collect air, water, and soil samples to study the community's impact on nearby Lake Erie.

HIGH SCHOOL

George Hademenos

Richardson High School
Richardson, TX

As part of a STEM-based project, George Hademenos challenged his students to design, model, construct, test, and navigate a robotic vehicle. Students used the ROAVEE (Remotely Operated Amphibious Vehicle for Environmental Exploration), which was equipped with Vernier sensors, to collect environmental data from areas not easily or safely accessible to students, such as in a lake and inside a drainage tunnel.

Misty Heredia

Los Fresnos High School
Los Fresnos, TX

As a teacher at a predominately Hispanic, economically-disadvantaged school, Misty Heredia believes expanded access to hands-on technology will help all students improve their comprehension and district assessment scores. Heredia plans to engage her physics students in various inquiry-based investigations utilizing Vernier technology, including an "Impulse and Falling Cell Phones" activity in which students design labs based on their experiences with broken cell phones due to accidental falls.

Bob Talbitzer

Kearney High School
Kearney, NE

The collection and analysis of data is a crucial component of the learning environment in Bob Talbitzer's high school biology classroom. To understand how oxygen is correlated to the creation of energy at the cellular level, students will use Vernier technology to design a fish respirometer that allow them to collect and analyze data on goldfish oxygen usage in water currents of different velocities.

COLLEGE

Marielle Postava-Davignon

Southern Vermont College
Bennington, VT

Assistant professor Marielle Postava-Davignon plans to implement a long-term ecological study in which students will map the campus' maple trees and track how climate change will affect the trees and their syrup production. Student will use Vernier technology to measure soil moisture and temperature, soil pH, air humidity and temperature, and more, as well as to track the amount of photosynthetically active radiation available to the trees.

Total Solar Eclipse: Using Vernier to Engage Students during the Real-World Phenomenon

By Mitsi Nessa,
North Kansas City Schools,
Kansas City, Missouri

"We got to witness 20,000-plus students and their teachers all being real scientists at the same time— it was phenomenal!"

For the past decade Vernier technology has been a valuable asset to North Kansas City Schools (NKC Schools) as we have looked for ways to immerse students in the scientific discovery process and make real-world connections. This summer, however, provided an opportunity to utilize the technology in a unique and exciting way when NKC Schools found itself in the path of 100% totality during the August 21st solar eclipse. We immediately looked to Vernier technology to make the eclipse a meaningful and once-in-a-lifetime learning experience for staff and students.

As part of our district-wide planning for the eclipse, we purchased 21,000 pairs of Vernier eclipse glasses so that all of our students and staff could safely view the phenomenon. All of our 30 elementary, middle, and high schools planned special events for the day. This included data-collection activities using Vernier technologies before, during, and after the eclipse at many of our middle and high schools.

Vernier technology continually allows our students to engage with scientific experiences that have deep meaning and purpose.

For the complete article, visit **www.vernier.com/r1820**

Hands-On Summer Institutes

Most schools may close for the summer, but the learning never stops at Vernier. Join us for a full-day exploration of our award-winning technology. Experiment with a variety of interfaces and sensors, including our new Go Direct® sensors with options for wireless and USB connectivity. You'll leave the workshop ready to enhance your students' learning with data collection.

The cost of the institute is $99, which includes an electronic lab manual of your choice. For registration options, including discounted workshop hardware packages, visit **www.vernier.com/summer-institutes**

State	City	Date
AR	Fayetteville	6/27
CA	Los Angeles	6/28
	San Diego	6/26
CO	Denver	6/12
CT	Hartford	7/25
GA	Atlanta	7/16
KY	Louisville	7/20
MA	Boston	7/27
MD	Baltimore	7/18
MO	Kansas City	6/29
NJ	Newark	7/20
NY	Long Island	7/23
OK	Oklahoma City	6/25
OR	Beaverton	7/26
TN	Nashville	7/18
TX	Dallas	6/22
	Houston	6/18
	San Antonio	6/20
UT	Salt Lake City	6/15
VA	Richmond	7/16
WA	Seattle	7/30

2 DAYS — Two-Day, Subject-Specific Institutes

Held in Beaverton, Oregon, at the Vernier Office

BIOLOGY INSTITUTE

July 19–20, 2018

The $199 registration fee includes lunch and a copy of a biology lab book of your choice.

CHEMISTRY INSTITUTE

July 16–17, 2018

The $199 registration fee includes lunch and a copy of a chemistry lab book of your choice.

PHYSICS INSTITUTE

July 9–10, 2018

The $199 registration fee includes lunch and a copy of a physics lab book of your choice.

1 DAY — One-Day, Subject-Specific Institutes

Held in Beaverton, Oregon, at the Vernier Office

ENVIRONMENTAL SCIENCE INSTITUTE

July 18, 2018

The $99 registration fee includes lunch and a copy of an environmental science lab book of your choice.

ENGINEERING AND CODING INSTITUTE

July 11, 2018

The $99 registration fee includes lunch and a Vernier Digital Control Unit, a $61 value.

VERNIER SENSORS WITH ARDUINO INSTITUTE

July 12, 2018

The $99 registration fee includes lunch and a SparkFun® Arduino® RedBoard with a Vernier Interface Shield, a $50 value.

RENEWABLE ENERGY INSTITUTE

July 13, 2018

The $99 registration fee includes lunch and a copy of the lab book, *Renewable Energy with Vernier.*

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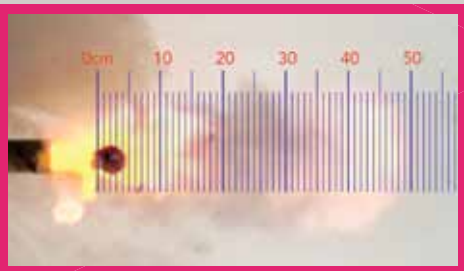





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