Vernier

K–12 Edition

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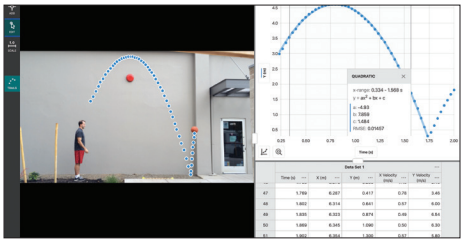
THE Caliper NEWSLETTER

Remote Learning Solutions

We understand how difficult the coronavirus crisis continues to be for educators, parents, and students. So many of you are trying to quickly stitch together an online learning curriculum with very limited school or district resources, all while trying to keep in mind that students might have limited access to technology. To help support you right now, we have created several free remote learning resources. Explore these solutions in the sections below.

We hope the experiment ideas, technology, and software detailed in the rest of these pages will help inspire you when it's time to plan for next school year.

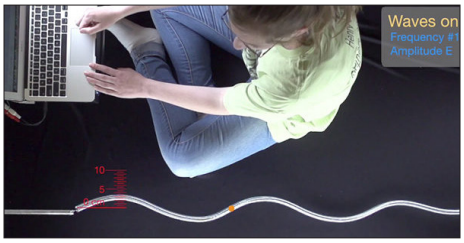
See our online training for remote learning at www.vernier.com/remote-learning



Study Physics Anywhere with Vernier Video Analysis™

Vernier Video Analysis is a physics-focused tool where students can use their mobile devices to insert their own videos with recorded motion, mark points to track the object in motion, and set the scale of the video. This app brings physics and video analysis to all your students regardless of their location. An extended free trial is available through June 2020.

Read more on page 2.



Pivot Interactives: Perfect for Distance Learning

Pivot Interactives is a video-based science learning environment. With more than 200 interactive activities, the high-quality videos from Pivot Interactives give your students the opportunity to observe and study hard-to-replicate experiments and phenomena no matter where they are.

A free 30-day trial and reduced subscription pricing are now available.

Read more on page 3.

Analyze Experiment Data at Home

To help ensure students continue to sharpen their critical-thinking skills and learn key scientific concepts during this precarious time, Vernier has put together the Experiment and Sample Data Library. This collection of over 200 free experiments with sample data files covers many subjects, and is available to you and your students for free. Though students won't be performing the experiments themselves, they can perform their own analysis of the sample data and answer questions based on their results.

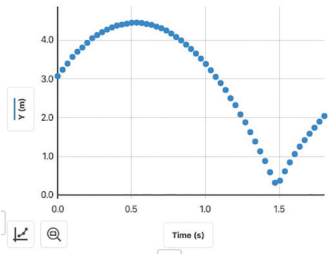
Read more on page 3.

Learn more about these free resources at **www.vernier.com/remote-learning**

Bring Video Analysis to Your Students in a Dedicated and Streamlined Application

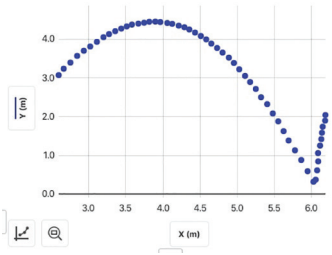
Vernier Video Analysis,™ a new member of our family of apps, is available. Right now, you can get a free trial through June and take advantage of our special introductory pricing.

Many physics instructors have long used the video analysis feature in Logger *Pro*® as a tool to help students learn key topics such as projectile motion, uniform acceleration, center of mass motion, and topics outside of mechanics. There's nothing quite like a video that the students have captured themselves to pique interest in a concept. Vernier Video Analysis now brings this tool to Chromebooks, smartphones, and tablets, as well as desktop and laptop computers.



With the ability to measure the location of an object frame by frame as it moves, Video Analysis lets students build motion graphs for just about any motion that can be captured in a short video.

To illustrate how Vernier Video Analysis works, we analyzed a basketball in flight. It is easy to collect such a video with a mobile device. When you're recording motion with students, be sure to set up in a location with plenty of light to obtain high quality video. Once the video has been captured, the analysis can begin.



We like to play the video first and ask students to sketch expected graphs of position and velocity. Then, the ball position can be marked frame by frame. If a meter stick is included in the frame of the video, students can also mark the ends of the meter stick to set the scale in the Video Analysis app.

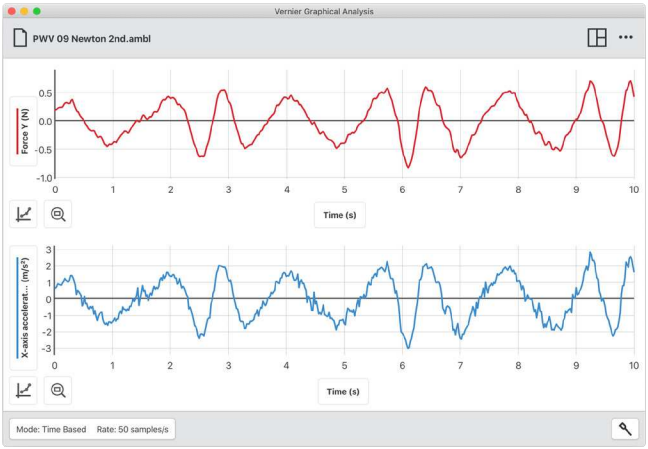
Video Analysis creates familiar graphs and data tables that have the same graph options, curve fits, and other analysis tools as our Graphical Analysis™ 4 app. In the example graphs, we've plotted Y position as a function of time, and Y *vs.* X position. Asking students to explain why these graphs are similar but not identical is an excellent discussion starter.

Learn more about Vernier Video Analysis, download the activity, and sign up for a free trial at **www.vernier.com/c201**

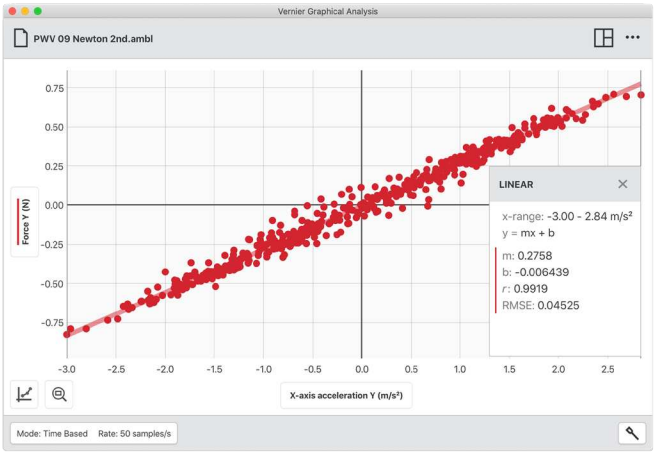
Experiment and Sample Data Library

Are your students stuck at home with no lab equipment? To assist you as you adjust to online teaching, we are introducing the Vernier Experiment and Sample Data Library—a free library of over 200 experiments along with sample data files that you can distribute to your students at home. Students won't actually conduct the experiment themselves, but they can follow along with the written procedure and then perform their own analysis of the sample data provided using one of our data-collection and analysis apps.

For example, the graphs below show the sample data provided for Newton's second law in our free Graphical Analysis™ 4 app. A Go Direct Sensor Cart measured force and acceleration as it was moved back and forth using the force sensor.



Guided by the instructions provided, your students end up with meaningful analysis relating force and acceleration, as shown in the graph below.



The Library contains many experiments across a variety of subject areas including biology, chemistry, and physics. There are experiments written for age groups ranging from elementary to college.

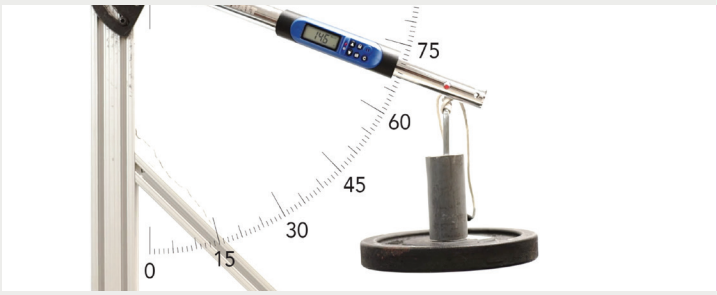
Sample data files are provided in one of the following Vernier apps, all of which are free for the remainder of the school year or longer:

- **Graphical Analysis 4.** Always free and available for Windows,® macOS,® Chrome OS,™ iPadOS,® iOS, and Android.™
- **Spectral Analysis.** Always free and available for Windows, macOS, Chrome OS, iPadOS, iOS, and Android.
- **Logger *Pro*.** Free through October 1, 2020, and available for Windows and macOS.
- **Video Analysis.** Free through June 30, 2020, and available for Windows, macOS, Chrome OS, iPadOS, iOS, and Android.

While we strongly advocate for hands-on science whenever possible, we understand that many schools are in a situation where it is not currently possible. We hope you and your students find this option helpful. If you have any questions, please feel free to contact us at support@vernier.com

Visit the Experiment and Sample Data Library at **www.vernier.com/sample-data-library**

Keep Students Engaged Remotely with Pivot Interactives



As 90 percent of schools are experiencing closures due to the COVID-19 pandemic, many educators are scrambling to find ways to teach classes remotely. Remote learning comes with a different set of challenges than the ones teachers face in the classroom or laboratory, but both types of learning need to engage students' interest. Hands-on science is a great way to capture students' attention, but with students stuck at home without the right equipment, teachers might feel as if they don't have the right resources.

Pivot Interactives, an online learning environment with more than 200 experiment videos spanning a wide variety of subjects, is just the right tool to help students learn remotely. Pivot Interactives has student assessment and classroom management features built into the experience, which means teachers don't have to create their own means of evaluation.

Designed to help teach students hard-to-replicate phenomena, Pivot Interactives is a great remote learning tool for any educator hoping to keep students engaged in science. This tool is a powerful supplement to hands-on experimentation, enabling students to vary experimental parameters one at a time to view results from a set of many recordings of the same experiment. While the students aren't conducting the experiment themselves, this ability to interact with experimental parameters and collect their own data allows students to gain a deeper understanding of the scientific concepts involved.

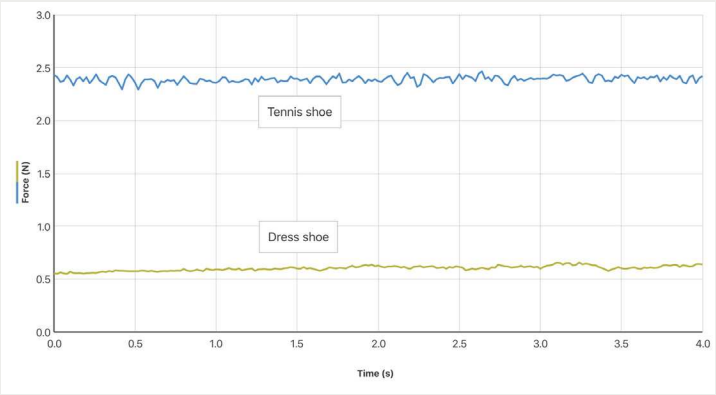
This web-based teaching resource has free trials and reduced pricing available to help teachers finish out the school year. To learn more about Pivot Interactives, visit **www.vernier.com/pivot-interactives**

ELEMENTARY SCHOOL

What a Drag!

Elementary Students Investigate Frictional Forces

Why do some shoes let you slide across the floor while others stop you in your tracks? The answer is friction, of course! The force of friction between the sole of a shoe and the surface below it can easily be measured by dragging the shoe with a force sensor. In this investigation, "What a Drag!", students use Go Direct® Force and Acceleration and our free app, Graphical Analysis™ 4, to collect and analyze their data.



This investigation can be found in our new e-book, *Investigating Force*, one of seven new elementary science e-books. Each of these e-books uses only one type of sensor, making it more affordable to introduce your students to data-collection technology. In addition to *Investigating Force*, other new e-books include *Investigating Motion*, *Investigating Temperature*, *Investigating Magnetism*, *Investigating Light*, *Investigating Voltage*, and *Investigating Gas Pressure*.

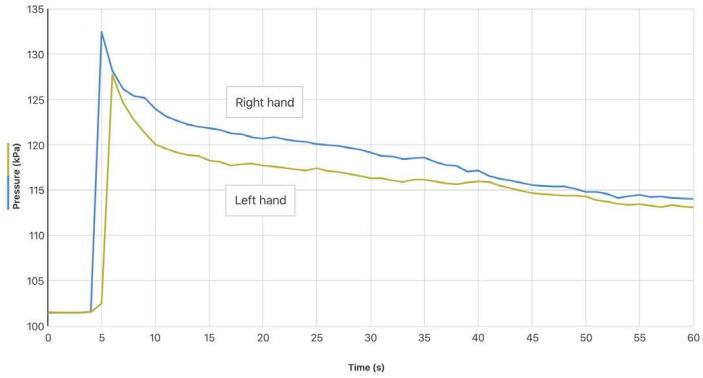
Learn more at **www.vernier.com/c202**

MIDDLE SCHOOL

Get a Grip

Life Science Experiments for Middle School

Middle school students have a lot of energy, but their muscles can actually fatigue faster than they realize. This idea of muscle fatigue is explored in the experiment "Get a Grip" found in our new middle school e-book, *Exploring Life Science*. In this experiment, students squeeze a bulb connected to Go Direct Gas Pressure.



The decreasing pressure exerted by the student on the bulb is graphed over time.

Exploring Life Science is one of our three new, affordable e-books for middle school science organized around the Disciplinary Core Ideas (DCI) of the Next Generation Science Standards (NGSS): Life Science, Earth & Space Science, and Physical Science. A corresponding package of Vernier Go Direct sensors is available for each e-book.

Learn more at **www.vernier.com/c203**

Science Humor

Imagine if Americans switched from pounds to kilograms overnight. There would be mass confusion!

Some biology pertains to elephants. The rest is irrelephant.

Has anyone checked Schrödinger's coffin?

35 Years Ago in this Newsletter

We were proud to announce that our Graphical Analysis II program had won an award from *Classroom Computer Learning*. Back then, the program was available only for Apple II. Now the program is available for Windows,® macOS,® iPadOS,™ iOS, Chrome,™ and Android.™ It's pretty amazing that we still have Graphical Analysis after all these years!

2020 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 to their students. The prizes for the contest winner 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 2020 Winner!

David Carter, an instructor at Kansas State University, Engineering Extension, uses wind energy to introduce middle school, high school, and college students to engineering and design concepts. This includes a statewide challenge, a STEM summer institute, Introduction to Mechanical Engineering 101, and an "Energy Library" for Kansas K–12 schools.

Honorable Mentions

Berkeley Gadbaw, an instructor at Catlin Gable School in Portland, Oregon, has her eighth-grade science students design a hot pack and perform an optional coding challenge. **Rachel Arbor**, at Altona Middle School in Longmont, Colorado, has her students design water wheels for different countries.

To see details about the contest and videos of the winning entries, visit **www.vernier.com/c204**

MIDDLE SCHOOL

Vernier and SAM Labs Help Educators Prepare Students for the Future

The deeper we dive into this technology-driven century, the more important it is for students to gain the skills needed for the future. Coding helps young learners build valuable experience using the 4Cs of 21st century skills: critical thinking, collaboration, creativity, and communication.

Vernier has created a series of experiments in Google Workbench that encourage students to use their coding skills to build SAM Labs projects that interact with Vernier sensors. Our "Sound Level Stoplight" activity challenges students to use a Vernier Go Direct Sound and a SAM Labs LED to react in real time to different sound levels in the classroom. Students will translate sound levels into code, so they will gain valuable experience with both data-collection technology and block-based coding. The collaboration between Vernier and SAM Labs was awarded the Tech & Learning Best of Show at TCEA this year.

Learn more about how Vernier and SAM Labs can help you boost coding skills in your classroom at **www.vernier.com/c205**

MIDDLE SCHOOL

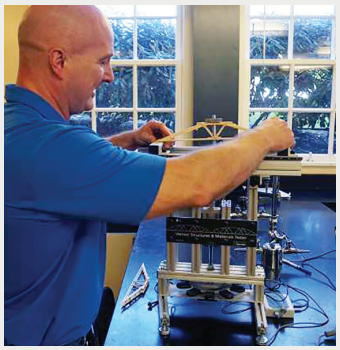
Vernier Technology and OpenSciEd Support Three-Dimensional Learning

In the three-dimensional learning approach, students need to understand critical scientific concepts, use them to solve problems, and understand how they connect to the real world.

To support three-dimensional learning, teachers need access to high-quality lessons and investigations that incorporate these principles. However, it can be frustrating to find a reliable source for these materials.

Vernier has teamed up with OpenSciEd to provide teachers with free hands-on lessons that use data-collection technology and support the three-dimensional learning approach.

See how Vernier and OpenSciEd can help your students establish a deep understanding of critical scientific concepts through data collection at **www.vernier.com/c206**



HIGH SCHOOL

Building a Successful Bridge-Building Program with Vernier Technology

Vernier is excited to announce the Go Direct Structures & Materials Tester. It sports a new displacement sensor, a more rigid frame, and connects easily to our Graphical Analysis 4 app. While bridge-building competitions are not the only activities that you can conduct with the Structures & Materials Tester, they may be the most fun. There is a carnival-like atmosphere when students put their engineering design and construction skills to the test and see how they fare against their peers.

Some teachers excel at making this event not only fun, but very educational. Mark Wechter, from Riverdale High School in Portland, Oregon, is one of those teachers. His students have competed in the Illinois Institute of Technology International Bridge Competition for years and, since integrating Vernier technology into the classroom, his students have won the contest two out of the last three years. We sat down with him to find out how he built such a successful program and how technology has helped him in the effort.

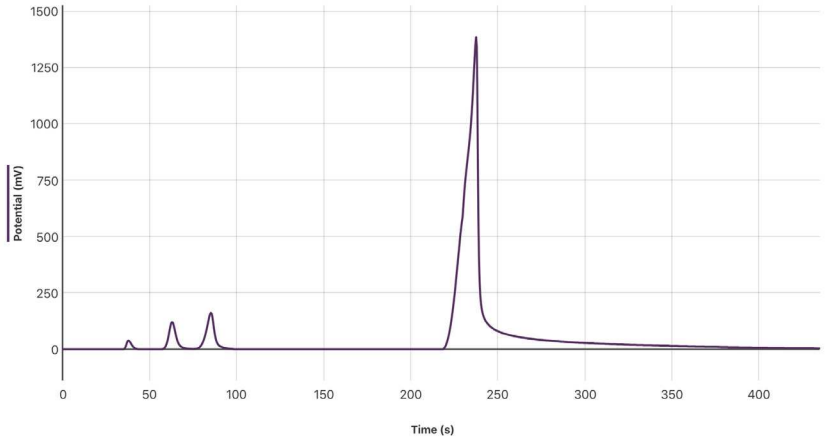
Q: How has data-collection technology affected the bridge-building activities?

A: We used to use a lever-and-bucket system to test bridges; the process would destroy the bridge. Now, students can test their bridges several times using the Vernier Structures & Materials Tester. Each time they test the bridge, only one little spot breaks; they're not continuing to have that downward gravitational force that's going to destroy the whole thing. Students can over-build that one spot and test it again without having to rebuild the entire bridge.

To read the full interview, visit **www.vernier.com/c207**

HIGH SCHOOL

New Go Direct Mini GC Detects Polar and Nonpolar Compounds



Separating a mixture of acetates and alkanes

It's been about a decade since we released the Mini GC Gas Chromatograph and educators have loved it. However, with the original version, only polar compounds such as alcohols, esters, and ketones can be injected. With the release of our new Go Direct® Mini GC,™ teachers and students can now detect both polar and nonpolar compounds, including alkanes and aromatics.

To take advantage of the expanded capabilities, new experiments, such as "Gas Chromatography Basics: Column Temperature and Loading," are included with the product as a free download. In this experiment, students inject a polar and nonpolar compound mixture and learn how adjustments to experimental parameters affect compound separation. These parameters affect the interaction between the analytes and stationary phase, which make for a great discussion about intermolecular forces—a topic that frequently appears on the AP* Chemistry Exam.

See the full list of the class of acceptable compounds and free experiments available for the Go Direct Mini GC at **www.vernier.com/gdx-gc**

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HIGH SCHOOL

Do You Teach Electrochemistry in Your Chemistry Course?

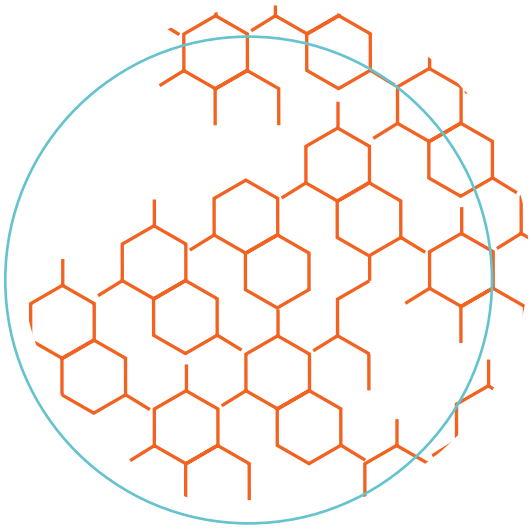
It can be challenging to teach electrochemistry to students in a way that is simple, yet engaging.

Using Go Direct Voltage, along with our experiments, makes teaching electrochemistry less complicated and more fun. Oxidation and reduction is a basic concept when teaching electrochemistry. This is easy to explore by setting up "micro-voltaic" cells, also known as galvanic cells.

Check out Experiment 28, "Establishing a Table of Reduction Potentials: Micro-Voltaic Cells" in our *Chemistry with Vernier* lab book for more details. In this simple and fun activity, students will learn how to write half reactions and calculate cell potentials.

Don't leave electrochemistry out of your curriculum. These simple experiments will give your students a basic introduction to oxidation and reduction as well as cell potentials.

For more electrochemistry experiment ideas, visit **www.vernier.com/c208**



HIGH SCHOOL

Data Aggregation for Biology Made Easy with Vernier and Google Workbench

We have made several of our hands-on experiments available on the innovative learning platform Google Workbench, and this new integration helps streamline data aggregation in biology classrooms.

Through the Google Workbench platform, instructors can share pre-built Google Sheets so students can analyze data and learn collaboratively.

"For students, one of the biggest benefits is that it decreases 'busy work' and allows them to see the full results of a complex experiment rapidly," said John Melville, PhD, Director of Biology at Vernier.

The experiments are available on the Vernier content channel of Google Workbench. Teachers can easily copy, customize, and implement these lessons and assign them to their classes with the built-in Google Classroom integration.

Read more about data aggregation and Vernier at **www.vernier.com/c209**

HIGH SCHOOL

BioBucs Follow the Carbon

By: Janet Ort, Hoover High School in Hoover, Alabama

My students, known as the BioBucs, decided CO_2 movement would be the focus of our Lexus EcoChallenge submission this fall. Carbon movement is an important part of ecological structure and processes. Carbon moves through ecosystems as a solid and a gas. A few years ago in the December 2016 edition of *The Science Teacher*, I saw a model of the Vernier CO_2 Gas Sensor inserted into a plastic container floating over water being used to measure CO_2 diffusing from water. Working through the engineering design process, we created one 3D printed model of a container and one "homemade" model of a container to hold the Go Direct CO_2 Gas Sensor.

Students testing their container models in a nearby water source (photo courtesy of Hoover High School)

Watch their video and download the full presentation of this application of engineering design at **www.vernier.com/c2010**

Agricultural Science Teachers Honored with Prestigious Awards

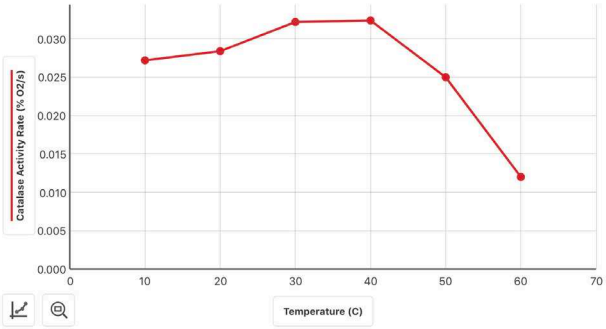
Bibiana Gifft of Baker Technical Institute in Baker City, Oregon, received the CASE (Curriculum for Agricultural Science Education) Innovation Award, while Randi and Joshua Krieg of Goldendale High School in Goldendale, Washington, received the CASE Model School Award. As a sponsor of these awards, Vernier Software & Technology supplies $1,000 in equipment to each school.

Learn more about CASE and these awards at **www.vernier.com/c2011**

HIGH SCHOOL

Enzyme Action: Temperature of Denaturation

In traditional laboratory investigations of catalase and temperature, students measure the reaction rate of the enzyme by placing the substrate and enzyme in a reaction vessel at different temperatures. This is a potential confounding factor, as higher temperatures may denature the enzyme, leading to a decrease in reaction rate. Students don't know whether the decrease in reaction rate was due to the temperature moving outside the enzyme's preferred range or to denaturation of the enzyme.



Temperatures above 40°C appear to denature the enzyme catalase.

Students can incubate a sample of the enzyme at a given temperature for 10 minutes, bring the enzyme back to room temperature, and then add the enzyme to the reaction vessel with the substrate before using an O_2 gas sensor to measure the reaction rate. Following this procedure, the reaction is always performed at room temperature. As shown in the example graph, treating the enzyme to temperatures above 40°C causes a marked decrease in the reaction rate. Since the reaction occurred at room temperature, we know that the enzyme begins to denature at temperatures greater than 40°C.

Download the modified instructions on measuring the heat of denaturation using our Go Direct O_2 Gas and Graphical Analysis™ 4 at **www.vernier.com/c2012**

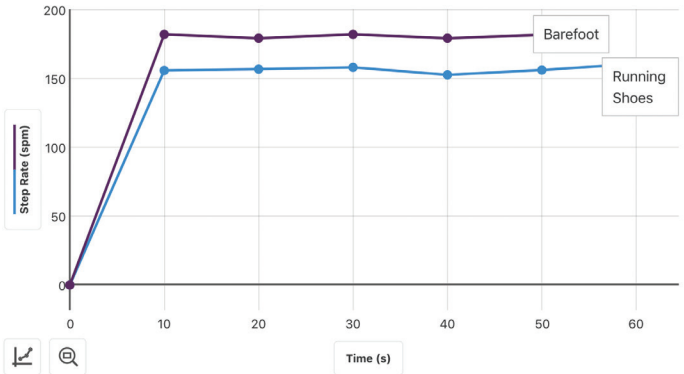
HIGH SCHOOL

Investigate the Biomechanics of Running

We recently used our Go Direct Respiration Belt to investigate the biomechanics of running. This sensor has a built-in pedometer that can measure steps and step rate. With this in mind, we modified our "Barefoot Running" experiment, which is available as a free download.

Barefoot running is a running trend that was popularized by Christopher McDougall in the book *Born to Run*. Traditional running technique emphasizes a heel-to-toe foot strike. Without the padding provided by traditional running shoes, barefoot running minimizes heel strike. This leads to an increase in step rate, or cadence, of the barefoot runner. As shown in the graph, barefoot running leads to an increase in stride rate of the subject.

Essential instructor information and word-processing files of student instructions for the experiment, "The Biomechanics of Running," are available as a free download at **www.vernier.com/c2013**



Comparison of step rate (spm) when wearing running shoes and running barefoot

2019 Ecology/ Environmental Science Teaching Award Winner Announced

Christine Brothers of Falmouth High School in Falmouth, Massachusetts, is the 2019 recipient of the National Association of Biology Teachers' NABT Ecology/Environmental Science Teaching Award, which is sponsored by Vernier.

As the science department head of her school, Christine strives to provide authentic learning experiences for her students. Christine has developed the Carbon Cycle and Climate Change Project as part of her environmental science curriculum, replicating the research techniques she learned during her research abroad. Her students participate in watershed testing, tour salt marshes with local scientists to learn about their research on the effects of sea level rise, visit cranberry bogs with the town's resource manager to discuss groundwater pollution, and much more. They have also taken part in a pilot project to raise endangered spadefoot toads in the classroom and later release them into vernal pools at a local wildlife sanctuary.

"I want my students to interact with scientists working in the environmental field who serve as role models, to experience the natural environment firsthand, and to engage my students in actual environmental research," she explains.

For more information about this award, visit **www.vernier.com/grants**

HIGH SCHOOL

Go Direct Weather Helps Students Study Their World

Monitoring weather and other environmental conditions are great ways to get students engaged with environmental and Earth science. However, measuring weather variables in the classroom can be a cumbersome, expensive endeavor. With our new Go Direct® Weather, educators now have an easy way to introduce students to the study of a variety of weather conditions.

Students can use Go Direct Weather to investigate weather patterns at different times of the year. As a multi-channel sensor, Go Direct Weather records wind speed, temperature, wind chill, heat index, barometric pressure, station pressure, altitude, and it is easy to use out in the field. The sensor can also be used to monitor humidity for indoor experiments and abiotic conditions for ecological studies. All collected data can be viewed in real time using the Graphical Analysis™ 4 app so students can better understand their findings.

Weather stations are valuable tools, but they can be difficult for students to operate and are often too expensive for elementary, middle school, and high school budgets. This new low-cost sensor makes it easy for students to stream collected weather data.

Learn more about how Go Direct Weather improves environmental and Earth science studies in the classroom at **www.vernier.com/gdx-wthr**

Software Updates

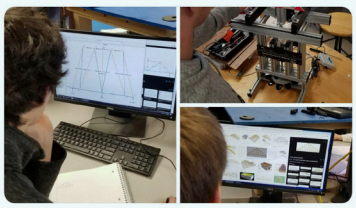
We regularly release software updates to support new sensors, add new features, and fix the occasional bug. Keeping up to date with software releases is one way to help things run smoothly in your classroom or lab. Have you updated your Vernier applications in the last few months? Updates are free, and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

Follow @VernierST on Twitter

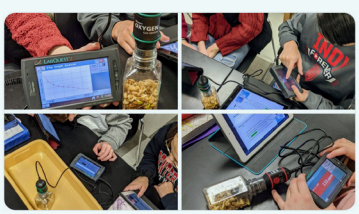
Chris Hurd
@CazHSTechLabs

POE students designing trusses to build and bust! All that work... For 3 seconds of glory. How much would your truss hold? @PLTWorg @mfgeducation #cazenoviacte #cazcte @cazenoviacsd @CazCTE



Jeff Peterson
@petersonjeffrey

Great lab today as we investigated how respiration gases change during cellular respiration. @VernierST @CenterGroveMSN #cgnorthpride #e3cg #wedoscience



2020 Vernier/NSTA Technology Award Winners Announced

Each year, Vernier Software & Technology and the National Science Teaching Association (NSTA) recognize seven educators—one elementary teacher, two middle school teachers, three high school teachers, and one college-level educator—with a Vernier/NSTA Technology Award for their innovative use of data-collection technology in the science classroom or laboratory.

Chosen by a panel of NSTA-appointed experts, the 2020 winners each received $1,000 in cash, $3,000 in Vernier products, and up to $1,500 toward expenses to attend an NSTA conference.

If you have a great idea for using data-collection technology to ignite learning for students, apply for the 2021 awards program by visiting **vernier.com/grants**

ELEMENTARY SCHOOL

Aaron Burke

South Avenue Elementary in Beacon, NY

Media teacher Aaron Burke plans to create a comprehensive curriculum that will provide students in grades K–5 with the opportunity to explore the health of the nearby Hudson River. Students will use data-collection technology, such as dissolved oxygen and turbidity sensors, to monitor water samples from the river as well as from tanks in the school's library.

MIDDLE SCHOOL

Colin Pattison

Indian Creek Road Public School in Chatham, Ontario

The technology acquired through this award will help teacher Colin Pattison continue to engage his students in data-collection activities and, in turn, better equip them for a successful transition to high school. This includes using Vernier interfaces and probeware to teach students various scientific concepts including force production, heat retention, and motion detection through hands-on activities.

Annette Simpson

McCleskey Middle School in Marietta, GA

The use of Vernier technology will help science teacher Annette Simpson enhance the in-the-field investigations she conducts with students at a local creek. Now, more students will be able to easily and more frequently conduct chemical and biological assessments of the waterway—and analyze their findings—using 21st century data-collection technology.

HIGH SCHOOL

Neil Ford

St. Helens High School in St. Helens, OR

This award will help STEM teacher Neil Ford incorporate the Vernier Mini GC™ into classroom labs. Using the technology, students will have the opportunity to engage in hands-on data collection as they perform quantitative analysis of an organic solvent mixture.

Kelley Parks

Forreston Jr./Sr. High School in Forreston, IL

Agriculture teacher and FFA advisor Kelley Parks plans to engage her students in various data-collection activities using Vernier technology as part of a project-based curriculum. For example, in a Curriculum for Agriculture Science Education (CASE) lab titled "Energy in Feed," students will use probeware to determine the energy content of different feedstuffs.

Kristine Schertz

Saugus High School in Santa Clarita, CA

In the Chemistry in the Earth System course, science teacher Kristine Schertz will engage her students in hands-on learning as they investigate the Earth's heat balance, the greenhouse effect, and climate change. Students will use Vernier carbon dioxide sensors along with materials such as clay, charcoal, and cotton to measure the reduction in carbon dioxide produced from a chemical reaction during the course's culminating engineering design challenge.

Read more about the innovative projects of this year's winners at **www.vernier.com/c2014**

Students researched a low-cost, electrochemical method for extracting copper from solutions.

Copper Recovery: Student-Led Chemistry Research Using Data-Collection Technology

At BASIS Flagstaff charter school in Flagstaff, Arizona, a group of 11th and 12th grade students is preparing for a future in STEM by acting as real-world scientists in their extracurricular chemistry research group.

Assisted by subject expert teacher Tom Talasek, PhD, the nine-student group chooses topics, defines problems, and completes comprehensive research, which challenges them to learn about different instrumentation and chemical techniques—things that help prepare for college and future careers.

Check out the rest of their story and get some ideas on how to inspire your students to start a research group of their own at your school at **www.vernier.com/c2016**

Share Your Experiments With Us

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

Vernier in the Journals

Recent journals have featured Vernier technology in the following articles:

- Electric Circuits as Seen by Thermal Imaging Cameras
- Design and Construction of a Low-Cost Arduino-Based pH Sensor for the Visually Impaired Using Universal pH Paper
- Exploring Chemical Equilibrium for Alcohol-Based Cobalt Complexation through Visualization of Color Change and UV–vis Spectroscopy
- Hot Reactions: Applying Infrared Thermography in the Chemistry Education Laboratory
- Revisiting the Determination of Percent Aspirin Lab: Using a Limiting Reactant Approach for Students to Also Determine the Amount of Iron (III) Chloride
- Aluminum Metal Digestion as a Demonstration of an Oscillating Voltage Reaction: An Application Beyond the Textbook

See the references and learn more about these uses at **www.vernier.com/c2015**

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