PASCO

Equip Your iPad for Science

Bring the full-featured version of SPARKvue® HD, *p. 235*

Sally Ride Science™ *Key Concepts in Science:*

A new inquiry-based approach to K-8 science, *p. 16*

Kena Digital Microscopes

Connect Directly to SPARK or to your computer running SPARKvue, *p. 42*

PASCO STEM Solutions:

Complete STEM modules powered by SPARKscience, *p. 180*

Solutions for:

Datalogging

21st Century Inquiry-Based Science Learning with SPARKscience™

Committed to Teacher Success

Many years ago, PASCO was born out of a science fair project. So hands-on, discovery-based science is built into our DNA. For more than 45 years we have focused on developing better tools for hands-on science education.

Over those years, the nature of those tools has changed—just as they have in the science profession—with a greater reliance on computing technology. Whether it is computers, interactive whiteboards, simulations, rich visualization software…we know that both science and science education are fundamentally transformed by technology.

We've also learned much over these years about what you—the teacher—need to be successful in your classroom. So, in consultation with hundreds of educators around the world, we have developed a new program to integrate the best of these technologies, learning frameworks and teacher and student support.

The result is SPARKscience, a 21st century discovery-based science learning environment. And we are partnering with key players in education to develop for SPARKscience, to ensure that this solution leverages the instructional materials you find most valuable.

We always remember that our role is to help you, the teacher in the classroom. We can only be successful when you are successful.

So, from our entire team of more than 200 teachers, researchers, engineers and professionals at PASCO, and our Science Education Partners worldwide...

Thank you for your continued dedication to science teaching and student learning.

We stand ready to help you in the challenge.

PASCO 5 YEAR WARRANTY

Paul Stokstad,
President & Founder
PASCO scientific

Instructional Resources

Inquiry-based interactive lab activities

Standards-based teacher guides & lab manuals

Web-based simulations & lessons

PASCO

Products & Technology

Sensors

Data collection devices

Software & interactive visualization

Lab equipment

Teacher Support

Live personal support by phone, email or webcam

Professional development

Online videos & tips

Recognized by the EdNET Community as a potential **"game changer"** in education.

EdNET'S BEST for 2011 SHINING STARS

2010 SIIA //CODiE// WINNER

TECH & LEARNING WINNER AWARDS of EXCELLENCE 2009

didac Award 2010

AWARDS of winner! EXCELLENCE TECH & LEARNING

The list of Leading education products and services for EdNET'S BEST was shaped by the EdNET community, and final selections were made by the EdNET's Best panel.

About PASCO's SPARKscience

K-8 Science Instructional Resources & Classroom Applications

High School Science Instructional Resources & Classroom Applications

New this year…

SPARKscience for Your iPad: Bring the full-featured version of SPARKvue to your iPad with SPARKvue® HD.

Sally Ride Science – Key Concepts in Science: A new inquiry-based approach to K-8 science

Connect Digital Microscopes Directly to SPARK Science Learning System or to your computer running SPARKvue.

PASCO STEM Solutions: Complete STEM modules powered by SPARKscience

spark science™

A "Game Changer" for Science Education

SPARKscience is a whole new generation of science learning technology.

Designed from the ground up to integrate inquiry-based science investigations within a research-based, state-of-the-art learning environment, SPARKscience provides both teacher and student support for success in science, technology, engineering, and math (STEM) programs.

- **Simple yet powerful.** Intuitive design keeps the technology transparent… and students focused on the science. Robust analysis tools always available but never in the way.
- **Completely integrated.** Instructional content, assessment, student and teacher process support, real-time data display and full interactive visualization and analysis tools, embedded assessment and reflection, electronic student journal. All in one seamless environment.
- **Universal.** You need flexibility. We know that. That's why SPARKscience is universal in design. Run it almost anywhere, on any technology in your classroom or lab. Computers, netbooks, interactive whiteboard, our own SPARK handheld. Even coming to the iPad this spring. It's the same award-winning experience—everywhere.
- **Modern.** Invented from the ground up to leverage—and integrate—21st century technologies, years of research on teaching and learning, and of course your input.
- **Fully supported.** Backed by PASCO, the global leader in 21st century science education. We've been delivering and supporting innovative solutions for science education since 1964.

EdNET'S BEST for 2011 SHINING STARS

SPARKscience was named one of five "Shining Stars" EdNET's Best for 2011 Awards, recognizing it as a potential "game changer" in education.

"As a 2011 'Shining Stars' recipient, PASCO's SPARKscience is believed to be one of the superstars of the education marketplace by the EdNET community and the EdNET's Best panelists. Being listed among the EdNET's Best top five puts you on the shortlist of exemplary offerings in the education industry."

— Dr. Nelson Heller, EdNET

"From the earliest grades, students should experience science in a form that engages them in the active construction of ideas and explanations that enhance their opportunities to develop the abilities of doing science." – National Science Education Standards

SPARKscience Is Designed for You

When we embarked on the SPARKscience program, we started by talking with over 1,000 educators around the world. We asked what mattered to you. And we listened.

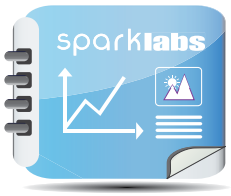
The result is SPARKscience. A completely re-imagined approach to both modern science and effective teaching and learning.

Designed to help you prepare your students for the modern world of science, technology, engineering, and mathematics.

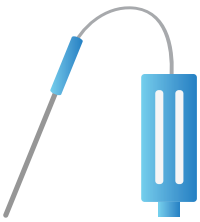
spark science™

SPARKvue Software is the media-rich hub of SPARKscience—a powerful science investigation tool and state-of-the-art learning environment all in one. Display and analyze live sensor data, collaborate, reflect, create electronic lab journals. One software operates on all your technology environments—interactive white boards, Mac and Windows computers, netbooks, and the SPARK Science Learning System. (And coming this spring—SPARKvue HD for the iPad.) See page 6.

The SPARK Science Learning System gives students access to anytime, anywhere science discovery. The SPARK Science Learning System gives students a portable stand-alone device that enables science discovery anytime, anywhere. Whether students are doing lab activities in the classroom or outdoors, this handhelds solution is perfect for collaborative learning. It has a large, full-colored touchscreen and includes two sensors. It comes with SPARKvue software with over 60 pre-loaded SPARKlabs! See page 8.



SPARKlabs are modern, highly interactive lab notebooks, complete with science content, setup and safety guidance, seamless data collection, and embedded assessment—fully contained on your computer or on a SPARK Science Learning System. PASCO offers a collection of over 60 free standards-based SPARKlabs to get you started, and our partners offer many more. Even author your own to tune your activities exactly to your curriculum needs. See page 10.



PASPORT Sensors allow students to wonder… then measure. It's a foundation of science. Equip your students with modern sensing technologies for authentic data collection. Whether measuring water quality, strength of a magnetic field, or the ethanol production of yeast during fermentation, there are more than 70 all-digital PASPORT Sensors that give your students the means to collect real-world data and "see the invisible." See page 184.

2010 SIIA //CODiE// WINNER

WINNER AWARDS of EXCELLENCE 2009

2010

Your 21st Century Science Learning Environment.

SPARKvue®

Software for interactive visualization and analysis

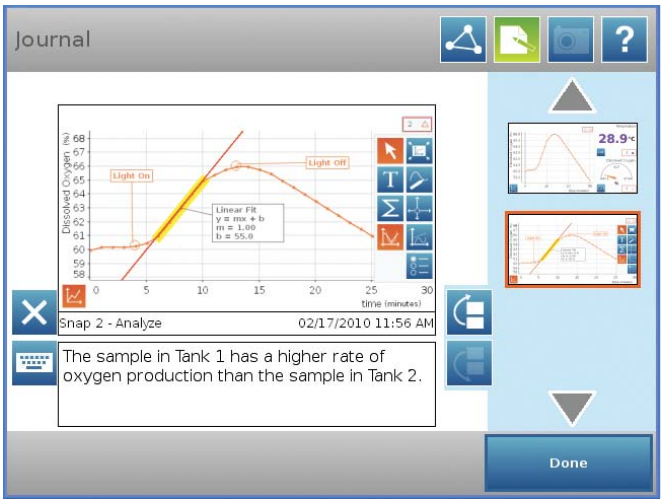
SPARKvue fully supports the learning process.

SPARKvue software is a science tool and state-of-the-art learning environment all in one. SPARKvue offers a full suite of display options, from graphs and meters to digits and tables. Powerful analysis tools are always available at the touch of a finger…but never in the way.

And SPARKvue creates opportunities for student reflection at every step, with the option to save a journal snapshot of work, including written observations, with just a touch of a finger.

SPARKvue is plug-and-learn.

Simply connect any of the more than 70 PASPORT Sensors to your SPARKlink or SPARK Science Learning System and immediately begin collecting data and seeing live measurements. It's powerful, yet simple—the way all probeware should be.



SPARKvue fully supports the learning process. Prompt student reflection with embedded questions, capture student response — even capture 'snapshots' of work, automatically stored in the electronic journal.

SPARKvue...
It's really different.

- Fully supports the learning process.
- Seamlessly integrates content and reflection prompts.
- Finger-touch design keeps students in the flow.
- Integrated electronic student journal

SPARKvue adapts to your technology

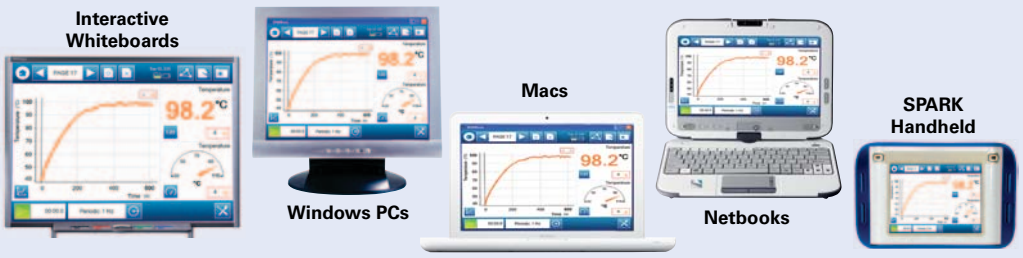
Chances are, you have a mix of technologies in your school. But there's no need to worry. It's the same award-winning experience of SPARKvue, whatever your environment!

- Interactive whiteboards
- Windows computers
- Mac computers
- Netbooks
- SPARK Science Learning System

One common science learning environment.

And coming this spring, SPARKvue HD supports the full SPARKscience experience on the iPad. (See page 234-235.)

And future-proof.... supporting platforms of today and tomorrow.



iPad

See new SPARKvue HD for iPad on page 234-235.

What Teachers Can Do with SPARKvue

- Give interactive lectures using live data and rich media
- Hold collaborative reviews of students' results and findings
- Prompt student reflection with embedded questions
- Assess student learning at any time in process
- Select your own measurements and display data your way

What Students Can Do with SPARKvue

- Make predictions before collecting data
- Display the results of their tests
- Graph their data
- Analyze their data
- Compare actual results with predicted results
- Reflect on the unexpected
- Save a snapshot of work
- Journal

SPARKvue® Site License

PS-2400

SPARKlink®

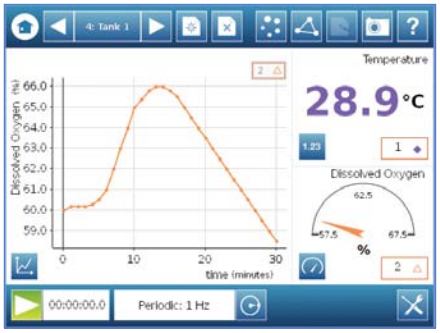
PS-2009

Includes two sensor ports, Built-in Temperature and Voltage Sensors with Probes, USB connection, and rugged polycarbonate case.

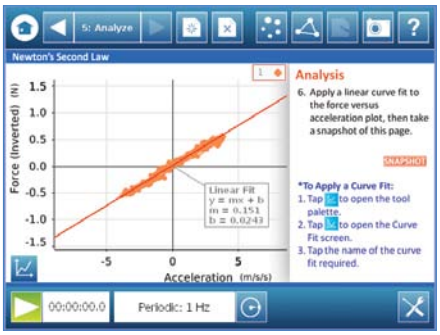
System Requirements: Available for both Windows (Windows XP or higher) and Mac (Mac OS X v10.5 or greater). 300 MHz processor, 128 MB RAM, 100 MB available disk space.

Languages: Arabic, Chinese (simplified), Chinese (traditional), Czech, Danish, Dutch, English, French, German, Italian, Japanese, Kazakh, Korean, Norwegian, Portuguese, Russian, Spanish, Swedish, Turkish.

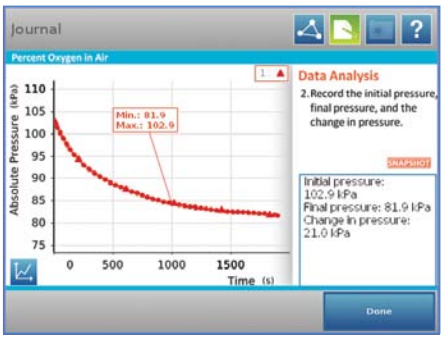
For the most current information, see pasco.com/sparkvue



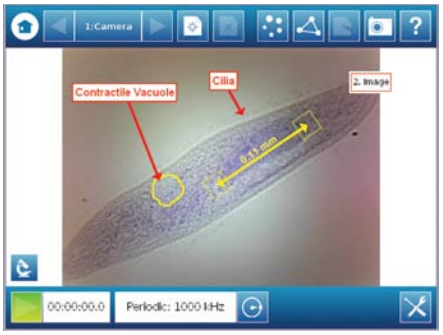
Display data your way.



SPARKvue boasts powerful analysis tools – right there when you need them but never in the way.



SPARKvue fully supports the learning process with built-in SPARKlabs.



USB microscope and video support with image analysis tools.

SPARK Science Learning System™

A fully integrated SPARKscience solution

The SPARK Science Learning System is an all-in-one mobile device that seamlessly integrates the power of probeware with inquiry-based content and assessment. With its large full-color display, finger-touch navigation, and completely intuitive data collection and analysis capabilities, SPARK completely redefines the concept of easy-to-use probeware, so that students can focus on learning the science.

The SPARK Science Learning System comes with more than 60 free pre-installed SPARKlabs to give you the full SPARKscience experience. SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion. Students no longer need to navigate to a separate file for instructions or even refer to paper manuals. Everything you and your students need is right there in context.

The SPARK Science Learning System supports all of the more than 70 PASPORT Sensors.

Features of the SPARK Science Learning System

- Full-color, large screen for easy viewing
- Simple two-button design
- Touch-screen navigation means there's no stylus to lose!
- Fast Response Temperature and Voltage Sensors included
- Comes with more than 60 free pre-loaded SPARKlabs
- Powered by SPARKvue software, so it shares the same user experience as students on computers or teacher at the electronic whiteboard
- Enables multiple modes of discovery, from guided inquiry to open-ended exploration
- Convenient annotation, snapshot, and journaling features support peer dialogue, classroom presentations, and assessment
- Data collection and display features include periodic sampling, manual sampling, graphs, digits, meters, tables, and even multiple representations on one screen

EdNET'S BEST for 2011

TECH & LEARNING WINNER AWARDS of EXCELLENCE 2009

SPARK Science Learning System™

PS-2008A

Includes Fast Response Temperature Probe, Voltage Probe and more than 60 pre-installed, guided inquiry SPARKlabs.

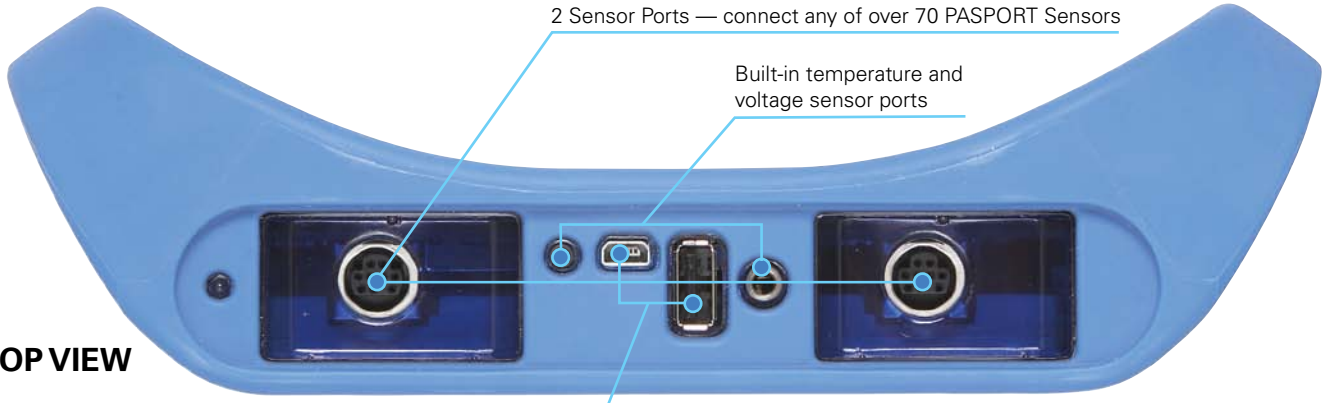
Optional:

SPARKvue Site License PS-2400 *(one per K-12 campus)*

SPARK Charging Station

PS-2570

Conveniently store and charge up to 10 SPARK Science Learning Systems with a single power source. SPARKs sold separately.



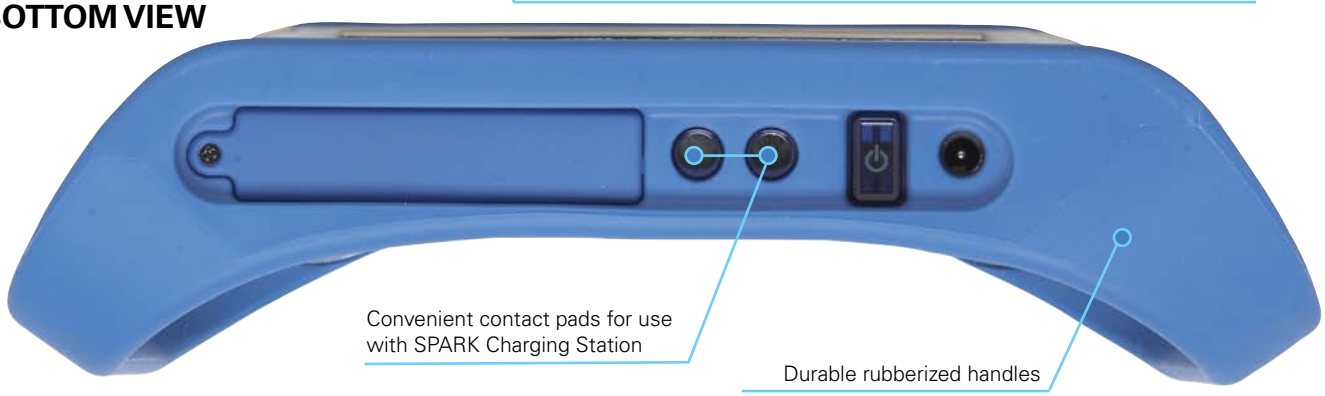
TOP VIEW

2 USB Ports — connect to printers, computers, and flash drives

Start/stop data collection—for one-hand operation, left or right

Large, high resolution finger-touch screen keeps focus on science, not menus

BOTTOM VIEW



Convenient contact pads for use with SPARK Charging Station

Durable rubberized handles

SPARKlabs®

Inquiry-based, interactive lab activities

A central design theme of SPARKscience is the integration of the scientific process with the learning process, and SPARKlabs are the ultimate example of this integration.

SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

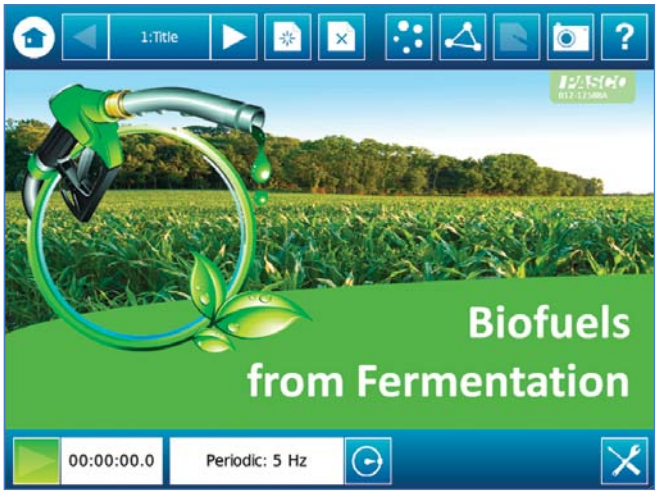
A central theme of SPARKscience is the integration of the scientific processwith the learning process. Each SPARKlab includes:

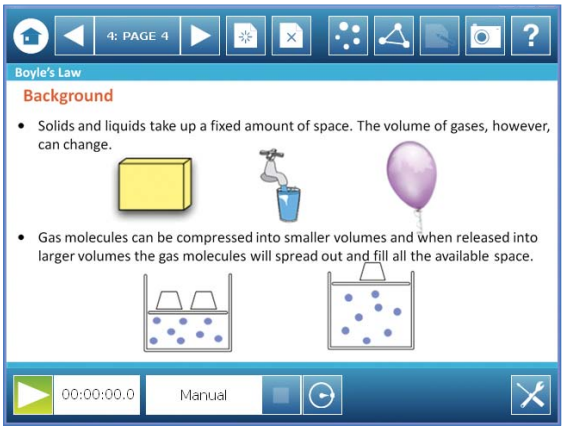
- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.

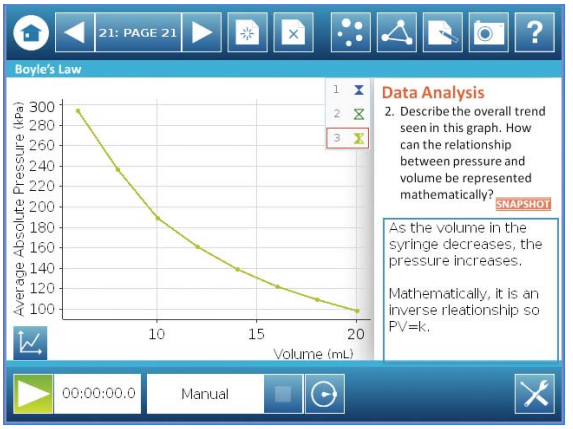
A Growing SPARKlab Collection

See the SPARKlab Online Library for the latest offerings from PASCO and a growing set of publishers.
pasco.com/sparklabs

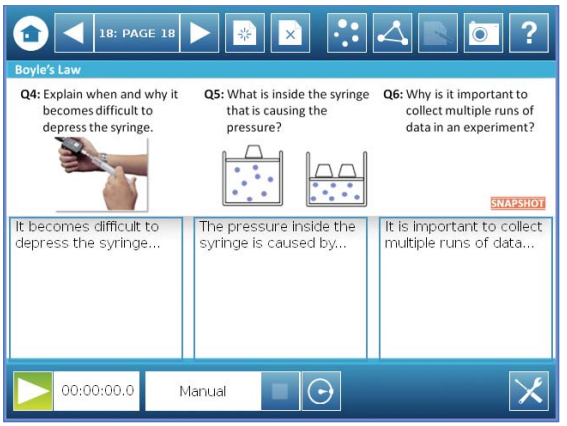




Integrated data collection and analysis means that students immediately draw meaning from the measurements and connect them to the science concept being investigated.



All background information, materials lists, safety notes and procedures are provided, keeping students in the flow of the lab, not flipping back and forth with paper reference materials.



Assessment throughout. Making predictions, sequencing challenges, free response and multiple choice questions are all used to keep students engaged — and to encourage reflection and retention.

Over 60 FREE SPARKlabs…

All Pre-installed on the SPARK Science Learning System & Included with SPARKvue Software!

Elementary School

- Endothermic & Exothermic Changes
- Feeling & Measuring Temperature
- Heating Land and Water
- Keeping Warm
- Lighting a Bulb
- Melting and Boiling
- Mixing Warm & Cool Water
- Temperatures in the Environment
- What is a Conductor?
- What is an Electric Circuit?

Middle School

- Acid Rain and Seed Germination
- Acid's Effect on Teeth
- Exploring Environmental Temperatures
- Mapping the Ocean Floor
- Measuring Light Intensity
- Measuring the Voltage of Elements in Series
- Observing Freezing Point Depression
- Recovery Heart Rate
- Soil Characteristics
- Speed and Velocity
- Thermoregulation of Body Temperature
- Varying Reaction Rates

Biology

- Acid Rain
- Enzyme Action
- Exploring Microclimates
- Membrane Permeability
- Organism and pH
- Osmosis
- Plant Respiration and Photosynthesis
- Respiration of Germinating Seeds
- The Role of Buffers
- Transpiration

Chemistry

- Absolute Zero (Gay-Lussac's Law)
- Acid-Base Titration
- Boyle's Law
- Concentration of a Solution (Beer's Law)
- Diprotic Acid Titration
- Electrochemical Battery
- Evidence of a Chemical Reaction
- Heats of Reaction and Solution
- Intermolecular Forces
- Percent Oxygen in Air

Earth Science

- Air Pollution and Acid Rain
- Insolation and the Seasons
- Monitoring the Quality of Water
- Properties of Water
- Radiation Energy Transfer
- Soil Salinity
- Soil pH
- Specific Heat – Land vs Water
- Water Treatment

Physics

- Acceleration
- Archimedes' Principle
- Conservation of Energy
- Electromagnetic Induction
- Magnetism
- Newton's First Law
- Newton's Second Law
- Ohm's Law
- Speed and Velocity
- Voltage – Fruit Battery

Over 60 SPARKlabs… FREE!

We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license. See the list at left for your free included SPARKlabs.

SPARK Science Learning System™

PS-2008A

Includes Fast Response Temperature Probe, Voltage Probe and more than 60 pre-installed, guided inquiry SPARKlabs.

Optional:
SPARKvue Site License PS-2400
(one per K-12 campus)

SPARKvue® Site License

PS-2400

Your SPARKvue license includes the more than 60 free guided inquiry SPARKlab activities, and authorizes you to run SPARKvue and the SPARKlab activities on any computer on your K-12 campus.

Wonder...

Science is about asking questions. PASCO provides the means to measure – almost anything – to help students discover the science with their own real-world, real-time data. We currently offer over 70 PASPORT Sensors to help students begin the process of constructing knowledge.

See a list of our sensors on page 184

Then Measure

Modern Measuring Technology with PASPORT Sensors

- **PASPORT Sensors** combine advanced technology with simple plug-and-play usability… the best of both worlds!
- **PASPORT Sensors** do things other sensors cannot do. For example, we have a line of MultiMeasure Sensors, each of which includes several individual sensors designed into one compact device. You can ***save money*** while giving your students real measuring convenience. And you can ***save management time*** with fewer sensors to inventory!
- **PASPORT Sensors** are rugged and reliable and can be used with confidence. We stand behind our sensors with a full five-year warranty.

Go to our Products pages, which start on page 184, and see a list of all our sensors and supporting equipment.

Bring K-8 Classrooms to Life with 21st Century Science Activities

Young learners have a natural curiosity about the world around them that merely needs to be encouraged and guided. SPARKscience was created just for that purpose—to help you create an effective and engaging hands-on learning experience with modern tools and technology.

In this K-8 Science section, you will find an offering of instructional resources, plus a wealth of classroom application examples—illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents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100

Key Concepts in Science:
Earth, Life & Physical Sciences

Dig deep into the "Big Ideas" in science with this new program from the science and education experts at Sally Ride Science and PASCO. *Key Concepts in Science* is an integrated, inquiry-based program for 21st century middle school science. It provides everything needed to teach the Big Ideas using modern technology. Aligned to both state and national standards, this program stimulates students' natural curiosity while building their science literacy and critical thinking skills. This leads to the affirmation of learning: *"Now I Get It!"*

Earth Science: page 16
Life Science: page 18
Physical Science: page 20

Our Learning Philosophy

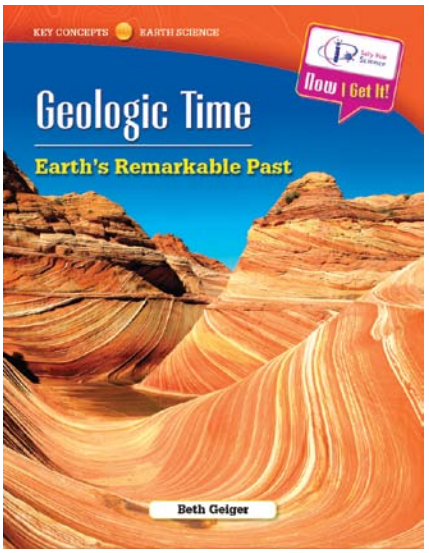
- **Learn by doing:** Guided-inquiry lab investigations activate prior knowledge while stimulating reflection and curiosity.
- **Make it meaningful:** Science concepts connect to current issues and highlight the work and lives of real scientists.
- **Go deep:** Exceptional student books and hands-on investigations guide in-depth exploration of the Big Ideas in science.

Solution at a Glance

Each module includes:

- **6 original book titles:** Each title explores one Big Idea, engaging students with stunning photography, colorful illustrations and compelling narrative.
- **30 SPARKlab activities:** These all-in-one interactive lab activities (5 per book title), guide students through all phases of hands-on investigations.
- **Sensor technology and software** to perform the SPARKlab activities.
- **Teacher Resources:** Teacher Guides and Teacher Lab Notes provide comprehensive planning and pacing guidance that helps you manage your time and customize your science instruction, along with tips for engaging all students.

Key Concepts in Earth Science



Immerse your students in the fascinating science behind Earth's atmosphere, oceans, and landmasses, and the interactions among them. This program takes students on a journey that helps them connect the Big Ideas in Earth Science to the world around them.

- Earth's Air
- Earth's Energy
- Geologic Time
- Plate Tectonics
- Space Exploration
- The Water Cycle

Engage your students in science investigations and readings that foster discovery and build understanding of the key concepts in science, technology, engineering, and math (STEM).

This integrated solution includes six copies of 6 high-interest books and 30 engaging SPARKlabs, along with sensor-based lab stations, innovative Teacher Guides and Teacher Lab Notes, plus an invitation to join the Sally Ride Science Community.

To help students develop a personal connection to science, both the books and the SPARKlabs introduce students to inspiring stories of current-day scientists and engineers. This exposes students to a variety of science, technology, engineering, and math careers, while grounding the science they are learning about.

Benefits

- Delves deep into the big ideas in science.
- Keeps students engaged and on-task with fun, relevant activities.
- Builds science literacy.
- Improves nonfiction literacy skills.
- Boosts in-depth science comprehension.
- Contributes to improvement on critical state tests.
- Compels students to pursue careers in science.

Complete Customizable Solution

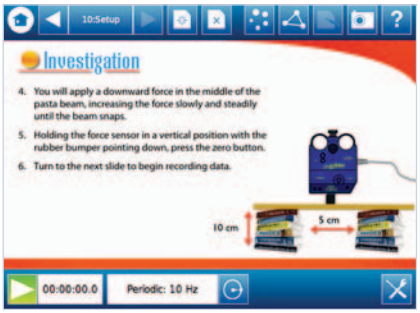
Our team will help you customize the Sally Ride Science *Key Concepts in Science* solution to meet your specific needs, including your choice of several professional development programs.

Contact us at
KeyConcepts@pasco.com

To download a complete brochure, see pasco.com/KeyConcepts

SPARKlab in Action

While exploring the key concept of plate tectonics, students measure the forces involved with stress fractures. This is just one of 30 SPARKlabs included in the *Key Concepts in Earth Science* solution.



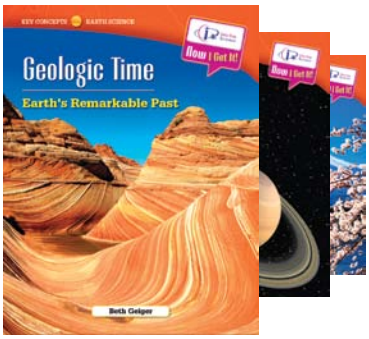
Using pasta as a model, students explore how much stress (force) materials of different shapes can withstand before breaking.

1

Order your book set. We recommend one book per student.

Key Concepts in Earth Science

PS-2439



Sally Ride Science *Key Concepts in Earth Science* consists of 6 book titles:

- Earth's Air
- Earth's Energy
- Geologic Time
- Plate Tectonics
- Space Exploration
- The Water Cycle

Includes: 6 copies of 6 book titles.

2

Choose your Teacher Kit. One per teacher (to license content for all the classes you teach).

Teacher Kit with SPARK Charging Station

PS-2419

Includes: Key Concepts in Earth Science SPARKlabs (teacher license), Comprehensive Teacher Guide, Teacher Lab Notes, SPARKvue teacher license, SPARKlink, and a SPARK Charging Station.

Teacher Kit

PS-2416

Includes: Key Concepts in Earth Science SPARKlabs (teacher license), Comprehensive Teacher Guide, Teacher Lab Notes, SPARKvue teacher license, and a SPARKlink.

3

Choose your Student Station and Accessory Kit. We recommend one for every 3-4 students.

Student Station (SPARK-based)

PS-2408

Includes: SPARK Science Learning System and weather, conductivity, force, temperature and fast response temperature sensors plus a sensor extension cable.

Student Station (computer-based)

PS-2404

Includes: Weather, conductivity, force, temperature and fast response temperature sensors, plus a sensor extension cable. **(Laptop not included.)**

Accessory Kit

PS-2423

Includes: Wire coil, GoCar, and solar cell.

Questions?

Email us at **KeyConcepts@pasco.com**

Key Concepts in Science:
Earth, Life & Physical Sciences

Dig deep into the "Big Ideas" in science with this new program from the science and education experts at Sally Ride Science and PASCO. *Key Concepts in Science* is an integrated, inquiry-based program for 21st century middle school science. It provides everything needed to teach the Big Ideas using modern technology. Aligned to both state and national standards, this program stimulates students' natural curiosity while building their science literacy and critical thinking skills. This leads to the affirmation of learning: *"Now I Get It!"*

Earth Science: page 16
Life Science: page 18
Physical Science: page 20

Our Learning Philosophy

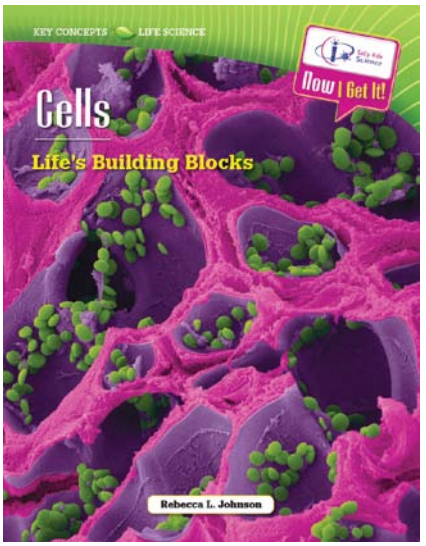
- **Learn by doing:** Guided-inquiry lab investigations activate prior knowledge while stimulating reflection and curiosity.
- **Make it meaningful:** Science concepts connect to current issues and highlight the work and lives of real scientists.
- **Go deep:** Exceptional student books and hands-on investigations guide in-depth exploration of the Big Ideas in science.

Solution at a Glance

Each module includes:

- **6 original book titles:** Each title explores one Big Idea, engaging students with stunning photography, colorful illustrations and compelling narrative.
- **30 SPARKlab activities:** These all-in-one interactive lab activities (5 per book title), guide students through all phases of hands-on investigations.
- **Sensor technology and software** to perform the SPARKlab activities.
- **Teacher Resources:** Teacher Guides and Teacher Lab Notes provide comprehensive planning and pacing guidance that helps you manage your time and customize your science instruction, along with tips for engaging all students.

Key Concepts in Life Science



Immerse your students in the fascinating science behind Earth's myriad living things and the interactions among them. This program takes students on a journey that helps them connect the Big Ideas in Life Science to the world around them.

- Adaptations
- Biodiversity
- Cells
- Genetics
- Organic Molecules
- Plant & Animal Systems

Engage your students in science investigations and readings that foster discovery and build understanding of the key concepts in science, technology, engineering, and math (STEM).

This integrated solution includes six copies of 6 high-interest books and 30 engaging SPARKlabs, along with sensor-based lab stations, innovative Teacher Guides and Teacher Lab Notes, plus an invitation to join the Sally Ride Science Community.

To help students develop a personal connection to science, both the books and the SPARKlabs introduce students to inspiring stories of current-day scientists and engineers. This exposes students to a variety of science, technology, engineering, and math careers, while grounding the science they are learning about.

Benefits

- Delves deep into the big ideas in science.
- Keeps students engaged and on-task with fun, relevant activities.
- Builds science literacy.
- Improves nonfiction literacy skills.
- Boosts in-depth science comprehension.
- Contributes to improvement on critical state tests.
- Compels students to pursue careers in science.

Complete Customizable Solution

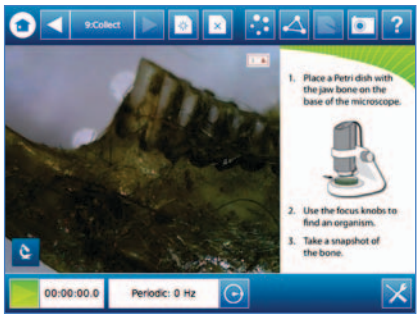
Our team will help you customize the Sally Ride Science *Key Concepts in Science* solution to meet your specific needs, including your choice of several professional development programs.

Contact us at
KeyConcepts@pasco.com

To download a complete brochure, see pasco.com/KeyConcepts

SPARKlab in Action

While exploring the key concept of biodiversity, students dissect an owl pellet under a microscope. This is just one of 30 SPARKlabs included in the *Key Concepts in Life Science* solution.



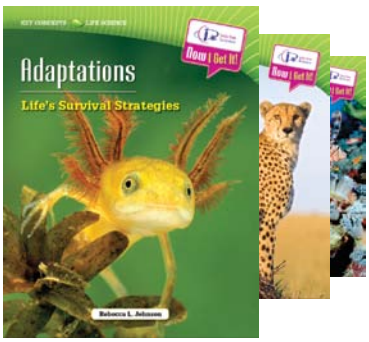
Students dissect an owl pellet, examine bones under the microscope and piece together the remains of the owl's prey.

1 Order your book set.

We recommend one book per student.

Key Concepts in Life Science

PS-2440



Sally Ride Science *Key Concepts in Life Science* consists of 6 book titles:

- Adaptations
- Biodiversity
- Cells
- Genetics
- Organic Molecules
- Plant & Animal Systems

Includes: 6 copies of 6 book titles.

2 Choose your Teacher Kit.

One per teacher (to license content for all the classes you teach).

Teacher Kit with SPARK Charging Station

PS-2420

Includes: Key Concepts in Life Science SPARKlabs (teacher license), Comprehensive Teacher Guide, Teacher Lab Notes, SPARKvue teacher license, SPARKlink, and a SPARK Charging Station.

Teacher Kit

PS-2417

Includes: Key Concepts in Life Science SPARKlabs (teacher license), Comprehensive Teacher Guide, Teacher Lab Notes, SPARKvue teacher license, and a SPARKlink.

3 Choose your Student Station and Accessory Kit.

We recommend one for every 3-4 students.

Student Station (SPARK-based)

PS-2409

Includes: SPARK Science Learning System. Pressure sensor, carbon dioxide gas sensor, and kena Digital Microscope.

Student Station (computer-based)

PS-2405

Includes: Pressure sensor, carbon dioxide gas sensor, and kena Digital Microscope. **(Laptop not included.)**

Accessory Kit

PS-2422

Includes: EcoChamber, Metabolism Chamber and Genetics Modeling Kit.

Questions?

Email us at **KeyConcepts@pasco.com**

Key Concepts in Science:
Earth, Life & Physical Sciences

Dig deep into the "Big Ideas" in science with this new program from the science and education experts at Sally Ride Science and PASCO. *Key Concepts in Science* is an integrated, inquiry-based program for 21st century middle school science. It provides everything needed to teach the Big Ideas using modern technology. Aligned to both state and national standards, this program stimulates students' natural curiosity while building their science literacy and critical thinking skills. This leads to the affirmation of learning: *"Now I Get It!"*

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Solution at a Glance

Each module includes:

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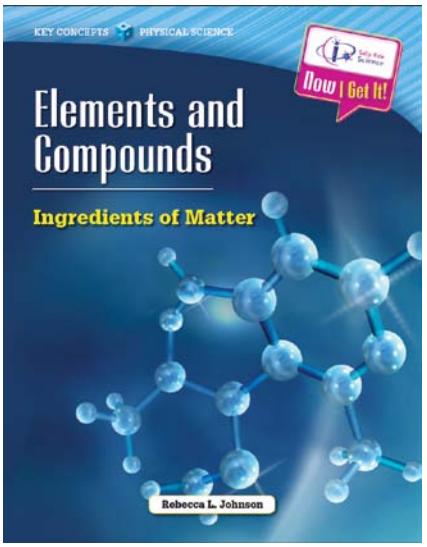
- **Sensor technology and software** to perform the SPARKlab activities.
- **Teacher Resources:** Teacher Guides and Teacher Lab Notes provide comprehensive planning and pacing guidance that helps you manage your time and customize your science instruction, along with tips for engaging all students.

Key Concepts in Physical Science



Immerse your students in the fascinating science behind elements and compounds; motion and forces; energy and energy transformations, and how they influence our world and Universe. This program takes students on a journey that helps them connect the Big Ideas in Physical Science to the world around them.

- Elements and Compounds
- Energy Transformations
- Forces
- Gravity
- Light
- Solids, Liquids, and Gases

Engage your students in science investigations and readings that foster discovery and build understanding of the key concepts in science, technology, engineering, and math (STEM).

This integrated solution includes six copies of 6 high-interest books and 30 engaging SPARKlabs, along with sensor-based lab stations, innovative Teacher Guides and Teacher Lab Notes, plus an invitation to join the Sally Ride Science Community.

To help students develop a personal connection to science, both the books and the SPARKlabs introduce students to inspiring stories of current-day scientists and engineers. This exposes students to a variety of science, technology, engineering, and math careers, while grounding the science they are learning about.

Benefits

- Delves deep into the big ideas in science.
- Keeps students engaged and on-task with fun, relevant activities.
- Builds science literacy.
- Improves nonfiction literacy skills.
- Boosts in-depth science comprehension.
- Contributes to improvement on critical state tests.
- Compels students to pursue careers in science.

Complete Customizable Solution

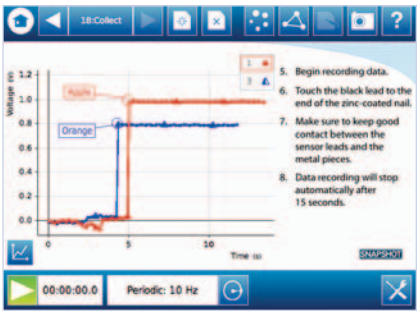
Our team will help you customize the Sally Ride Science *Key Concepts in Science* solution to meet your specific needs, including your choice of several professional development programs.

Contact us at
KeyConcepts@pasco.com

To download a complete brochure, see pasco.com/KeyConcepts

SPARKlab in Action

While exploring the key concept of energy transformations, students construct their own batteries. This is just one of 30 SPARKlabs included in the *Key Concepts in Physical Science* solution.



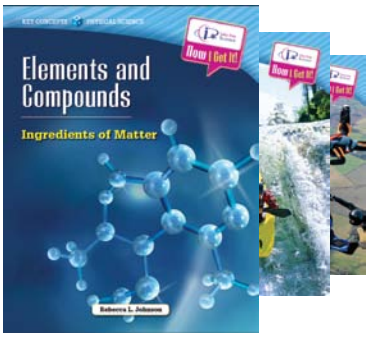
Students place electrodes of copper wire and a galvanized (zinc-plated) nail into a fruit or vegetable and discover that a voltage (potential) exists – the fruit battery.

1 Order your book set.

We recommend one book per student.

Key Concepts in Physical Science

PS-2441



Sally Ride Science *Key Concepts in Physical Science* consists of 6 book titles:

- Elements and Compounds
- Energy Transformations
- Forces
- Gravity
- Light
- Solids, Liquids, and Gases

Includes: 6 copies of 6 book titles.

2 Choose your Teacher Kit.

One per teacher (to license content for all the classes you teach).

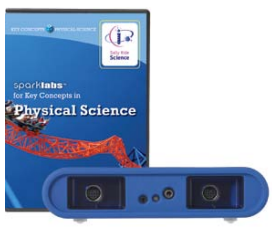
Teacher Kit with SPARK Charging Station

PS-2421

Includes: Key Concepts in Physical Science SPARKlabs (teacher license), Comprehensive Teacher Guide, Teacher Lab Notes, SPARKvue teacher license, SPARKlink, and a SPARK Charging Station.

Teacher Kit

PS-2418



Includes: Key Concepts in Physical Science SPARKlabs (teacher license), Comprehensive Teacher Guide, Teacher Lab Notes, SPARKvue teacher license, and a SPARKlink.

3 Choose your Student Station.

We recommend one for every 3-4 students.

Student Station (SPARK-based)

PS-2410

Includes: SPARK Science Learning System and the sensors to perform all the Key Concepts in Physical Science SPARKlab activities (motion, force, light level, temperature, conductivity, fast response temperature, plus a sensor extension cable).

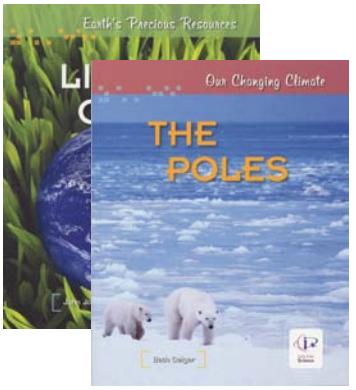
Student Station (computer-based)

PS-2406

Includes: All the sensors to perform the Key Concepts in Physical Science SPARKlab activities (motion, force, light level, temperature, conductivity, fast response temperature, plus a sensor extension cable), using your own computer. **(Laptop not included.)**

Caring for Our Earth

Provide your students a solid, inquiry-based foundation in the science underlying two of today's hottest topics with these two solutions from Sally Ride Science and PASCO: *Our Changing Climate* and *Earth's Precious Resources*. Each solution consists of 4 highly engaging books and 10 interactive SPARKlab activities, along with sensor-based lab stations and Teacher Lab Notes.



Earth's Precious Resources

Students explore Earth's precious resources, the many challenges we face in protecting them, and approaches for conservation. Titles include Clean Air, Clean Energy, Clean Water, and Living Green.

Our Changing Climate

Help your students develop an understanding of the global impacts of climate change—epic changes occurring in the atmosphere and on every continent, ocean and ecosystem around the world. Book titles include The Poles, The Atmosphere, Ecosystems, and The Ocean. For a more complete description of these modules, see **pasco.com/SallyRideScience**

Order Guide: Earth's Precious Resources *More options available online at **pasco.com/SallyRideScience***

1 Order your book set.

We recommend one book per student.

Earth's Precious Resources

PS-2018

Sally Ride Science *Earth's Precious Resources* consists of 4 book titles:

- Clean Air
- Clean Energy
- Clean Water
- Living Green

Includes: 8 copies of 4 book titles.

2 Choose your Teacher Kit.

One per teacher (to license content for all the classes you teach).

Teacher Kit with SPARK Charging Station

PS-2463

Includes: Earth's Precious Resources SPARKlabs (teacher license), Teacher Lab Notes, SPARKvue teacher license, SPARKlink, and a SPARK Charging Station.

Teacher Kit

PS-2461

Includes: Earth's Precious Resources SPARKlabs (teacher license), Teacher Lab Notes, SPARKvue teacher license, and a SPARKlink.

3 Choose your Student Station.

We recommend one for every 3-4 students.

Student Station (SPARK-based)

PS-2024

Includes: SPARK Science Learning System and the sensors to perform 10 SPARKlab activities (Chemistry Sensor, Pressure Sensor, plus a Sensor Extension Cable).

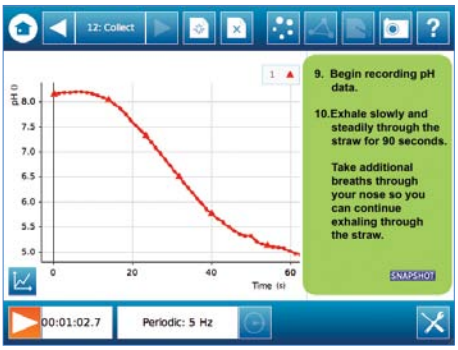
Student Station (computer-based)

PS-2021

Includes: All the sensors to perform 10 SPARKlab activities (Chemistry Sensor, Pressure Sensor, plus a Sensor Extension Cable), using your own computer. **(Laptop not included.)**

SPARKlab in Action

This activity from *Our Changing Climate* gives students an understanding of how large bodies of water (oceans) affect greenhouse gases by absorbing carbon dioxide.



Students explore how water absorbs carbon dioxide in the Sally Ride Science SPARKlab "Carbon-Nation"

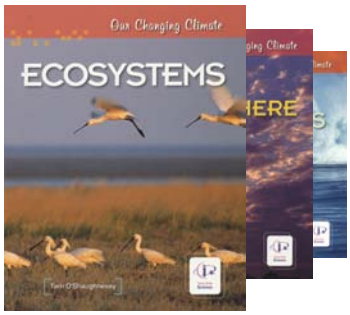
As a student blows into the straw, the pH level drops immediately, but eventually flattens. This leads to a discussion of how much dissolved carbon dioxide a body of water can absorb.

Order Guide: Our Changing Climate *More options available online at* ***pasco.com/SallyRideScience***

1 **Order your book set.** We recommend one book per student.

Our Changing Climate

PS-2014



Sally Ride Science *Our Changing Climate* consists of 4 book titles:

- Ecosystems
- The Atmosphere
- The Oceans
- The Poles

Includes: 8 copies of 4 book titles.

2 **Choose your Teacher Kit.** One per teacher (to license content for all the classes you teach).

Teacher Kit with SPARK Charging Station

PS-2462

Includes: Our Changing Climate SPARKlabs (teacher license), Teacher Lab Notes, SPARKvue teacher license, SPARKlink, and a SPARK Charging Station.

Teacher Kit

PS-2460

Includes: Our Changing Climate SPARKlabs (teacher license), Teacher Lab Notes, SPARKvue teacher license, and a SPARKlink.

3 **Choose your Student Station.** We recommend one for every 3-4 students.

Student Station (SPARK-based)

PS-2023

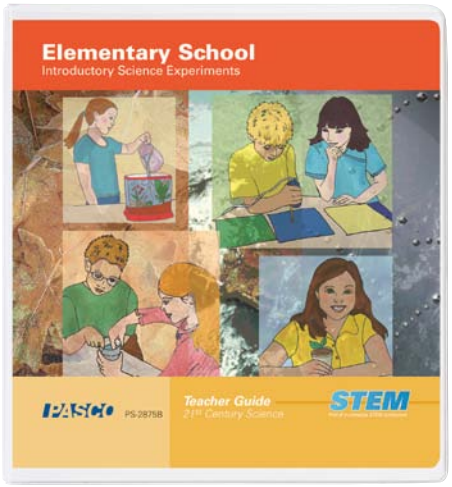
Includes: SPARK Science Learning System and the sensors to perform 10 SPARKlab activities (Chemistry Sensor, Weather Sensor, plus a Sensor Extension Cable).

Student Station (computer-based)

PS-2020

Includes: All the sensors to perform 10 SPARKlab activities (Chemistry Sensor, Weather Sensor, plus a Sensor Extension Cable), using your own computer. **(Laptop not included.)**

Elementary School Science Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide is designed by educators for both new and experienced teachers alike.
- Activities for grades K-1, 2-3, and 4-5 cover core topics in life, earth, and physical sciences.
- The lab activities engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Multiple-choice questions give students practice for standardized exams.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

29 Challenging Lab Activities

Grades K-1
Exploring Temperatures
Heavy & Heavier ■
Hot & Cold
Light & Dark ■
Mixing Water
Near & Far ■
Weather Instruments ■

Grades 2-3
Can Plants Survive Without Light & Water? ■
Cars & Heat
Conservation of Matter ■
Feeling & Measuring Temperature
Freezing & Melting Water
Hunting with Light ■
Investigating Sound Levels ■
Observing Clouds ■

Grades 4-5
Chemical Reactions
Conductor or Not?
Determining Sound Levels ■
Dew & Frost ■
Electric Circuits
Heating Land & Water
How a Greenhouse Works: Heat
How a Greenhouse Works: Light ■
Keeping Warm
Microclimates ■
Temperature & Change
The Water Cycle ■
Weather Station ■
What Is an Electromagnet?

■ *Lab activities with the color box require the Standard Bundle. All other activities can be done with either bundle.*

Ordering Guide

The 29 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Elementary School Science Teacher Guide

- Elementary School Science Teacher Guide (PS-2875B)

2 Select the sensors.

Choose the bundle that aligns with the topics you want to cover.
Or build your own bundle from our over 70 sensors (see page 184).
We recommend one bundle per lab station (3-4 students).

- No extra sensors are required to perform the 14 starter lab activities. All you need is the Temperature and Voltage Sensor included in the SPARK Science Learning System or with SPARKlink and SPARKvue.
- To perform all 29 lab activities, order the **Standard Sensor Bundle** (PS-2934).

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Elementary School Science Teacher Guide

PS-2875B

Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2884A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2895A

(A printed version of the same student handouts which are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

SPARK Science Learning System™

PS-2008A

Includes Fast Response Temperature Probe, Voltage Probe and more than 60 pre-installed, guided inquiry SPARKlabs.

Optional:

SPARKvue Site License PS-2400 *(one per K-12 campus)*

(For teacher computers and interactive whiteboards)

OR

SPARKvue® on your computers

SPARKvue Site license PS-2400 (One Per K12 Campus)

SPARKlink PS-2009 (One Per Student Station)

Your SPARKvue license includes the more than 60 free guided inquiry SPARKlab activities, and authorizes you to run SPARKvue and the SPARKlab activities on any computer on your K-12 campus.

Elementary School Standard Sensor Bundle *Allows you to do all 29 lab activities*

PS-2934

1

2

3

4

5 6

1 Temperature/Sound Level/ Light Sensor PS-2140

2 Motion Sensor PS-2103A

3 Force Sensor PS-2104

4 Weather Sensor PS-2154A

5 Sensor Extension Cable PS-2500

6 Fast Response Temperature Probes (3-pack) PS-2135

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

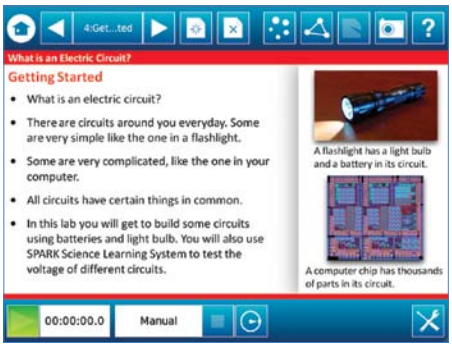
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

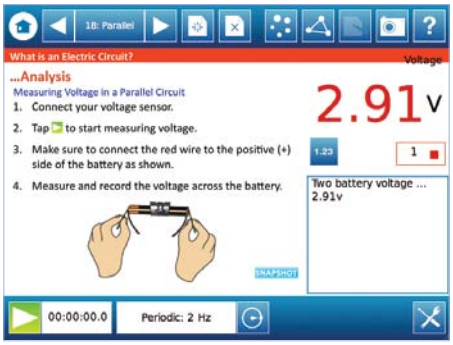
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



Integrated instructions and live data displays make it simple for students to perform activities.

The SPARKlab Online Library

A growing collection for 21st century science learning

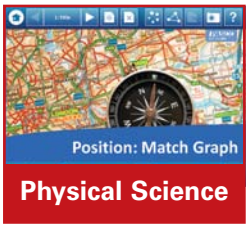
The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

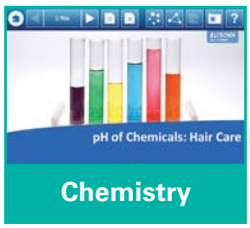
See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs



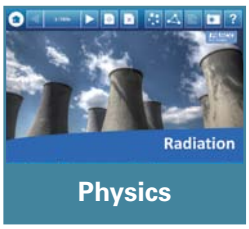
NEW! pH of Household Chemicals: Hair Care & Position: Match Graph

NEW! Diffusion, Fermentation in Yeast, & Heart Rate



NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration

NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics



NEW! Projectile Motion, Position Match Graph, & Radiation

SPARKlabs for Elementary School Science

FREE…

10 FREE Elementary School SPARKlabs

We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

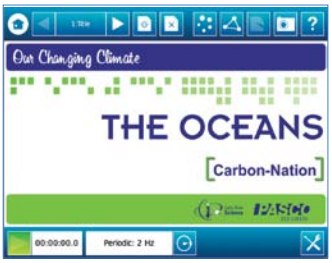
The 10 free Elementary School Science SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

- Endothermic & Exothermic Reactions
- Feeling & Measuring Temperature
- Heating Land & Water
- Keeping Warm
- Lighting a Bulb
- Melting & Boiling
- Mixing Warm & Cool Water
- Temperatures in the Environment
- What Is a Conductor?
- What Is an Electric Current?

Collections

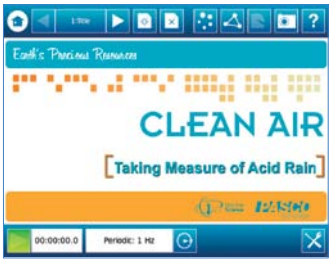
Climate Change

Our Changing Climate from **Sally Ride Science** explores the impacts of climate change through inquiry-based activities. See pages 22-23.



Earth's Resources

Earth's Precious Resources from **Sally Ride Science** helps students develop an understanding of the science related to managing Earth's natural resources. See pages 22-23.



New Additions to the SPARKlab Online Library!

Amazing Body Parts: Eyes

Teacher License PS-2096
One per teacher (one license for all your classes).

Students use a light sensor to determine whether white paper or black paper reflects more light – then they relate this to how our eyes work.

Electronic Delivery.
Upon purchase, download to your computer.

Sharing the Warmth

Teacher License PS-2097
One per teacher (one license for all your classes).

Students use the temperature sensor to determine what happens when hot objects are put next to cooler ones. Then they describe how heat is transferred between objects of different temperatures.

Electronic Delivery.
Upon purchase, download to your computer.

Monitoring the Weather

Teacher License PS-2098
One per teacher (one license for all your classes).

Students collect data on weather conditions to find patterns that can be used to make a weather forecast..

Electronic Delivery.
Upon purchase, download to your computer.

Elementary School SPARKlab Solution

The 10 Elementary School SPARKlab activities are designed for use with the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

10 Elementary School Science SPARKlab Activities

Endothermic and Exothermic Reactions
Feeling and Measuring Temperature
Heating Land and Water
Keeping Warm
Lighting a Bulb
Melting and Boiling
Mixing Warm and Cool Water
Temperatures in the Environment
What Is a Conductor?
What Is an Electric Circuit?

SPARK Science Learning System™

PS-2008A

Includes Fast Response Temperature Probe, Voltage Probe and more than 60 pre-installed, guided inquiry SPARKlabs.

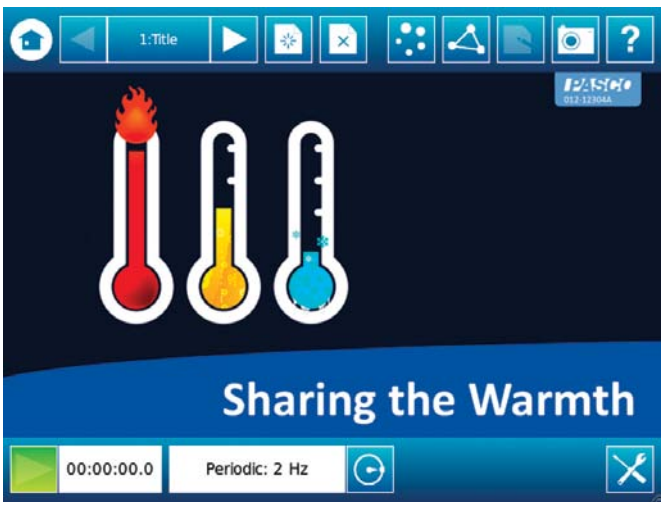
(See pages 8-9 for more information on the SPARK Science Learning System.)

Optional:
SPARKvue Site License PS-2400 *(one per K-12 campus)*

SPARKvue® on your own computers

SPARKvue Site License PS-2400 (One per K-12 Campus)
SPARKlink PS-2009 (One per Student Station)

Your SPARKvue license includes the more than 60 free guided inquiry SPARKlab activities, and authorizes you to run SPARKvue and the SPARKlab activities on any computer on your K-12 campus.
(See pages 6-7 for more information on SPARKvue and SPARKlink.)



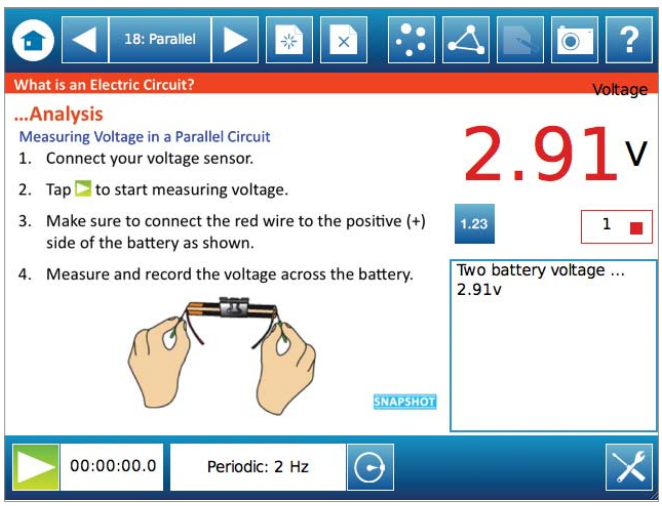
Students build circuits using batteries and Christmas lights in order to measure the voltage in parallel and series circuits.

SPARKlab Sample Activity: What Is an Electric Circuit?

At any age, the best way to learn science is by doing, such as in this SPARKlab activity where they build and examine different circuits. By constructing a simple circuit with batteries, wire and a Christmas tree light, they will learn that a circuit needs to be closed in order for current to flow.

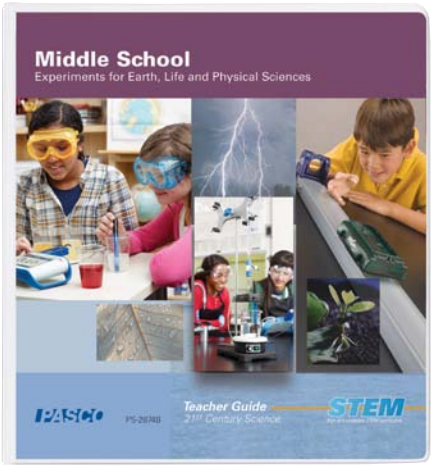
With a second bulb students will be able to create both a parallel and series circuit. Observing the brightness of the bulbs in each circuit as well as voltage measurements, students will not only understand the difference between these two types of circuits but will start to form an understanding of the role of voltage.

And as with all SPARKlabs, students will be guided through the entire activity with checks for understanding at each step to ensure that they will have their own "light bulb moment" when they come to understand the basics of circuits.



Integrated instructions and data displays make it simple for students to perform activities.

Middle School Science Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide is designed by educators for both new and experienced teachers alike.
- The lab activities engage students as they collect real-time data, make predictions, use critical thinking skills, and build vocabulary skills with key term challenges.
- Students get practice for standardized exams with multiple-choice questions.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

49 Challenging Lab Activities

Earth Science

Acid Rain & Weathering
Exploring Environmental Temperatures
Investigating Evaporation & Condensation ■
Investigating Seismic Waves
Mapping the Ocean Floor
Monitoring Weather ■
Night & Day
Observing Clouds ■
Seasons
Soil Characteristics
Soil Salinity ■
Water, the Universal Solvent ■
Water's Role in Climate

Life Science

Acid Rain & Seed Germination
Acid's Effect on Teeth
Air Pressure & the Lungs
Introduction to Acids & Bases
Muscle Fatigue ■
Photosynthesis
Recovery Heart Rate
Seasonal Pond Exploration
Sunlight & Photosynthesis in Aquatic Plants
Thermoregulation of Body Temperature
Transpiration ■
Venous Blood Flow
Yeast Growth

Physical Science

Archimedes' Principle ■
Boyle's Law
Conservation of Matter
Energy Transfer
Exploring Velocity & Inertia
Heat Transfer in Fluids
Investigating Evaporative Cooling
Investigating Solar Energy
Measuring Light Intensity
Measuring Voltage of Elements in Series
Motions Graphs
Newton's First Law ■
Newton's Third Law ■
Neutralizing an Acid & a Base
Observing Freezing Point Depression
Observing Phase Changes
Simple Harmonic Motion
Simple Machines & Force ■
Speed & Velocity
Transfer of Energy in Chemical Reactions
Varying Reaction Rates
Voltage Time
Work & Mechanical Advantage ■

■ *Lab activities with the color box require the Standard Bundle. All other activities can be done with either bundle.*

Ordering Guide

The 49 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Middle School Science Teacher Guide

- Middle School Science Teacher Guide (PS-2874B)

2 Order your sensor bundles.

Choose the bundle that aligns with the topics you want to cover.
Or build your own bundle from our over 70 sensors (see page 184).
We recommend one bundle per lab station (3-4 students).

- Get the **Starter Bundle** (PS-2924C); contains 4 sensors. Allows you to do 37 lab activities.

OR

- Get the **Standard Bundle** (PS-2933A); contains 9 sensors. Allows you to do all 49 lab activities.

3 Select your data collection and analysis tool.

- Get the **SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: ***Use our SPARKvue software on your own computers.***

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

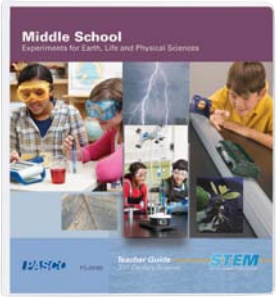
  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Middle School Science Teacher Guide

PS-2874B



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2884A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2894A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Middle School Starter Sensor Bundle

Allows you to do 37 of the 49 lab activities

PS-2924C

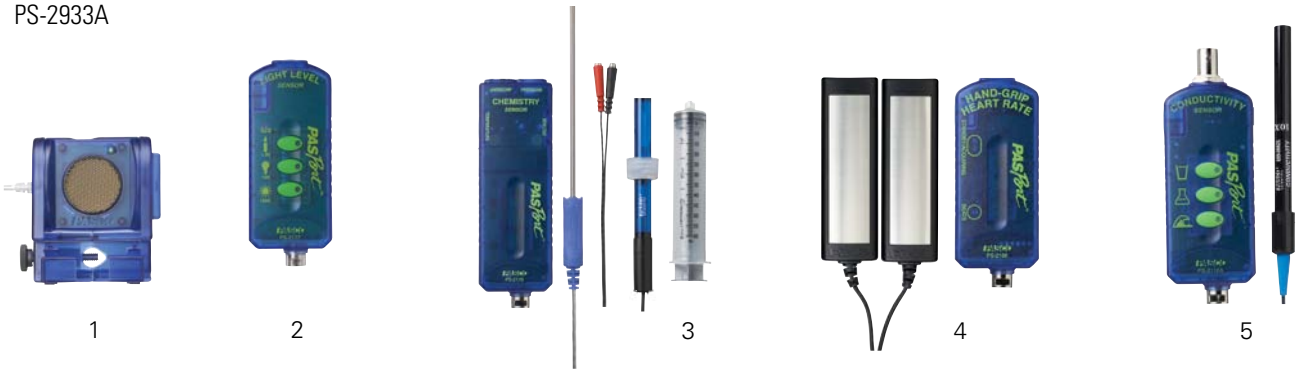
1 2 3 4

1. Motion Sensor PS-2103A
2. Light Level Lux Sensor PS-2177
3. Chemistry Sensor PS-2170
4. Hand Grip Heart Rate Sensor PS-2186

Middle School Standard Sensor Bundle

Allows you to do all 49 lab activities

PS-2933A



1 2 3 4 5

6 7 8 9

1. Motion Sensor PS-2103A
2. Light Level Lux Sensor PS-2177
3. Chemistry Sensor PS-2170
4. Hand Grip Heart Rate Sensor PS-2186
5. Conductivity Sensor PS-2116A
6. Force Sensor PS-2104
7. Weather Sensor PS-2154A
8. Fast Response Temperature PS-2135
9. Sensor Extension Cable PS-2500.

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

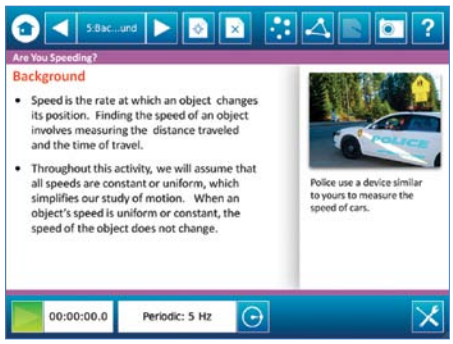
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

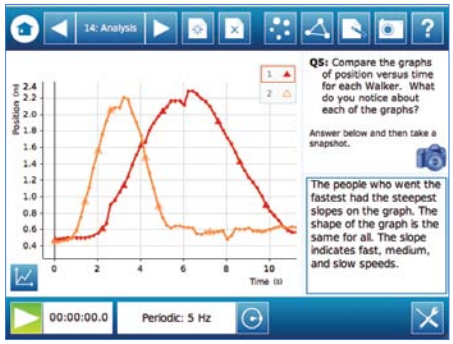
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



SPARKlabs integrate student-collected data with question prompts to guide the learning process.

The SPARKlab Online Library

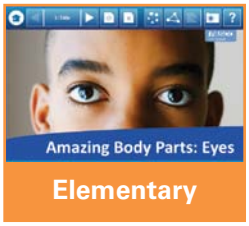
A growing collection for 21st century science learning

The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

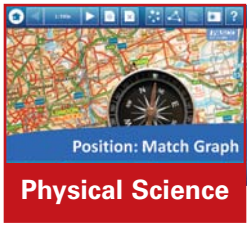
SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

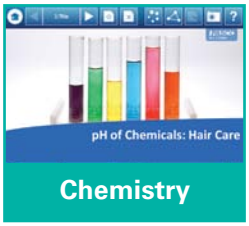


NEW! Amazing Body Parts/Eyes, Sharing Warmth, & Monitoring the Weather



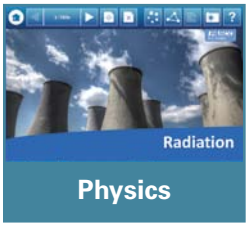
NEW! pH of Household Chemicals: Hair Care & Position: Match Graph

NEW! Diffusion, Fermentation in Yeast, & Heart Rate



NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration

NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics



NEW! Projectile Motion, Position Match Graph, & Radiation

SPARKlabs for Middle School Science

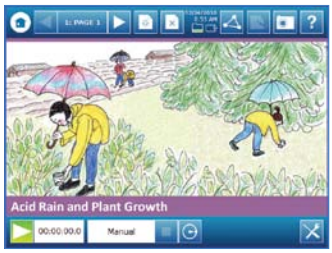
FREE…

12 FREE Middle School SPARKlabs

We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

The 12 free Middle School Science SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

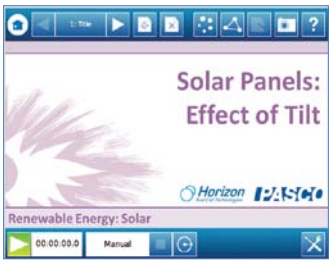
- Acid Rain & Seed Germination
- Acid's Effect on Teeth
- Exploring Environmental Temperatures
- Mapping the Ocean Floor
- Measuring Light Intensity
- Measuring the Voltage of Elements in a Series
- Observing Freezing Point Depression
- Recovery Heart Rate
- Soil Characteristics
- Speed & Velocity
- Thermoregulation of Body Temperature
- Varying Reaction Rates



Collections

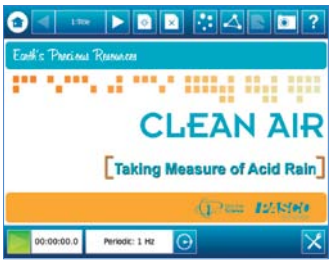
Renewable Energy

Help students develop an understanding of renewable energy with investigations in solar, wind, and hydrogen fuel cell power. Developed with **Horizon Fuel Cell Technologies**. See page 36 for details.



Earth's Resources

Earth's Precious Resources from **Sally Ride Science** helps students develop an understanding of the science related to managing Earth's natural resources.
See pages 22-23.



New Additions to the SPARKlab Online Library!

Yeast Growth

Teacher License PS-2094
One per teacher (one license for all your classes).

Students use a closed environment to measure the carbon dioxide gas emitted by yeast as it ferments. Then they explore further with a pressure sensor.

Electronic Delivery.
Upon purchase, download to your computer.

Water Quality

Teacher License PS-2093
One per teacher (one license for all your classes).

Students use a conductivity sensor to determine the quality of water as they measure the concentration of ions present in the water.

Electronic Delivery.
Upon purchase, download to your computer.

Exploring Motion Graphs

Teacher License PS-2095
One per teacher (one license for all your classes).

This lab challenges students to determine the motion necessary to produce a graph of position vs. time that matches a given graph..

Electronic Delivery.
Upon purchase, download to your computer.

Middle School Science Starter Sensor Bundle

Get the sensors needed to conduct the 12 free Middle School Science SPARKlabs included with your SPARK Science Learning System or SPARKvue license.

12 Middle School SPARKlab Activities

- Acid Rain and Seed Germination
- Acid's Effect on Teeth
- Exploring Environmental Temperatures
- Mapping the Ocean Floor
- Measuring Light Intensity
- Measuring the Voltage of Elements in Series
- Observing Freezing Point Depression
- Recovery Heart Rate
- Soil Characteristics
- Speed and Velocity
- Thermoregulation of Body Temperature
- Varying Reaction Rates

Middle School Science Starter Sensor Bundle

PS-2924C

1. Motion Sensor PS-2103A
2. Light Level Lux Sensor PS-2177
3. Chemistry Sensor PS-2170
4. Hand Grip Heart Rate Sensor PS-2186

1

2

3

4

Ordering Guide *The 12 Middle School SPARKlab activities are designed for use with the sensors above and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.*

1 Order your sensor bundle.

With the Middle School Science Starter Sensor Bundle, you will have the sensors you need to perform the 12 free SPARKlab activities.

- To perform the 12 SPARKlab activities, order the **Middle School Science Starter Sensor Bundle** (PS-2924C); which contains the 4 sensors listed above.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

2 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

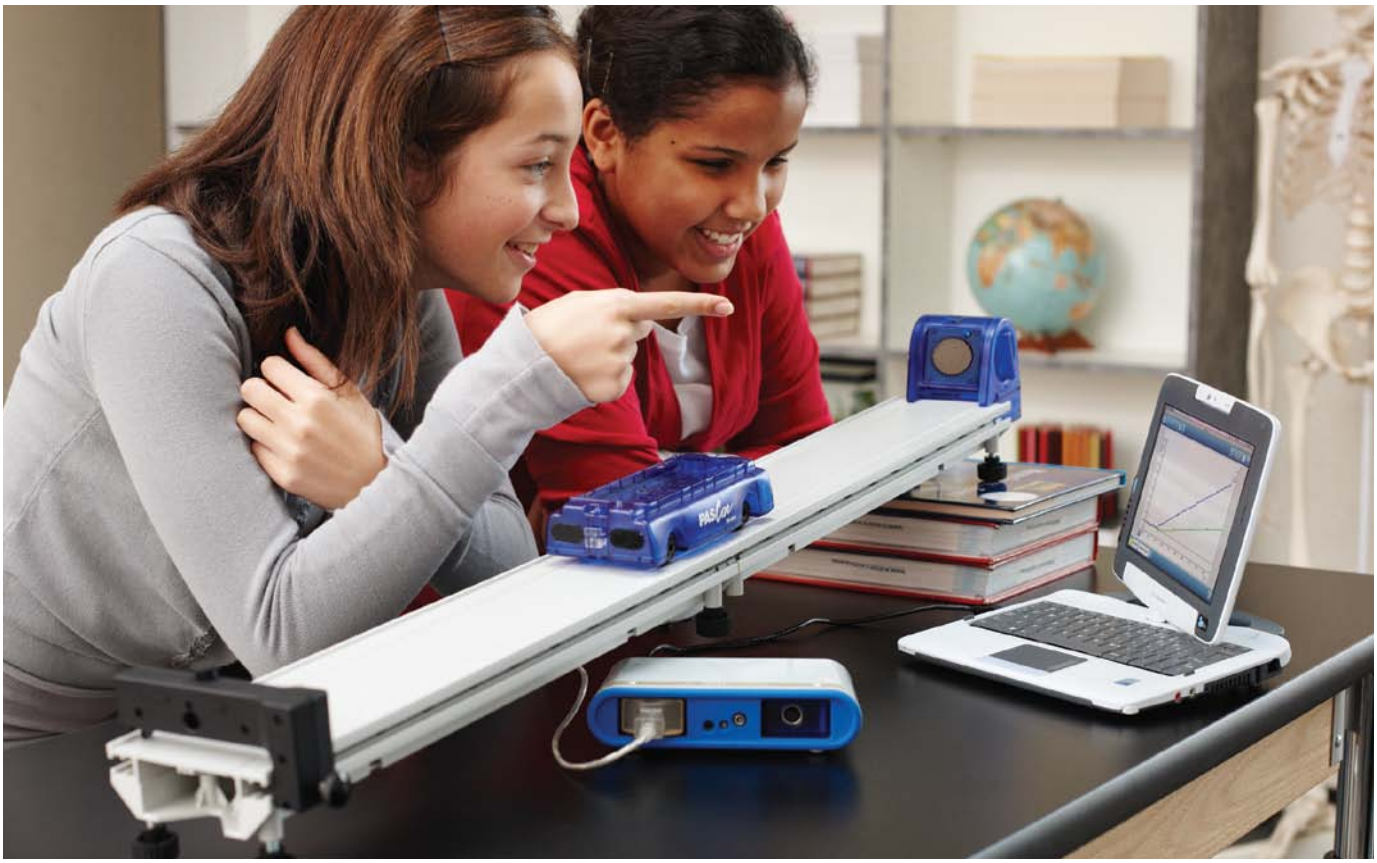
OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

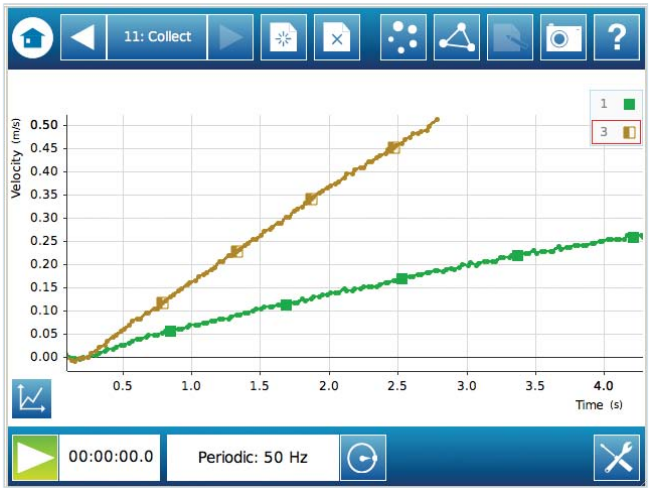
  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)



Sample SPARKlab Activity: Speed and Velocity

In this activity students use a Motion Sensor to record the cart's velocity and acceleration as it rolls down the PAStrack. By varying the angle of the track set up at an incline, students can see the change in the cart's motion.

The Basic PAStrack Dynamics System is an ideal way for students to investigate concepts of motion. The track itself snaps together easily and it includes leveling feet and a built-in scale, two feature-packed, low friction PAScars and additional masses are also included.



Comparing graphs of different angles, students can see acceleration as the rate of change of velocity.

Basic PAStrack Dynamics System

ME-6962

Includes two 0.5m lengths of PAStrack, leveling feet, 2 track connectors, two adjustable end stops, two PAScars (one red, one blue), two 250g masses.

Also Available:

PAStrack (track only) ME-6960

Extend your track an extra 1.0 m or more in 0.5 m increments.

Horizon Renewable Energy SPARKlabs for Middle School

PS-2856

One per teacher (one license for all your classes).

Includes 9 SPARKlab activities to help students develop an understanding of renewable energy.

Electronic Delivery.
Upon purchase, download to your computer.

SPARK Science Learning System™

PS-2008A

Includes Fast Response Temperature Probe, Voltage Probe and more than 60 pre-installed, guided inquiry SPARKlabs.

Optional:
SPARKvue Site License PS-2400 *(one per K-12 campus)*

SPARKlink®

PS-2009

Includes Fast Response Temperature Probe, Voltage Probe and USB connector cable.

Required for computers:
SPARKvue Site License PS-2400 *(one per K-12 campus)*

Horizon Renewable Energy SPARKlab Collection

Like PASCO's other great SPARKlabs, Horizon SPARKlabs are designed to guide students through the process of discovery and investigation and to promote critical thinking and group discussion. These Horizon SPARKlabs include background science content, setup guidance, seamless integration with data collection and analysis, and embedded assessment and reflection prompts.

9 Renewable Energy SPARKlab Activities

Hydrogen Fuel Cell
Assembling the Reversible Hydrogen Fuel Cell
Water Decomposition for Hydrogen Fuel Cells
Comparing Hydrogen Fuel Cells to Batteries

Solar
The Effect of Heat on Solar Panels
The Effect of Shade on Solar Panels
The Effect of Tilt Angle on Solar Panels

Wind
Altering the Length of Blades in a Wind Turbine
Altering the Pitch of Blades in a Wind Turbine
Altering the Number of Blades in a Wind Turbine

Horizon Renewable Energy Kit

SE-7238

Includes wind turbine, 9 long curved blades (3 sets of different curvatures), 3 long flat blades and 6 short flat blades, reversible Fuel Cell module; Gas/Water storage module; small motor with propeller, 1 W Solar cell, AA battery pack and 2 pairs of banana plug cables.

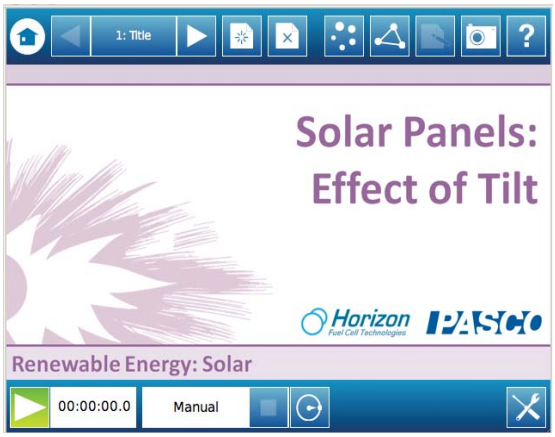
Students investigate the relationship between the voltage produced and the angle of the solar panel. Knowing the relationship between the angle of the sun relative to the panel is an important consideration in building a solar electrical system.

Sample Horizon SPARKlab Activity: The Effect of Tilt Angle on Solar Panels

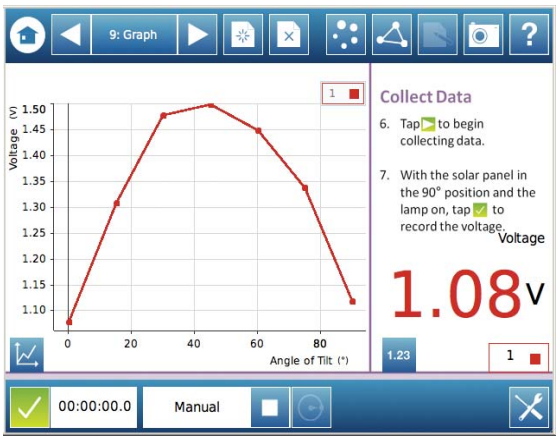
In this SPARKlab activity, students will learn from their own collected data that the more directly that sunlight strikes the solar cell, the greater the voltage output. The setup is simple and can be done indoors (with lamps) or outdoors under sunlight.

As students understand how the angle of sunlight affects solar power production capability, they can begin to explore means of maximizing this directly overhead exposure: What orientation should the cell have to maximize its exposure to direct (perpendicular) sunlight? What could be done to increase the time during the day when a cell is receiving optimum sunlight? Discuss differences in orientation for solar cells depending on geographic region and season.

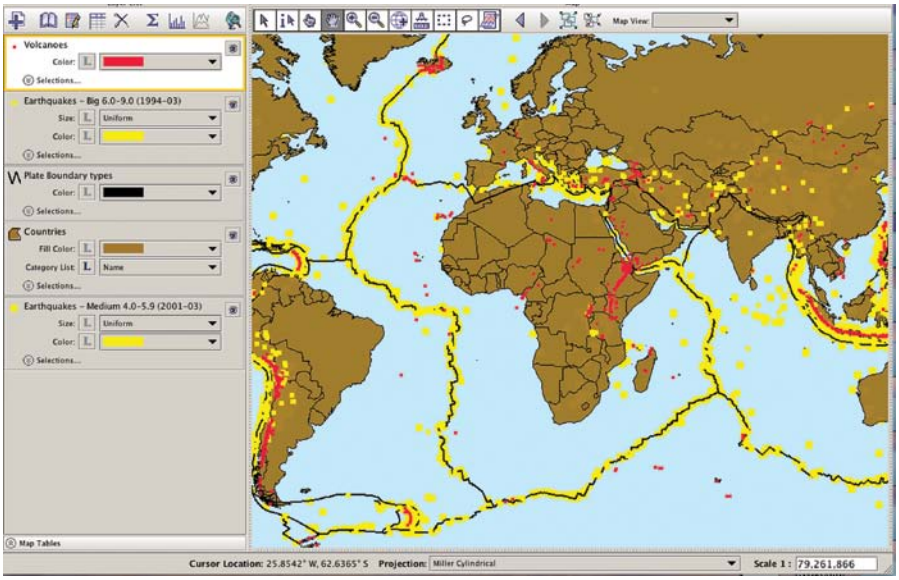
Just one of 9 SPARKlabs in the Horizon Renewable Energy SPARKlabs for Middle School collection.



Topic-specific SPARKlabs guide students through investigations of Solar, Wind, and Hydrogen Fuel Cell technologies.



The maximum voltage output is when the light strikes perpendicular to the surface of the solar cell – this maximizes the amount of light energy available.



Explore plate tectonics with included earthquake and volcano datasets.

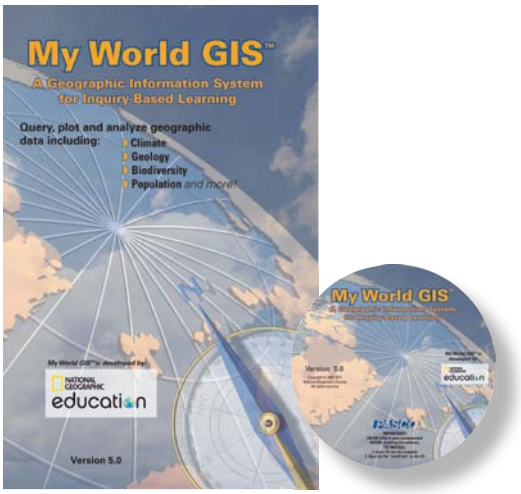
My World GIS

My World GIS is an award-winning geographic information system designed specifically for schools, featuring drag-and-drop simplicity and over 50 data libraries to get you started. Right out of the package, you can explore earthquakes, volcanoes, plate tectonics, climate, glaciers, country populations, literacy and mortality rates, and much, much more.

AWARD
eSchool News
Readers' Choice
WINNER

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



High volume and district licenses also available. See pasco.com/myworld for more license options.

System Requirements:
Windows 95/98/NT/2000/XP/Vista/Windows 7,
Mac OS X (Universal Binary), Linux and Solaris.
Minimum of 128MB of RAM (256MB recommended).

What's the value of a GIS in the classroom?

Whether teaching science, history or social sciences, much of the data we use is spatial – referenced to a location. With a GIS, teachers and students have the opportunity to interact with that data visually via maps – and have the power to query the wealth of data behind those maps. Ideal for:

- Oceanography
- Climatology
- Biology
- Earth Science
- Geography
- Environmental Science
- Physics
- Social Studies
- History

Great for lectures or student projects

Free 45-day trial version and GIS activity. ***Get them now at pasco.com/myworld***

Version 5.0

What's new?

- Updated data sets for included data library
- Access to a wealth of new (and free) data using new connections to ArcGIS Server and USGS National Map Seamless Server
- Plot time series data – see how data in a specific location changes over time
- And much more!

For complete list of new features and for upgrade information, see pasco.com/myworld

Key Features

- Hot-link graphics, videos and documents to points on a map
- Import and export industry-standard file formats
- GPS import wizard – collect your data with GPS location and easily view it on a map (see page 199 for example)
- Simplified downloads from WMS and ArcIMS servers
- One-disk installation including more than 50 data libraries

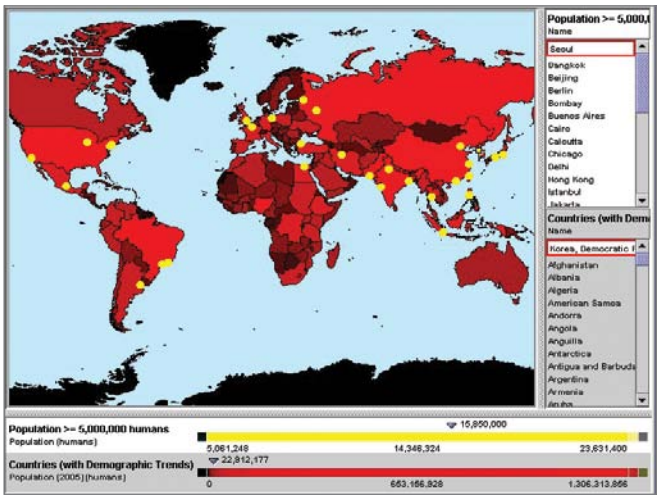
Bonus – live WeatherBug data

Your license of My World GIS now includes a live feed of weather data from over 8,000 weather stations across the globe. With WeatherBug's real-time data and satellite imagery, you can bring any weather-making headline right into your classroom. This service from WeatherBug includes:

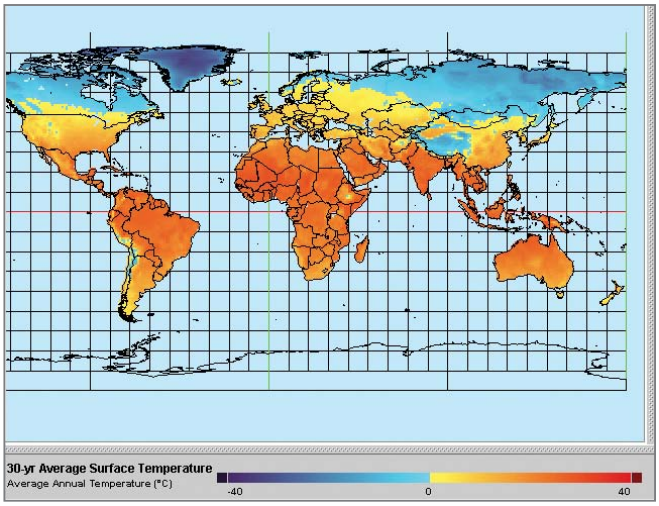
- Real-time weather data
- High resolution satellite images
- Rich analysis for connecting the dynamic nature of weather to Earth science concepts

My World GIS™ is developed by:

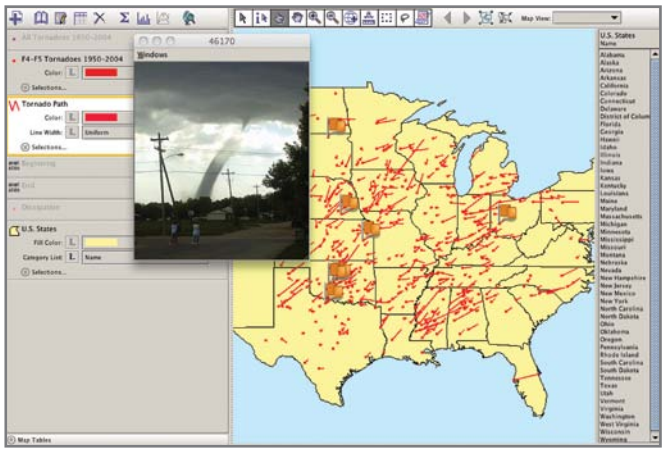
NATIONAL GEOGRAPHIC education



World countries colored by population and cities with populations more than five million. Use My World's pointer tool to click on a city to see population value – in this case Seoul, Korea.



Thirty-year average surface temperature and lines of latitude and longitude. Hot areas are red, cool are yellow, and cold are blue. Connect climate data to specific areas of the globe.



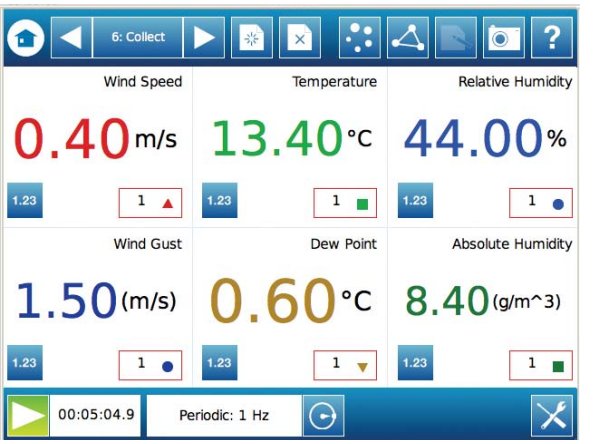
My World supports "hot-linking" images and video to data points – here on a map of US tornadoes. Hot links are indicated by flags.

Students explore their school surroundings with the Weather/Anemometer and GPS Position Sensors – all the data is tagged with GPS coordinates for automatic mapping in My World GIS.

Investigate – and map – microclimates

Equip students with the Weather/Anemometer Sensor and GPS Position Sensor and send them out to explore the school surroundings. As they move throughout the grounds, all their data is automatically location-referenced. Have them explore asphalt parking lots, buildings that block breezes, open fields, heavily shaded areas, even small bodies of water or the outdoor pool. Open the collected data in My World GIS and see it on an aerial photo of the school grounds.

Use this as a foundation for discussing factors affecting different microclimates, then extend to regional and global climate investigation.



The Weather/Anemometer Sensor measures temperature, barometric pressure, relative and absolute humidity, dew point, wind speed, wind gust and wind chill – all with just one sensor.

Using the bird's eye view of student-collected data, have students ask and answer questions such as "Why did the temperature go down there?" to develop an understanding of factors affecting microclimates.

Weather/Anemometer

PS-2174

Includes Sensor Extension Cable.

GPS Position Sensor

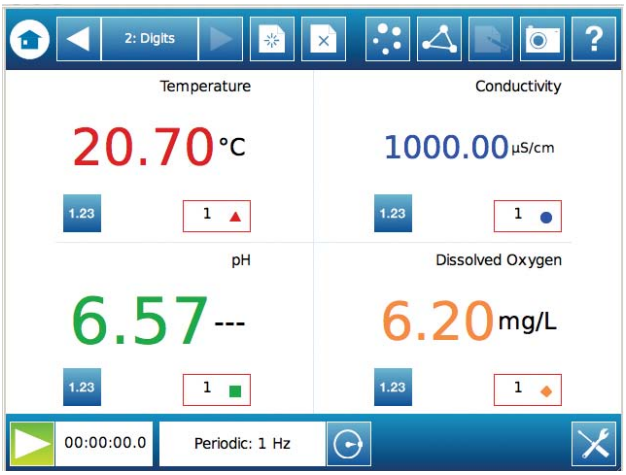
PS-2175

Includes Sensor Extension Cable.

Investigate water quality

Understanding water quality and the factors that affect water quality is essential given the importance of water in ecosystems and everyday life. Whether you plan a field trip, participate in project-based learning, or are lucky enough to have a water source on the school grounds, students need the ability to determine the health and quality of the water through measurement.

Our Water Quality Sensor is perfect for measuring in the field – just one sensor measures four key water quality parameters: pH, dissolved oxygen, conductivity and temperature. To easily map your water quality measurements, take the GPS Position Sensor with you – all your measurements will be tagged with GPS coordinates. Just open your data in My World GIS and see it plotted against maps or aerial photos.

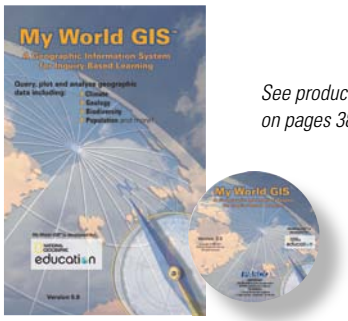


The Water Quality Sensor measures four important water quality parameters – pH, Dissolved Oxygen, Conductivity, and Temperature – in one convenient sensor package.

Students use the SPARK Science Learning System and Water Quality Sensor to investigate natural bodies of water. With real time measurements, students can think about the data in the actual setting, and look for explanations or conduct additional tests. For example, with a low dissolved oxygen reading, they might observe that the water is very stagnant or see algae growth.

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



See product information on pages 38-39.

High volume and district licenses also available. See pasco.com/myworld for more license options.

System Requirements: Windows 7, Windows 95/98/NT/2000/XP/Vista, Mac OS X (Universal Binary), Linux and Solaris. Minimum of 128MB of RAM (256MB recommended).

Water Quality Sensor

PS-2169

Includes Dissolved Oxygen Probe, Conductivity Probe, pH Probe and Stainless Steel Temperature Probe.

Students dissect an owl pellet, examine bones under the microscope, and piece together the remains of the owl's prey.

New! SPARK and SPARKvue now support digital microscopes

SPARKvue's new digital imaging capabilities support a wide variety of USB imaging devices, including most modern digital microscopes and webcams.

Don't have a computer? No problem—use SPARK Science Learning System and get all the advantage of digital microscopy.

No need for your students to learn a new software just for microscopy—collect sensor data and capture and analyze images all in your SPARKvue software.

The kena® Digital Microscope performs in the classroom or the field. The removable camera/magnification head fits snugly in your hand or onto the sleek, sturdy metal base. The USB-powered LED lighting on top and the battery-powered LED light on the bottom increase clarity for viewing slide specimens. The silicone non-slip stage pad eliminates the need for stage clips. This is an ideal digital microscope for your middle school science program!

Magnification: 20X, 40X, 100X.

View a live video feed from the microscope.

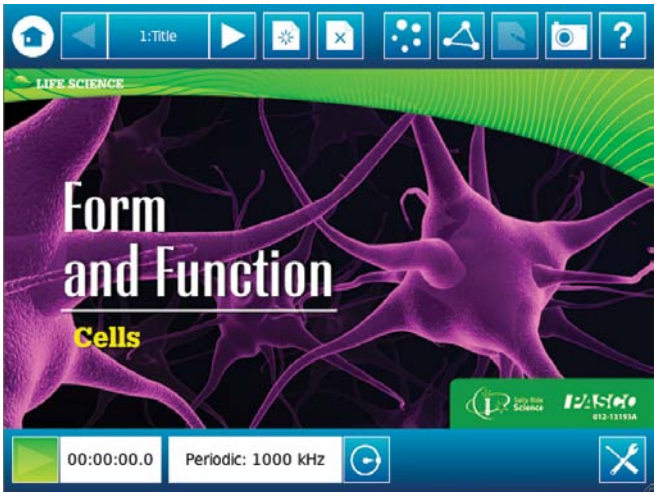
Magnify stored images even further using digital zoom.

Use the measurement tool to analyze captured images.

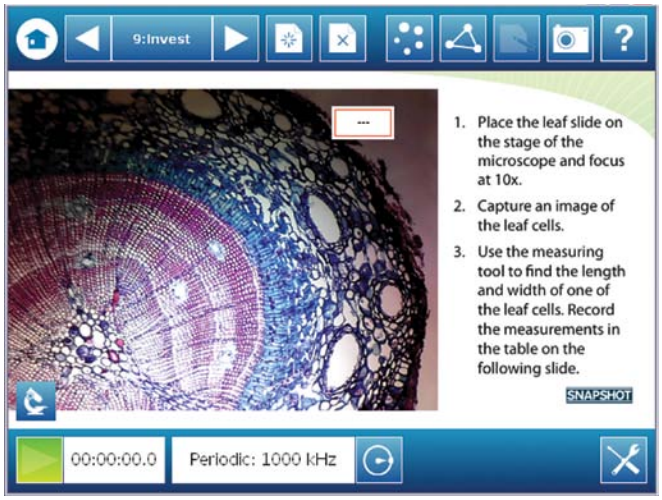
Autozoom re-centers images after using other software features.

Add annotations to captured images using the text tool.

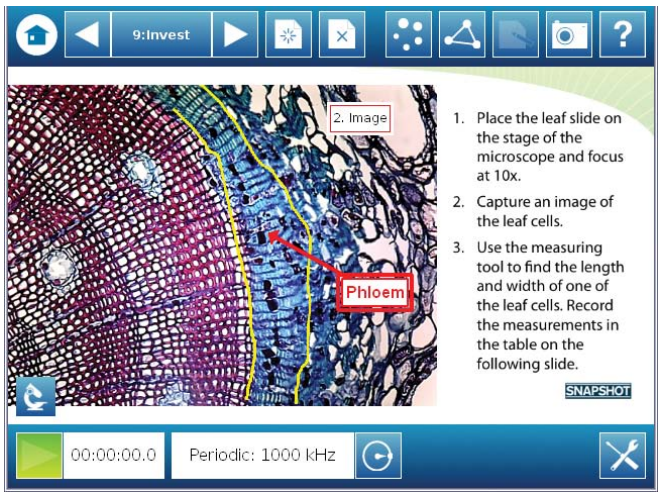
Draw on captured images to indicate features and structures or add notes.



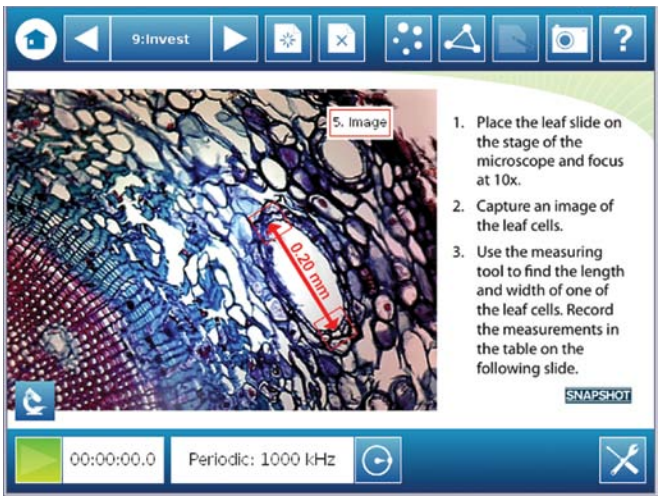
The kena Digital Microscope is used in this SPARKlab "Form & Function" from the Sally Ride Science Key Concepts in Life module (see page 18).



No need to lose time learning a new software environment… use the kena Digital Microscope with SPARKvue (even within SPARKlabs).

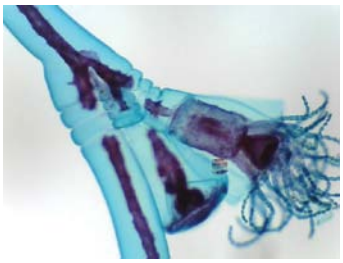


Use the SPARKvue software to capture images and add drawing and text annotations.



With a simple calibration the measurement tool can make on-screen measurements to make microscopy quantifiable.

Use in the lab or – with the removable camera head – take it to the field.



Obelia are aquatic invertebrate animals that belong to the same phylum as jellyfish. Under the kena Digital Microscope you can easily see its anatomical parts.

kena® Digital Microscope

SE-7236

Includes a removable camera/magnification head, touch tube (for placing the microscope flush against specimens), sturdy metal base, and convenient carry/storage bag. Magnification: 20X, 40X, 100X.

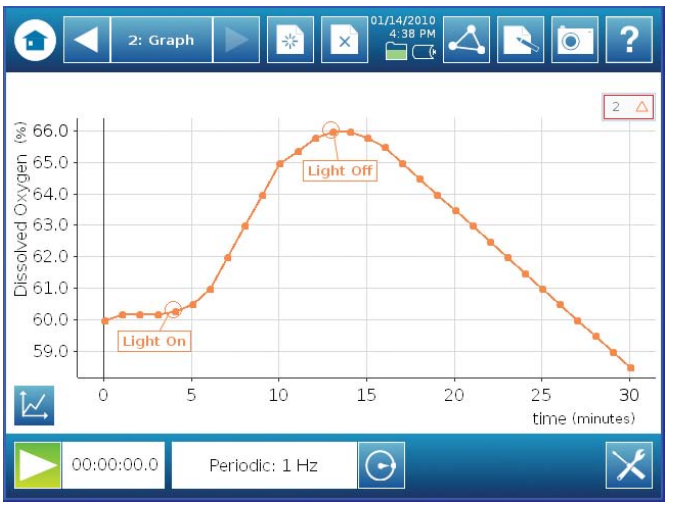
For use with SPARKvue: *Requires a SPARK Science Learning System or a USB port on a computer (Mac or Windows) that has SPARKvue version 1.3 or later.*

Exploring Photosynthesis

No inferred measurements or messy indicators needed! Students make direct measurements of dissolved oxygen and investigate the photosynthetic activity of an aquatic plant. With the Photosynthesis Tank and sensors, it is easy to collect accurate data and investigate a complex process.

Turning the light on and off creates an easily-analyzed graph in real-time, showing the relationship between light and the rate of oxygen production. No longer will you have to tell students: "what you should have seen was. . ." SPARKvue illustrates the plant's activity with light on and off on a graph that is easily analyzed.

Using the Photosynthesis Tank and a Dissolved Oxygen Sensor, students measure the dissolved oxygen content in the environment of an aquatic plant.



Dissolved oxygen increases when light shines on the plant and decreases when it is turned off.

Photosynthesis Tank

PS-2521A

Includes Photosynthesis Tank, large #14 stopper with sensor ports, and 2 small #3 stoppers.

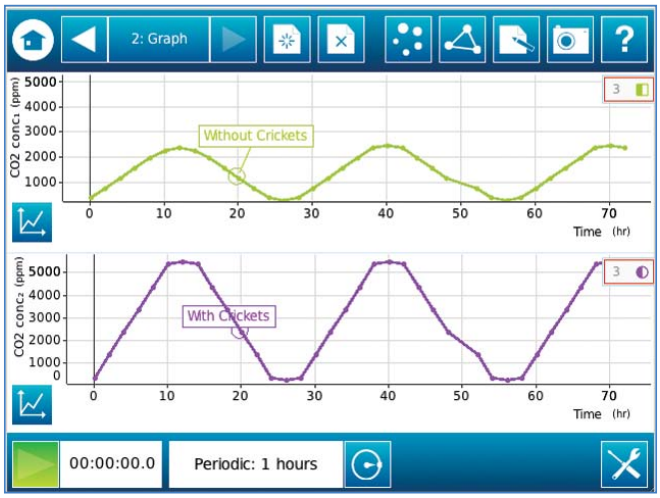
EcoZone™ System

The PASCO EcoZone System consists of three chambers that can be interconnected or used independently. Because the system remains closed and is designed to accommodate PASPORT sensors, students will collect accurate data with minimal impact on the ecosystem.

A basic lab activity uses two of the chambers separately to measure O_2 and CO_2 levels, one chamber containing plants and one containing plants and crickets. Students see how the presence of animals affects the concentration of oxygen and carbon dioxide in the system.

Use the traditional terrestrial, aquatic, and decomposition arrangement to create your unique biome space and collect the data you want. The openings within the chambers allow air to circulate between the chambers, and the included cord efficiently wicks water and ions between the chambers.

- Connect three different environments together (terrestrial, aquatic and decomposition) and observe the interaction.
- Add animals (crickets) to an environment and measure effect of respiration.



Students observe the photosynthesis cycle and its effect on carbon dioxide, plus the contribution of the crickets to higher carbon dioxide production (through respiration).

EcoZone™ System

ME-6668

Includes 3 EcoChambers, tray, rubber stoppers, syringe, tubing and wicking cord.

No more cutting up plastic bottles! With the EcoZone System, you can easily create isolated ecosystems or interconnect up to three ecosystems.

Isolate ecosystems for comparison studies. Here the impact of animals on carbon dioxide production is explored. Two separate ecosystems – one with crickets, one without.

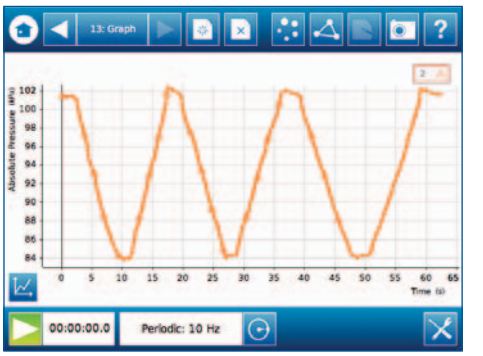
Monitor any ecosystem over time – oxygen gas, carbon dioxide, dissolved oxygen, humidity, you name it! The EcoZone System is designed for sensor-based measurement while maintaining a closed environment.

Students examine how air pressure and changes in air pressure allow us to breathe.

Taking a Breath – Exploring Lung Function

In this activity, students create a model of a lung by attaching a syringe to the Metabolism Chamber. Pushing or pulling on the syringe changes the volume of the model's "chest cavity". By connecting a Pressure Sensor, students can measure the changes in air pressure inside the model's "lung" and create a graph of their results to fully explore how we breathe.

The graph demonstrates that as the pressure in the chest cavity decreases, the air volume in the lung increases.



Metabolism Chamber

ME-6936

250ml sampling bottle with hole to insert Sensor.

Recommended for use with:

Chemistry Sensor PS-2170

When students measure their own blood pressure the concept becomes much more exciting and productive.

Understanding Blood Pressure

Measure blood pressure simply and accurately. Wrap the cuff around the arm of a student and pump air into the cuff with the inflation bulb. Release the bulb and within seconds see systolic (maximum) and diastolic (minimum) pressures alongside heart rate. Cuff pressure also reported (see meter display in screen at right).

The meter and digits displays provide a clear and easy way to observe heart rate plus systolic and diastolic blood pressure.

Blood Pressure Sensor

PS-2207 (Standard Cuff)
PS-2208 (Small Cuff)
PS-2209 (Large Cuff)

All models include a sensor and an arm cuff with inflation bulb. Most students use standard sized cuff.
For size assistance, see pasco.com

The student exercises for three minutes to raise her heart rate.

After three minutes, the student sits and measures her heart rate, by gripping the handles of the Hand Grip Heart Rate sensor, until it returns to the resting rate.

Get a Grip – Measuring Heart Rate

No belts or clips to worry about. To measure heart rate at rest or during exercise, simply grab the handles and the sensor will measure the number of times the cardiac muscle contracts per minute. Highly accurate and much easier than other solutions for measuring heart rate. Belts or clips won't get in the way and the two ergonomic paddles ensure freedom of movement for both hands.

In this activity students will measure their resting heart rate, then exercise for a short time, and finally hold the paddles as their body recovers from the exertion. The graph that is created will show their heart rate in great detail before, during and after exercise.

The graph shows the time it takes for the student's heart rate to return to a resting rate after exercise.

Hand-Grip Heart Rate Sensor

PS-2186

Includes 2 hand-grip paddles.

Chemistry Sensor

PS-2170

Includes Stainless Steel Temperature Probe, pH Probe, Voltage Probe, built-in Pressure Sensor, 60cc syringe, tubing and quick-release connectors.

Students measure the pH of different juices using the pH probe of the Chemistry Sensor.

Investigating acids and pH

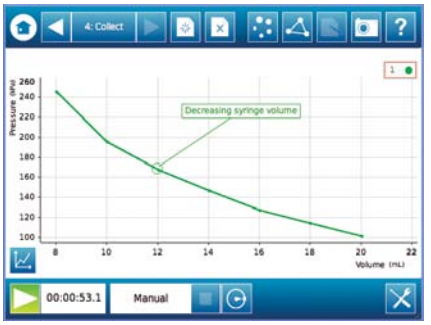
Using the Chemistry Sensor students can measure the pH of different juices without the hassle or mess of indicator solutions or pH paper. And the results are incredibly accurate and easy to read, making it easy to compare the acidity of the different samples.

The advantage of using PASCO sensors and SPARKvue software is that the ease of data collection means that there's plenty of additional time for further investigation or classroom discussion.

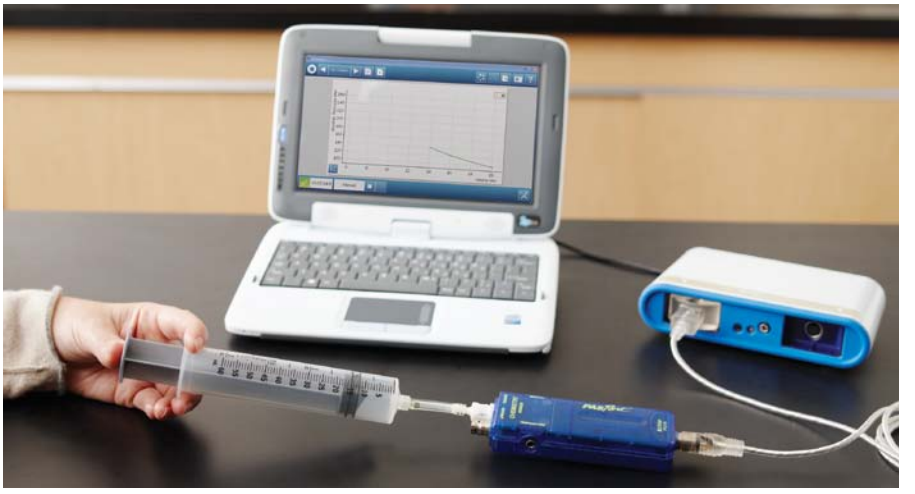
Your choice – display pH in digits for point measurement or use graph to observe changes over time.

Under Pressure – Boyle's Law

One of the fundamental gas laws, Boyle's Law explains the relationship between changes in pressure and the volume of a confined gas. In this activity students will again use the MultiMeasure Chemistry Sensor, but this time will be monitoring the pressure of air in a syringe as the plunger is depressed.



The graph shows that the pressure inside the syringe decreases as the volume increases.



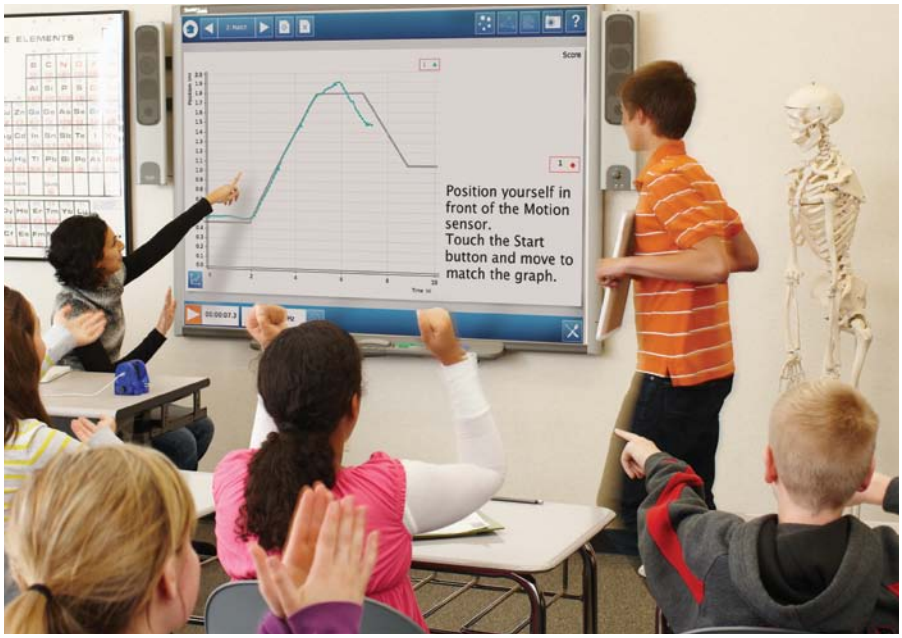
Students study Boyle's Law by studying the effect of changes in the volume of a confined gas on pressure using the Chemistry Sensor.

Students in Motion – Graph Matching

There is no better way for students to internalize the concepts of motion graphs than to create them in real-time using their own motion. By tracking their movements with a Motion Sensor, students will intuitively come to understand position, velocity and relative motion as they attempt to match the graph on the screen. It is also a perfect introduction to the concept of slope as the rate of change.

Motion Sensor

PS-2103A

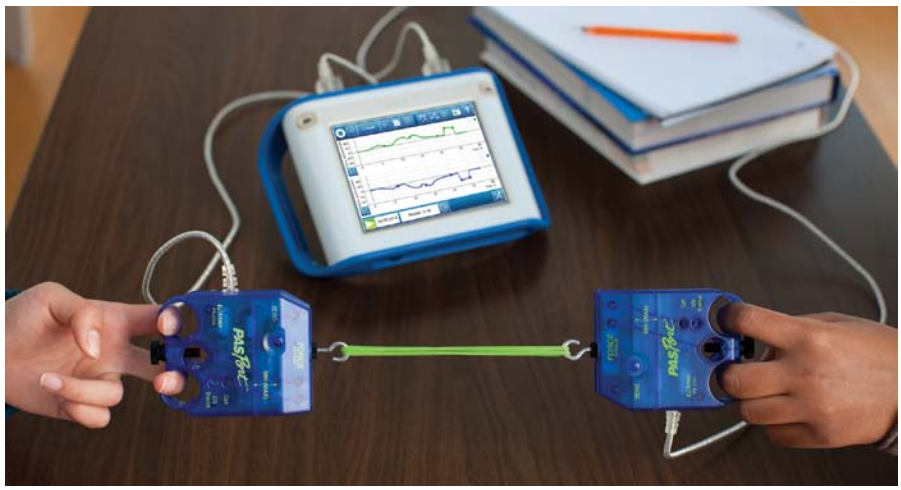


The entire class can participate by coaching the "walker" as he moves in front of the motion sensor to mimic the plot shown on the graph.

For Every Action...

There's an equal and opposite reaction. Students will quickly grasp the concept of Newton's Third Law with this simple activity. Connecting a pair of Force Sensors with a strong rubber band, two students can pull against one another. SPARKvue displays the data and the graph will clearly show that the forces were always equal and opposite.

Regardless of which student holds their sensor in place while the other pulls, the graphs of force will always be perfectly symmetrical. Students can even use the built-in thumbscrew to mount one of the Force Sensors to a ringstand while pulling on the other. They will see the same results: forces always come in pairs!

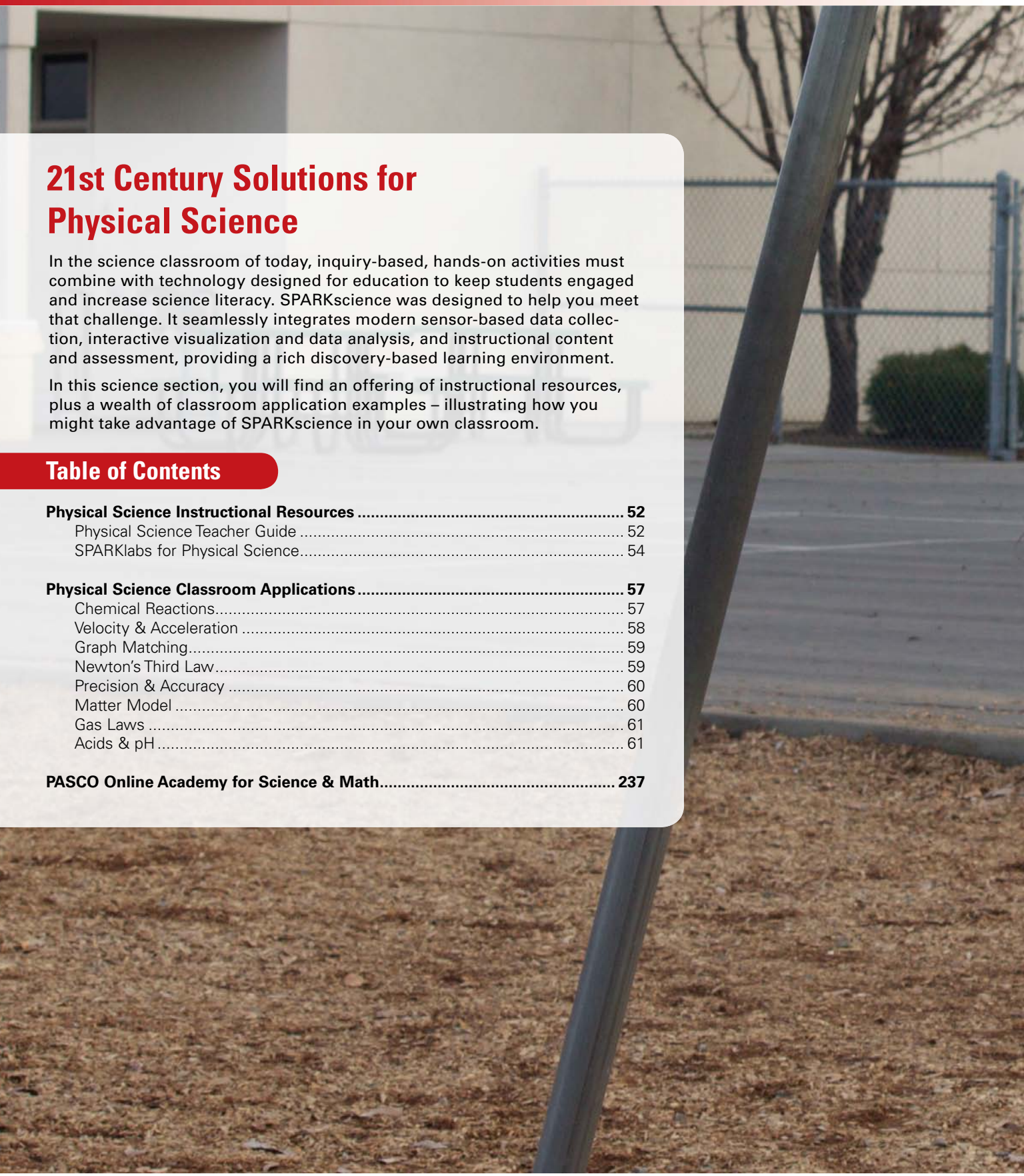


To demonstrate Newton's Third Law, students use two force sensors and take turns pulling against each other.

Force Sensor

PS-2104

As the students pull, the graphs show there is always an equal force in the opposite direction.



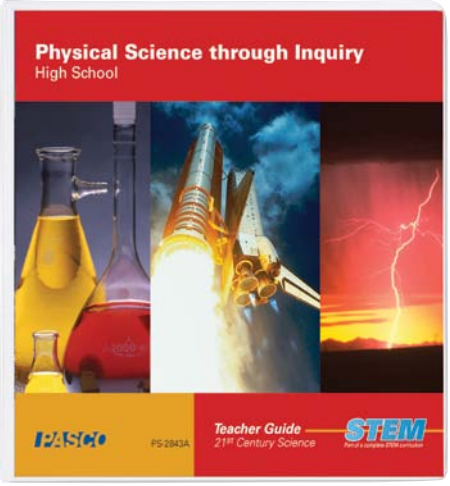
21st Century Solutions for Physical Science

In the science classroom of today, inquiry-based, hands-on activities must combine with technology designed for education to keep students engaged and increase science literacy. SPARKscience was designed to help you meet that challenge. It seamlessly integrates modern sensor-based data collection, interactive visualization and data analysis, and instructional content and assessment, providing a rich discovery-based learning environment.

In this science section, you will find an offering of instructional resources, plus a wealth of classroom application examples – illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents

Physical Science through Inquiry Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide is designed by educators for both new and experienced teachers alike.
- Core topic areas include mechanics, chemical reactions, properties of matter, energy transfer, and the geosphere.
- The lab activities engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Activities also help students build vocabulary skills with key term challenges.
- Multiple-choice questions give students practice for standardized exams.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

29 Challenging Lab Activities

Acceleration
Air Pollution & Acid Rain
Archimedes' Principle ■
Boyle's Law
Conservation of Matter
Density ■
Electrolyte vs. Non-Electrolyte Solutions ■
Endothermic or Exothermic
Evidence of a Chemical Reaction
Faraday's Law
Insolation & the Seasons
Introduction to Force ■
Newton's First Law
Newton's Second Law ■
Newton's Third Law ■
Percent Oxygen in Air
pH of Household Chemicals
Phase Change
Position
Properties of Ionic & Covalent Compounds ■
Radiation Energy Transfer
Significant Figures ■
Soil pH
Specific Heat of Sand vs. Water
Speed & Velocity
Temperature vs. Heat
Varying Reaction Rates
Voltage
Water, the Universal Solvent ■

■ *Lab activities with the color box require the Standard Bundle. All other activities can be done with either bundle.*

Ordering Guide

The 29 lab activities in the teacher guide are designed for use with the following sensors and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Physical Science Teacher Guide

- Get the Physical Science Teacher Guide (PS-2843A).

2 Order your sensor bundles.

Choose the bundle that aligns with the topics you want to cover.
Or build your own bundle from our over 70 sensors (see page 184).
We recommend one bundle per lab station (3-4 students).

- Get the **Starter Sensor Bundle** (PS-2845); contains 6 sensors and allows you to do 20 lab activities.

OR

- Get the **Standard Sensor Bundle** (PS-2846); contains 12 sensors and allows you to do all 29 lab activities.

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

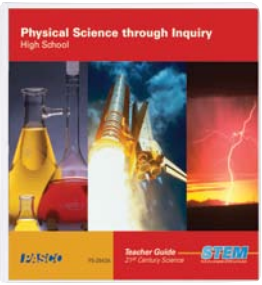
  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Physical Science through Inquiry Teacher Guide

PS-2843A



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2847A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2894A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide flash drive only)

Physical Science Starter Sensor Bundle

PS-2845


1


2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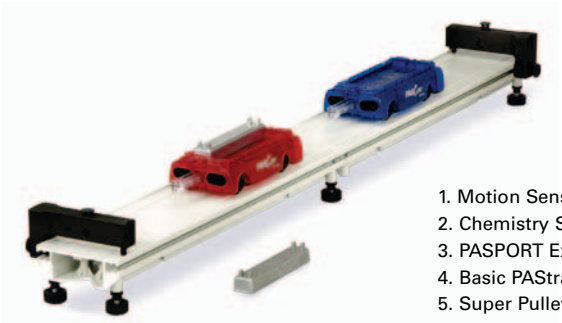
4


5


6

1. Motion Sensor PS-2103A
2. Chemistry Sensor PS-2170
3. PASPORT Extension Cable PS-2500
4. Basic PAStrack Dynamics System ME-6962
5. Super Pulley with Clamp ME-9448B
6. Dynamics Track Rod Clamp ME-9836

Physical Science Standard Sensor Bundle *(Includes all Starter Bundle sensors)*

PS-2846


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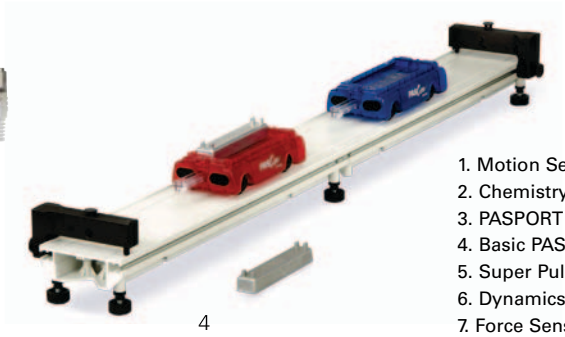
3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5


6

1. Motion Sensor PS-2103A
2. Chemistry Sensor PS-2170
3. PASPORT Extension Cable PS-2500
4. Basic PAStrack Dynamics System ME-6962
5. Super Pulley with Clamp ME-9448B
6. Dynamics Track Rod Clamp ME-9836
7. Force Sensor PS-2104
8. Conductivity Sensor PS-2116A
9. PASCO Density Set ME-8569
10. Mass & Hanger Set ME-8979
11. Significant Figures Set – Single ME-9850
12. Overflow Can SE-8568


7


8


9


10


11


12

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

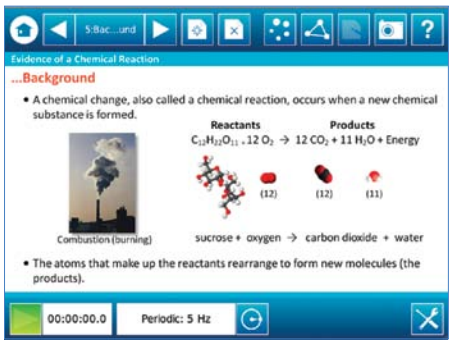
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

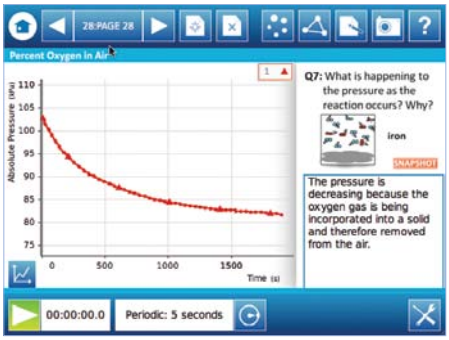
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



Guided questions in the SPARKlab encourage students to understand pressure data on a molecular level.

The SPARKlab Online Library

A growing collection for 21st century science learning

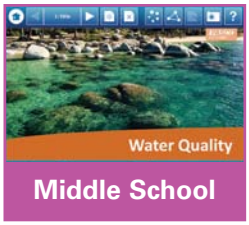
The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

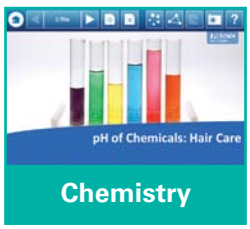
See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

NEW! Plant Metabolism & the Carbon Cycle, Toxicology Using Yeast, and Biofuels from Fermentation



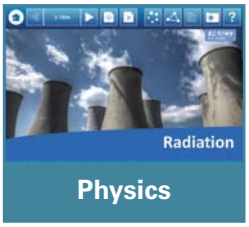
NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs

NEW! Diffusion, Fermentation in Yeast, & Heart Rate



NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration

NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics



NEW! Projectile Motion, Position Match Graph, & Radiation

SPARKlabs for Physical Science

FREE…

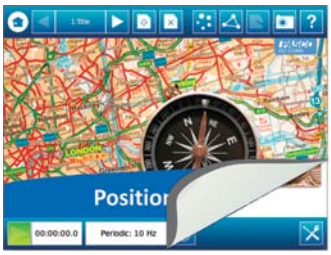
We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

The 13 free Physical Science SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

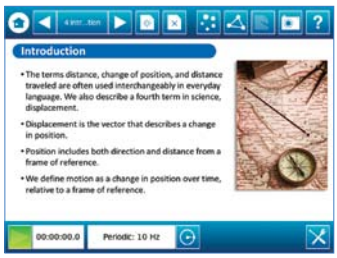
13 FREE Physical Science SPARKlabs

- Acceleration
- Air Pollution & Acid Rain
- Evidence of a Chemical Reaction
- Faraday's Law
- Insolation & the Seasons
- Newton's First Law
- Percent Oxygen in Air
- Radiation Energy Transfer
- Soil pH
- Specific Heat of Sand vs. Water
- Speed & Velocity
- Varying Reaction Rates
- Voltage

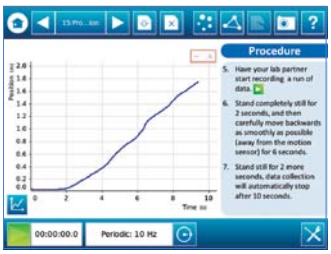
Inside a SPARKlab



All background information, materials lists, safety notes and procedures are provided keeping students in the flow of the lab, not flipping back and forth with paper reference materials.



Integrated data collection and analysis means that students immediately draw meaning from the measurements and connect them to the science concept being investigated.



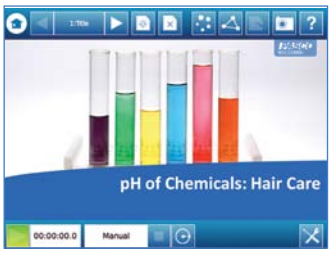
New Additions to the SPARKlab Online Library!

pH of Household Chemicals: Hair Care

Teacher License PS-2078

One per teacher (one license for all your classes).

Students determine the average pH of common hair products, then they assess the potential benefits and risks of using household items as hair care remedies.



Electronic Delivery.
Upon purchase, download to your computer.

Position: Match Graph

Teacher License PS-2081

One per teacher (one license for all your classes).

Students measure back and forth motion and explore the differences between distance, position, *and* displacement. *Then, in groups, they conduct their own motion tests and display their results graphically, using a motion sensor.*

Electronic Delivery.
Upon purchase, download to your computer.

NEW SPARKLAB ANNOUNCEMENTS

Get the latest information on new SPARKlab announcements and releases.

Visit pasco.com/SPARKscience

Physical Science Starter Sensor Bundle

Get the sensors needed to conduct the 13 free Physical Science SPARKlabs included with your SPARK Science Learning System or SPARKvue license.

13 Free Physical Science SPARKlab Activities

- Acceleration
- Air Pollution and Acid Rain
- Evidence of a Chemical Reaction
- Faraday's Law
- Insolation and the Seasons
- Newton's First Law
- Percent Oxygen in Air
- Radiation Energy Transfer
- Soil pH
- Specific Heat of Sand vs Water
- Speed and Velocity
- Varying Reaction Rates
- Voltage

Physical Science Starter Sensor Bundle

PS-2845

1. Motion Sensor PS-2103A
2. Chemistry Sensor PS-2170
3. Sensor Extension Cable PS-2500
4. Dynamics Track Rod Clamp ME-9836
5. Super Pulley with Clamp ME-9448B
6. Basic PAStrack Dynamics System ME-6962

Ordering Guide

The 13 Physical Science SPARKlab activities are designed for use with the equipment above and with the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order your sensor bundle.

- To perform the 13 SPARKlab activities, order the **Physical Science Starter Sensor Bundle** (PS-2845); which contains the 6 sensors listed above.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

2 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

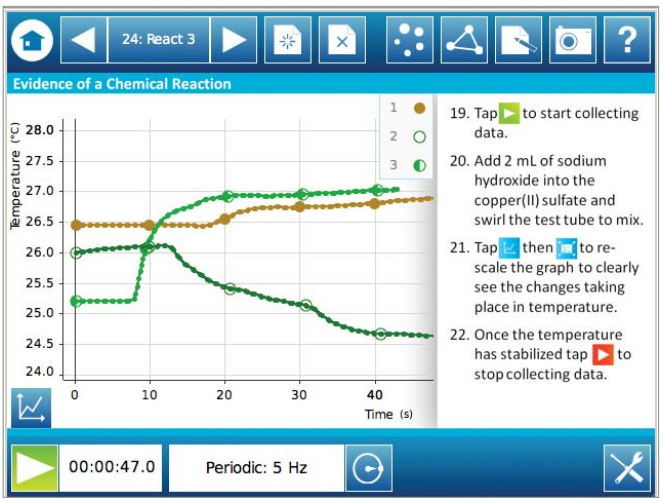
Students mix three sets of chemicals in test tubes to observe the changes. The sensor measures the temperature change as students observe visual changes.

Sample SPARKlab Activity: Evidence of a Chemical Reaction

How can students tell when a chemical reaction has taken place? In this Physical Science SPARKlab students will learn the basics of chemical reactions.

Students will come to understand that unlike a physical change, a chemical reaction is one in which at least one new substance is formed. Visual evidence includes a precipitate forming, a gas being produced or absorbed or a change in color. A fourth indicator is a change in temperature. Using a Fast Response Temperature Probe students will measure temperature, create graphs and determine if the reaction is exothermic or endothermic.

After this activity students will be able to distinguish between physical changes and chemical reactions, know the signs that a chemical reaction has taken place and be able to identify a reaction as endothermic or exothermic.



This graph shows one strongly exothermic reaction, one weakly exothermic reaction and one endothermic reaction.

Basic PAStrack Dynamics System

ME-6962

Includes two 0.5m lengths of PAStrack, leveling feet, 2 track connectors, two adjustable end stops, two PAScars (one red, one blue), two 250g masses.

Also Available:

PAStrack (track only) ME-6960

Extend your track an extra 1.0 m or more in 0.5 m increments.

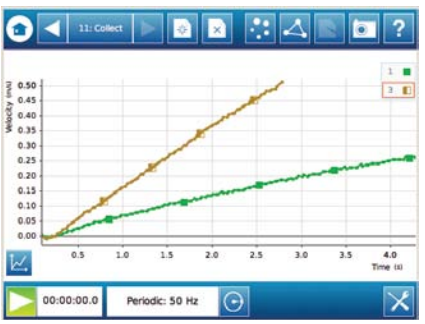
Velocity and Acceleration

The Basic PAStrack Dynamics System is an ideal way for students to investigate concepts of motion. The track itself easily snaps together and includes leveling feet and a built-in scale. It also includes two feature-packed, low friction PAScars and additional masses.

THE TEACHING ADVANTAGE

- In this activity students use a Motion Sensor to record the cart's velocity and acceleration as it rolls down an incline created with the PAStrack. By varying the angle of the track, students can see the change in the cart's motion.
- With all the available accessories (including the Dynamics Track Optics Kit, on page 174), the PAStrack is one piece of equipment students can and will use all year long.

Track pieces snap together for easy assembly and storage.



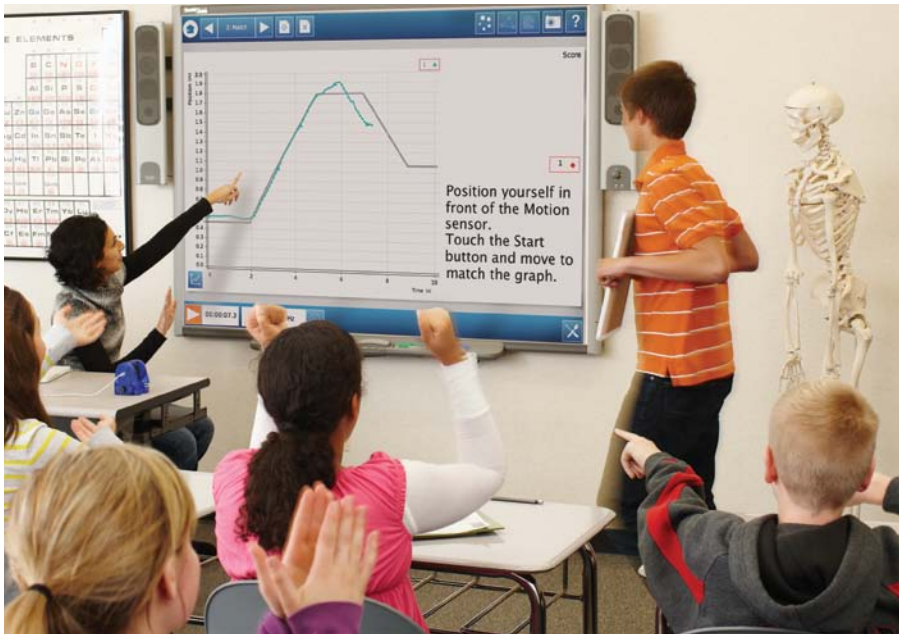
Comparing graphs of different angles, students can see acceleration as the rate of change of velocity.

Students in Motion – Graph Matching

There is no better way for students to internalize the concepts of motion graphs than to create them in real-time using their own motion. With a Motion Sensor students will intuitively come to understand position, velocity and relative motion as they attempt to match the graph on the screen. It provides a perfect introduction to the concept of slope as the rate of change.

Motion Sensor

PS-2103A



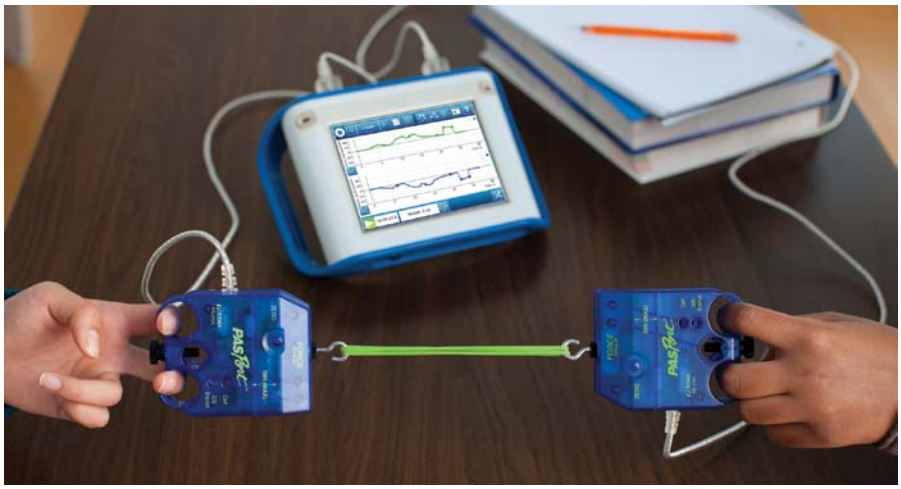
The entire class can participate by coaching the "walker" as he moves in front of the motion sensor to mimic the plot shown on the graph.

For Every Action...

There's an equal and opposite reaction. Students will quickly grasp the concept of Newton's Third Law with this simple activity. Connecting a pair of Force Sensors with a strong rubber band, two students can pull against one another. The data recorded will be displayed in SPARKvue and the resulting graph will clearly show that the forces applied were always equal and opposite.

THE TEACHING ADVANTAGE

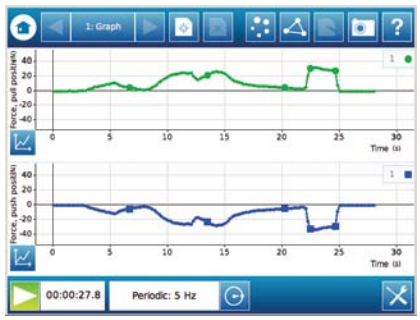
- Regardless of which student holds their sensor in place while the other pulls, the graphs of force will always be perfectly symmetric. Students can even use the built-in thumbscrew to mount one of the Force Sensors to a ring stand and see the same result when pulling on the other. Forces always come in pairs!



To demonstrate Newton's Third Law, students use two force sensors and take turns pulling against each other.

Force Sensor

PS-2104



As the students pull, the graphs show there is always an equal force in the opposite direction.

A student dropping a ball onto a bulls-eye to create examples of results that are precise but not accurate, accurate but not precise, and accurate.

Teach Students the Value of Precision and Accuracy

With this set students will truly understand measurement uncertainty.

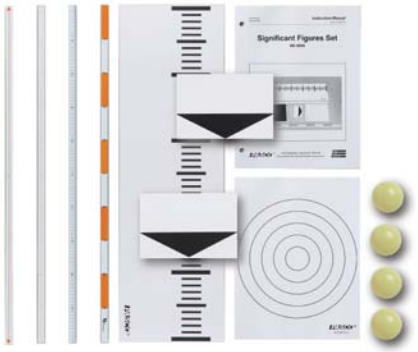
ACTIVITIES INCLUDE:

- **Ball Drop:** Students toss small balls on a bulls-eye to discover the relationship between technique and measurements, leading to the concepts of accuracy and precision.
- **"Forced Error" Measurements:** Students use a meter stick that has inaccurate markings to take measurements to reinforce that precise measurements are not always accurate.
- **Mass/Length Measurements:** Students use a balance or Four-Scale Meter Stick with imprecise scales to limit the certainty in their measurements.
- **Area/Volume/Density Calculations:** Students use a variety of measuring devices to calculate the area, volume and density of various objects, with emphasis placed on the precision of the measuring devices throughout.

Significant Figures Set (4-Pack)

ME-9849

Includes materials for four student groups: plastic balls, carbon paper, bull's eyes, four-scale meter sticks, data pointers, meter stick labels and balance labels. Plus one large laminated number line.



Matter Model: See the structure of matter with this dynamic visualization

The atoms of the Matter Model are brightly colored spheres specifically designed to allow students to better understand the structure of matter. The bonds between the atoms are modeled by springs, so that when forces are applied, the atoms can move in response. Use this model to demonstrate normal force, atmospheric pressure or even wave motion.

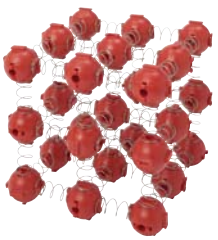
TYPICAL APPLICATIONS

- Modeling a Solid: By constructing a matrix of spheres, students can build a model of matter that is dynamic and responds to external forces similarly to real solids.
- Wave Properties: Students can investigate wave properties including reflection, wave speed and standing waves.

Matter Model

ME-9825A

Includes atoms (40), heavy springs (60), light springs (60) long springs (60), nuts (for increasing the atom mass) (30) and one brass rod (90 cm long).



This model of a solid can be used to help students visualize the atomic level of matter.

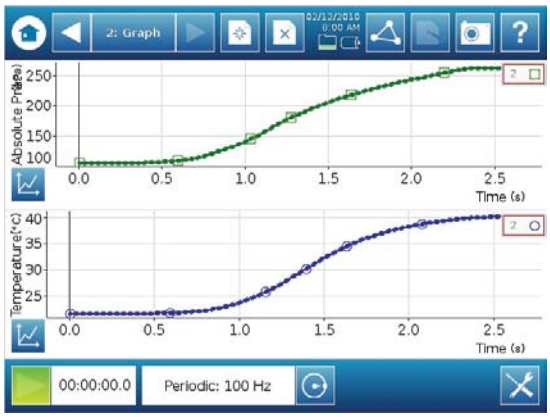
Stack them vertically to model atmospheric pressure.

Under Pressure – Investigating the Gas Laws

The Ideal Gas Law Apparatus has a stable design that ensures consistently repeatable results and long-term reliability. By connecting a Pressure Sensor and a Temperature Sensor to this large syringe, students will be able to quantitatively investigate relationships between pressure, temperature and volume of a gas.

FEATURES

- Low thermal-mass thermistor
- Quick-connect port for a pressure sensor
- Mechanical stop on the plunger to prevent damage



Students observe that both pressure and temperature increase as the volume inside the Ideal Gas Law Apparatus is decreased.

Students observe that both pressure and temperature increase as the volume inside the Ideal Gas Law Apparatus is decreased over time.

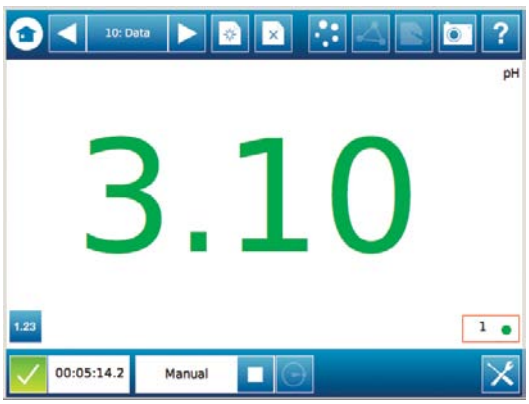
Ideal Gas Law Apparatus

TD-8596A

Includes Ideal Gas Law syringe, built-in Fast Response Thermistor Probes, and quick-connect pressure port.

Exploring Acids and pH

Exploring acids and bases has never been easier. No messy indicators or rolls of pH paper needed! Students can investigate the pH of various juices simply and accurately using the pH probe included with PASCO's Chemistry MultiMeasure Sensor. Being able to gather data quickly means more time for discussion or further analysis using the powerful tools of SPARKvue software.



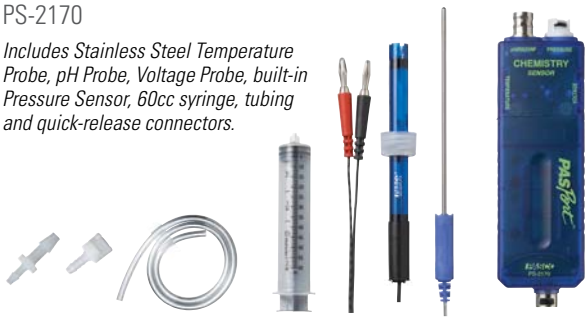
Large digit display makes it easy for students to view the changes in pH from juice to juice.

Students measure the pH of different juices using the pH probe of the Chemistry Sensor.

Chemistry Sensor

PS-2170

Includes Stainless Steel Temperature Probe, pH Probe, Voltage Probe, built-in Pressure Sensor, 60cc syringe, tubing and quick-release connectors.



21st Century Solutions for Biology

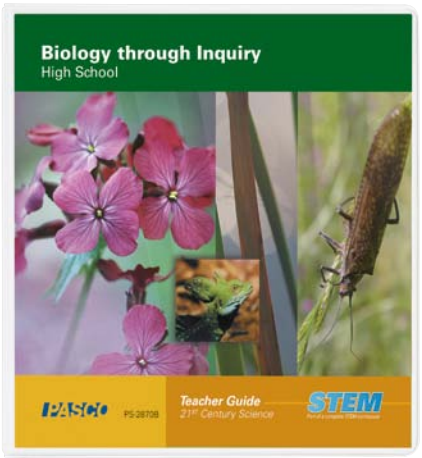
In the science classroom of today, inquiry-based, hands-on activities must combine with technology designed for education to keep students engaged and increase science literacy. SPARKscience was designed to help you meet that challenge. It seamlessly integrates modern sensor-based data collection, interactive visualization and data analysis, and instructional content and assessment, providing a rich discovery-based learning environment.

In this science section, you will find an offering of instructional resources, plus a wealth of classroom application examples – illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents


CARBON DIOXIDE GAS

Biology through Inquiry Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide is designed by educators for both new and experienced teachers alike.
- Core topic areas include cell biology, ecology, and physiology.
- The lab activities engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Activities also help students build vocabulary skills with key term challenges.
- Multiple-choice questions give students practice for standardized exams.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

25 Challenging Lab Activities

Acid Rain
Cellular Respiration in Yeast ■
EKG: Factors That Affect the Heart ◆
Energy Content of Food ■
Enzyme Action
Exercise & Heart Rate ◆
Exercise & Respiration Rate ◆
Exploring Microclimates
Exploring Microclimates Through Temperature ■
Membrane Permeability
Metabolism of Yeast ■
Muscle Fatigue ◆
Organisms & pH
Osmosis
Plant Respiration & Photosynthesis
Rate of Photosynthesis for an Aquatic Plant ■
Regulation of Body Heat ■
Respiration of Germinating Seeds
Role of Buffers in Biological Systems
Soil pH ■
Transpiration
Volume of Breath ◆
Water & pH ■
Water Purification ■
Weather in a Terrarium ■

■ Lab activities with the color square require the Standard Sensor Bundle.
◆ Labs with the color diamond require the Extension Bundle for Physiology.
All other activities can be done with either the Starter or Standard bundle.

Ordering Guide

The 25 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Biology Teacher Guide

- Biology Through Inquiry Teacher Guide (PS-2870B)

2 Order your sensor bundles.

Choose the bundle that aligns with the topics you want to cover. Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

- To perform the 10 starter labs (those without symbols), order the **Starter Sensor Bundle** (PS-2920), which gives you 4 sensors.
- To perform all the lab activities except the 5 physiology labs (those with a ◆ symbol), order the **Standard Sensor Bundle** (PS-2925).
- To perform the 5 physiology labs (those with a ◆ symbol), order the **Extension Bundle for Physiology** (PS-2935).

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

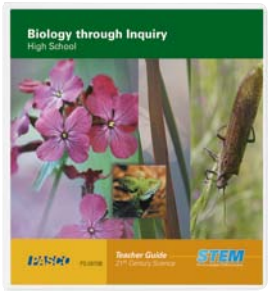
  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Biology through Inquiry Teacher Guide

PS-2870B



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2880A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2894A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

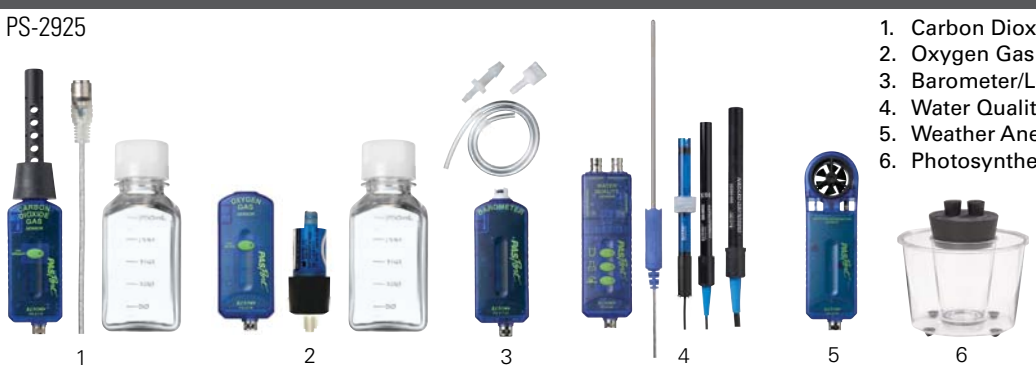
Biology Starter Sensor Bundle

PS-2920

1. Carbon Dioxide Gas Sensor PS-2110
2. Oxygen Gas Sensor PS-2126A
3. Barometer/Low Pressure Sensor PS-2113A
4. pH Sensor PS-2102

Biology Standard Sensor Bundle *(Includes all Starter Bundle sensors)*

PS-2925



1. Carbon Dioxide Gas Sensor PS-2110
2. Oxygen Gas Sensor PS-2126A
3. Barometer/Low Pressure Sensor PS-2113A
4. Water Quality Sensor PS-2169
5. Weather Anemometer PS-2174
6. Photosynthesis Tank PS-2521A

Extension Bundle for Physiology

PS-2935

1. Breath Rate Sensor PS-2187
2. Hand-Grip Heart Rate Sensor PS-2186
3. EKG Sensor PS-2111
4. Spirometer PS-2152
5. Spirometer Mouth Pieces PS-2522
6. Force Sensor PS-2104

Advanced Biology Teacher Guide

Designed for Teacher and Student Success

- This standards-based, Advanced Biology Guide, which is designed by educators, includes all 12 required AP®* Biology labs.
- Labs cover all six national life science education strands: the cell; molecular basis of heredity; biological evolution; interdependence of organisms; matter, energy, and organization in living systems; and behavior of organisms.
- The lab activities engage students as they make predictions, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Multiple-choice questions bridge the gap between "lecture and lab" and help students gain confidence for the AP exam.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

Advanced and AP® Biology Labs

AP® Biology Labs

Lab 1: Diffusion and Osmosis
Lab 2: Enzyme Catalysis
Lab 3: Mitosis and Meiosis
Lab 4: Plant Pigments and Photosynthesis
Lab 5: Cellular Respiration
Lab 6A: Bacterial Transformation
Lab 6B: Mitochondrial Genetics and Biotechnology
Lab 7: Genetics of Organisms with Drosophila melanogaster
Lab 8: Evolution and Population Genetics
Lab 9: Transpiration
Lab 10: Physiology of the Circulatory System
Lab 11: Animal Behavior
Lab 12: Dissolved Oxygen and Primary Productivity

Advanced Biology Labs

Diffusion
Exploring Surface Area to Volume Ratios
pH and Buffers
Elodea and the Snail
Exploring the Effects of pH on Amylase Activity
Factors that Affect Photosynthetic Activity
Fermentation in Yeast
Measuring Aerobic Cellular Respiration in Yeast
Air Pollution and Acid Rain
Interrelationship of Plants and Animals
Population Ecology
Endotherms and Ectotherms: Temperature Regulation in Animals
Reflex versus Reaction

Revised edition for New AP® Curriculum available Fall 2012

Ordering Guide

The 25 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Advanced Biology Teacher Guide

- Advanced Biology Teacher Guide (PS-2876C)

2 Order your sensor bundles.

- **To perform all 25 advanced biology labs** included in the teacher guide (12 AP® Biology Labs + 13 advanced biology labs), order the **Advanced Biology Standard Sensor Bundle** (PS-2926A), which gives you the 12 sensors shown on the opposite page.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: Use our SPARKvue software on your own computers.

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

4 Order DNA

- To perform Lab 6B: Mitochondrial Genetics & Biotechnology, you will also need DNA. For your convenience, you can order this through PASCO. Order one Mitochondrial Genetics Kit (BP-6946) per lab station. For ordering info, see page 85.

* AP is a registered trademark of the College Board, which was not involved in the production of, and does not endorse, this product.

Advanced Biology Teacher Guide

PS-2876C

Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2886B

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2896B

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Advanced Biology Standard Sensor Bundle

PS-2926A

1. Water Quality Sensor PS-2169
2. Colorimeter PS-2121
3. Oxygen Gas Sensor PS-2126A
4. Carbon Dioxide Gas Sensor PS-2110
5. Ethanol Sensor PS-2194
6. Barometer/Low Pressure Sensor PS-2113A
7. Blood Pressure Sensor PS-2207
8. Quad Temperature Sensor PS-2143
9. Photosynthesis Tank PS-2521A
10. EcoChamber ME-6667
11. Metabolism Chamber ME-6936
12. Aquatic Productivity Bottles ME-6937

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12

Students use the Dissolved Oxygen Sensor to measure the dissolved oxygen of the algae solution before and after incubation in fluorescent light.

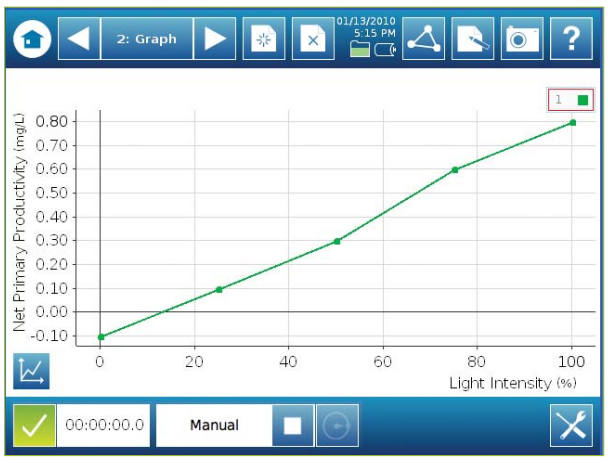
Study Photosynthesis and Primary Productivity

A Great Solution for AP® Biology Lab 12

An ecosystem's primary production is the amount of light energy converted to chemical energy by autotrophs in a given time period. In this activity from AP Biology, students will explore the effect of temperature on the concentration of dissolved oxygen, use dissolved oxygen as a direct indicator of primary productivity of algae, and investigate how changing light intensity will affect the primary productivity of algae.

The PASCO Aquatic Productivity Bottles block light in 25% increments from zero to 100% with total accuracy. Used with the Dissolved Oxygen Sensor, students will demonstrate the relationship between light intensity and Net Primary Productivity and Gross Primary Productivity of algae or pond water by comparing initial and final measurements of dissolved oxygen concentrations.

Much easier to use than traditional methods – no more wrapping bottles with screens and rubber bands!



Using the dissolved oxygen measurements, students can calculate the net and gross primary productivity of the aquatic ecosystem they are studying.

Aquatic Productivity Bottles

ME-6937

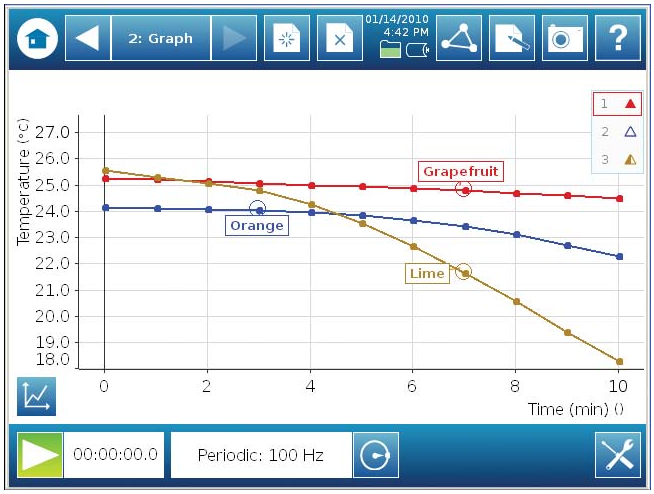
Includes Plastic bottles w/lids (5), and case with slotted lid.

To measure dissolved oxygen, one of the following is required:

Water Quality Sensor PS-2169
(measures dissolved oxygen, conductivity, pH and temperature)
Dissolved Oxygen Sensor PS-2108

Explore surface-area-to-volume ratios

An elegant demonstration made possible by use of the Quad Temperature Sensor. Students place various fruits in an ice bath and observe their cooling rates. In this activity the fruits serve as models for cells with the different sizes of fruit representing different surface-areas-to-volume ratios. After collecting temperature data, students will discern the importance of cells having the correct size and shape.



Using the fruit as a model for the cell, students learn that smaller fruits have a more beneficial surface-area-to-volume ratio.

Quad Temperature Sensor

PS-2143

Includes 2 Stainless Steel Temperature Probes, 3 Fast Response Temperature Probes, and adhesive disks.

Also Available:

Temperature Array (8) PS-2157

See www.pasco.com for details on this product.

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

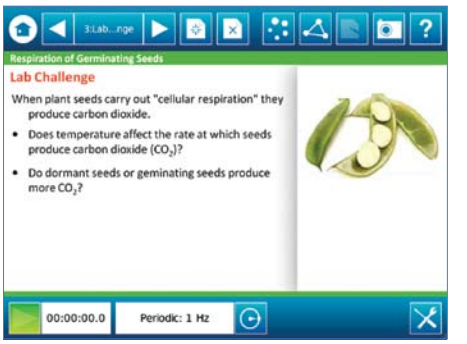
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

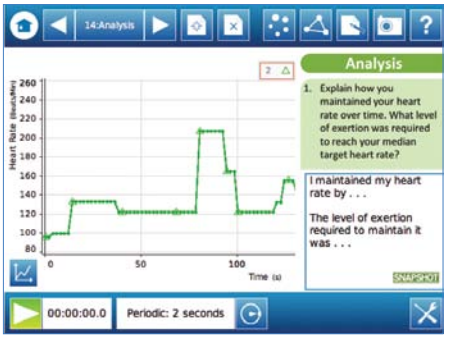
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



Heart rate data is easily analyzed and understood with SPARKlab embedded questions. Students experience the relationship between heart rate and their level of exertion.

The SPARKlab Online Library

A growing collection for 21st century science learning

The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

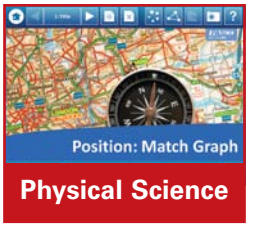
SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

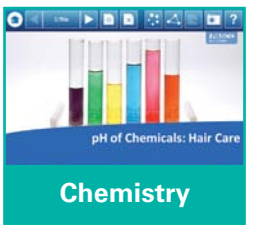
See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

NEW! Plant Metabolism & the Carbon Cycle, Toxicology Using Yeast, and Biofuels from Fermentation

NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs



NEW! pH of Household Chemicals: Hair Care & Position: Match Graph



NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration

NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics

NEW! Projectile Motion, Position Match Graph, & Radiation

SPARKlabs for Biology

FREE…

10 FREE Biology SPARKlabs

We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

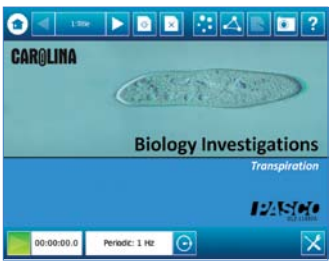
The 10 free Biology SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

- Acid Rain
- Enzyme Action
- Exploring Microclimates
- Membrane Permeability
- Organisms & pH
- Osmosis
- Plant Respiration & Photosynthesis
- Respiration of Germinating Seeds
- Role of Buffers in Biological Systems
- Transpiration

Carolina SPARKlabs

Carolina Investigations in Biology SPARKlabs

This set of ten SPARKlabs covers every strand of the biology standard, including genetics and evolution, in an engaging and fully interactive approach to science learning.
See page 74.



Activities

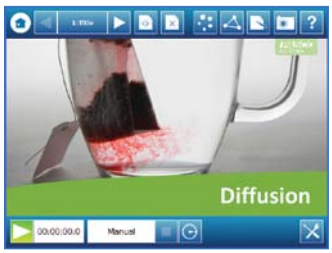
Animal Metabolism
Cellular Respiration
Dissolved Oxygen & Aquatic Ecosystems
Enzyme Catalysis
Osmosis & Diffusion
Photosynthesis
Physiology: Reaction Time
Population Genetics
Population Growth Rate of Yogurt Cultures
Transpiration

New Additions to the SPARKlab Online Library!

Diffusion

Teacher License PS-2077
One per teacher (one license for all your classes).

Investigate semi-permeable membranes using the colorimeter, conductivity, and pH sensors to measure diffusion and osmosis.

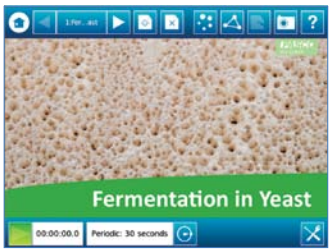


Electronic Delivery.
Upon purchase, download to your computer.

Fermentation in Yeast

Teacher License PS-2076
One per teacher (one license for all your classes).

Students determine the types of metabolic pathways yeast cells are using by measuring the oxygen and ethanol levels in a closed environment. Then they establish if yeast cells can digest the disaccharide sucrose.



Electronic Delivery.
Upon purchase, download to your computer.

Heart Rate

Teacher License PS-2075
One per teacher (one license for all your classes).

Students establish their mean resting heart rate, determine the level of exertion required to reach a target heart rate, and identify additional factors that may influence heart rate.

Electronic Delivery.
Upon purchase, download to your computer.

Biology Starter Sensor Bundle for SPARKlabs

Get the sensors needed to conduct the 10 free SPARKlabs included with your SPARK Science Learning System or SPARKvue license.

10 Free Biology SPARKlab Activities

- Acid Rain
- Enzyme Action
- Exploring Microclimates
- Membrane Permeability
- Organisms and pH
- Osmosis
- Plant Respiration and Photosynthesis
- Respiration of Germinating Seeds
- Role of Buffers in Biological Systems
- Transpiration

Biology Starter Sensor Bundle

PS-2920

1. **Carbon Dioxide Gas Sensor** PS-2110
2. **Oxygen Gas Sensor** PS-2126A
3. **Barometer/Low Pressure Sensor** PS-2113A
4. **pH Sensor** PS-2102

1 2 3 4

Ordering Guide *The 10 Biology SPARKlab activities are designed for use with the sensors above and with the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.*

1 Order your sensor bundle.

- To perform the 10 free SPARKlab activities, order the **Biology Starter Sensor Bundle** (PS-2920), which contains the 4 sensors listed above.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

2 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Cellular respiration is traditionally explored with time-consuming apparatus like a respirometer. With the Carbon Dioxide Sensor, students observe cell respiration directly and get results in minutes.

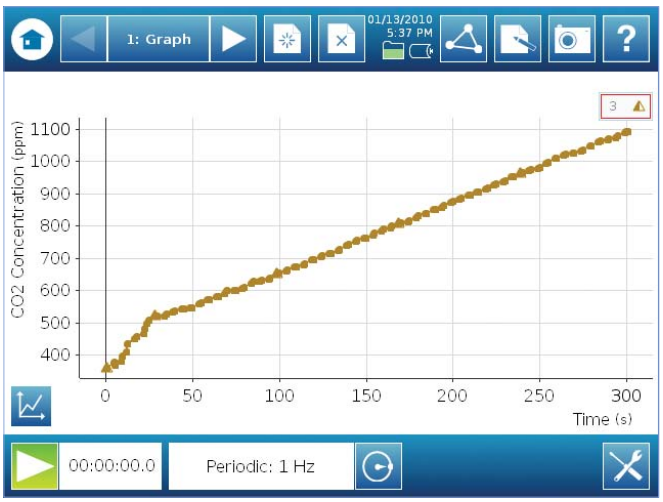
Sample SPARKlab Activity: Respiration of Germinating Seeds

Investigate germination and its effect on cellular respiration simply and directly

In this Biology SPARKlab students will explore differences in the rate of cellular respiration by creating graphs in real time and comparing the rates of carbon dioxide production of:

- Dry, dormant seeds
- Wet, germinating seeds at room temperature
- Wet, icy-cold germinating seeds

Using a Carbon Dioxide Sensor makes this a fast and easy process, leaving more time for discussion. You can talk about the process of germination and how it changes the seeds' demands for energy, as well as how temperature affects the rate of all biological processes, including cellular respiration.



The production of carbon dioxide gas by germinating pea seeds.

Carolina™ Biology Investigations for SPARKscience

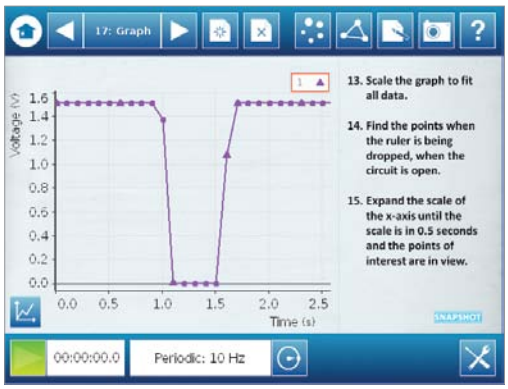
A new approach to hands-on biology

This set of 10 SPARKlabs covers every strand of the Biology standards, including genetics and evolution, in an engaging and fully interactive approach to science learning.

SPARKlab activities include:

- Osmosis and Diffusion
- Cellular Respiration
- Transpiration
- Photosynthesis
- Enzyme Catalysis
- Population Genetics
- Population Growth Rate of Yogurt Cultures
- Animal Metabolism
- Physiology: Reaction Time
- Dissolved Oxygen and Aquatic Ecosystems

Sensor Bundle provides the four sensors required for these SPARKlab activities. For your convenience we offer a perishables and supplies kit to give you most of the materials necessary to complete these lab activities.



The change in voltage reflects the opening of the circuit (the drop) and the closing of the circuit (the catch). Reaction time is length of time the circuit is open.

Measure reaction time to a visual stimulus with this simple circuit closed by a metal ruler. One student randomly drops the ruler (opens the circuit), and the other catches it (closing it).

Ordering Guide

The 10 Carolina Biology Investigations are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Carolina Biology Investigations for SPARKscience.

- Carolina Biology Investigations (PS-2864)

2 Order your sensor bundle.

- Get the **Carolina Biology Investigations for SPARK Science Sensor Bundle** (PS-2865), which contains the sensors on the opposite page and allows you to do all 10 investigations.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

3 Order your materials kit.

- **Order the Carolina Biology Investigations for SPARK Science Materials Kit** (PS-2861), which contains the supplies to do the investigations (see opposite page for full list).

4 Select your data collection and analysis tool.

- Get the **SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

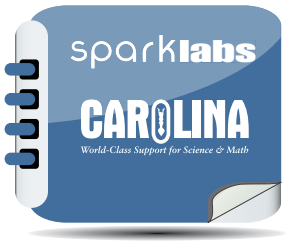
Carolina™ Biology Investigations for SPARKscience

Teacher License PS-2864

One per teacher (one license for all your classes).

Includes 10 general level high school Biology SPARKlabs.

Electronic Delivery.
Upon purchase, download to your computer.



Carolina™ Biology Investigations for SPARKscience Sensor Bundle

PS-2865

Order one bundle per student group (3-4 students)

1. Barometer/Low Pressure Sensor PS-2113A
2. pH Sensor PS-2102
3. Dissolved Oxygen Sensor PS-2108
4. Carbon Dioxide Sensor PS-2110

1 2 3 4

Carolina™ Biology Investigations for SPARKscience Materials Kit

PS-2861

Includes the following supplies to do the investigations.

Osmosis apparatus	Plastic bag
Dialysis tubing 12"	Small foam cooler
Sucrose 172g	Dextrose powder 50 g
Red food coloring 1 oz	Lactose powder 25 g
Air line tubing 18"	Glass marking pencil
Yellow tips (qty. 4)	Test tube 15 x 125 mm (qty. 4)
Straight tubing connector	Plastic containers, 250 mL (qty. 2)
Micro-tip pipet (qty. 2)	White beads (qty. 100)
Cord clips (qty. 6)	Black beads (qty. 100)
Battery holder	Paper cup, 3 oz
Zinc electrodes (qty. 12)	Test tube 25 x 150 mm (qty. 4)
Metal ruler 12"	Abrasive paper
Graduated pipet 3 mL (qty. 12)	Hot Pot (electric water kettle)
Plant mister sprayer	Fluorescent light bulb, 19W
Plant mister bottle	Battery, size D
Petroleum jelly 3.34 oz	Live card to receive mealworms
Tygon® tubing 12"	

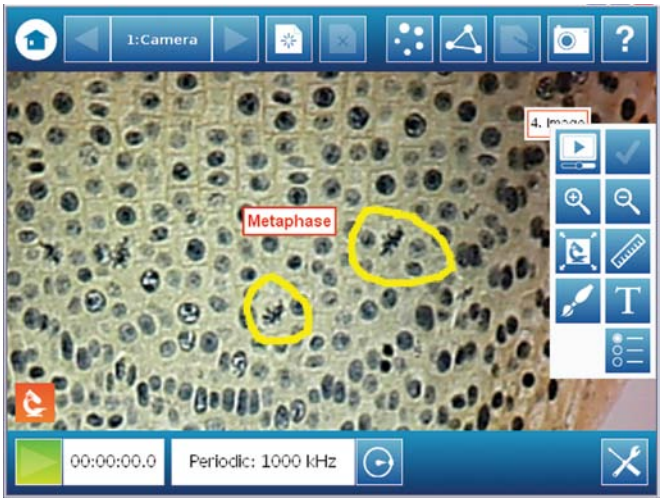
Order one per student group (3-4 students)
Contents will vary for addresses outside the U.S.

The kena Digital Microscope connects directly to SPARK or your own computer for a very portable and durable digital microscopy solution.

New! SPARK and SPARKvue now support digital microscopes

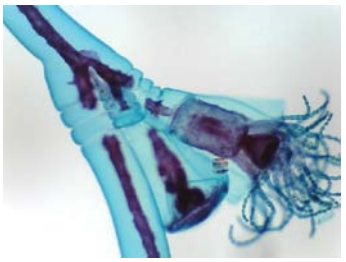
SPARKvue's new digital imaging capabilities support a wide variety of USB imaging devices, including most modern digital microscopes and webcams. Don't have a computer? No problem—use SPARK Science Learning System and get all the advantage of digital microscopy. No need for your students to learn a new software just for microscopy—collect sensor data and capture and analyze images all in your SPARKvue software.

- Make measurements right on the screen.
- Use digital zoom for even more magnification.
- Add labels using the text tool.
- Annotate, highlight, and more!



Use SPARKvue software to capture images and add drawing and text annotations.

Use in the lab or – with the removable camera head – take it to the field.



Obelia are aquatic invertebrate animals that belong to the same phylum as jellyfish. Under the kena Digital Microscope you can easily see its anatomical parts.

kena® Digital Microscope

SE-7236

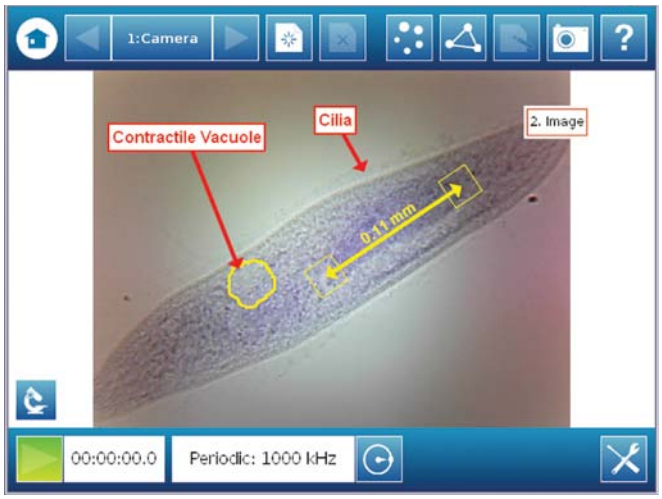
Includes a removable camera/magnification head, touch tube (for placing the microscope flush against specimens), sturdy metal base, and convenient carry/storage bag. Magnification: 20X, 40X, 100X.

For use with SPARKvue: *Requires a SPARK Science Learning System or a USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.*

This ken-a-vision® Digital Monocular Comprehensive Scope connects directly to SPARK or your computer running SPARKvue.

Combine powerful digital tools with traditional microscopy

The Comprehensive scope 2 offers a more powerful alternative for biology classrooms. This microscope features a mechanical stage, 3.2 megapixel camera, battery-powered lamp, and 40X, 100X, 400X, and 1000X magnification. Here's a cost-effective and easy-to-use solution that lets you combine digital tools and traditional microscopy skills to enhance student learning and achievement.



Use SPARKvue software to capture images and add drawing and text annotations. With a quick calibration the SPARKvue software can make onscreen measurements, making the microscope meaningful for students.

ken-a-vision® Digital Monocular Comprehensive Scope 2

SE-7246

Includes 10X eyepiece; 4X, 10X, 40X, and 100X objectives lenses (the 40X and 100X objectives are spring-loaded to avoid crushing slides and damaging optics); USB cable; calibration slide; and charger.

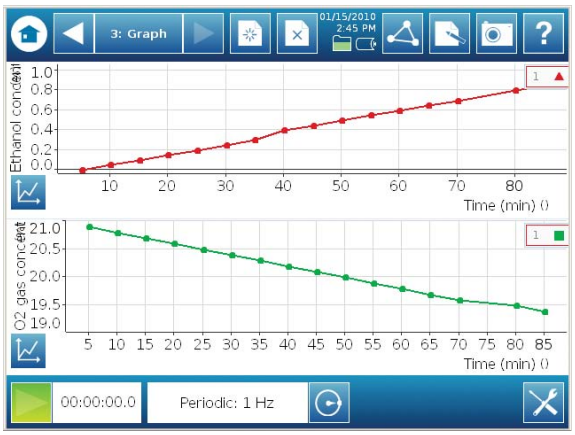
For use with SPARKvue: *Requires a SPARK Science Learning System or a USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.*

The EcoChamber and sensors give a direct method to measure yeast activity.

Directly measure the activity of yeast during anaerobic respiration.

Why rely on indirect indications of yeast activity during fermentation? PASCO offers a better way. The EcoChamber provides a closed system that is both durable and transparent and allows students to use Oxygen, Carbon Dioxide and Ethanol Sensors for a complete picture of what is going on during anaerobic respiration.

Challenge students to explain the changes in concentration of each gas as the activity progresses, including the point at which the yeast predominantly changes from aerobic to anaerobic respiration.



By monitoring the rate of oxygen consumption, students observe the yeast's shift from aerobic respiration to anaerobic respiration.

EcoChamber

ME-6667 $39

Includes EcoChamber tank with lid, 7 stoppers of various sizes, 5 probe stoppers, syringe and plastic tubing with connector.

The sturdy design of PASCO's EcoChamber makes it a versatile, easy-to-use, easy-to-clean science learning tool. It is an acrylic chamber specially designed to accommodate up to three PASCO sensors so that students can model and understand the workings of an eco-system. In addition to being used as a fermentation chamber, it can serve as a:

- Model ecosystem in photosynthesis and respiration experiments.
- Temperature regulation chamber that facilitates studies of endothermic and ectothermic animals.

Ethanol Sensor

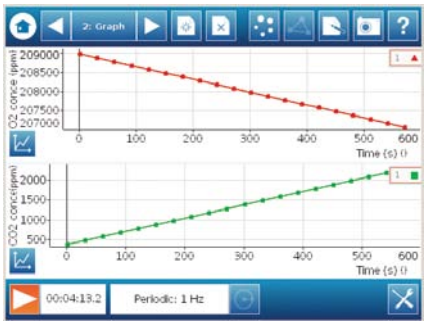
PS-2194

Includes PTFE tape for membrane replacement.

Get the full picture of cellular respiration.

Because of their small size and increased energy needs, germinating peas are ideal studies of metabolism and cellular respiration. Students can set up this simple activity and then allow it to run during the day, collecting data for six hours. To give a full representation of the activity of the peas, both a Carbon Dioxide Sensor as well as an Oxygen Gas Sensor will be used. The resulting graphs will be analyzed by students who can then explain the changes in the concentrations of each gas.

The study of cellular respiration becomes richer when students directly measure both carbon dioxide gas and oxygen gas data and see the relationship graphed in real time.



Students analyze oxygen gas consumption and carbon dioxide gas production of the pea seeds.

PASPORT gas sensors

The Carbon Dioxide Sensor and Oxygen Gas Sensor are also ideal for photosynthesis experiments, chemical reaction studies and much more. Both provide high resolution and accuracy and are simple to use, not only with the Metabolism Chamber, but also with the EcoZone system or with any piece of glassware in your classroom.

Metabolism Chamber

ME-6936

Includes 250-mL sampling bottle with cap.

Oxygen Gas Sensor

PS-2126A

Includes integrated rubber stopper, and 250-mL sampling bottle with cap.

Carbon Dioxide Gas Sensor

PS-2110

Includes Sensor Extension Cable and 250mL sampling bottle with cap.

Students can observe water moving from the hypotonic (water) side to the hypertonic (sucrose) side, across the membrane, down its concentration gradient.

Measure diffusion and osmosis –directly!

A great solution for AP® Biology Lab 1

While every biology student has seen a U-shaped tube with a permeable membrane separating a hypotonic and hypertonic solution, few have actually used this simple and elegant design for lab work. The Diffusion/Osmosis Kit contains the apparatus and a Dual Pressure Sensor that allows students to explore the rate of water movement. Students can quantify pressure changes accurately and in a fraction of the time it would take with a dialysis bag.

FEATURES

- Graduated transparent columns
- Air-tight joints prevent pressure leaks
- Free-standing unit requires no additional lab equipment to hold it in place
- Plastic rather than glass columns improve durability and student safety

Diffusion/Osmosis Kit

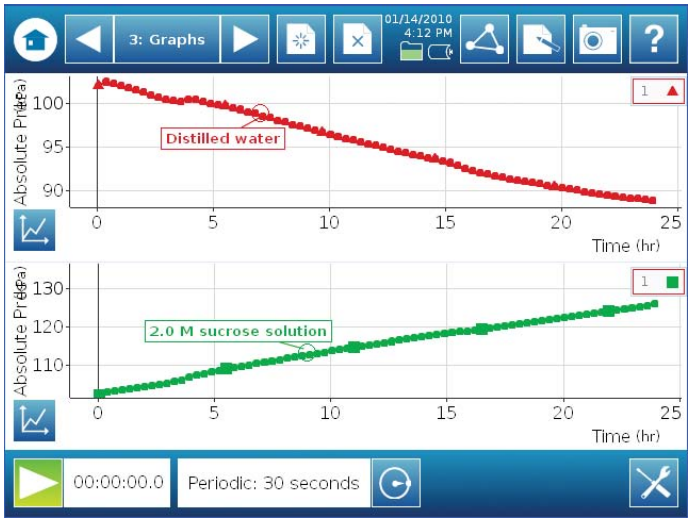
ME-6942

Includes Diffusion/Osmosis Apparatus (20 membranes and mounting stud), Dual Pressure Sensor PS-2181, tubing and connectors.

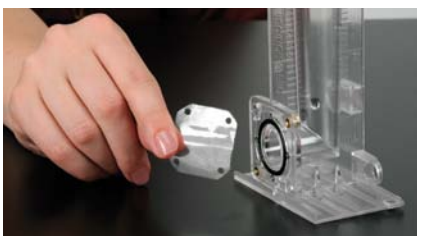
Also Available:

Diffusion/Osmosis Apparatus (no sensor)
ME-6940

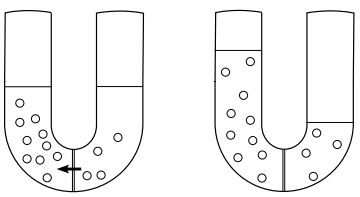
Replacement Membranes (20-pack)
ME-6941



The graph shows the pressure changes that occurred in the hypotonic and hypertonic chambers over 24 hours.



The pre-cut, semi-permeable dialysis membrane separates the apparatus into two chambers.



The apparatus is modeled after this classic and recognizable image.

HOW IT WORKS:

The U-shaped tube of the Diffusion/Osmosis Apparatus consists of two separate columns connected by a semi-permeable dialysis membrane. Osmotic movement of water across the membrane causes measurable changes in pressure and volume.

Using a plastic bag with water mimics a tropical environment in which a plant would experience less transpiration.

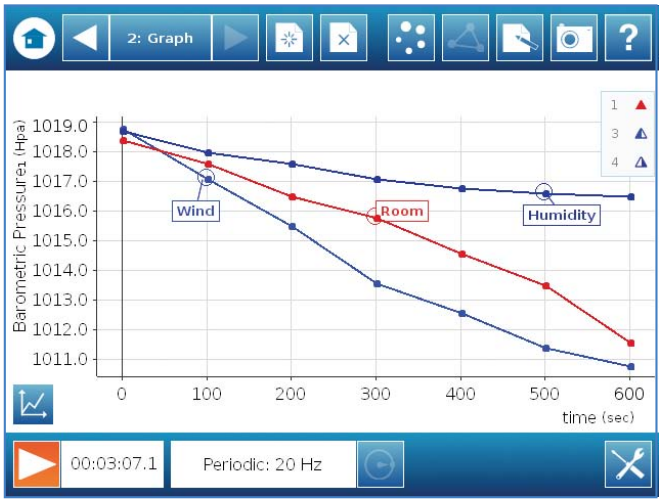
Using a fan mimics a windy environment in which a plant would experience increased transpiration.

Students investigate transpiration using a very sensitive potometer that incorporates the PASPORT Barometer/Low Pressure Sensor.

Transpiration done simply and accurately

A great solution for AP® Biology Lab 9

Set up a potometer using the Barometer/Low Pressure Sensor to measure those very small changes in pressure that indicates transpiration is taking place.



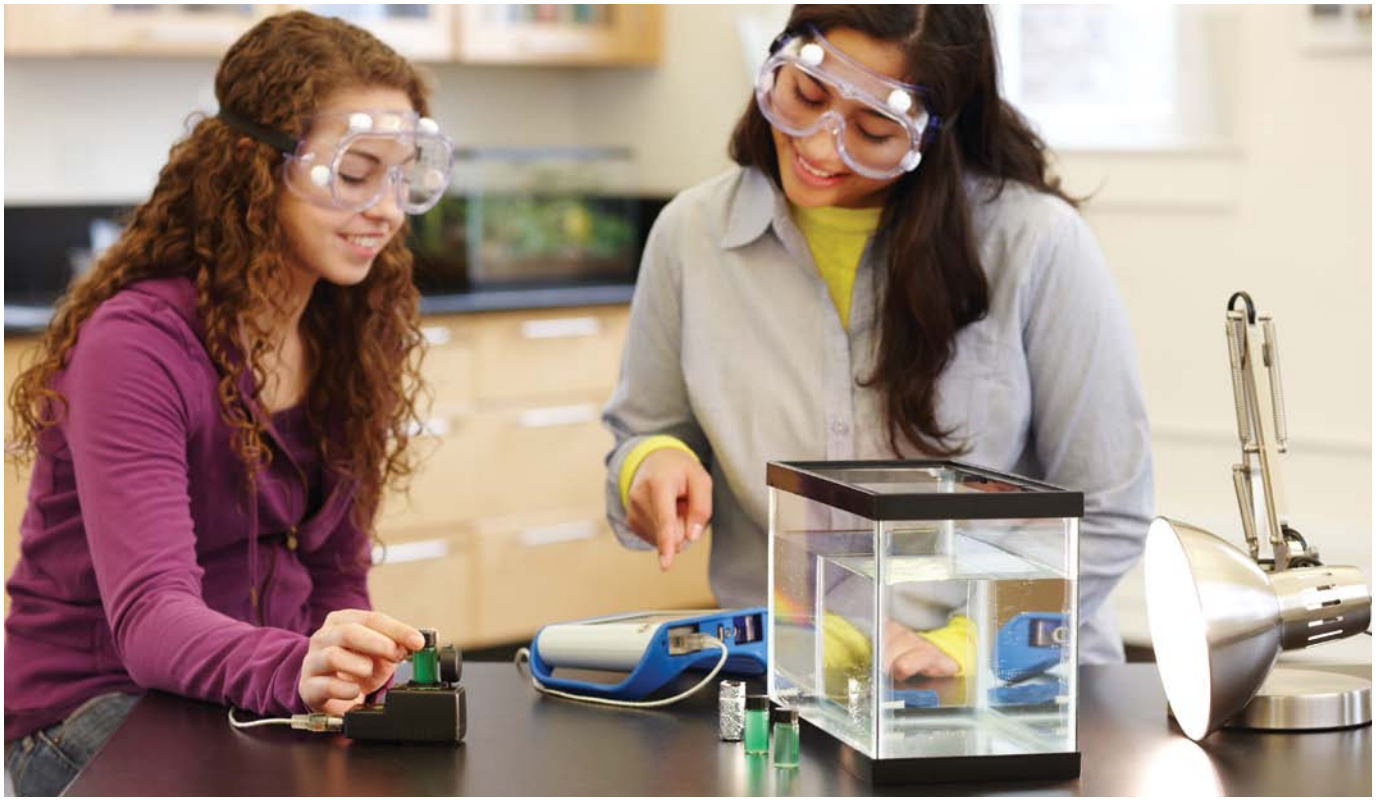
From the graph, students discover that wind increases the rate of transpiration and humidity decreases the rate of transpiration.

By varying factors on the plant such as the presence of wind or humidity, students can see what effect environmental influences have on the rate of transpiration. The sensitivity of the barometer makes this a great solution for AP Biology Lab 9: Transpiration.

Barometer/Low Pressure Sensor

PS-2113A

Includes Quick-connect fittings and tubing (for low-pressure experiments).



Plant Pigments and Photosynthesis

A PASCO solution for AP® Biology Lab 4

In addition to separating the various photosynthetic pigments in spinach leaves using paper chromatography, students will measure the rate of photosynthesis in chloroplast suspensions using a Colorimeter (an incredible replacement for the old, bulky and hard-to-use spectrophotometer) and the reduction of 2, 6-dichlorophenolindophenol (DPIP).

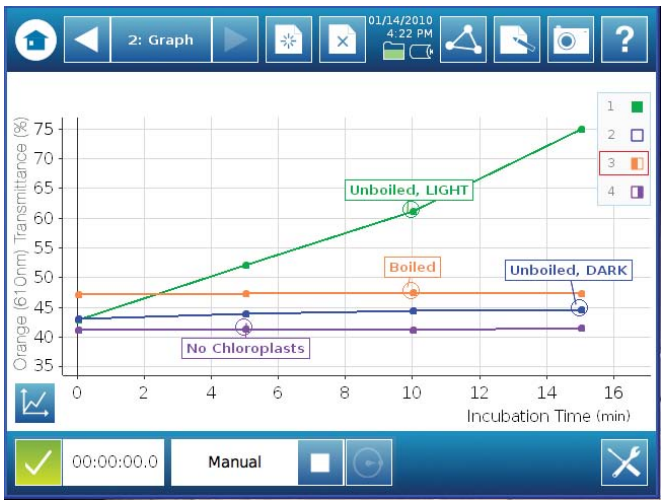
Students will compare the amount of photosynthetic activity shown by four different solutions:

- No chloroplasts
- Boiled chloroplasts kept in the dark
- Boiled chloroplasts kept in the light
- Unboiled chloroplasts kept in the light

Colorimeter

PS-2121

Includes cuvettes (5), plastic storage case, cuvette labeling stickers, and Sensor Extension Cable.



Students view graphs of all four samples on one graph in order to compare the photosynthetic activity of each group of chloroplasts.

A quantitative approach to photosynthesis experiments

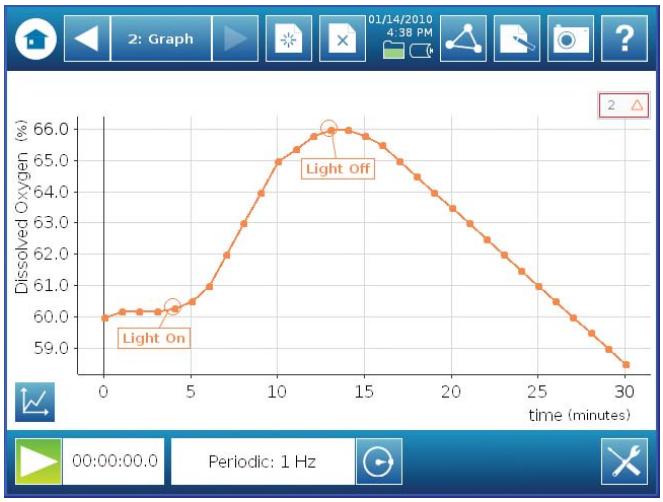
With the photosynthesis tank, students can measure the dissolved oxygen content in the environment of an aquatic plant, thereby directly measuring its photosynthetic activity. Water in the outer tank is used to control large fluctuations in temperature when the light is used. And the PASPORT Water Quality Sensor (or Dissolved Oxygen Sensor) measures the concentration directly and provides quantitative results without the need for inferred measurements or messy chemical indicators.

No more "what you should have seen is..."

Turning the light on and off creates an easily analyzed graph in real-time, showing the relationship between light and the rate of oxygen production. Students can further their understanding of photosynthetic rates by adding dyes as colored filters.

Complete your set of equipment for this activity with the Magnetic Stirrer.

The photosynthesis tank has two concentric Plexiglas® chambers. This unique design allows students to control the environment without interfering with the measurements.



Dissolved oxygen concentration of the water is used to measure the plant's photosynthetic activity. It increases when light is shined on the plant and begins to decrease when the light is turned off.

Magnetic Stirrer

SE-7700

Includes stir bar, removable rod, and power adapter.

Photosynthesis Tank

PS-2521A

Includes large #14 Stopper with sensor ports, and two small #3 Stoppers

Water Quality Sensor

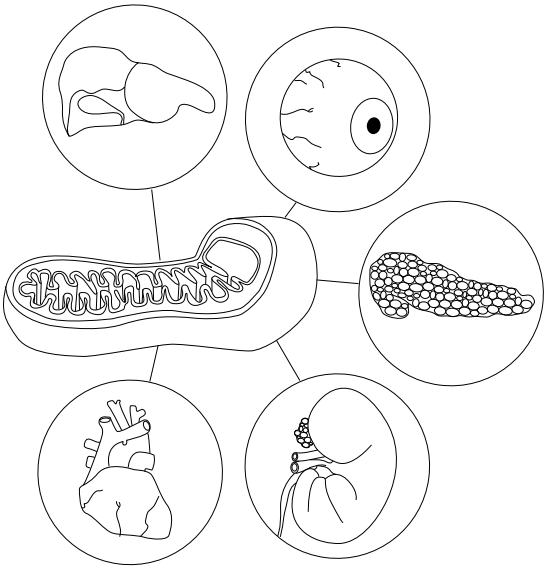
PS-2169

Includes Dissolved Oxygen Probe, Conductivity Probe, pH Probe and Stainless Steel Temperature Probe.

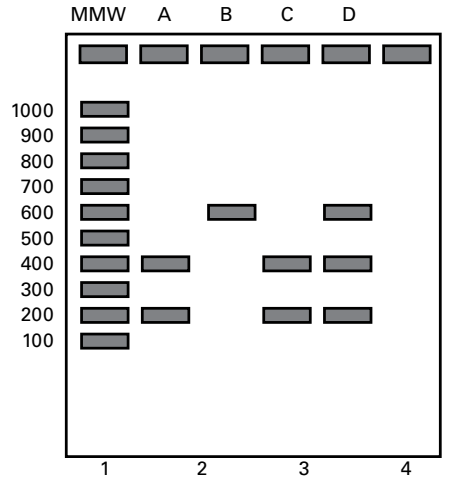
Mitochondrial DNA and its role in disease

An affordable kit for studying genetics and biotechnology

Some diseases in organs with high energy demands--such as the eyes, liver, pancreas, kidneys, and heart—are the result of mutations in mitochondrial DNA. In this inquiry-based activity students discover how a mitochondrial disease is inherited and diagnosed. (Activity jointly created by PASCO, the Carnegie Institution for Science, GENA, the Smithsonian Institute, and the University of Alabama).



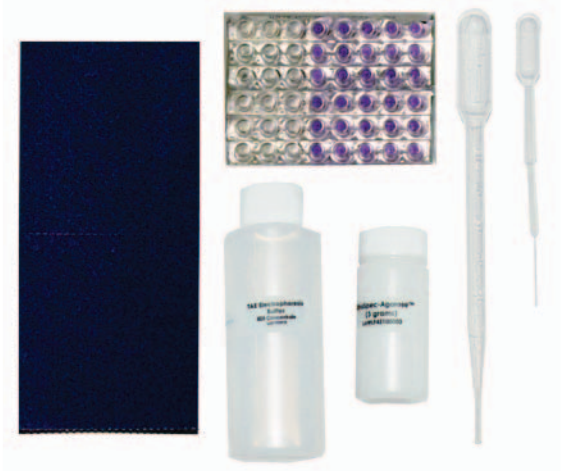
The nucleus is not the only place that houses DNA within a human cell. DNA is also found within the mitochondria.



Through pedigree construction and gel electrophoresis students discover how a mitochondrial disease is inherited and diagnosed.

Mitochondrial Genetics Kit

BP-6946



Included:

QuickStrip™ DNA samples (6 strips), containing Standard DNA Marker (40 mL) and DNA Samples (40 mL each)

UltraSpec-Agarose™ powder (3.0 g)

Electrophoresis Buffer 50x (60 mL)

InstaStain™ Blue Card (6)

Graduated Transfer Pipet (1)

Transfer Pipet (10); and student lab activity

Developed in partnership with

EDVOTEK®

Bring Biotech into your classroom

The Electrophoresis Classroom Set includes everything you need for six lab groups to conduct the mitochondrial genetics lab. Practice pipetting year after year using the DuraGel, measuring gels with the MtDNA GelSizer before using valuable consumables in the lab. Get fast results for two groups using the dual electrophoresis apparatus by running two 7x7 gels simultaneously.

Order the Mitochondrial Genetics Kit separately. Each kit supports 6 lab groups.

Electrophoresis Classroom Set

SE-7239

Includes:

SE-7240 M12 Dual Electrophoresis Apparatus (qty 3)
SE-7241 EVT 300 Dual Power Supply (qty 2)
SE-7242 Variable Micropipet (qty 3)
SE-7243 Yellow Micropipet Tips (qty 2 Racks of 96)
SE-7245 PASCO MtDNA GelSizer image
SE-7244 DuraGel

Limited distribution in Western Europe and Australia. See pasco.com/edvotek for details.

EVT 300 Dual Power Supply (SE-7241)

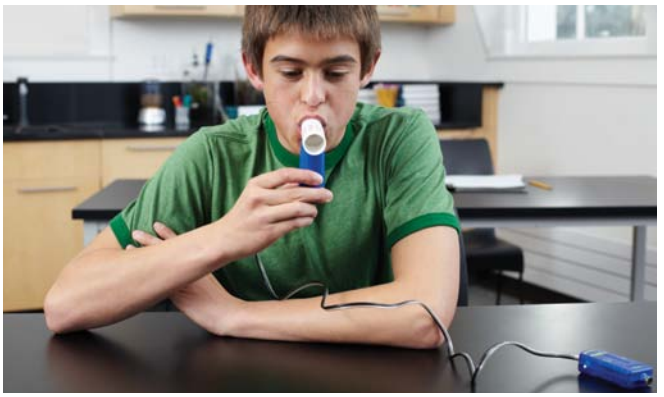
M12 Dual Electrophoresis Apparatus (SE-7240)

Dual Electrophoresis Apparatus Accessories

Variable Micropipet (SE-7242)

Test your lung power and learn about the respiratory system

With the Spirometer Sensor students can collect accurate air-flow data from a pulmonary function test and create graphs to measure airflow, pressure, duration and lung volume. The mouthpiece and sensor are designed for safely and accurately measuring both airflow out (expiration) and airflow in (inspiration). Compare air-flow before and after exercise or even determine total lung capacity.



A student uses the spirometer to measure his lung volume. He observes the difference in the volume of his lungs when breathing normally vs. forced breathing.

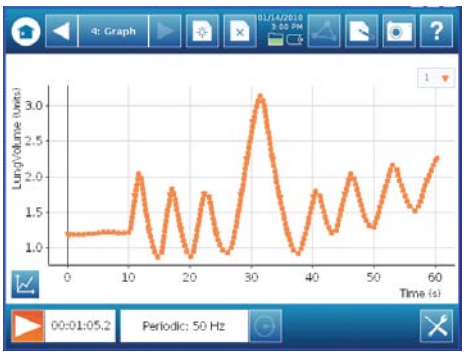
Spirometer

PS-2152

Includes 2 disposable mouth pieces

Also Available:

Replacement Mouth Pieces (10) PS-2522



The volume of the lungs increases when he forces air into his lungs.

How is breath rate affected by exercise?

The Breath Rate Sensor measures breathing rate before, during and after exercise. The sensor detects each breath by monitoring the air pressure in a mask worn by the student, calculating breath rate by measuring the time between exhalations. The Breath Rate Sensor has two modes:

- One reading for every breath
- Running average over the last four breaths

With the Breath Rate Sensor, students who study breath rate can use a totally reliable method, instead of simply counting the number of breaths per minute.

Breath Rate Sensor

PS-2187

Includes 10 masks and 10 clips

Also Available:

Replacement Masks (10 pack) PS-2567

Replacement Clips (10 pack) PS-2568

A graph showing a student's breath rate before, during and after exercise.

How does body position affect heart rate?

Measure heart rate without the restriction of belts or clips

To measure heart rate at rest or during exercise, simply grab the handles and the Hand Grip Heart Rate Sensor will measure the number of times your cardiac muscle contracts per minute. Perfect for comparing heart rate before and after exercise. In this activity students will monitor their heart rate as they change body positions with a rest between and analyze the results graphically.

Students discover that the heart works harder in sitting and standing positions, and they may recognize that the heart has to overcome gravity.

Hand-Grip Heart Rate Sensor

PS-2186
Includes 2 hand-grip paddles.

Moving beyond simply measuring blood pressure

Give students a true understanding

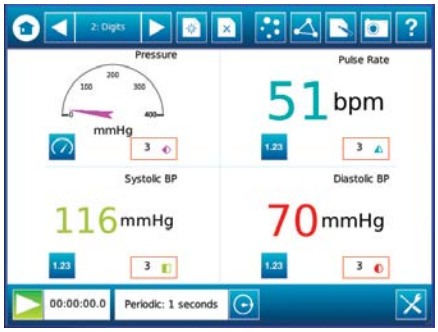
PASCO's Blood Pressure Sensor allows students to quickly and easily measure both systolic and diastolic blood pressure (mmHg) as well as heart rate (bpm). Comparing the digits display for systolic and diastolic pressure with the display of blood pressure from the real-time graph moves blood pressure from a simple measurement to a way to help students truly understand the complex physiology of the circulatory system.

Not only can students quickly measure systolic and diastolic pressure, but they learn the actual concepts behind blood pressure.

Blood Pressure Sensor

PS-2207 (Standard Cuff, 19.0-27.2 cm)
PS-2208 (Small Cuff, 26.1-40.9 cm)
PS-2209 (Large Cuff, 34.3-50.9 cm)

All models include a sensor and an arm cuff with inflation bulb. Most students use standard sized cuff.



A clear and easy way to observe heart rate plus systolic and diastolic blood pressure.

Model large-scale changes occurring in real-world ecosystems. The EcoZone System is designed specifically to support sensor-based measurements while maintaining a closed environment.

Isolate ecosystems for comparison studies. Here the impact of animals on carbon dioxide production is explored with two separate ecosystems – one with crickets, one without.

Create stand-alone environments or interconnected environments. Here, this single EcoChamber is monitored by the Dual Humidity and Soil Moisture Sensors.

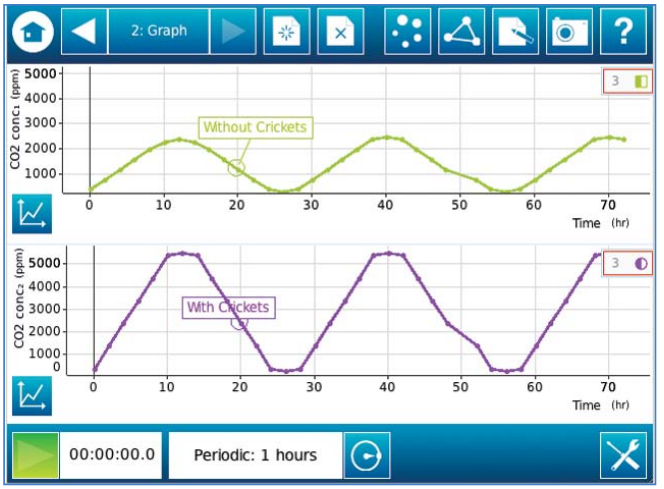
Create and monitor your own ecosystems

The PASCO EcoZone™ System consists of three chambers that can be interconnected or used independently. Because the system remains closed and is designed to accommodate PASPORT sensors, students will collect accurate data with minimal impact on the ecosystem.

A basic lab activity uses two of the chambers separately to measure O_2 and CO_2 levels, one chamber containing plants and one containing plants and crickets. See how the presence of animals affects the concentration of oxygen and carbon dioxide in the system.

Use the traditional terrestrial, aquatic, and decomposition arrangement to create your unique biome space and collect the data you want. The openings within the chambers allow air to circulate between the chambers, and the included cord efficiently wicks water and ions between the chambers.

- Connect three different environments together (terrestrial, aquatic and decomposition) and observe their interaction.
- Add animals (crickets) to an environment and measure effect of respiration.

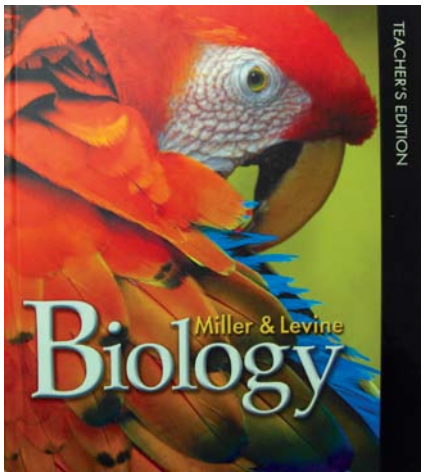


Students observe the photosynthesis cycle and its effect on carbon dioxide, plus the contribution of the crickets' higher carbon dioxide production (through respiration).

EcoZone™ System

ME-6668

Includes 3 EcoChambers, tray, rubber stoppers, syringe, plastic tubing and wicking cord.



Miller & Levine Biology Bundle

PS-2936

Includes 4 sensors:
Carbon Dioxide, Barometer/Low Pressure, Oxygen Gas, and Quad Temperatures

or

Order one sensor bundle for each lab station, plus either SPARK Science Learning System or SPARKlink (with SPARKvue software). *For more info, see pages 226-227.*

Investigate body heat response and change of blood flow and skin temperature.

Lab Activities for Miller & Levine Biology

PASCO and Pearson are pleased to offer lab activities to support the Miller & Levine *Biology* textbook (2010 edition).

6 lab activities ship with your bundle as a supplemental manual:

- Introduction to Scientific Inquiry
- Transpiration
- Respiration in Seeds
- Microclimates
- Enzyme Action
- Regulation of Body Heat

Sample Lab Activity: Regulation of Body Heat

How does your body respond when one part (in this case one hand) is much colder than the rest? Are there any changes in blood flow?

In this activity, students observe temperature readings as they experience the physiological phenomenon for themselves – and more easily overcome the misconceptions. They will clearly observe that the hand not in the ice bath experiences a drop in temperature as the body thermoregulates.

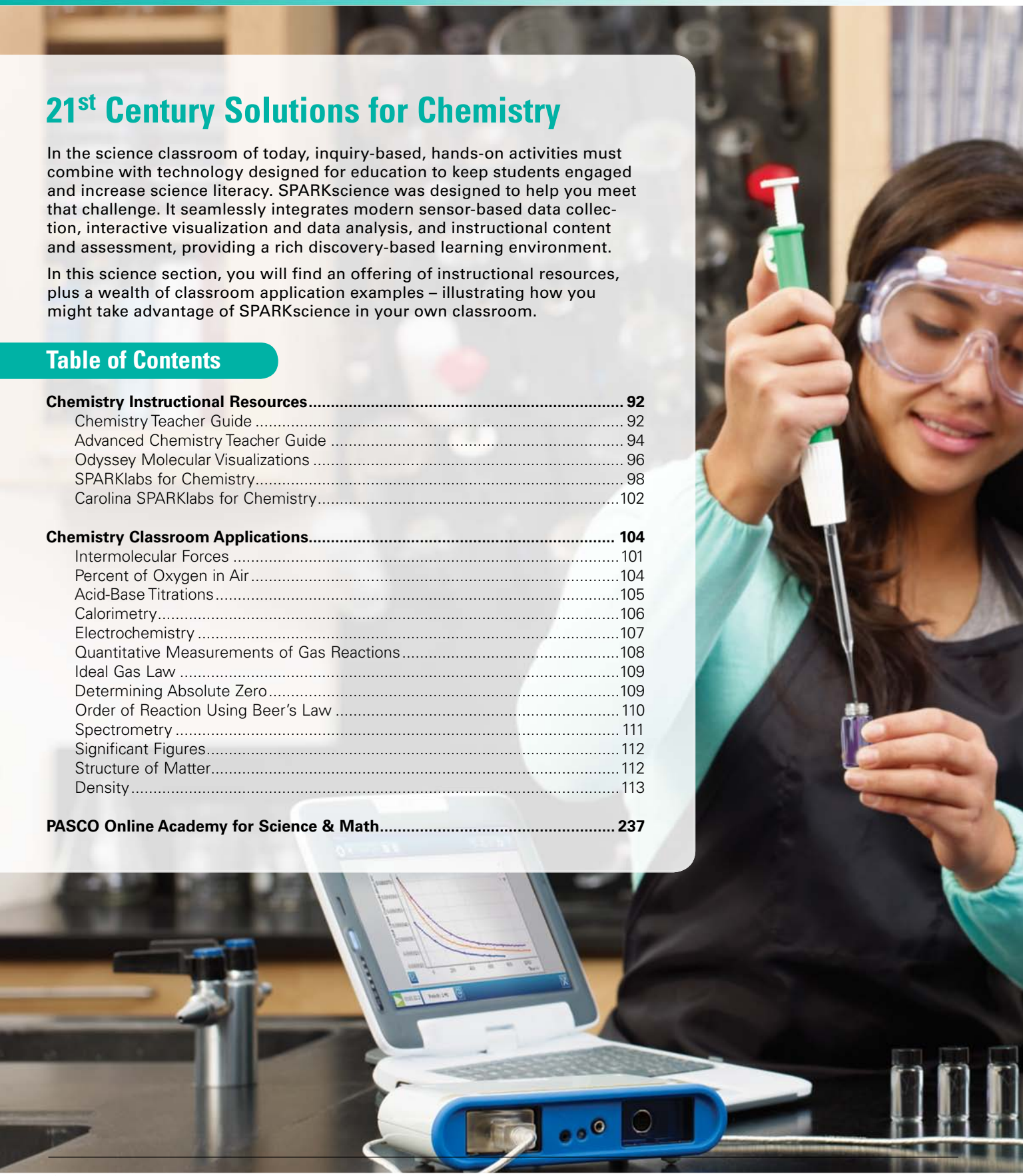
All lab activities follow the same format familiar in the Miller & Levine text. This activity features the Quad Temperature Sensor and a pair of Fast Response Probes from the Miller & Levine Sensor Bundle.

21st Century Solutions for Chemistry

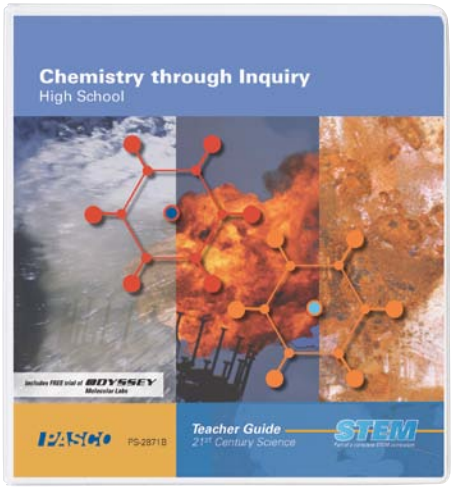
In the science classroom of today, inquiry-based, hands-on activities must combine with technology designed for education to keep students engaged and increase science literacy. SPARKscience was designed to help you meet that challenge. It seamlessly integrates modern sensor-based data collection, interactive visualization and data analysis, and instructional content and assessment, providing a rich discovery-based learning environment.

In this science section, you will find an offering of instructional resources, plus a wealth of classroom application examples – illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents



Chemistry Through Inquiry Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide has been designed by educators.
- Core topic areas include lab skills, structure and properties of matter, and chemical reactions.
- The lab activities engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Activities also help students build vocabulary skills with key term challenges.
- Multiple-choice questions give students practice for standardized exams.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts. It also includes a 60-day license of the High School ODYSSEY molecular modeling software.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

28 Challenging Lab Activities

An Acid-Base Titration
Boyle's Law
Concentration of a Solution: Beer's Law
Conservation of Matter
Density ■
Diprotic Titration: Multi-Step Chemical Reactions
Double Replacement Reactions
Electrochemical Battery: Energy from Electrons
Electrolyte versus Non-Electrolyte Solutions ■
Evidence of a Chemical Reaction
Gay-Lussac's Law and Absolute Zero
Graphing Mass versus Volume to Determine Density ■
Heat of Fusion
Heats of Reaction and Solution
Hess's Law
Ideal Gas Law
Intermolecular Forces
Le Châtelier's Principle
Molar Mass of Copper ■
Percent Oxygen in Air
pH of Household Chemicals
Phase Change
Properties of Ionic and Covalent Compounds ■
Rates of Reaction
Significant Figures ■
Single Replacement Reactions
Specific Heat
Stoichiometry

■ *Lab activities with the color box require the Standard Bundle. All other activities can be done with either bundle.*

Ordering Guide

The 28 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Chemistry Through Inquiry Teacher Guide

- Chemistry Through Inquiry Teacher Guide (PS-2871B)

2 Order your sensor bundles.

Choose the bundle that aligns with the topics you want to cover.
Or build your own bundle from our over 70 sensors (see page 184).
We recommend one bundle per lab station (3-4 students).

- To perform 22 of the labs (those without the color box) in the teacher guide, order the **Starter Sensor Bundle** (PS-2921), which gives you 3 sensors.

OR

- To perform all 28 lab activities in the teacher guide, order the **Standard Sensor Bundle** (PS-2927A), which contains 9 sensors.

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

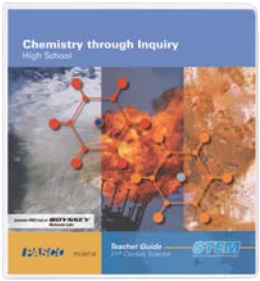
  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Chemistry Through Inquiry Teacher Guide

PS-2871B



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also includes a 60-day license of the High School ODYSSEY molecular modeling software.

Also Available:

Teacher Guide Flash Drive only PS-2881A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2891A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Chemistry Starter Sensor Bundle *(Allows you to do 22 lab activities)*

PS-2921

1

2

3

1. Chemistry Sensor PS-2170
2. High Accuracy Drop Counter PS-2117
3. Colorimeter PS-2121

Chemistry Standard Sensor Bundle *(Includes all Starter Bundle sensors and allows you to do all 28 lab activities)*

PS-2927A

1

2

3

4

5

6

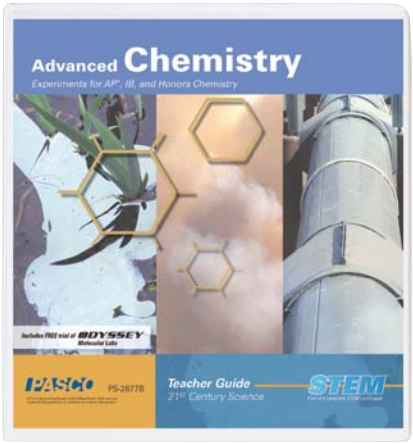
7

8

9

1. Chemistry Sensor PS-2170
2. High Accuracy Drop Counter PS-2117
3. Colorimeter PS-2121
4. Fast Response Temperature Probe PS-2135
5. Conductivity Sensor PS-2116A
6. Voltage/Current Sensor PS-2115
7. Significant Figure Set-Single ME-9850
8. Discover Density Set SE-9719A
9. Density Set ME-8569

Advanced Chemistry Teacher Guide



Designed for Teacher and Student Success

- This standards-based, STEM-focused guide has been designed by chemistry educators to teach students through inquiry.
- Includes all 22 recommended Chemistry AP®* Labs and more.
- The lab activities engage students as they make predictions, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Multiple-choice questions bridge the gap between "lecture and lab" and help students gain confidence for the AP exam.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts. It also includes a 60-day license of the Advanced ODYSSEY molecular modeling software.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

Advanced and AP® Chemistry Labs

Chemical Composition & Stoichiometry
Determining the Empirical Formula of a Compound
Determining the Percentage of Water in a Hydrate
Mole Relationships in a Chemical Reaction
Gravimetric Determination of a Precipitate
Identifying an Unknown Metal
Synthesis of a Coordination Compound
Analysis of a Coordination Compound

Thermochemistry & Thermodynamics
Enthalpy of a Chemical Reaction

Atomic & Nuclear Structure
Absorption Spectra
Determining the Half-life of an Isotope

Gas Laws
Determine the Molar Mass of a Volatile Liquid
Molar Volume of a Gas
Exploring Gas Laws

Intermolecular Forces & States of Matter
Molecular Interaction in Ethanol & Acetone

Solutions & Solubility
Molecular Weight by Freezing Point Depression
Colorimetric Analysis
Separation by Liquid Chromatography
Conductometric Titration
Separation & Analysis of Cations
Analysis of Anions

Acid–Base Chemistry
Standardizing a Solution of Sodium Hydroxide
Acid–Base Titrations
Using Different Indicators for pH Determination
Properties of Buffer Solutions
Determining K_a by Half-Titration of a Weak Acid
Determining K_a Values of Two Isomeric Multi-Protic Acids

Kinetics & Equilibrium
Determine the Equilibrium Constant for a Chemical Reaction
Determine the Rate of Decomposition of Hydrogen Peroxide
Determination of a Solubility Product
Order of Reaction

Electrochemistry
Oxidation–Reduction Titration
Determination of Electrochemical Series
Electroplating
Breathalyzer Test™ for Alcohol

Organic Chemistry
Organic Synthesis I – Preparation
Organic Synthesis II – Analysis

Ordering Guide

The 36 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Advanced Chemistry Teacher Guide

- Chemistry Teacher Guide (PS-2877B)

2 Order your sensor bundles.

With the Advanced Chemistry Sensor Bundle, you will have the sensors you need to perform 35 of the 36 labs in the teacher guide. Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

- To perform 35 of the 36 lab activities in the teacher guide, order the Advanced Chemistry Standard Sensor Bundle (PS-2928), which contains 7 sensors.

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: ***Use our SPARKvue software on your own computers.***

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

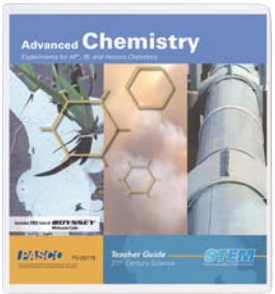
4 Add a spectrometer for the Absorption Spectra lab.

- To perform the Absorption Spectra lab, a spectrometer is required. We recommend the Amadeus Spectrometer, which is designed for student use without sacrificing quality measurement.

* AP is a registered trademark of the College Board, which was not involved in the production of, and does not endorse, this product.

Advanced Chemistry Teacher Guide

PS-2877B



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(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2897A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Advanced Chemistry Standard Sensor Bundle

Allows you to do 35 of the 36 lab activities in the teacher guide

PS-2928

1. Chemistry Sensor PS-2170
2. Conductivity Sensor PS-2116A
3. Colorimeter PS-2121
4. High Accuracy Drop Counter PS-2117
5. Voltage/Current Sensor PS-2115
6. Alpha Beta Gamma Radiation Sensor PS-2166 (includes Digital Adapter PS-2159)
7. Oxidation Reduction Potential Probe CI-6716

1

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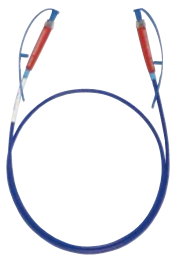
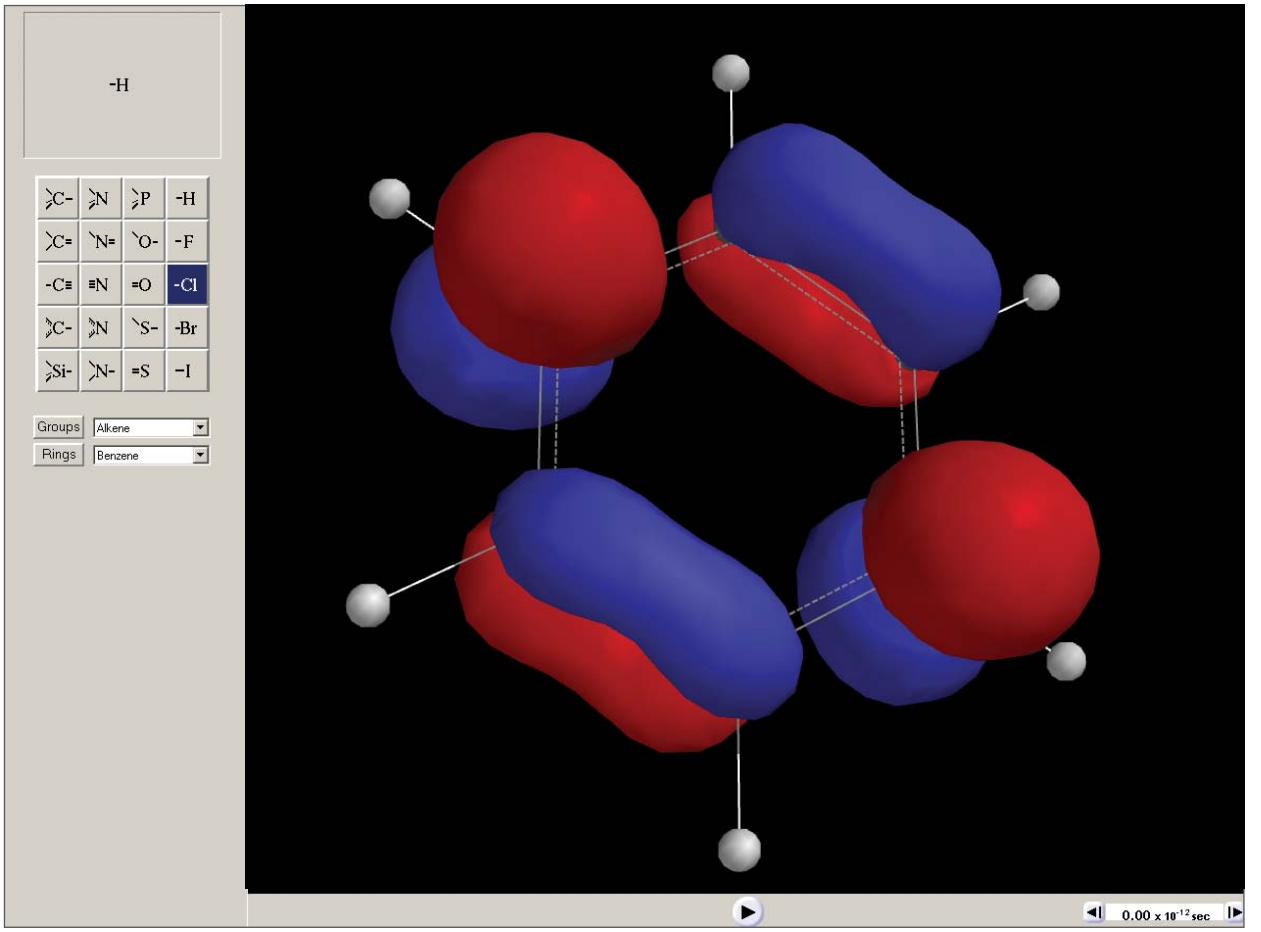
Amadeus Spectrometer System

SE-7183

Includes Amadeus spectrometer, Tungsten light source with power supply, 1.8 meter fiber optic probe, USB cable, 10 cuvettes. Now compatible with SPARKvue software and SPARK Science Learning System.





Far beyond a digital representation of ball and stick models, ODYSSEY software allows students to view and manipulate 3D representations of atomic and molecular orbitals.

Stunning molecular visualization

ODYSSEY is chemistry education software for visualization and simulation at the molecular level. From carbon monoxide to DNA, from hydrogen gas to liquid water – ODYSSEY shows matter in full atomic detail and stunning molecular motion. ODYSSEY includes more than 85 core chemistry topics in self-contained units with ready-to-use activities. Each experiment is designed to engage students in discovery-based learning, but can also be used for classroom demonstrations.

- The ODYSSEY High School version contains a robust engine for building and analyzing molecules and simulations. The content of the molecular labs and tutorials is designed for beginning chemistry students and correlated to most state science standards.
- The ODYSSEY AP version contains the same robust engine, with about 50% more labs, analysis questions, and molecular models. The content is designed for a more advanced user with additional emphasis on higher-level concepts such as organic molecules, coordination compounds, and electrostatic potential maps.

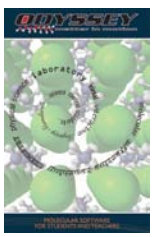
ODYSSEY High School Instructor Edition

SE-7160-K12

Also Available:

Student Edition CD
SE-7161-K12

Student Lab (10 pack)
SE-7163-K12



*See **pasco.com/odyssey** for more options*

ODYSSEY AP Instructor Edition

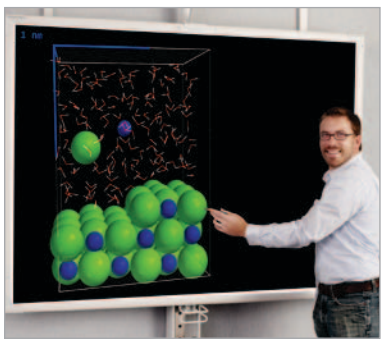
SE-7160-AP

Also Available:

Student Edition CD
SE-7161-AP

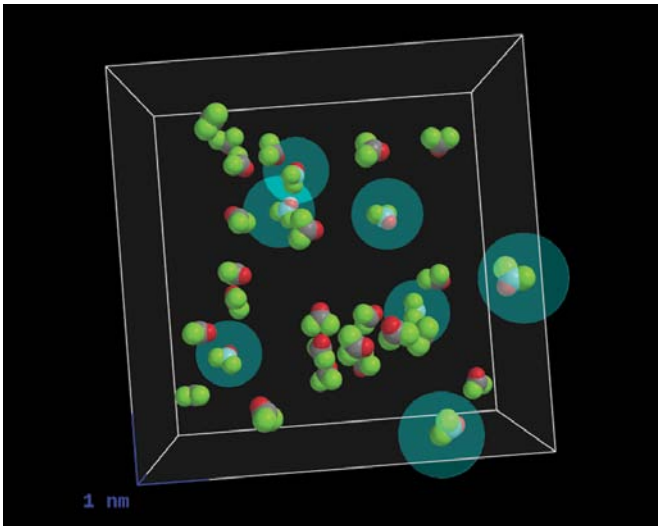
Student Lab (10 pack)
SE-7163-AP

*See **pasco.com/odyssey** for more options*



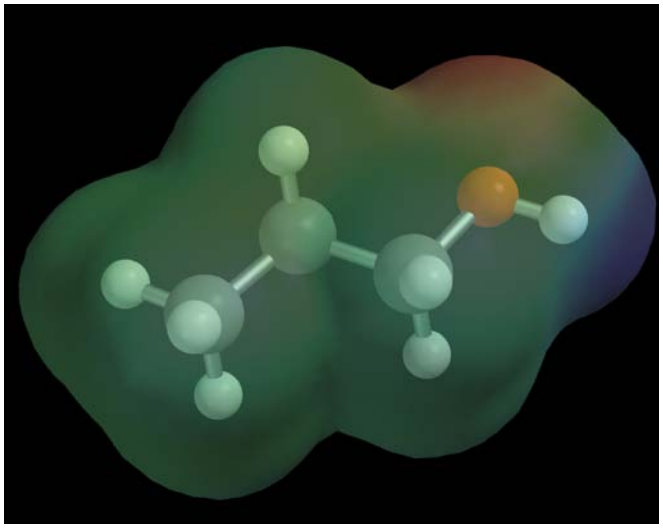
Perfect for classroom demonstrations and discussions.

Visualize states of matter.



Investigate the motion of molecules in a gas to gain a deeper understanding of pressure and its relationship to the number of particles, temperature and volume. Intermolecular forces, close packing in metals, and structures of solids and liquids can all be visualized and experimented with on a molecular level.

Investigate the properties of any molecule.

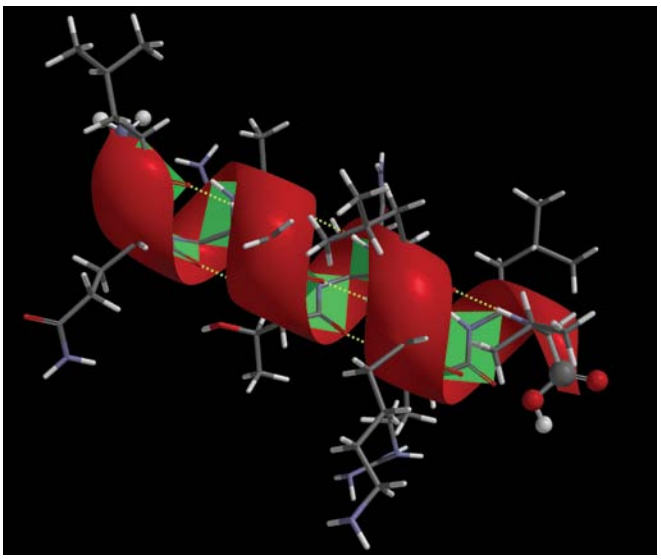


ODYSSEY allows students to create and rotate any structure in three dimensions. Beyond that, students are given the power to study topics such as electron density, bonding, resonance, and isomerism. They can even create simulations.

***See* pasco.com/odyssey**

for product descriptions and a complete range of license options, including school licenses and demo requests.

Observe complex structures.



Investigate topics in general, organic, and biochemistry by building polypeptides from amino acids or from a DNA molecule from nucleotide bases. Here is a dramatic look at some of the most fundamental building blocks of life in a 3-D environment.

ODYSSEY matter in motion

SYSTEM REQUIREMENTS

Windows

Intel Core Duo, Pentium/Celeron (2 GHz and up), or AMD equivalent; Windows XP/Vista/Windows 7; 512 MB RAM; 700 MB disk space

Mac

Intel-Based Macintosh Only (No Power PC); Mac OS X 10.5/10.6; 512 MB RAM; 700 MB disk space

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

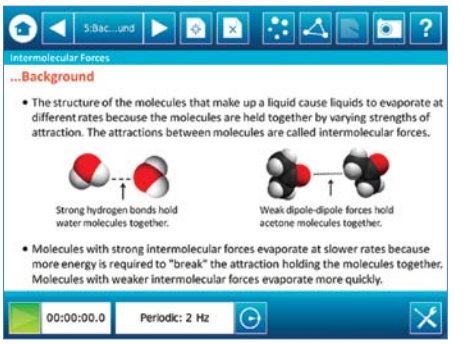
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

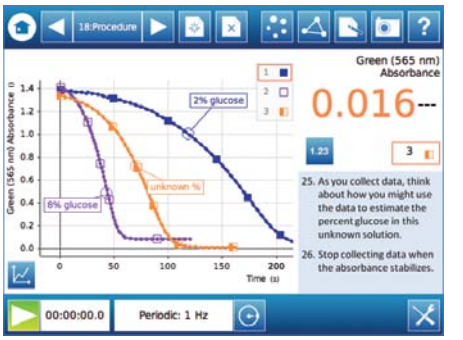
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



Embedded questions in the SPARKlab guide students to understand the relationship between glucose concentration and the rate of reaction with potassium permanganate.

The SPARKlab Online Library

A growing collection for 21st century science learning

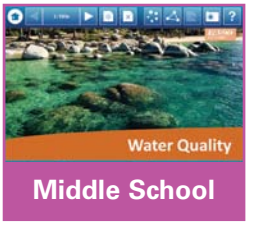
The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

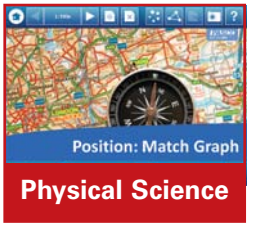
New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

NEW! Plant Metabolism & the Carbon Cycle, Toxicology Using Yeast, and Biofuels from Fermentation



NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs



NEW! pH of Household Chemicals: Hair Care & Position: Match Graph

NEW! Diffusion, Fermentation in Yeast, & Heart Rate

NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics

NEW! Projectile Motion, Position Match Graph, & Radiation

SPARKlabs for Chemistry

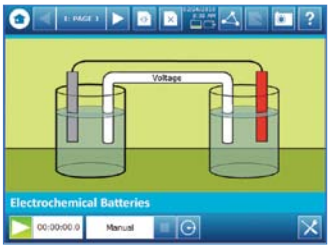
FREE…

10 FREE Chemistry SPARKlabs

We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

The 10 free Chemistry SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

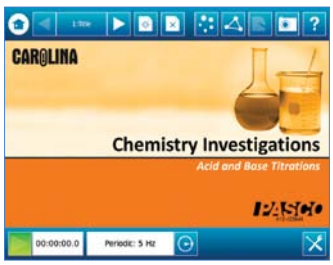
- An Acid-Base Titration
- Boyle's Law
- Concentration of a Solution: Beer's Law
- Diprotic Titration: Multi-Step Chemical
- Reactions
- Electrochemical Battery: Energy from
- Electrons
- Evidence of a Chemical Reaction
- Gay-Lussac's Law and Absolute Zero
- Heats of Reaction and Solution
- Intermolecular Forces
- Percent Oxygen in Air



Carolina SPARKlabs

Carolina Investigations in Chemistry SPARKlabs

This set of ten SPARKlabs provides an engaging and fully interactive approach to science learning. See page 102.



Activities

Acid & Base Titrations
Exploring Equilibrium
Freezing Point Depression: A Colligative Property
Molar Volume of a Gas
Organic Chemistry: Biodiesel
Radioactive Half-Life
Rates of Chemical Reactions
Stoichiometry
Thermochemistry
Voltaic Cells

New Additions to the SPARKlab Online Library!

pH of Household Chemicals: Hair Care

Teacher License PS-2078
One per teacher (one license for all your classes).

Students determine the average pH of common hair products. Then they assess the potential benefits and risks of using household items as hair care remedies.

Electronic Delivery.
Upon purchase, download to your computer.

Emission Spectra: Bohr's Model

Teacher License PS-2079
One per teacher (one license for all your classes).

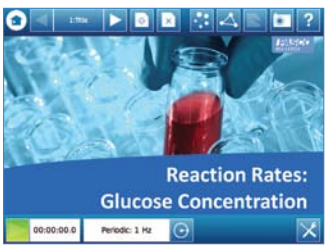
Students determine the composition of a variety of light sources using spectroscopy and an understanding of atomic structure.

Electronic Delivery.
Upon purchase, download to your computer.

Reaction Rates: Glucose Concentration

Teacher License PS-2080
One per teacher (one license for all your classes).

Students determine how the concentration of glucose in solution affects the time for a chemical reaction to occur. Then they estimate the concentration of an unknown glucose solution.



Electronic Delivery.
Upon purchase, download to your computer.

Chemistry Starter Sensor Bundle for SPARKlabs

Get the sensors needed to conduct the 10 free Chemistry SPARKlabs included with your SPARK Science Learning System or SPARKvue license.

10 Free Chemistry SPARKlab Activities

An Acid-Base Titration
Boyle's Law
Concentration of a Solution: Beer's Law
Diprotic Titration: Multi-Step Chemical Reactions
Electrochemical Battery: Energy from Electrons
Evidence of a Chemical Reaction
Gay-Lussac's Law and Absolute Zero
Heats of Reaction and Solution
Intermolecular Forces
Percent Oxygen in Air

Chemistry Starter Sensor Bundle

PS-2921

1

1. Chemistry Sensor PS-2170
   (Measures pH, pressure, voltage and temperature - all in one convenient package)
2. High Accuracy Drop Counter PS-2117
3. Colorimeter PS-2121

2

3

Ordering Guide *The 10 Chemistry SPARKlab activities are designed for use with the sensors above and with SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.*

1 Order your sensor bundle.

- To perform the 10 free SPARKlab activities, order the **Chemistry Starter Sensor Bundle** (PS-2921); which contains the 3 sensors shown above.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

2 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: ***Use our SPARKvue software on your own computers.***

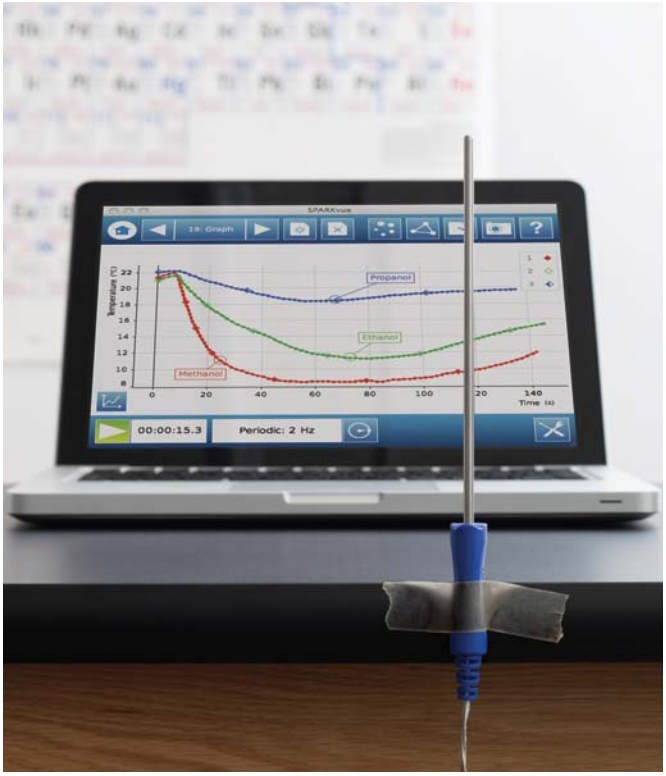
- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Students learn that molecular size and shape effects the strength of intermolecular forces for different alcohols.



Students are able to observe a change in temperature as an alcohol evaporates from a temperature probe.

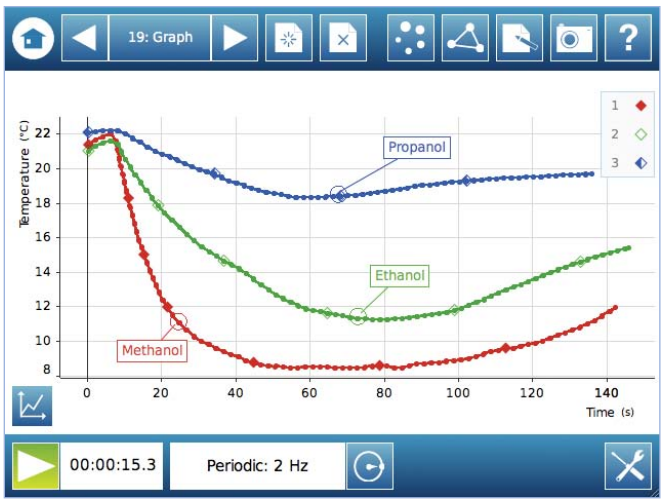
Sample SPARKlab Activity: Intermolecular Forces

How does the size and shape of a molecule affect evaporation rates?

Evaporation occurs when a substance changes from liquid to vapor. Surface area and temperature are two factors that determine the rate at which this occurs. A third factor is vapor pressures which is largely determined by the strength of intermolecular forces. In this Chemistry SPARKlab students will create graphs showing the change in temperature as each of the homologous alcohols evaporates.

While observing the rate of change of each graph, students will:

- Explain why evaporation causes a decrease in temperature.
- Investigate the relationship between the size of alcohols and the strength of their intermolecular forces.
- Use isomeric alcohol pairs to discover the role that the shape of a molecule has on its vapor pressure.



The rate at which evaporation occurs depends on the strength of the intermolecular attractions holding the particles together.

Carolina™ Chemistry Investigations for SPARKscience

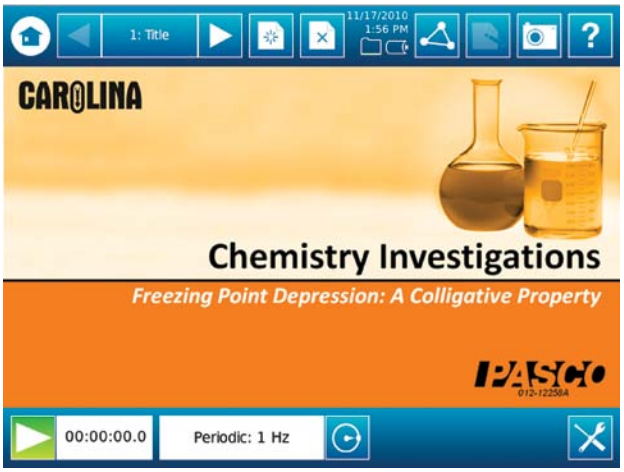
A new approach to hands-on chemistry

Help students learn the core chemistry topics while developing their skills in scientific inquiry.

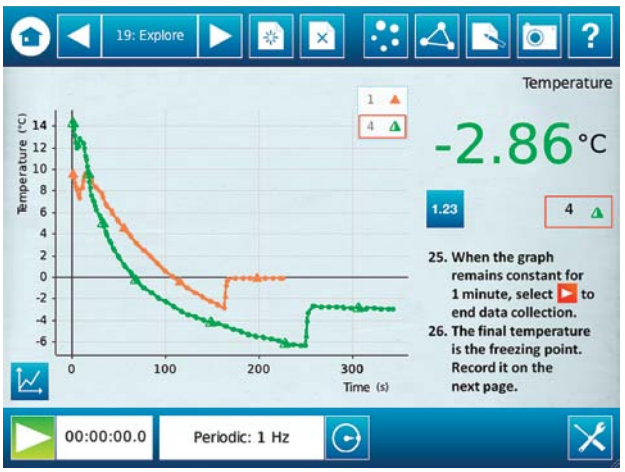
The new Carolina Chemistry Investigations for SPARKscience is a set of ten SPARKlabs, each with two parts. First, students engage in a guided exploration of a core chemistry topic. Part two of each lab activity is an open inquiry investigation in which students design their own experiment around the same topic.

- Molar Volume of a Gas
- Thermochemistry
- Voltaic Cells
- Exploring Equilibrium
- Rates of Chemical Reactions
- Acid and Base Titrations
- Radioactive Half-Life
- Organic Chemistry - Biodiesel
- Stoichiometry
- Freezing Point Depression: A Colligative Property

PASCO and Carolina™ have come together to offer this complete solution of instructional material, modern science tools, and the chemicals and materials to conduct the labs.



In this SPARKlab, students investigate the colligative property of freezing point depression. Each SPARKlab guides the student through the learning cycle of focus, explore, explain and experiment.



Students perform several trials to determine how different types of compounds (ionic, molecular, unknown) affect the freezing point of a solution. Students then apply what they have learned by designing an experiment to find the molality of different solutions that depress the freezing point to -5 °C.

Ordering Guide

The 10 Carolina Chemistry Investigations are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Carolina Chemistry Investigations for Sparkscience.

- Carolina Chemistry Investigations (PS-2866)

2 Order your sensor bundle.

- Get the **Carolina Chemistry Investigations for SPARK Science Sensor Bundle** (PS-2867), which contains the sensors on the opposite page and allows you to do all 10 investigations.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

3 Order your materials kit.

- **Order the Carolina Chemistry Investigations for SPARK Science Materials Kit** (PS-2862), which contains the supplies to do the investigations (see opposite page for full list).

4 Select your data collection and analysis tool.

- Get the **SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computer.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

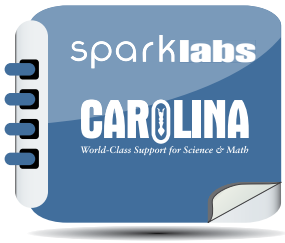
Carolina™ Chemistry Investigations for SPARKscience

Teacher License PS-2866

One per teacher (one license for all your classes)

Includes 10 general level high school Chemistry SPARKlabs.

Electronic Delivery.
Upon purchase, download to your computer.



Carolina™ Chemistry Investigations for SPARKscience Sensor Bundle

PS-2867

Includes Chemistry Sensor (measures pH, temperature, pressure and voltage), Drop Counter and Colorimeter.

Order one bundle per student group (3-4 students)

Carolina™ Chemistry Investigations for SPARKscience Materials Kit

PS-2862

Includes the following supplies to do the investigations.

Ammonium chloride
Buffer pH 10
Buffer pH 4
Calcium chloride
0.5 M calcium chloride
Canola oil
Copper metal
0.5 M copper (II) chloride
0.5 M copper (II) sulfate
Clorox® Bleach
Food Coloring Red # 40
Food Coloring Blue # 1
0.1 M hydrochloric acid
3.0 M hydrochloric acid
Iron nail
0.1 M iron (II) sulfate
Isopropyl alcohol
Magnesium metal
0.1 M magnesium sulfate
Methanol
Phenolphthalein
Potassium hydroxide pellets
Sodium chloride
0.878 M sodium chloride
0.5 M sodium chloride
0.5 M sodium sulfate
1.0 M sodium hydroxide
Sodium thiosulfate
Sugar
0.5 M sucrose
0.5 M sulfuric acid
Zinc metal
0.1 M zinc sulfate

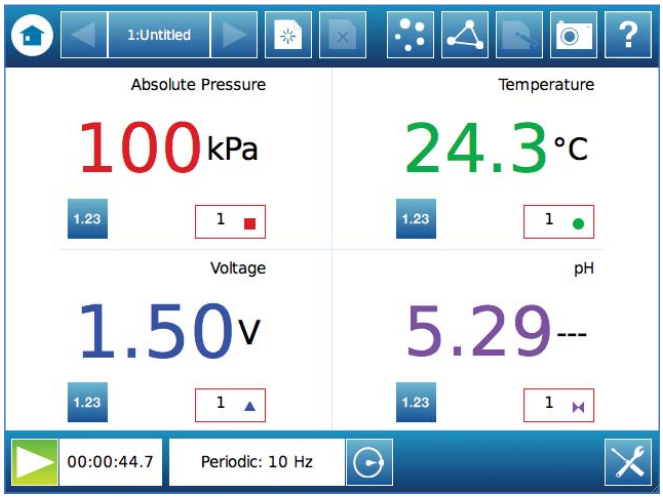
Beaker, Pyrex® 400 mL
Cups, foam, 8 oz
Erlenmeyer Flask, Pyrex® 250 mL
Filter discs 9 cm
Forceps
Glass dropper
Grease pencil
Jelly tray/ 20 sections
Leads, red
Leads, black
Mason jar
Mason jar lid
Pipet, graduated, nonsterile
Stopper, 1 hole

Order one per student group (3-4 students)
Contents will vary for addresses outside the U.S.

Chemistry Sensor – One Sensor, Many Applications

You'll use this sensor for almost your entire chemistry curriculum.

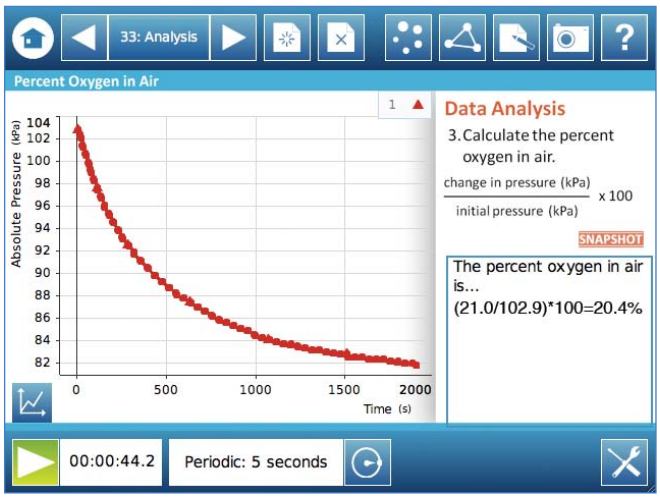
The MultiMeasure Chemistry Sensor gives your students the ability to measure pressure, temperature, voltage, and pH simultaneously. The versatility of the Chemistry Sensor provides coverage for most of the content in High School chemistry. The possible applications range from electrochemistry and acid–base reactions to reaction rates and gas laws.



The Chemistry MultiMeasure Sensor allows you to monitor four measurements simultaneously.

Measure the Percent of Oxygen in Air

Use the Chemistry Sensor to investigate the percentage of oxygen in the air. This activity provides an opportunity to build an understanding of states of matter, pressure at the molecular level, and chemical reactions from different standpoints. Real-time graphing of their live pressure vs. time data helps students clearly visualize this difficult concept.



The pressure inside the test tube decreases as the oxygen in the air bonds with iron in the steel wool to form iron(III) oxide (rust).

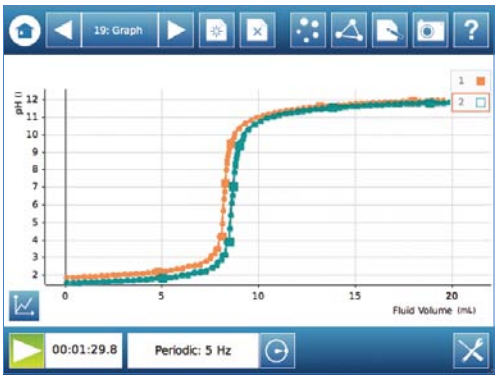
A test tube, piece of steel wool, and a Pressure Sensor are all you need to have your students calculate the amount of oxygen in the air.

Acid-base titrations – done quickly and accurately!

Using the Chemistry MultiMeasure sensor to monitor pH and the High Accuracy Drop Counter, students will create acid-base titration curves in a fraction of the time, allowing them to repeat their trials and ensure consistency. In this lab activity, that means determining the concentration of an unknown sample of hydrochloric acid by reacting it with an known concentration of sodium hydroxide.

THE TEACHING ADVANTAGE:

- Fast and accurate results every time
- Ensure repeatability with the High Accuracy Drop Counter
- High quality Magnetic Stirrer available
- Analyze your titration curves further using SPARKvue's tools



Multiple trials of titration curves can easily be collected in one class period.

A drop counter and pH sensor can be used together to quickly perform accurate titrations.

Chemistry Sensor

PS-2170

Includes Stainless Steel Temperature Probe, pH Probe, Voltage Probe, built-in Pressure Sensor, 60cc syringe, tubing and quick-release connectors.

High-Accuracy Drop Counter

PS-2117

Includes Micro Stir Bar plus a Stainless Steel Sensor rod for easy attachment to ring stand.

Magnetic Stirrer

SE-7700

Includes stir bar, removable rod, and power adapter.

Quantitatively measure exothermic and endothermic processes

Have your students explore concepts ranging from specific heat capacity, to heats of solution and Hess' Law. With PASCO's Calorimeter Cups, Specific Heat Set, Hot Plate and Stainless Steel Temperature Probe, your students will be outfitted with the necessary equipment to perform a wide range of thermochemistry experiments.

Calorimetry Cups

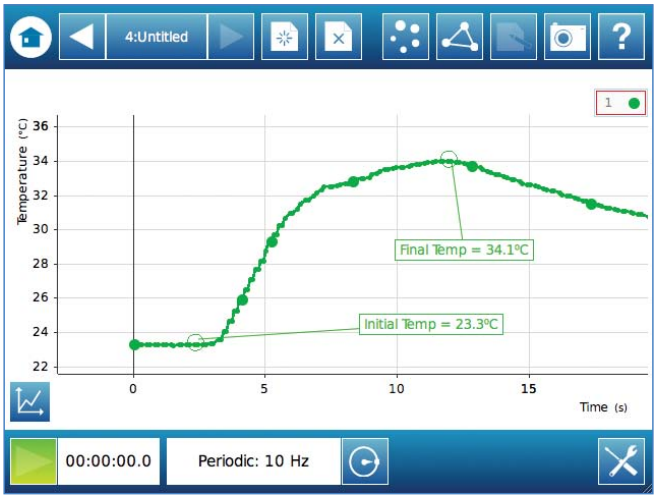
- Includes set of six Styrofoam™ cups that are 7.5 cm inside diameter, 10 cm deep, with 1.3 cm thick walls for excellent thermal properties.
- The lids have a hole, which is ideal for inserting a temperature probe.

Hot Plate

- The compact and durable plate can reach up to 400 C in minutes.
- The cast aluminum top plate provides an even heating surface and has a built-in support rod holder (rod not included).

Specific Heat Set

- Comes with five different materials (aluminum, brass, stainless steel, zinc, and copper), each with a mass of 80 g.
- Each has a hole to tie a loop of string, so it can be suspended in a liquid.



Use the change in temperature to determine specific heat capacity of a metal sample.

Calorimetry Cups

TD-8825A

Styrofoam calorimeter cups (7.5 cm inside diameter, 10 cm deep) have 1.3 cm thick walls for excellent thermal properties. The lids have a hole for a temperature probe.

Includes set of six cups with lids.

Hot Plate

SE-8830

This compact and durable hot plate can reach up to 400 °C in minutes. The cast aluminum top plate provides an even heating surface, and it even has a built-in support rod holder (rod not included).

Specific Heat Set

SE-6849

This specific heat set has five different materials, all having the same mass (80 g). Each has a hole to tie a loop of string to hang the samples in water.

The Voltage/Current Sensor measures the electrochemical potential in a voltaic cell as electrons move from the zinc anode to copper cathode.

Electrochemistry made easy . . . with the Voltage/Current Sensor

The Voltage/Current Sensor provides the perfect solution for the electrochemistry portion of your curriculum. Using this MultiMeasure Sensor during electrochemistry experiments, students will be able to simultaneously measure voltage and current in voltaic and electrolytic cells.

About the Voltage/Current Sensor:

- Measures voltage and current simultaneously.
- Is equipped with overload protection and automatic reset.
- Automatically shuts down and sounds alarm when current gets too high.

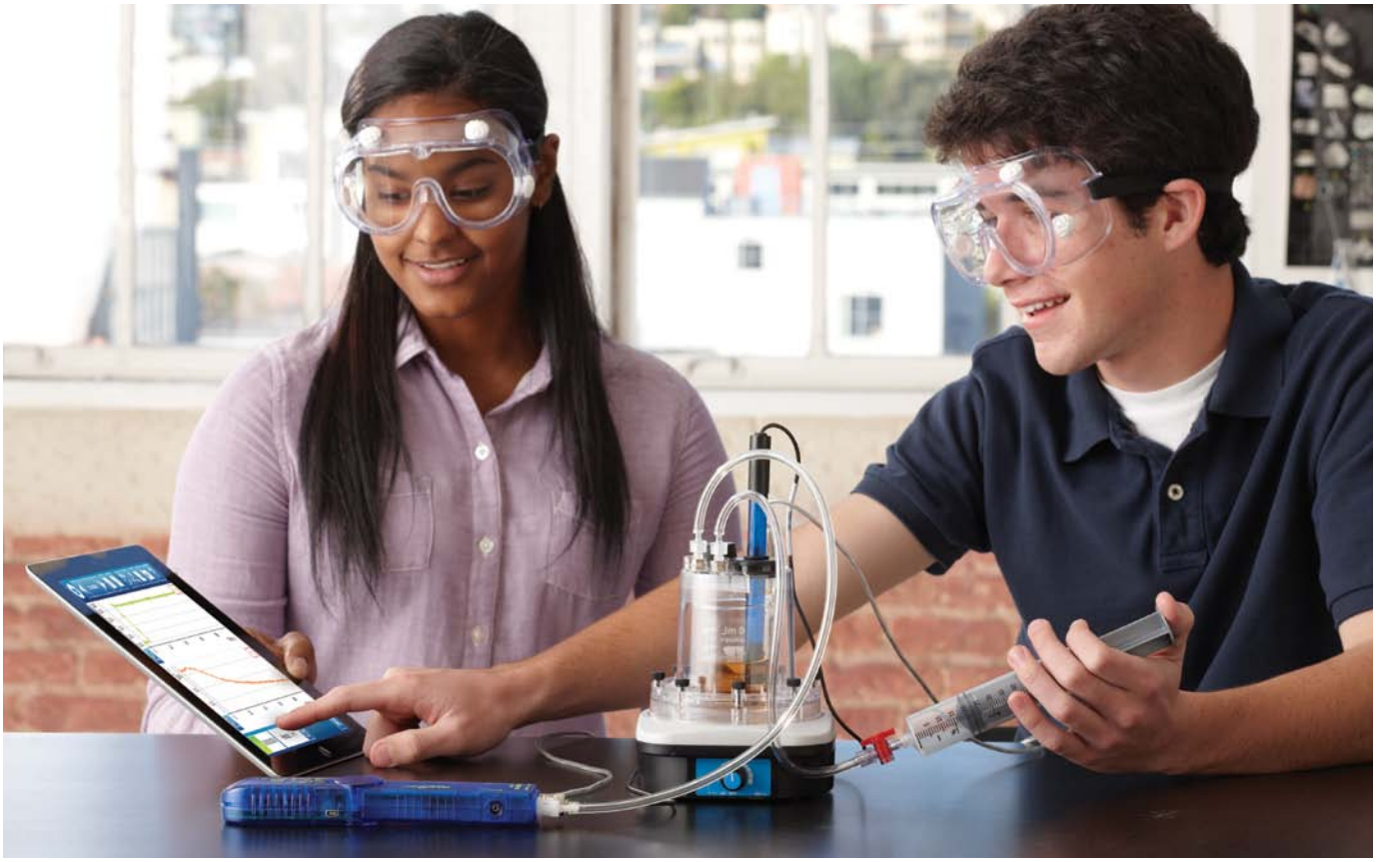
The voltage determined by the Voltage/Current Sensor is a measure of the driving force on the electrons in an electrochemical cell.

Voltage/Current Sensor

PS-2115

Combines 2 sensors in 1 case. Includes 2 pairs of voltage leads and 1 pair of alligator clips.

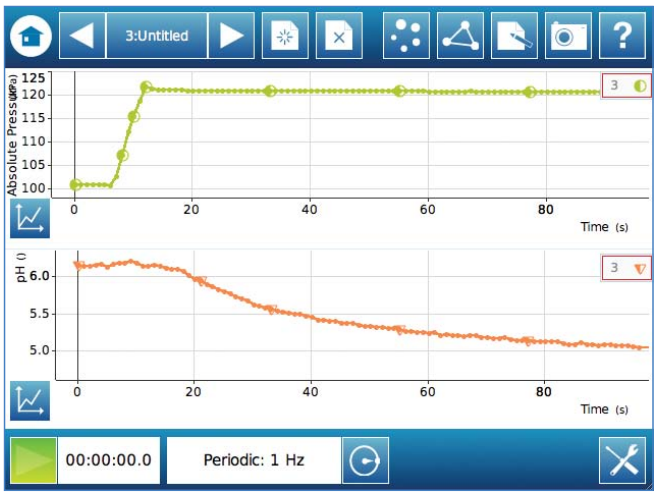
Recommended:
Alligator Clip Leads EM-8634 *(set of 10)*



As carbon dioxide is injected into the chamber, the pressure quickly rises. As the gaseous CO_2 equilibrates with the water, the indicator changes color and the pH drops.

Perform quantitative gas reaction studies.

This reaction vessel is designed for sensor-based measurement. Study gas reactions safely while collecting continuous real-time measurements. See what you've been missing. Use the provided syringe to vary the pressure in the chamber or introduce other gases.



As carbon dioxide is injected into the chamber, the pressure quickly rises. As the gaseous carbon dioxide equilibrates with the water, the indicator changes color and the pH drops.

WITH THIS CHAMBER, STUDENTS WILL BE ABLE TO STUDY:

- Gas laws
- Vapor pressure
- Reactions involving gases
- Gaseous equilibrium

Atmospheric Properties Chamber

ME-6813A

Includes chamber, tubing, rubber stoppers, stop cocks, and syringe

Required for Measurement:

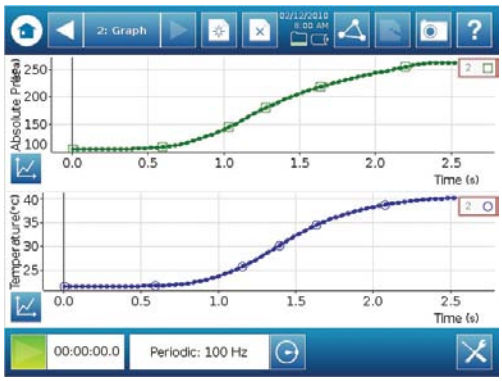
Chemistry Sensor PS-2170

Investigate the Ideal Gas Law simply and effectively

The Ideal Gas Law Apparatus has a stable design that ensures consistently repeatable results and long-term reliability. By connecting a Pressure Sensor and a Temperature Sensor to this large syringe, students will be able to quantitatively investigate relationships between pressure, temperature, and volume of a gas.

FEATURES:

- Low thermal mass thermistor
- Quick connect port for a pressure sensor
- Mechanical stop on the plunger to prevent damage



Students observe that both pressure and temperature increase as the volume inside the Ideal Gas Law Apparatus is decreased.

Students observe that both pressure and temperature increase as the volume inside the Ideal Gas Law Apparatus is decreased over time.

Ideal Gas Law Apparatus

TD-8596A

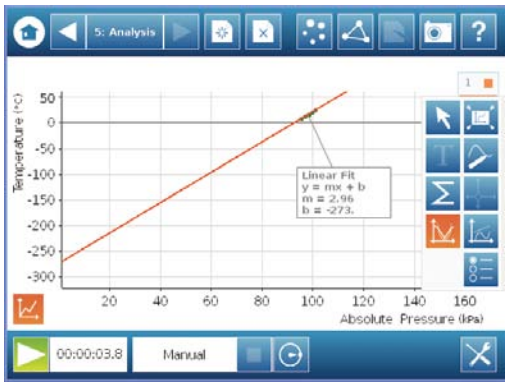
Includes Ideal Gas Law syringe, built-in fast response thermistor, and quick connect pressure port.

Recreate a classic experiment and experimentally determine absolute zero

The Absolute Zero Sphere has a constant volume – perfect for determining absolute zero temperature. Connect a Pressure Sensor and Temperature Sensor and immerse the sphere in water baths of several different temperatures. See pressure and temperature changes in real-time. Once the data is collected, students can use a linear fit to extrapolate the value of absolute zero.

THE TEACHING ADVANTAGE:

- Experimentally determine the temperature of absolute zero
- Investigate the relationship between pressure and temperature (Gay-Lussac's Law)
- Discover the Ideal Gas Law



A linear fit can be applied to the pressure versus temperature data collected to extrapolate absolute zero.

Immerse the sphere in water baths of several different temperatures to see pressure and temperature changes in real-time.

Absolute Zero Sphere

TD-8595

Includes built-in Fast Response Thermistor Probe and quick connect pressure port.

Also Requires:

Chemistry Sensor PS-2170

or

Pressure/Temperature Sensor PS-2146

The student on the right is removing a Colorimeter cuvette from a previous trial, while the other student is filling the cuvette for the next trial.

Order of Reaction using Beer's Law

Using the PASPORT Colorimeter students will graph the absorbance of crystal violet versus time as it reacts with sodium hydroxide. Since crystal violet is a dye that absorbs light in the visible range and the products of this reaction do not absorb light, the absorbance will decrease as the crystal violet is used up. Using Beer's Law to calculate concentration, students can then calculate the order of reaction using the initial rate method.

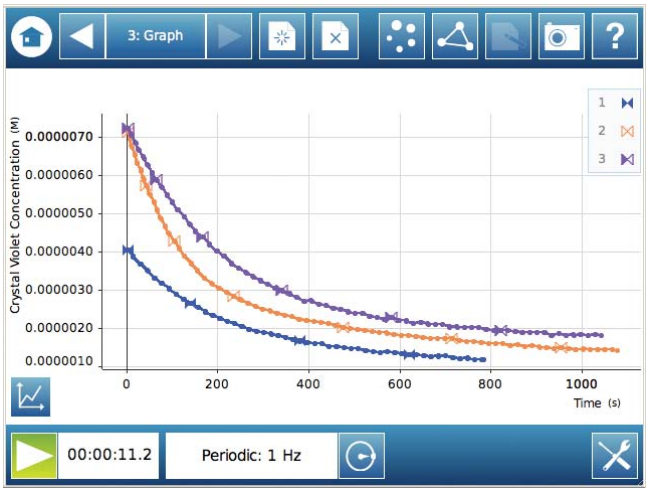
Colorimeter

PS-2121

Includes 5 glass cuvettes, plastic storage case, cuvette labeling stickers, Sensor Extension Cable

THE TEACHING ADVANTAGE:

- Auto-calibration with the push of a button
- Sample five times per second
- Simultaneously reports transmittance and absorbance
- Stabilized light source for consistent readings



The concentration of crystal violet decreases as it reacts with the sodium hydroxide in the cuvette. The various starting conditions allow the order of the reaction to be calculated using the initial rate method.

Real Spectrometry at a reasonable price

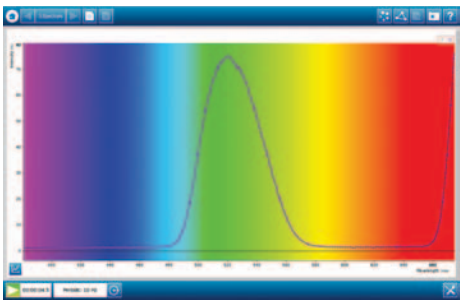
Measure absorbance, emission and fluorescence!

This affordable Amadeus spectrometer from Ocean Optics is designed for ease of use at high schools. From the tungsten light source to the included fiber optic cable, this system is a great value!

Now compatible with SPARKvue software and SPARK Science Learning System.

THE TEACHING ADVANTAGE

- Perfect for the "Absorption Spectra" activity from the Advanced Chemistry manual
- Spectral Range: 350 to 850 nm
- Resolution: 3 nm (FWHM) with a total of 300 datapoints



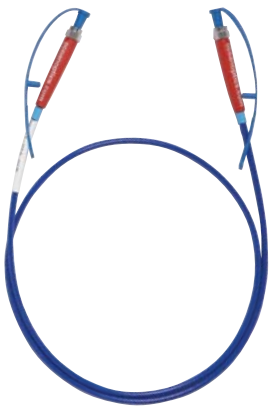
Students collect full absorption spectra to determine the concentration of species in the solution.

Quick quantitative identification of emission peaks from elemental and molecular species

Amadeus Spectrometer System

SE-7183

Includes Amadeus spectrometer, tungsten light source with power supply, 1.8 meter fiber optic probe, USB cable, 10 cuvettes. Now compatible with SPARKvue software and SPARK Science Learning System.



Spectral Tube Power Supply and Mount

SE-9460

Spectral Tubes not included – select from list below.

Spectral Tubes available:

Argon SE-9463
Carbon Dioxide SE-9464
Helium SE-9462
Hydrogen SE-9461
Krypton SE-9465
Mercury SE-9466
Neon SE-9467
Water Vapor SE-9468

A student dropping a ball onto a bull's-eye to create examples of results that are precise but not accurate, accurate but not precise, and accurate.

Help students discover the value of significant figures

With this set students will truly understand measurement uncertainty.

ACTIVITIES INCLUDE:

- Ball Drop: Students toss small balls on a bull's-eye to discover the relationship between technique and measurements, leading to the concepts of accuracy and precision.
- "Forced Error" Measurements: Students use a meter stick that has inaccurate markings to take measurements to reinforce that precise measurements are not always accurate.
- Mass/Length Measurements: Students use a balance or Four-Scale Meter Stick with imprecise scales to limit the certainty in their measurements.
- Area/Volume/Density Calculations: Students use a variety of measuring devices to calculate the area, volume and density of various objects, with emphasis placed on the precision of the measuring devices throughout.

Significant Figures Set (4 pack)

ME-9849

Includes materials for 4 student groups: plastic balls, carbon paper, bull's-eyes, 4-scale meter sticks, data pointers, meter stick labels and balance labels. Plus 1 large laminated number line.

Matter Model: Investigate the structure of matter with this dynamic visualization

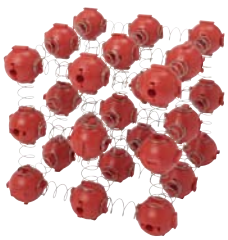
The atoms of the Matter Model are brightly colored spheres specifically designed to allow students to better understand the structure of matter. The bonds between the atoms are modeled by springs, so that when forces are applied, the atoms can move in response. Use this model to demonstrate normal force, atmospheric pressure or even wave motion.

- Modeling a Solid: By constructing a matrix of spheres, students can build a model of matter that is dynamic and responds to external forces similarly to real solids.
- Wave Properties: Students can investigate wave properties including reflection, wave speed and standing waves.

Matter Model

ME-9825A

Includes Atoms (40), heavy springs (60), Light springs (60, long springs (60), nuts (for increasing the atom mass) (30) and one brass rod (90 cm long).



This model of a solid can be used to help students visualize the atomic level of matter.

Stack them vertically to model atmospheric pressure.

Finding the volume of an object using water displacement allows students to calculate density.

Using displacement to determine density

Lowering any of the shapes from the Density Set (even the irregularly-shaped aluminum piece) into an overflow can will displace water equal to its volume, allowing for an accurate calculation of its density. But don't let the name fool you, this PASCO Density Set is a versatile set of materials that can also be used to investigate specific heats and length/volume relationships. It includes pieces that have the same shape, volume, density and mass, allowing students to isolate and study the variable of interest.

- Compare different shapes of like materials
- Compare like shapes of different materials

Density Set

ME-8569

Includes 1 irregular aluminum shape, 2 blocks, (aluminum and brass), 3 identically-sized cylinders (aluminum, brass and plastic).

Also available
Overflow Can SE-8568

Mole Set

SE-7586

Includes 1 mole each of copper, iron, zinc and aluminum.

Help your students visualize the concept of a mole

Yes, students can memorize that a mole is 6.02 x 10^{23} atoms or molecules of a substance, but how can that concept be made tangible? The PASCO Mole Set contains four element specimens of copper, iron, zinc and aluminum, all containing Avogadro's number of atoms. In addition to providing a physical example of the concept of a mole, this set can be used in a number of other ways:

- As specific heat specimens
- As an introduction to the concept of molar heat capacity
- As simple examples of the properties of each of these four elements, such as density

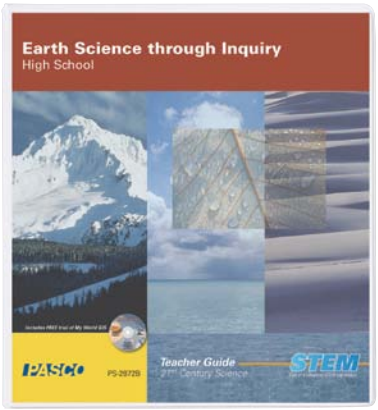
21st Century Solutions for Earth Science

In the science classroom of today, inquiry-based, hands-on activities must combine with technology designed for education to keep students engaged and increase science literacy. SPARKscience was designed to help you meet that challenge. It seamlessly integrates modern sensor-based data collection, interactive visualization and data analysis, and instructional content and assessment, providing a rich discovery-based learning environment.

In this science section, you will find an offering of instructional resources, plus a wealth of classroom application examples – illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents

Earth Science Through Inquiry Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide is designed by educators.
- Core topic areas include: the geosphere, the hydrosphere, and the atmosphere.
- The lab activities engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Activities also help students build vocabulary skills with key term challenges.
- Multiple-choice questions give students practice for standardized exams.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

31 Challenging Lab Activities

Air Pollution and Acid Rain ■
Climate Zones with My World GIS ▶GIS
Coastal Features with My World GIS ▶GIS
Coral Reefs with My World GIS ▶GIS
Earthquake Epicenters and Tsunamis with My World GIS ▶GIS
Earth's Magnetic Field
Glacial Features with My World GIS ▶GIS
Glaciers Around the World with My World GIS ▶GIS
Global Resources and Energy Consumption with My World GIS ▶GIS
Greenhouse Gases
Hurricanes with My World GIS ▶GIS
Insolation and the Seasons ■
Mapping and Understanding Weather Systems with My World GIS ▶GIS
Monitoring the Quality of Water ■
Physical Features of the Ocean Floor with My World GIS ▶GIS
Plate Tectonics with My World GIS ▶GIS
Properties of Water ■
Radiation Energy Transfer ■
Seafloor Spreading and Plate Tectonics
Soil Moisture Field Study with My World GIS ▶GIS+
Soil pH ■
Soil Salinity ■
Specific Heat of Sand versus Water ■
Sunlight Intensity and Reflectivity
Tornadoes with My World GIS ▶GIS+
Tracking Weather
Urbanization and Land Use with My World GIS ▶GIS+
Volcanoes with My World GIS ▶GIS
Water Treatment ■
Watersheds, Drainage Basins and Rivers with My World GIS ▶GIS
Wind Power Development with My World GIS ▶GIS

■ Lab activities with the color box require only the Starter Sensor Bundle.

Lab activities with the ▶GIS use My World GIS software

Lab activities with ▶GIS+ include student-collected data using sensors and explorations in My World GIS software.

Ordering Guide

The 31 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Earth Science Teacher Guide

- Earth Science Through Inquiry Teacher Guide (PS-2872B)

2 Order your sensor bundles.

Choose the bundle that aligns with the topics you want to cover.
Or build your own bundle from our over 70 sensors (see page 184).
We recommend one bundle per lab station (3-4 students).

- Get the **Starter Sensor Bundle** (PS-2922), which contains only the Water Quality Sensor and allows you to do the 10 lab activities with the color box.
- Get the **Standard Sensor Bundle** (PS-2929A); contains 7 sensors and allows you to do all 31 lab activities.

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: ***Use our SPARKvue software on your own computers.***

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

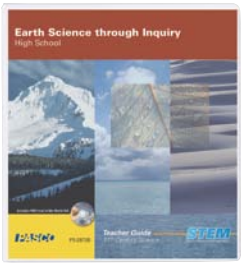
  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

4 Add GIS Software.

- The 21 lab activities with ▶GIS or ▶GIS+ use My World GIS and its datasets, or call for collecting, mapping, and analyzing sensor-based data. To perform these labs, order a license for My World GIS.

Earth Science Through Inquiry Teacher Guide

PS-2872B



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2882A $79

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2892A $59

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Earth Science Starter Sensor Bundle

Earth Science Starter Sensor Bundle allows you to do 10 lab activities

PS-2922

Includes: Water Quality Sensor PS-2169

Measures dissolved oxygen, pH, conductivity and temperature in one convenient package.

Earth Science Standard Sensor Bundle

Earth Science Standard Sensor Bundle allows you to do all 31 lab activities

PS-2929A


1


2


3


4


5


6


7

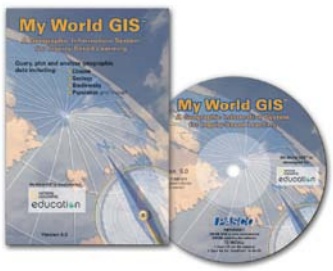
1. Water Quality Sensor PS-2169
2. Light Sensor PS-2106A
3. Weather/Anemometer Sensor PS-2174
4. GPS Position Sensor PS-2175
5. Turbidity Sensor PS-2122
6. Soil Moisture Sensor PS-2163
7. Magnetic Field Sensor PS-2112

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366

High volume and district licenses also available. See www.pasco.com/myworld for more license options.

See page 122 for more information.



System Requirements:
Windows 95/98/NT/2000/XP/Vista/Windows 7, Mac OS X (Universal Binary), Linux and Solaris. Minimum of 128MB of RAM (256MB recommended).

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

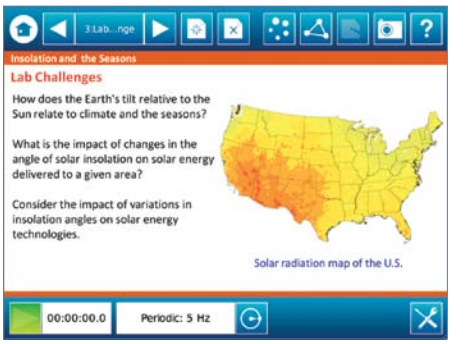
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

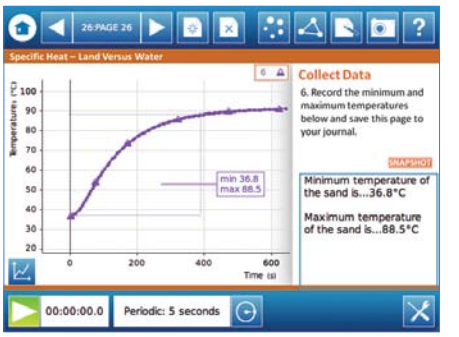
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



Using the embedded SPARKlab questions, students will understand the relationship between specific heat of sand and changes in temperature.

The SPARKlab Online Library

A growing collection for 21st century science learning

The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

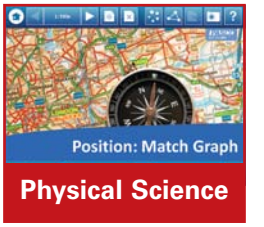
SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

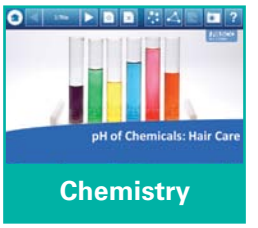
See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

NEW! Plant Metabolism & the Carbon Cycle, Toxicology Using Yeast, and Biofuels from Fermentation

NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs



NEW! pH of Household Chemicals: Hair Care & Position: Match Graph



NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration

NEW! Diffusion, Fermentation in Yeast, & Heart Rate

NEW! Projectile Motion, Position Match Graph, & Radiation

SPARKlabs for Earth Science

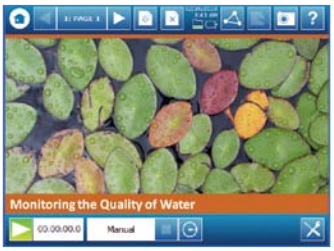
FREE…

9 FREE Earth Science SPARKlabs

We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

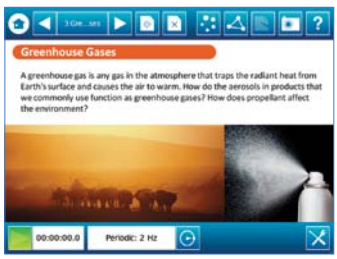
The 9 free Earth Science SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

- Air Pollution and Acid Rain
- Insolation and the Seasons
- Monitoring the Quality of Water
- Properties of Water
- Radiation Energy Transfer
- Soil pH
- Soil Salinity
- Specific Heat of Sand vs Water
- Water Treatment



Inside a SPARKlab

All background information, materials lists, safety notes and procedures are provided keeping students in the flow of the lab, not flipping back and forth with paper reference materials.



Integrated data collection and analysis means that students immediately draw meaning from the measurements and connect them to the science concept being investigated.

New Additions to the SPARKlab Online Library!

Greenhouse Gases

Teacher License PS-2085
One per teacher (one license for all your classes).

Using temperature sensors and a controlled environment, students investigate how certain gases act as greenhouse gases when heated. Then they modify the experiment to test how the "atmosphere" is affected by the greenhouse effect.

Electronic Delivery.
Upon purchase, download to your computer.

Earth's Magnetic Field

Teacher License PS-2084 One per teacher
(one license for all your classes).

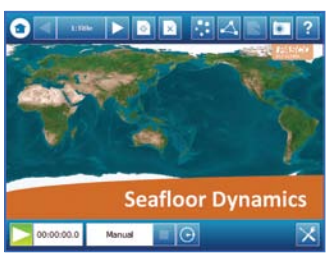
Using a magnetic field sensor, students investigate magnetism and explore the Earth's magnetic field. They use this knowledge to model properties of Earth's magnetic field in open inquiry.

Electronic Delivery.
Upon purchase, download to your computer.

Seafloor Dynamics

Teacher License PS-2086 One per teacher
(one license for all your classes).

In this experiment students use a magnetic field sensor to investigate how rocks contain natural magnetism. Then they learn how magnetism led to the identification of sea floor spreading in the ocean.



Electronic Delivery.
Upon purchase, download to your computer.

Earth Science Starter Sensor Bundle for SPARKlabs

This bundle is just one sensor, but this Water Quality Sensor measures a lot – dissolved oxygen, pH, conductivity and temperature. Everything you need for the 9 free SPARKlab activities included with your SPARK Science Learning System or SPARKvue license.

9 Free Earth Science SPARKlab Activities

- Air Pollution and Acid Rain
- Insolation and the Seasons
- Monitoring the Quality of Water
- Properties of Water
- Radiation Energy Transfer
- Soil pH
- Soil Salinity
- Specific Heat of Sand versus Water
- Water Treatment

Earth Science Starter Sensor Bundle

PS-2922

Water Quality Sensor PS-2169

Measures dissolved oxygen, pH, conductivity and temperature in one convenient package.

Ordering Guide *The 9 Earth Science SPARKlab activities are designed for use with the sensors above and with the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.*

1 Order your sensor bundle.

- To perform the 9 free SPARKlab activities, order the **Earth Science Starter Sensor Bundle** (PS-2922).

2 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Students investigate how the angle of sunlight (using lamps) affects the temperature at the earth's surface (using cardboard), as monitored by a Fast Response Temperature Probe.

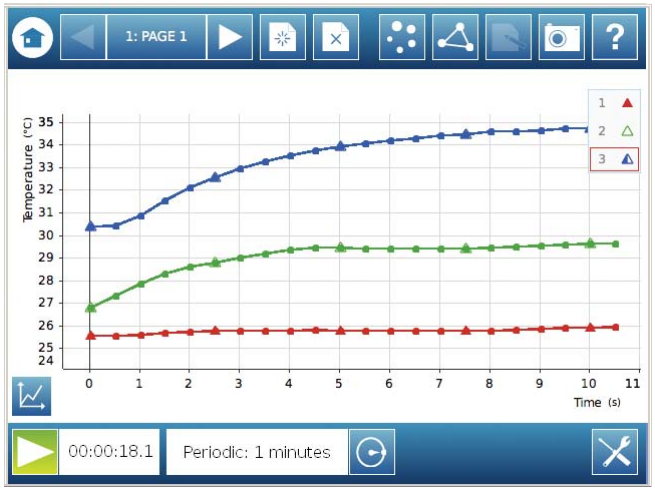
Sample SPARKlab Activity: Insolation and the Seasons

We all know this is one of the biggest misconceptions to overcome—why does the Earth experience seasons?

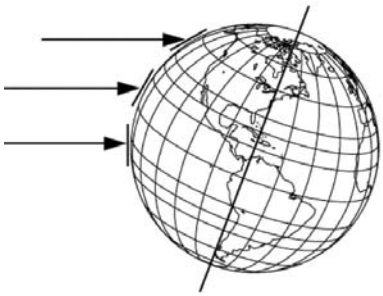
In this SPARKlab activity, students will learn from their own collected data that the more directly sunlight strikes the Earth's surface, the greater the temperature increase will be. The setup is simple and can be done indoors (with lamps) or outdoors under sunlight.

Once students understand this fundamental concept, they are prompted to reflect further:

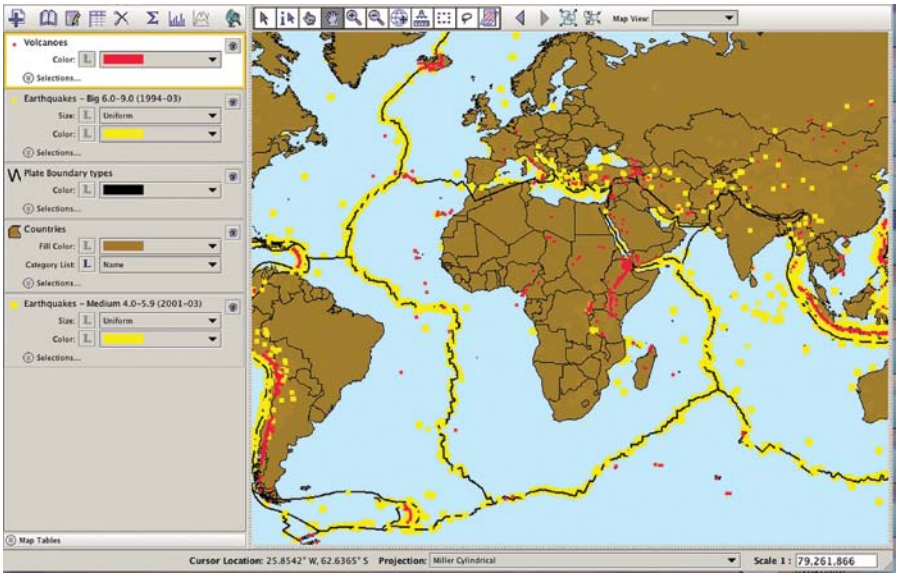
- How does this angle of insolation (or incoming solar radiation) explain the seasons?
- How does angle of insolation drive climate at the equator and the poles?



Temperature increase for direct sunlight (90 degree), and angled sunlight (60 and 30 degrees) clearly reveals the effect of angle of insolation.



The relationship between latitude and global heating is connected in this activity. Students can then relate seasons to the Earth's tilt and its revolution around the sun.



Explore plate tectonics with included earthquake and volcano datasets.

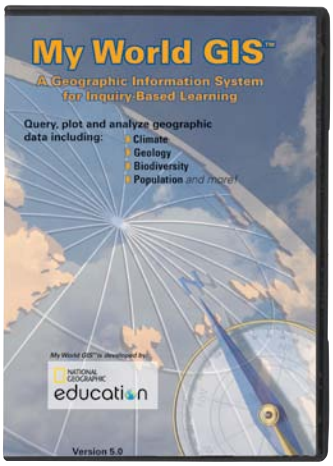
My World GIS

My World GIS is an award-winning geographic information system designed specifically for schools, featuring drag-and-drop simplicity and over 50 data libraries to get you started. Right out of the package, you can explore earthquakes, volcanoes, plate tectonics, climate, glaciers, country populations, literacy and mortality rates, and much, much more.

AWARD
eSchool News
Readers' Choice
WINNER

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



High volume and district licenses also available.
See www.pasco.com/myworld for more license options.

System Requirements:
Windows 95/98/NT/2000/XP/Vista/Windows 7,
Mac OS X (Universal Binary), Linux and Solaris.
Minimum of 128MB of RAM (256MB recommended).

What's the value of a GIS in the classroom?

Whether teaching science, history or social sciences, much of the data we use is spatial – referenced to a location. With a GIS, teachers and students have the opportunity to interact with that data visually via maps – and have the power to query the wealth of data behind those maps. Ideal for:

- Oceanography
- Climatology
- Biology
- Earth Science
- Geography
- Environmental Science
- Physics
- Social Studies
- History

Great for lectures or student projects

Free 45-day trial version and GIS activity. ***Get them both now at pasco.com/myworld***

Version 5.0

What's new?

- Updated data sets for included data library
- Access to a wealth of new (and free) data using new connections to ArcGIS Server and USGS National Map Seamless Server
- Plot time series data – see how data in a specific location changes over time
- And much more!

For complete list of new features and for upgrade information, see pasco.com/myworld

Key Features

- Hot-link graphics, videos and documents to points on a map
- Import and export industry standard file formats
- GPS import wizard – collect your data with GPS location and easily view it on a map (see page 199 for example)
- Simplified downloads from WMS and ArcIMS servers
- One-disk installation including more than 50 data libraries

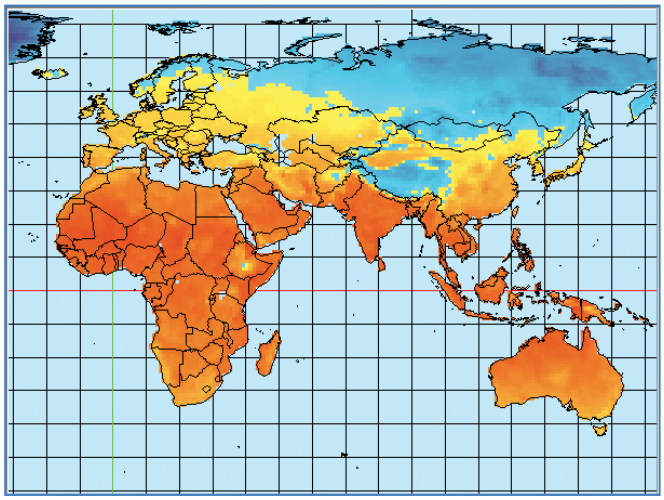
Bonus – live WeatherBug data

Your license of My World GIS now includes a live feed of weather data from over 8,000 weather stations across the globe. With WeatherBug's real-time data and satellite imagery, you can bring any weather-making headline right into your classroom. This service from WeatherBug includes:

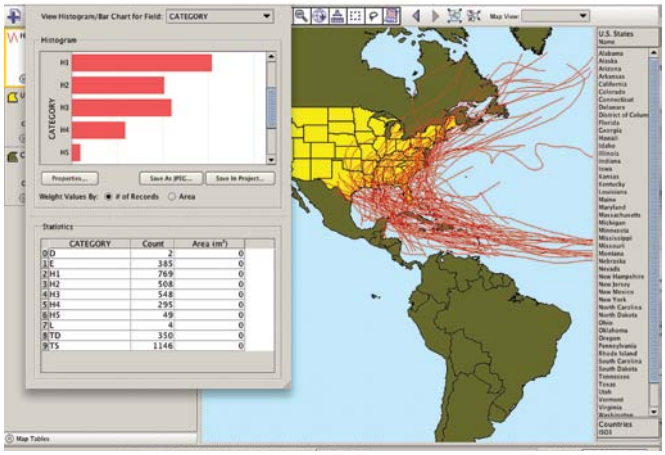
- Real-time weather data
- High resolution satellite images
- Rich analysis for connecting the dynamic nature of weather to Earth science concepts

My World GIS™ is developed by:

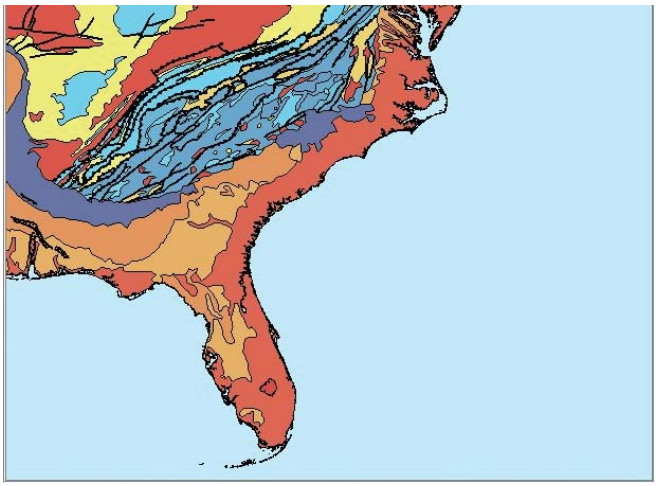
NATIONAL GEOGRAPHIC education



Thirty-year average surface temperature and lines of latitude and longitude. Hot areas are red, cool areas are yellow, and cold areas are blue. Connect climate data to specific areas of the globe.



Histogram showing category and number of Atlantic Hurricanes. My World's built-in analysis tools allow students to investigate how many and what category of hurricanes made landfall over the last 150 years.

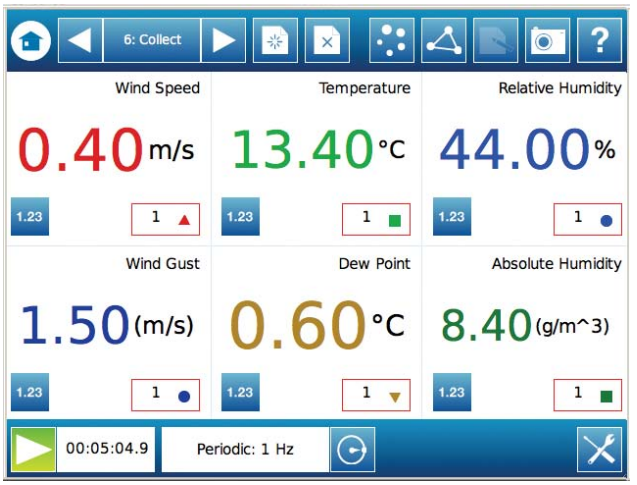


Geologic map of the Southeastern US with geologic units colored according to age and type, and major faults in black. Students can investigate the unique geology of the Appalachian Mountains.

Students explore their school surroundings with the Weather/Anemometer and GPS Position Sensors – all the data is tagged with GPS coordinates for automatic mapping in My World GIS.

Investigate – and map – microclimates

Equip students with the Weather/Anemometer Sensor and GPS Position Sensor and send them out to explore the school surroundings. As they move throughout the campus, all their data is recorded and location-referenced. Have them explore asphalt parking lots, buildings that block breezes, open fields, heavily shaded areas, even small bodies of water or the outdoor pool. Open the data in My World GIS and see it overlayed on an aerial photo of the school grounds, which sets the foundation for discussing microclimates and the factors affecting them. Use the data as the basis for discussing influences on different microclimates, as well as regional and global climate investigation.



The Weather/Anemometer measures temperature, barometric pressure, relative and absolute humidity, dew point, wind speed, wind gust and wind chill – all with just one sensor.

Weather/Anemometer

PS-2174

Includes Sensor Extension Cable

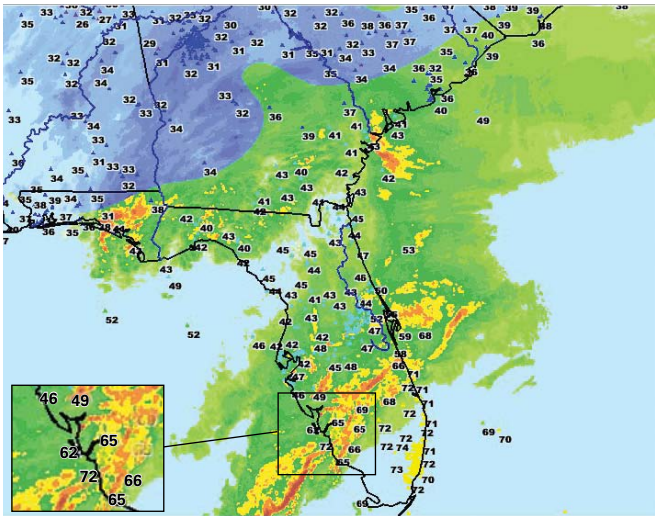
GPS Position Sensor

PS-2175

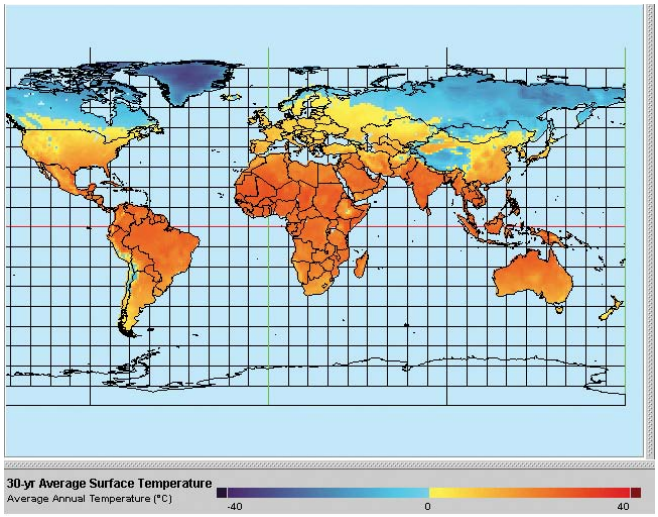
Includes Sensor Extension Cable

Using the bird's eye view of student-collected data, have students reflect on and present the factors that may contribute to different microclimate conditions.

Scaffold to regional and global climate studies



With WeatherBug's real-time data and satellite imagery, you can bring the weather-making headlines right into your classroom.



Connect your discussions of local and regional weather to regional and global climate patterns using the included datasets in My World.

SEE LIVE REGIONAL WEATHER DATA

Build on your students' understanding of microclimates by connecting to live weather data in your region. Your license of My World GIS now includes a live feed of weather data from over 8,000 weather stations around the globe. This WeatherBug service includes:

- Real-time weather data
- High-resolution weather satellite overlays
- Forecasts and weather alerts for instant storm feedback

Use My World GIS and live WeatherBug data to investigate local weather and connect it to regional and national scales – all in real time. Identify high and low pressure centers, air masses and movement, fronts and frontal movement, and even severe weather events. Take advantage of the passing storm to create a compelling learning experience. Explore the many variables that influence weather such as local geography, altitude, time of year, pressure, ocean currents, geographic features and more.

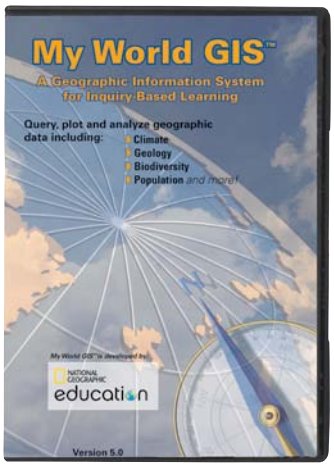
WeatherBug A WEALTH OF REAL-TIME DATA

The real-time weather data from WeatherBug features over 20 parameters including:

- Pressure and change in pressure
- Temperature and change in temperature
- Humidity, change in humidity, and dew point
- Wind speed, direction and gust
- Light level
- Daily rainfall
- Infrared satellite, current radar, and visible overlays
- Heat index and wind chill
- National Weather Service alerts

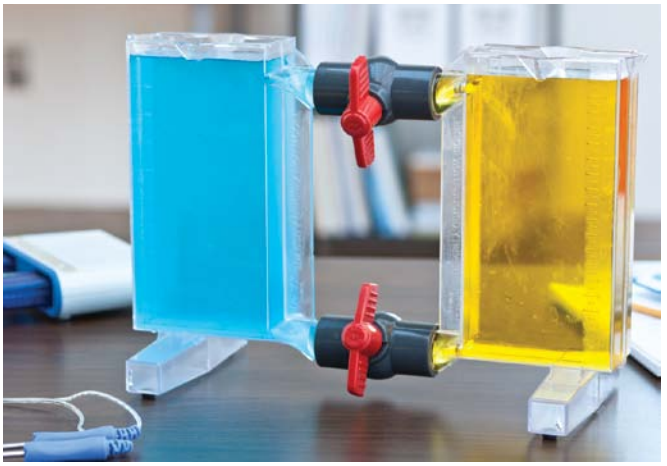
My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



High volume and district licenses also available.
See pasco.com/myworld for more license options.

System Requirements:
Windows 95/98/NT/2000/XP/Vista/Windows 7,
Mac OS X (Universal Binary), Linux and Solaris.
Minimum of 128MB of RAM (256MB recommended).



To model density-driven circulation, each chamber is filled with water (one hot, one cold), and food coloring added for visualization. Alternate trials can use salt and fresh water.

As students open the valves, convection-driven circulation begins and the water types begin to layer—even for very small temperature/density differences.

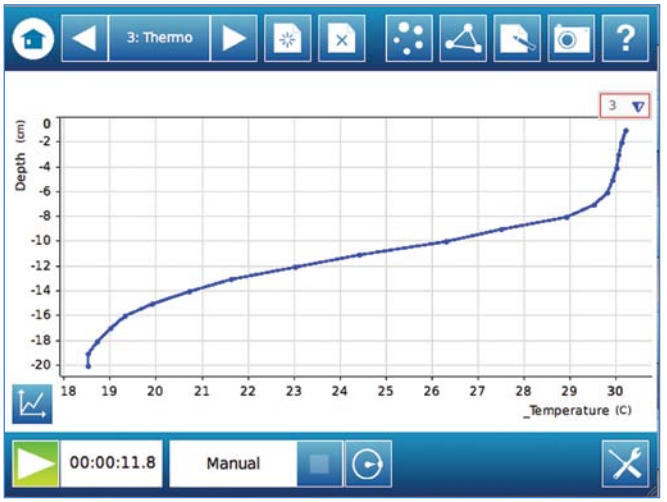
Once equilibrium occurs, students take temperature measurements at several depths—and discover that the chambers contain two distinct temperature layers. The chambers are marked with depth (cm) for easy measurement.

Density Circulation Model

The PASCO Density Circulation Model helps students understand the complex density-driven circulation associated with heat transfer through convection. Specifically, students simulate vertical ocean currents driven by water bodies with density differences (the "ocean conveyor belt").

With the Density Circulation Model, students can investigate:

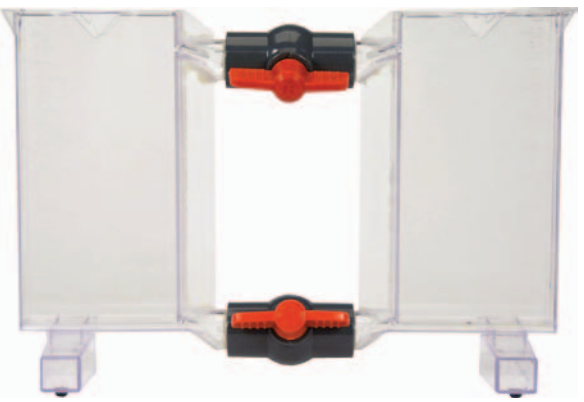
- Vertical ocean currents
- Upwelling
- Tropical vs. polar water bodies
- Thermocline and haliocline
- Convection
- Inversions



The student data clearly shows that the water bodies are stratified by temperature (density), with a very rapid change of temperature at the boundary between the two (the small green area where mixing does occur).

Density Circulation Model

ME-6816



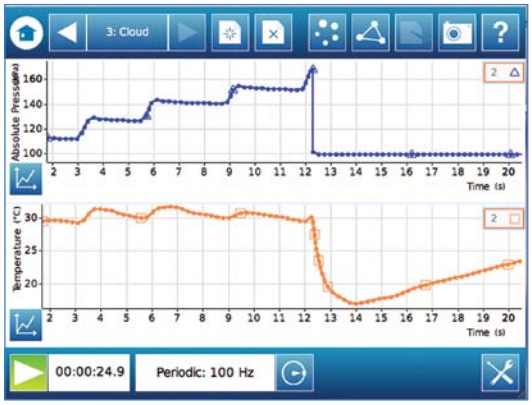
Investigate Cloud Formation — visually and quantitatively

The Atmospheric Properties Chamber helps students model gas behavior in the atmosphere—complete with sensor-based measurements of temperature and pressure.

Students model cloud formation by adding just a small amount of water in the chamber and connecting a pressure and temperature sensor. Students use the included syringe to increase pressure in the chamber. When pressure is high enough, the rubber stopper pops, and a cloud forms.

The clear acrylic chamber is safe under both high and low pressures. An integrated safety catch allows the stopper to pop under pressure, but prevents the stopper from flying.

This versatile chamber is also great for modeling low-pressure environments. Your students can make water boil by evacuating air from the chamber…and of course simultaneously measuring both pressure and temperature.



Students see that the instantaneous release of pressure (when the stopper pops) causes the temperature to drop quickly, resulting in cloud formation.

Atmospheric Properties Chamber

ME-6813A

Includes chamber, tubing, rubber stoppers, and syringe

Required for measurement:

Chemistry Sensor PS-2170

(see page 176)

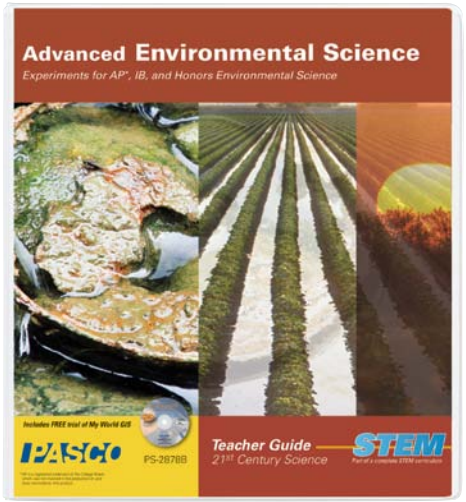
21st Century Solutions for Environmental Science

In the science classroom of today, inquiry-based, hands-on activities must combine with technology designed for education to keep students engaged and increase science literacy. SPARKscience was designed to help you meet that challenge. It seamlessly integrates modern sensor-based data collection, interactive visualization and data analysis, and instructional content and assessment, providing a rich discovery-based learning environment.

In this science section, you will find an offering of instructional resources, plus a wealth of classroom applications and field studies examples – illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents

Advanced Environmental Science Teacher Guide



Designed for Student & Teacher Success

- This standards-based, Advanced Environmental Science Guide has been designed by educators and includes core activities from every topics area in the AP®* course outline.
- The topics are correlated to the national science standards and cover: earth systems and resources, the living world, population, energy resources and consumption, and pollution.
- The lab activities engage students as they make predictions, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Multiple-choice questions bridge the gap between "lecture and lab" and help students gain confidence for the AP exam.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

27 Challenging Lab Activities

Earth Systems and Resources
Determining Soil Quality
Insolation and the Seasons
Investigating Specific Heat
Monitoring Microclimates
Plate Tectonics ▶GIS
Sunlight Intensity and Reflectivity
Urbanization and Land Use ▶GIS
Water Treatment

The Living World
Biodiversity and Invasive Species ▶GIS+
Biodiversity and Native Species ▶GIS+
Cellular Respiration and the Carbon Cycle
Ecological Niche: Coral Reefs ▶GIS
Modeling an Ecosystem
Photosynthesis and Cell Respiration in a Terrarium
Photosynthesis and Primary Productivity
Pollution and Harmful Algal Blooms ▶GIS
Weather in a Terrarium
Yeast Respiration

Population
Human Population Dynamics ▶GIS
Survivorship and Mortality Curves: Cemetery Dynamics ▶GIS

Energy Resources and Consumption
Energy Content of Food
Global Resources and Energy Consumption ▶GIS
Wind Power—Where Do We Build? ▶GIS

Pollution
Acid Deposition and Natural Water Bodies ▶GIS
Air Pollution and Acid Rain
Monitoring Water Quality
Toxicology Using Yeast

▶GIS *(Exploration using My World GIS software)*
▶GIS+ *(Includes student-collected data using sensors and explorations in My World GIS software)*

Ordering Guide

The 27 lab activities in the teacher guide are designed for use with sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Advanced Environmental Science Teacher Guide

- Advanced Environmental Science Teacher Guide (PS-2878B).

2 Order your sensor bundle.

- To perform all 27 lab activities in the teacher guide, order the **Advanced Environmental Science Standard Sensor Bundle** (PS-2930), which gives you the 7 sensors shown on the opposite page.

OR

- Build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: ***Use our SPARKvue software on your own computers.***

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

4 Add GIS software.

The 11 labs with ▶GIS or ▶GIS+ use My World GIS and its datasets, or call for collecting, mapping, and analyzing sensor-based data. To perform these labs, order a license for My World GIS.

**AP is a registered trademark of the College Board, which was not involved in the production of, and does not endorse, this product.*

Advanced Environmental Science Teacher Guide

PS-2878B

Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2887A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2898A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Advanced Environmental Science Standard Sensor Bundle *(Allows you to perform all 27 lab activities)*

PS-2930

1. Light Sensor PS-2106A
2. Turbidity Sensor PS-2122
3. GPS Position Sensor PS-2175
4. Weather Sensor PS-2154A
5. Oxygen Gas Sensor PS-2126A
6. Water Quality Sensor PS-2169
7. Carbon Dioxide Sensor PS-2110

My World GIS 5.0

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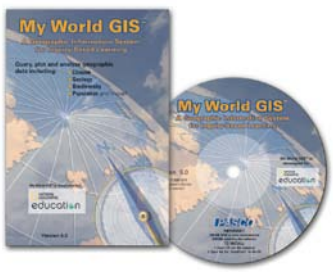
35-seat License SE-7365
K-12 Campus Site License SE-7366

High volume and district licenses also available. See www.pasco.com/myworld for more license options.



System Requirements:
Windows 95/98/NT/2000/XP/Vista/Windows 7, Mac OS X (Universal Binary), Linux and Solaris. Minimum of 128MB of RAM (256MB recommended).

SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

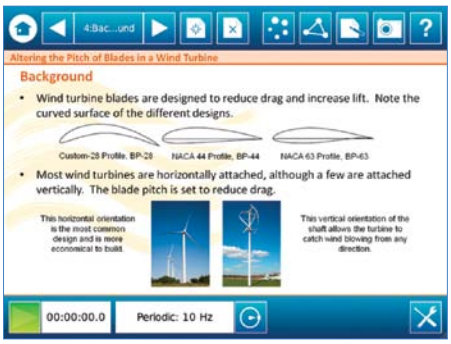
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.

Following guided questions during data collection, students observe that the CO_2 levels increase in the Ecozone Chamber when the plant is exposed to light.

The SPARKlab Online Library

A growing collection for 21st century science learning

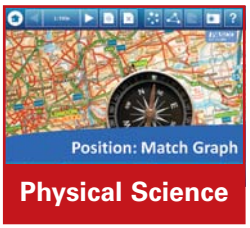
The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

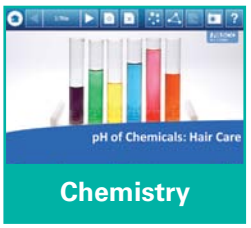
New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

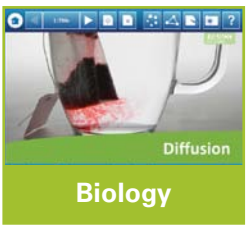
NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics



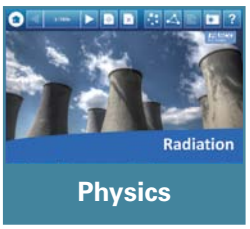
NEW! pH of Household Chemicals: Hair Care & Position: Match Graph



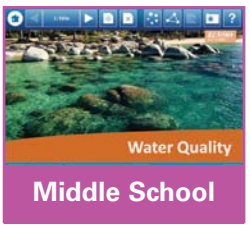
NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration



NEW! Diffusion, Fermentation in Yeast, & Heart Rate



NEW! Projectile Motion, Position Match Graph, & Radiation

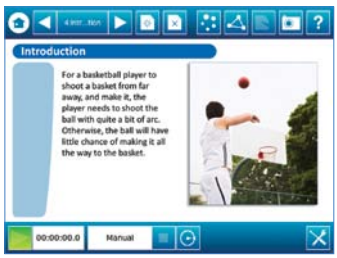


NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs

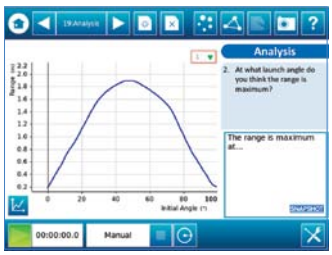
SPARKlabs for Environmental Science

Inside a SPARKlab

All background information, materials lists, safety notes and procedures are provided, keeping students in the flow of the lab, not flipping back and forth with paper reference materials.



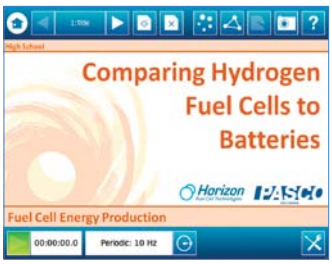
Integrated data collection and analysis means that students immediately draw meaning from the measurements and connect them to the science concept being investigated.



Collections

The Horizon Renewable Energy SPARKlab Collection

Help students develop an understanding of renewable energy with 9 investigations in solar, wind, and hydrogen fuel cell power. Developed with **Horizon Fuel Cell Technologies**.
See page 134 for details.



9 Lab Activities

Hydrogen Fuel Cell
- Assembling the Reversible Hydrogen Fuel Cell
- Water Decomposition for Hydrogen Fuel Cells
- Comparing Hydrogen Fuel Cells to Batteries

Solar
- The Effect of Heat on Solar Panels
- The Effect of Shade on Solar Panels
- The Effect of Tilt Angle on Solar Panels

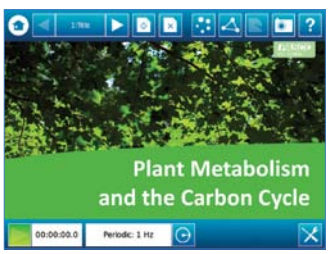
Wind
- Altering the Length of Blades in a Wind Turbine
- Altering the Pitch of Blades in a Wind Turbine
- Altering the Number of Blades in a Wind Turbine

New Additions to the SPARKlab Online Library!

Plant Metabolism and the Carbon Cycle

Teacher License PS-2087
One per teacher (one license for all your classes).

Students will create a model that isolates portion of the carbon cycle. They will explore their model by measuring and comparing the consumption of carbon dioxide during photosynthesis and the production of carbon dioxide during respiration.

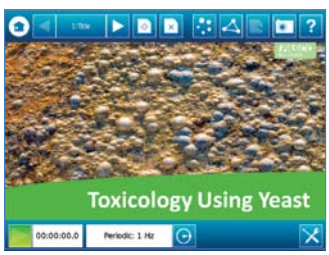


Electronic Delivery.
Upon purchase, download to your computer.

Toxicology Using Yeast

Teacher License PS-2088
One per teacher (one license for all your classes).

Students will demonstrate how yeast cells can serve as simple models to assess chemical hazards. By measuring carbon dioxide gas as an indicator, they will be able to evaluate the role of pH in toxicity and extrapolate the medial lethal dose (LD50) from half-strength bleach.

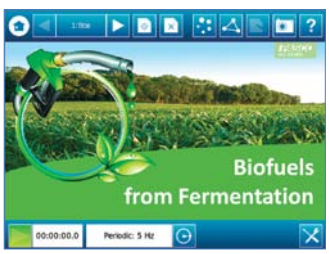


Electronic Delivery.
Upon purchase, download to your computer.

Biofuels from Fermentation

Teacher License PS-2089
One per teacher (one license for all your classes).

During this investigation, students will use the ethanol sensor to gather evidence of fermentation by yeast. Then they will explore how changing one or more variables can alter the rate of ethanol production.



Electronic Delivery.
Upon purchase, download to your computer.

The Horizon Renewable Energy SPARKlab Kit

Get the equipment needed to conduct the following 9 SPARKlab activities in the Horizon Renewable Energy Collection. The labs in the collection are:

Hydrogen Fuel Cell
Assembling the Reversible Hydrogen Fuel Cell
Water Decomposition for Hydrogen Fuel Cells
Comparing Hydrogen Fuel Cells to Batteries

Solar
The Effect of Heat on Solar Panels
The Effect of Shade on Solar Panels
The Effect of Tilt Angle on Solar Panels

Wind
Altering the Length of Blades in a Wind Turbine
Altering the Pitch of Blades in a Wind Turbine
Altering the Number of Blades in a Wind Turbine

Horizon Renewable Energy SPARKlabs

Teacher License PS-2857

One per teacher (one license for all your classes).

Includes 9 SPARKlab activities to help students develop an understanding of renewable energy.

Electronic Delivery.
Upon purchase, download to your computer.

Horizon Renewable Energy Kit

SE-7238

Includes wind turbine, 18 long curved blades (3 sets of different curvatures), 3 long flat blades, 3 short flat blades, reversible Fuel Cell module, Gas/Water storage module, small motor with propeller, 1 W Solar Cell, AA battery pack and 2 pairs of banana plug cables.

Ordering Guide

The nine lab activities in the Horizon Renewable Energy SPARKlab Collection are designed for use with the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Horizon Renewable Energy SPARKlab Collection

- Horizon Renewable Energy SPARKlab Collection (PS-2857)

2 Order your equipment.

- To perform the 9 labs included in the collection, order the Horizon Renewable Energy Kit (SE-7238). We recommend one kit per lab station (3-4 students).

3 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

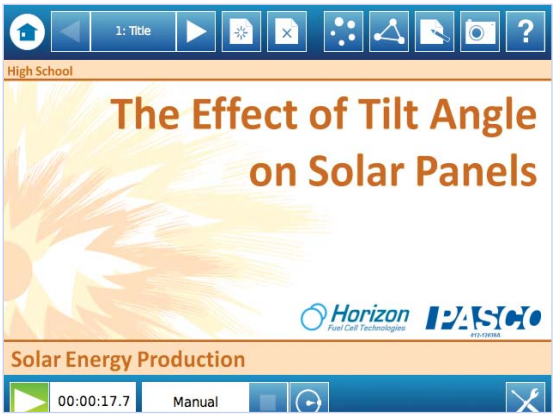
Students investigate the relationship between the voltage produced and the angle of the solar panel. Knowing the relationship between the angle of the sun relative to the panel is an important consideration in building any solar electrical system.

Sample Horizon SPARKlab Activity: The Effect of Tilt Angle on Solar Panels

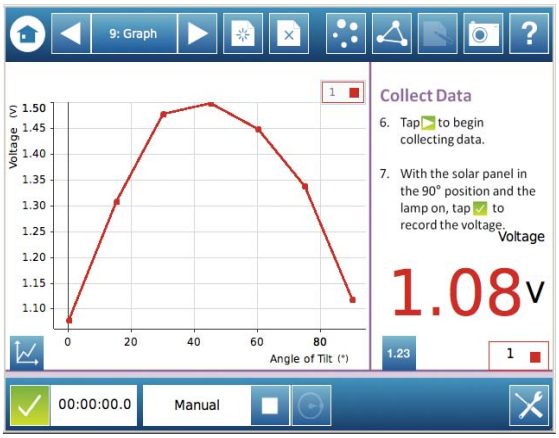
In this SPARKlab activity, students will learn from their own collected data that the more directly sunlight strikes the solar cell, the greater the voltage output. The setup is simple and can be done indoors (with lamps) or outdoors under sunlight.

As students understand how the angle of sunlight affects solar power production capability, they can begin to explore means of maximizing this directly-overhead exposure. What orientation should the cell have to maximize its exposure to direct (perpendicular) sunlight? What could be done to increase the time during the day when a cell is receiving optimum sunlight? Discuss differences in orientation for solar cells depending on geographic region and season.

Just one of nine SPARKlabs in the Horizon Renewable Energy SPARKlabs for High School collection.



Topic-specific SPARKlabs guide students through investigations of Solar, Wind and Hydrogen Fuel Cell technologies.



The maximum voltage output is when the light strikes perpendicular to the surface of the solar cell, which maximizes the amount of light energy available.

Canned dust remover is an efficient greenhouse gas. By filling the EcoChamber, students can model the greenhouse effect caused by the earth/sun relationship.

Build a greenhouse gas model

While global warming is debated in the headlines, this activity gives students an opportunity to learn for themselves something about the debate.

Students create a model environment with the EcoChamber, which supports sensor-based measurement of a closed system. This environment is monitored by a Fast Response Temperature Probe as the lamp's "sun energy" is absorbed by the rocks, re-radiated into the chamber, and absorbed by the gas in the chamber.

Students first run a trial with normal environmental air (the control), then a second trial after spraying computer duster into the environment. This spray (difluoroethane) is a very efficient – yet "ozone-friendly" – greenhouse gas, and students will see the significant difference in temperature increase between the two trials.

This activity provides a great foundation for further exploration of greenhouse gas and the effect of man-made gases on the environment. Students can connect to the Law of Unintentional Consequences.

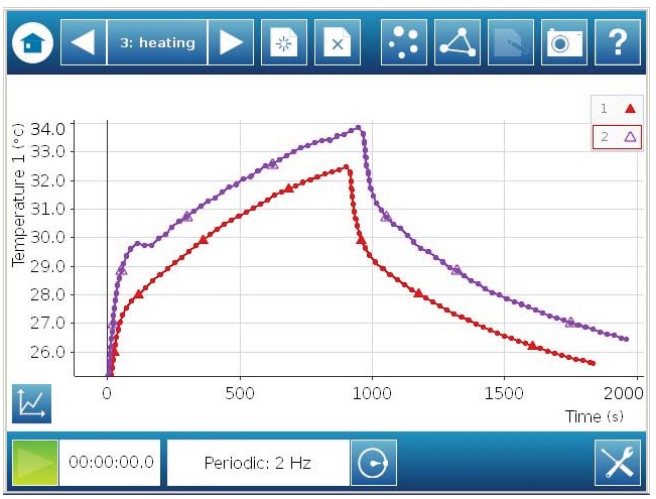
Greenhouse Gases SPARKlab now available!

See pasco.com/sparklabs

EcoChamber

ME-6667

Includes acrylic chamber,
7 stoppers of various sizes,
5 probe stoppers,
20 cc calibrated syringe and
sample tube with connector.



Two trials – one control, one with greenhouse gas. The greenhouse-gas trial resulted in a higher temperature and a longer cooling-off period.

How much energy do common household appliances use — even when not in use?

Measure energy consumption

Build an awareness of how everyday appliances consume energy. Use this Watt Meter in class with appliances you provide, or send the Watt Meter home with your students to perform home energy audits. They'll be surprised to find the "vampire" sources of energy consumption — even when appliances (such as TVs) are turned off.

Displays Voltage, Amps, Watts, Hertz, records cumulative Kilowatt Hours and even calculates appliance energy costs.

Watt Meter

SE-7237

Sorry, not available in 220 voltage

Non-Contact Temperature

The Non-Contact Temperature Sensor allows the measurement of surface temperatures without direct contact — for both safety and convenience.

Students creating a heat profile of a building wall.

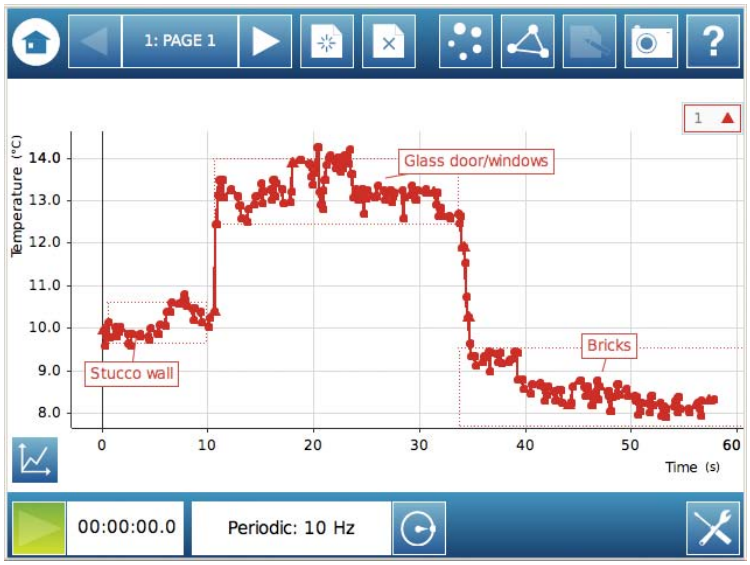
Investigate how different materials heat up under direct energy from the sun, or try to discern the inner structure of an exterior wall by measuring and mapping temperatures across its surface. Even compare surface temperatures at different locations on the body.

Energy audits of home and school buildings are easy — create profiles of heat loss or heat absorption with just a scan.

Non-Contact Temperature Sensor

PS-2197

Recommended:
Sensor Extension Cable PS-2500



Profile of an outside wall shows the clear increase in heat loss by the window.

PASCO EcoZone™ System

Create and monitor models of the environment

Understanding interactions within and between environmental systems is essential in environmental science studies. The carbon and nitrogen cycles, the water cycle, and the flow of energy are fundamental, yet often difficult to grasp. The EcoZone System gives students the means to create their own model environments, configured from the start for continuous, real-time measurement.

With three interconnected chambers, students can model the interactions between three different ecosystems. Choose a terrestrial, aquatic, and decomposition chamber, or create unique biomes to model and measure. Decouple the system for isolated investigations. For example, how does light affect the ecosystem? Students can create two identical ecosystems, then vary light conditions and collect solid quantitative data.

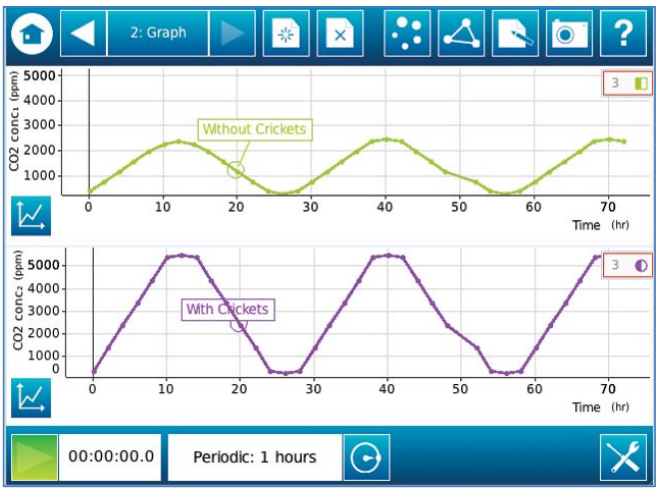
The openings within the chambers allow air to circulate, and the included cord efficiently "wicks" water between chambers, if desired. Additionally, ions are transported through the cord, so dissolved materials move from the terrestrial chamber, too!

The PASCO Difference

- Your measurements have minimal impact on the system because it remains closed!
- Custom-built to easily accommodate PASCO's line of over 70 sensors.
- Individual chambers easily decoupled for studies of single ecosystems.

Dual Humidity Sensor reports temperature and absolute and relative humidity, while the Soil Moisture Sensor provides water content of the soil in this ecosystem.

Isolate ecosystems for comparison studies. Here the impact of animals on carbon dioxide production is explored in two separate ecosystems – one with crickets, one without.



Students observe the photosynthesis cycle and its effect on carbon dioxide, plus the contribution of the crickets' higher carbon dioxide production (through respiration).

Create stand-alone environments or interconnected environments. Here, this single EcoChamber is monitored by the Dual Humidity and Soil Moisture Sensors.

Designed for measurement

The EcoZone System is designed specifically to accommodate PASPORT Sensors for effective, sensor-based measurement of your model environment.

Select from a wealth of sensor measurements for monitoring soil, oxygen, carbon dioxide, water quality, and ecosystem "weather"conditions. Even use the included syringe to extract water samples for chemical-based testing using the ezSample Water Quality Test Kits.

Our new Dual Humidity Sensor is designed to support monitoring multiple environments simultaneously, and its small size makes it perfect for measuring conditions in the chambers. Compare humidity conditions in two connected chambers, at different locations within a single chamber, or in two completely isolated chambers.

Easily create interconnected ecosystems (aquatic, terrestrial and decomposition) with live, continuous sensor monitoring.

Carbon Dioxide Gas Sensor

PS-2110

Includes Sensor Extension Cable and 250mL sampling bottle with cap.

Dual Humidity Sensor

PS-2156

Includes 2 probes, to measure humidity and temperature in two locations at the same time.

EcoZone™ System

ME-6668

Includes 3 EcoChambers, tray, rubber stoppers, syringe, plastic tubing and wicking cord.

Students create a closed system containing cultured yeast cells in a solution. They use an EcoChamber – which supports sensor monitoring of a closed environment – and add sensors to measure carbon dioxide gas and pH as they add controlled doses of the pollutants (bleach or vinegar).

How toxic is a pollutant?

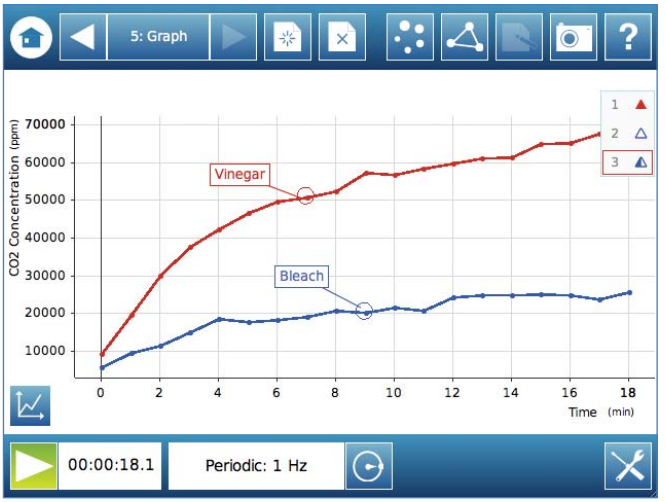
To understand toxicity, scientists need to conduct tests on living organisms. In this lab activity from the Advanced Environmental Science Teacher Guide, yeast cells are used to test the toxicity of two pollutants on a living organism. Students will introduce two pollutants: half-strength bleach and full-strength vinegar and compare the results.

Scientists typically measure toxin strength in terms of:

Lethal Dose (LD_{50}-50% of organisms are killed) *or*

Effective Dose (ED_{50}-50% of organisms are cellularly inhibited).

Students will measure the carbon dioxide production rate to determine whether the yeast cells are metabolically active, and as a result find the Effective Dose (ED_{50}) for each toxin (in mL/L).



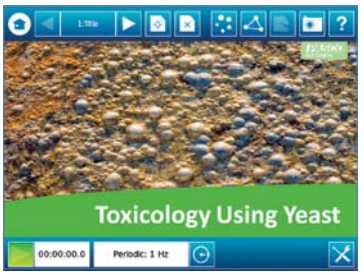
Both bleach (blue line) and vinegar (red line) reduce the rate of carbon dioxide production, but even at half strength the bleach proves to be significantly more toxic than vinegar. Students will next plot the rate of carbon dioxide production against dosage of the toxin to determine the Effective Dose (ED_{50}).

Toxicology Using Yeast

Teacher License PS-2088

One per teacher (one license for all your classes)

In this SPARKlab, using a magnetic field sensor, students investigate magnetism and explore the Earth's magnetic field. They use this knowledge to model properties of Earth's magnetic field in open inquiry. *See page 133.*

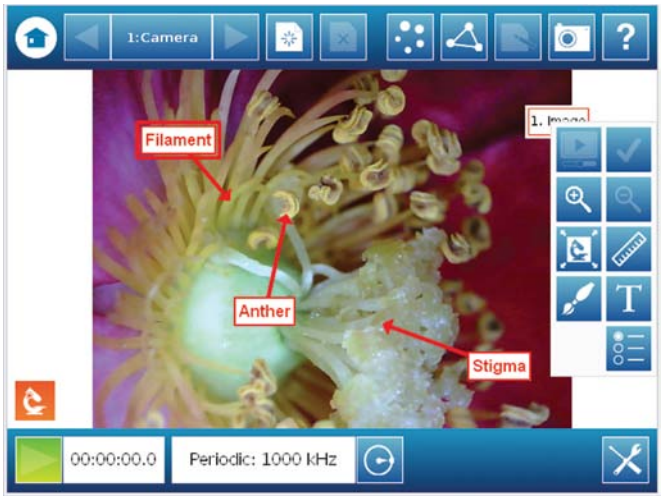


Electronic Delivery.
Upon purchase, download to your computer.

New! SPARK and SPARKvue now support digital microscopes

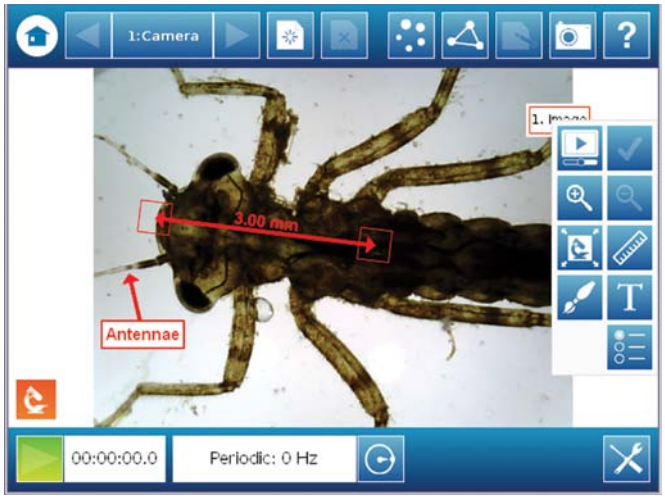
SPARKvue's new digital imaging capabilities support a wide variety of USB imaging devices, including most modern digital microscopes and webcams. Don't have a computer? No problem—use SPARK Science Learning System and get all the advantage of digital microscopy. No need for your students to learn a new software just for microscopy—collect sensor data and capture and analyze images all in your SPARKvue software.

- Make measurements right on the screen.
- Use digital zoom for even more magnification.
- Add labels using the text tool.
- Annotate, highlight, and more!



Use the SPARKvue software to capture images and add drawing and text annotations.

Use in the lab or — with the removable camera head and your SPARK Science Learning System — take it to the field.



With a quick calibration the SPARKvue software can make onscreen measurements, making the microscopic meaningful for students.

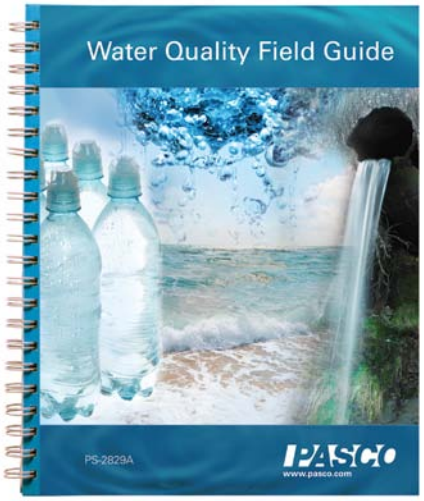
kena® Digital Microscope

SE-7236

Includes a removable camera/magnification head, touch tube (for placing the microscope flush against specimens), sturdy metal base, and convenient carry/storage bag. Magnification: 20X, 40X, 100X.

For use with SPARKvue: *Requires a SPARK Science Learning System or a USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.*

Water Quality Field Guide



Educator-designed, Student-tested.

The Water Quality Field Guide is a combination 'how-to' and 'why?' reference. It covers how to plan for and successfully measure water quality in the field, and it explains why these measurements are important and what they mean.

Covers 16 Water Quality Parameters:

8 Sensor-Based Parameter Measurements

Biological Oxygen Demand (BOD)
Conductivity
Dissolved Oxygen
pH
Salinity
Stream Flow Rate
Temperature
Turbidity

8 Chemical-Based Parameter Measurements

Ammonia
Chlorine
Dissolved Carbon Dioxide
Iron
Nitrate
Phosphate
Total Alkalinity
Total Hardness

5 key questions for each parameter:

- What to observe and how to interpret?
- What is it?
- Why measure it?
- What factors affect its values?
- What are ideal values for it?

Ordering Guide

The Water Quality Field Guide is an essential resource for your field investigations. Here's how to equip your student groups.

1 Order the Mobile Water Quality Sensor Bundle.

- Each sensor bundle includes the Water Quality Field Guide for use by the student group, plus the 5 sensors shown on page 143. This allows you to perform the 8 sensor-based measurements listed above. We recommend one sensor bundle per student group (3-4 students).

2 Add our ezSample chemical water quality tests.

- To perform the 8 chemical-based parameter measurements listed above, order PASCO's ezSample Test Kits and our Water Quality Colorimeter on page 144.

3 Order your field data collection device

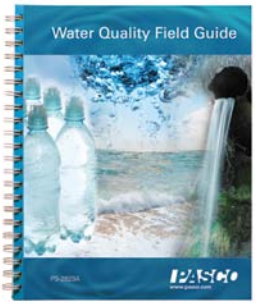
- **Get the SPARK Science Learning System (PS-2008A),** a fully integrated science solution, with complete mobility for field investigations. Fully stand-alone, but at your option connect to a computer upon your return from the field. Order one per student group (3-4). (See pp. 8-9 for more SPARK info.)

4 Add GIS software.

- Field water quality studies often call for mapping and spatial analysis of the sensor-based data. To map your water quality data, order a license for **My World GIS.**

Mobile Water Quality Sensor Bundle *Allows you to perform all 8 sensor-based parameter measurements*

PS-2612A



1

1. Water Quality Field Guide PS-2829A
2. Water Quality Sensor PS-2169
3. Thermocline Sensor PS-2151
4. Turbidity Sensor PS-2122
5. Weather Sensor PS-2154A
6. Flow Rate/Temperature Sensor PS-2130

Water Quality Field Guide includes an electronic version of materials (MS Word) on a USB flash drive.

2

3

4

5

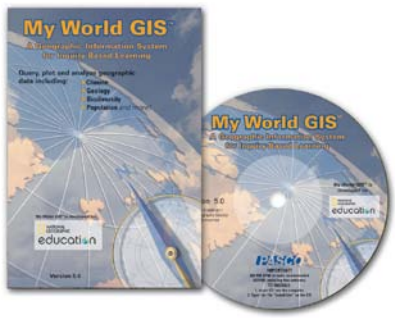
6

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366

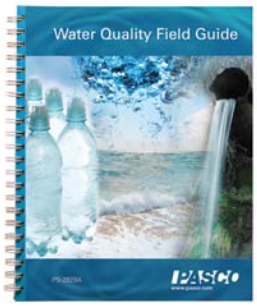
High volume and district licenses also available.
See pasco.com/myworld for more license options.

See page 38 for more information.



Water Quality Field Guide

PS-2829A



Includes the spiral-bound Field Guide and an electronic version of editable MS Word files on a USB flash drive.

Need extra copies?

Although the Water Quality Field Guide is included in the above sensor bundle, we realize you may wish to order separately.

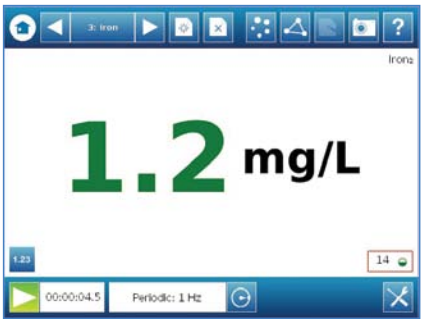
Chemical Water Quality Testing in the Field

PASCO's ezSample water quality test kits simplify the chemical testing of water sources. Avoid the mess and difficulty of handling chemicals directly and get great results, even in the field.

Snap tip of the vial and...

...sample instantly flows into tube, mixing with the reagent.

Place in Water Quality Colorimeter and read your results.



Iron concentration using ezSample Snap Vial and Water Quality Colorimeter.

Colorimetric Analysis

Conduct colorimetric tests in the field and avoid the mess and tedium of mixing chemicals. These ezSample Snap Vials contain a pre-formulated reagent to test a variety of water quality parameters. No more guessing at color variations—drop the vial into the Water Quality Colorimeter and read the concentration.

ezSample™ Snap Vial Kits

Ammonia EZ-2334
Chlorine EZ-2339
Iron EZ-2331
Nitrate EZ-2333A
Phosphate EZ-2337

Each Kit Contains 30 tests.

Requires:
Water Quality Colorimeter PS-2179

Water Quality Colorimeter

PS-2179

Includes Sensor Extension Cable.

Titration in the field

PASCO also simplifies measurements that require a titration method. The ezSample Field Titrators contain a vacuum-sealed quantity of a titrant. The entire process requires only a minute or two, is completely portable, and avoids all the setup and cleanup associated with ordinary titrations.

Begin titrating by gently squeezing the lever to draw in your sample.

In this titration for Alkalinity, color initially changes to pink.

On final color change, turn titrator over and measure concentration using built-in scale. That's it!

ezSample™ Field Titrator Kits

Alkalinity EZ-2340
Carbon Dioxide EZ-2341
Total Hardness EZ-2338

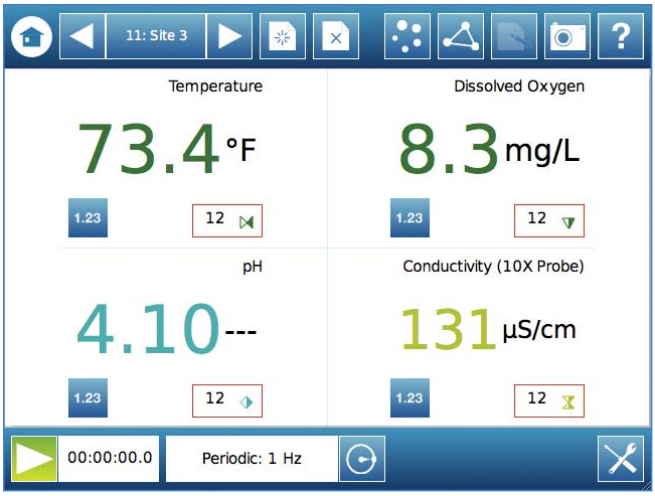
Each Kit Contains 30 tests.

Water Quality Sensor – a "Best in Field"

Easy, accurate, and ready for your field studies

The PASPORT Water Quality Sensor provides field water quality measurement in one very compact sensor module.

This MultiMeasure Sensor measures water temperature, pH (acidity), dissolved oxygen, and conductivity simultaneously. No more fumbling with multiple sensors in your field studies!



Convenience in field measurement – the Water Quality Sensor captures 4 important measurements at once: dissolved oxygen, pH, conductivity, and temperature.

Water Quality Sensor

PS-2169

Includes Stainless Steel Temperature Probe, pH Probe, Dissolved Oxygen Probe, and Conductivity Probe.

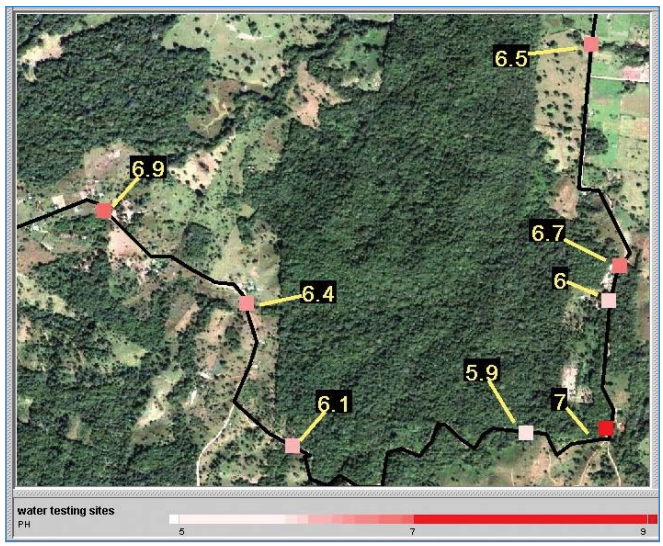
Now connect your data to the real world

Map your data in My World GIS

Collecting data is just part one. To take a water quality investigation to the next level, students must understand what their data means in the context of its surroundings.

Map your water quality data on aerial images and topographic maps using My World GIS—just collect your water quality data along with our GPS Position Sensor, and you instantly put it in context! (See page 199 for details.)

Students collect several parameters with just one sensor – the Water Quality Sensor simultaneously collects pH, dissolved oxygen, conductivity and temperature.



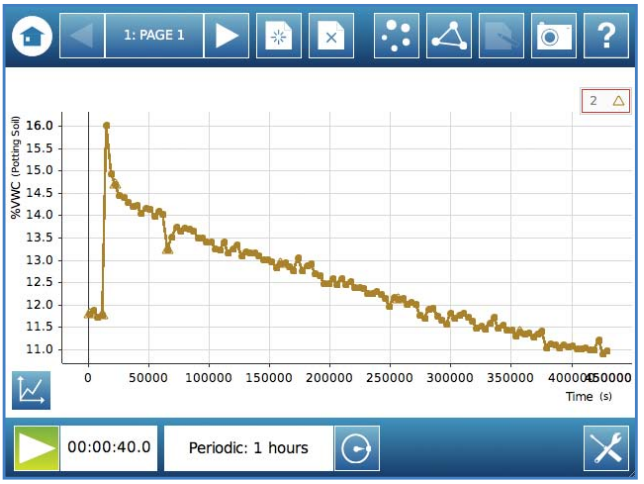
Student-collected pH data along a stream near a preserve. In mapping the data, students can discover potential sources of pollutants affecting stream health, including in this case runoff from local farms.

Investigate soil science

Soil moisture plays an important role in soil science, hydrology, and agriculture studies, since soil moisture is essential to plant growth and soil stability. The soil moisture for a given area is dependent on many factors, including the availability of water and the type and composition of the soil. Students can use the Soil Moisture Sensor in field measurements to help determine if a soil is a good candidate to support a certain crop or plant type. By comparing different soil types, students can construct a soil moisture map of the area and decide where the best location is for agriculture or for a building.

Students can also investigate the connection between soil moisture and transpiration. Under normal conditions the plants pull their moisture from the soil. With the Soil Moisture Sensor, students can investigate the rate at which moisture is removed from the soil in various conditions.

Study soil conditions in different settings to identify optimal environments for different plant species.



Soil moisture data over time

Soil Moisture Sensor

PS-2163

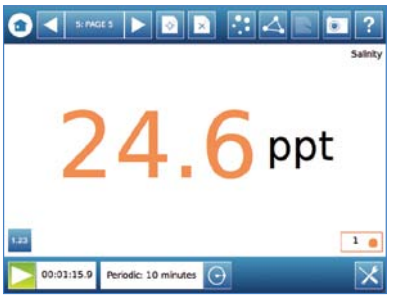
Explore saltwater environments

With PASCO's new Salinity Sensor you now can explore your local coastal ecosystems. Study estuaries and even ocean and brine environments. Explore transition areas where fresh water and salt water mix — even map them for yourself using the GPS Position Sensor and My World GIS.

The Salinity Sensor is calibrated to global standards — once you have identified the salinity of your local ecosystem, you can compare your data to similar saltwater ecosystems around the world.

FEATURES

- Measures salinity, conductivity and temperature
- Automatically temperature-compensates based on Practical Salinity Standard



Salinity level of sample taken from a bay

Salinity Sensor

PS-2195

Map your water quality data

When collecting water quality data out in the field, why not view it on a map?

Use our GPS Position Sensor to collect GPS data simultaneously with other sensor measurements, automatically synching the data to your latitude, longitude, and altitude.

Collect data with confidence!

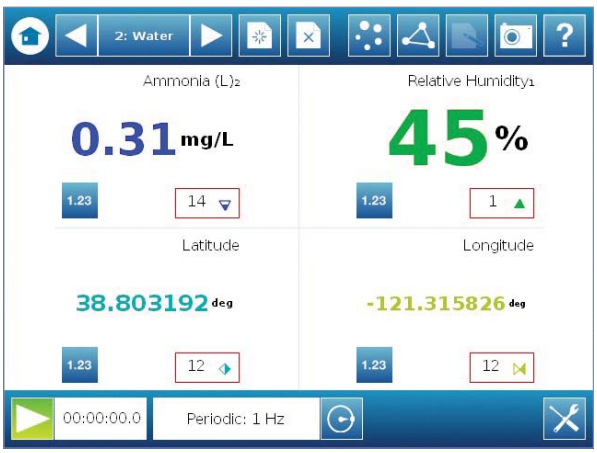
Our highly sensitive GPS receiver can track satellites even under tree canopies often found along rivers.

Ready to map your data?

Just open your data in My World GIS and you can visualize your data on topographic maps, aerial photos, and more. Even add annotations—including videos and photographs of the local environment. Annotation flags are easily accessible via clickable hotspots on your map.

Samples of ammonia collected along a creek running from a golf course and through a development. Note the high concentrations of ammonia begin to dissipate as the creek leaves the development for open space.

Annotate your map with photos or videos – visually document site conditions including possible sources of contamination or physical changes between sample dates.



Connect your GPS Position Sensor when you're in the field and all your collected data is automatically paired to GPS coordinates.

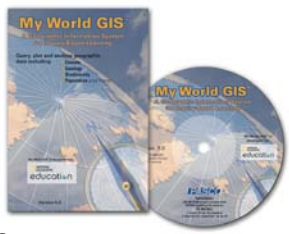
GPS Position Sensor

PS-2175

Includes Sensor Extension Cable.

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



High volume and district licenses also available. See pasco.com/myworld for more license options.

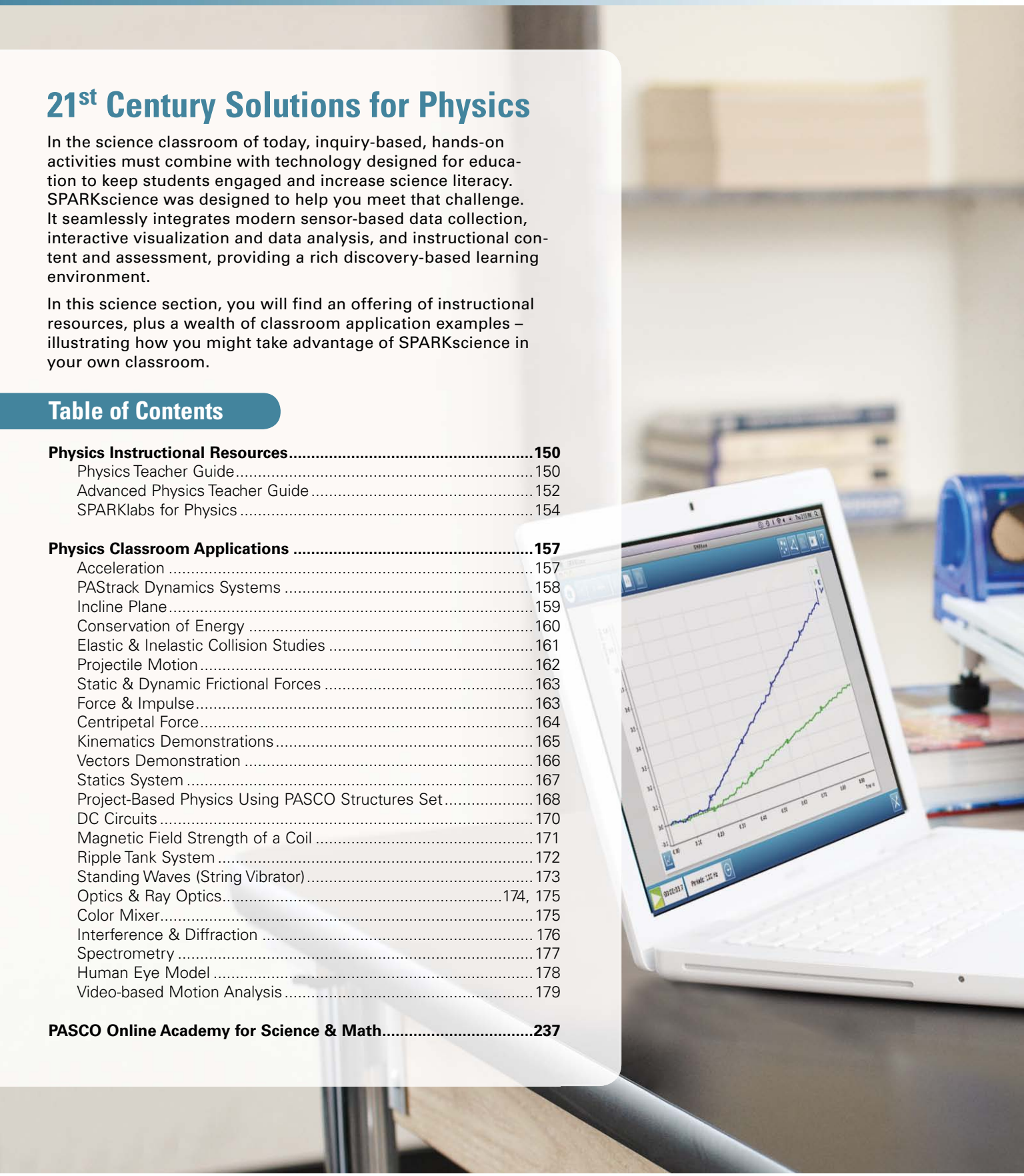
See page 122 for more information.

21st Century Solutions for Physics

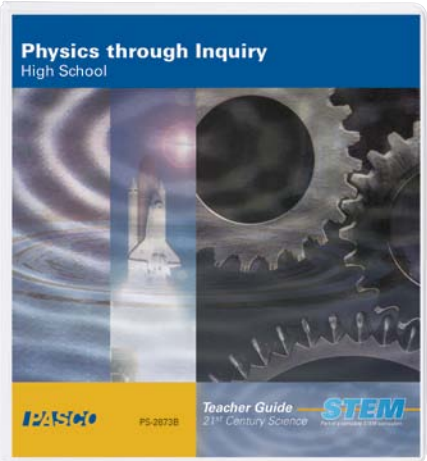
In the science classroom of today, inquiry-based, hands-on activities must combine with technology designed for education to keep students engaged and increase science literacy. SPARKscience was designed to help you meet that challenge. It seamlessly integrates modern sensor-based data collection, interactive visualization and data analysis, and instructional content and assessment, providing a rich discovery-based learning environment.

In this science section, you will find an offering of instructional resources, plus a wealth of classroom application examples – illustrating how you might take advantage of SPARKscience in your own classroom.

Table of Contents



Physics Through Inquiry Teacher Guide



Designed for Student & Teacher Success

- This standards-based, STEM-focused guide has been designed by educators.
- Core topic areas include mechanics, electricity and magnetism, optics, and thermodynamics.
- The lab activities engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer questions embedded throughout each activity.
- Activities also help students build vocabulary skills with key term challenges.
- Multiple-choice questions give students practice for standardized exams.
- The guide includes assessment and a flash drive with teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

37 Challenging Lab Activities

Absolute Zero ■
Acceleration
Archimedes' Principle
Boyle's Law ■
Centripetal Force
Charge and Electric Field ■
Circular Motion
Conservation of Energy
Conservation of Momentum ■
Faraday's Law of Induction
Heat of Fusion
Heat of Vaporization
Hooke's Law
Impulse Momentum
Introduction to Force
Inverse Square Law ■
Magnetic Field: Coil
Magnetic Field: Permanent Magnet
Newton's First Law
Newton's Second Law
Newton's Third Law ■
Ohm's Law
Pendulum
Phase Change ■
Polarization ■
Position: Match Graph
RC Circuit
Relative Motion
Series and Parallel Circuits
Simple Harmonic Motion
Sound Intensity ■
Specific Heat of a Metal ■
Speed and Velocity
Static and Kinetic Friction
Temperature versus Heat ■
Voltage: Fruit Battery/Generator
Work and Energy

■ *Lab activities with the color square require the Standard Sensor Bundle. All other activities can be done with either the Starter or Standard bundle.*

Ordering Guide

The 37 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Physics Through Inquiry Teacher Guide

- Physics Through Inquiry Teacher Guide (PS-2873B)

2 Order your sensor bundles.

Choose the bundle that aligns with the topics you want to cover.
Or build your own bundle from our over 70 sensors (see page 184).
We recommend one bundle per lab station (3-4 students).

- To perform 26 of the labs (those without the color box) in the teacher guide, order the **Starter Sensor Bundle** (PS-2923), which gives you 4 sensors.

OR

- To perform all 37 lab activities in the teacher guide, order the **Standard Sensor Bundle** (PS-2931), which contains 9 sensors.

3 Select your data collection and analysis tool.

- Get the **SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

***OR:** Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

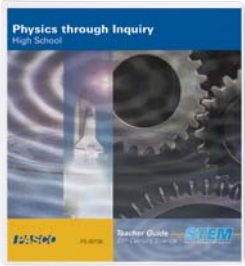
  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Remember to check your lab equipment list!

Many physics lab activities require specific apparatus and equipment.
For a full list of required equipment by lab activity, see **www.pasco.com/equip**

Physics Through Inquiry Teacher Guide

PS-2873B



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2883A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2893A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Physics Starter Sensor Bundle *(Allows you to do 26 lab activities)*

PS-2923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1. Motion Sensor (2) PS-2103A
2. Force Sensor (2) PS-2104
3. Voltage Current Sensor PS-2115
4. Magnetic Field Sensor PS-2112

Physics Standard Sensor Bundle *(Includes all Starter Bundle sensors and allows you to do all 37 lab activities)*

PS-2931


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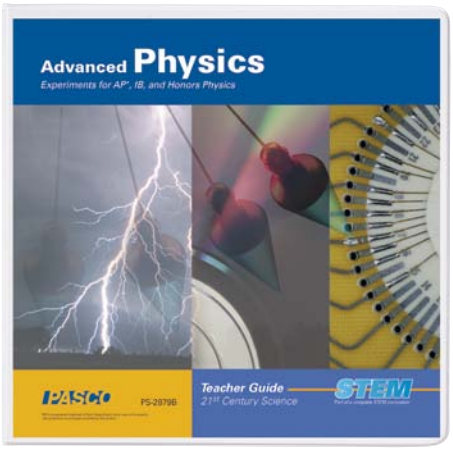
1. Motion Sensor (2) PS-2103A
2. Force Sensor (2) PS-2104
3. Voltage Current Sensor PS-2115
4. Magnetic Field Sensor PS-2112
5. Absolute Pressure/ Temperature Sensor PS-2146
6. Stainless Steel Temperature Probe PS-2153
7. Light Sensor PS-2106A
8. Sound Level Sensor PS-2109
9. Charge Sensor PS-2132

Advanced Physics Teacher Guide



Designed for Student & Teacher Success

- This guide has been designed by educators and includes AP®* Physics exam-inspired lab activities.
- Each lab includes analysis, synthesis, and multiple-choice questions.
- Three formats allow teachers to choose which degree of inquiry best suits their students' needs.
- Lab activities are designed to emulate the open AP Physics exam lab questions and use standard AP Physics graphical analysis techniques to simplify complex physical phenomena and mathematics.
- Suggested pre-lab discussions and activities (including student-take home assignments) help bridge the gap between lecture and lab.
- The printed guide provides extended inquiry suggestions to investigate topics further.
- The included flash drive contains teacher tips, the full teacher edition, and an editable MS Word version of student handouts.
- It supports use of the SPARK Science Learning System, SPARKvue, Xplorer GLX, or DataStudio.

31 Challenging Lab Activities

Introductory Material
- Measurements and Graphical Analysis
- Scientific Methods

Mechanics
- 1-Dimensional Motion: Inclined Plane
- 2-Dimensional Motion: Projectiles
- Air Drag
- Atwood's Machine
- Circular Motion
- Coefficients of Friction
- Conservation of Energy
- Determining the Acceleration Due to Gravity
- Graphical Analysis: Motion
- Hooke's Law
- Momentum and Impulse
- Periodic Motion: Mass and Spring System
- Rotational Dynamics
- Simple Harmonic Motion and Pendulums
- Work and Power

Waves and Sound
- Resonance and Standing Waves
- Wave Speed

Fluid Mechanics
- Buoyant Force
- Static Pressure and Flow

Thermodynamics
- Latent Heat and Specific Heat of Water
- Thermal Expansion
- Gas Laws

Geometric Optics
- Focal Length of a Lens
- Index of Refraction
- Interference and Diffraction of Light
- Spherical Mirror Reflection

Electricity & Magnetism
- Electric Field Mapping
- Electromagnetic Fields
- Ohm's Law: Series and Parallel Resistors
- RC Circuits

Ordering Guide

The 31 lab activities in the teacher guide are designed for use with the sensors on the opposite page and the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order the Advanced Physics Teacher Guide

- Advanced Physics Teacher Guide (PS-2879B)

2 Order your sensor bundle.

With the Advanced Physics Sensor Bundle, you will have the sensors you need to perform all 31 labs in the teacher guide. Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

- To perform all 31 lab activities in the teacher guide, order the **Advanced Physics Standard Sensor Bundle** (PS-2932), which contains 13 sensors.

3 Select your data collection and analysis tool.

- Get the **SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

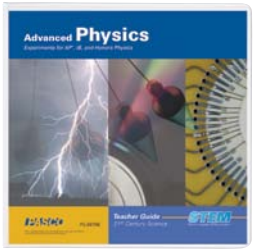
  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Remember to check your lab equipment list!

Many of the advanced physics lab activities require the combination of PASPORT sensors and PASCO's signature physics equipment. For a full list of required equipment by lab activity, see **www.pasco.com/equip**

Advanced Physics Teacher Guide

PS-2879B



Includes a printed manual and flash drive. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Flash drive contains teacher tips, a PDF of the full teacher edition, and an editable MS Word version of student handouts.

Also Available:

Teacher Guide Flash Drive only PS-2889A

(Contains all materials from the teacher guide and teacher tips in electronic format only)

Student Lab Activity Blackline Master PS-2899A

(A printed version of the same student handouts that are included electronically with both the Teacher Guide and Teacher Guide Flash Drive only)

Advanced Physics Standard Sensor Bundle *(Allows you to perform all 31 lab activities in the teacher guide)*

PS-2932

1. Freefall Adapter ME-9207B
2. Photogate Head ME-9498A
3. Motion Sensor PS-2103A
4. High Sensitivity Light Sensor PS-2176
5. Magnetic Field Sensor PS-2112
6. Barometer/Low Pressure Sensor PS-2113A
7. Stainless Steel Temperature Probe PS-2153
8. High Resolution Force Sensor PS-2189
9. Rotary Motion Sensor PS-2120
10. Absolute Pressure/Temperature Sensor PS-2146
11. Voltage/Current Sensor PS-2115

Digital Adapter (not shown) PS-2159

Sensor Extension Cable (not shown) PS-2500

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SPARKlabs

Effective inquiry-based science learning, with over 60 FREE activities

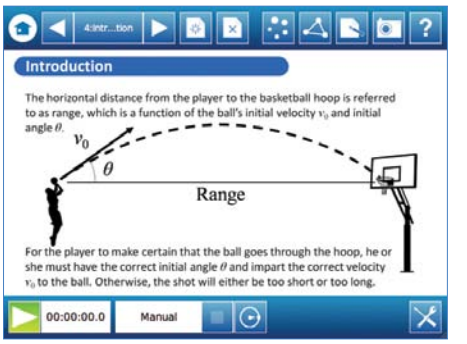
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

Think of SPARKlabs as a modern, highly interactive lab notebook—fully contained on your computer or on a SPARK Science Learning System. Then add on "guide on the side" supports embedded throughout the investigation process. Add completely seamless data collection and analysis tools. The result? Everything you need in one place to keep students focused on learning.

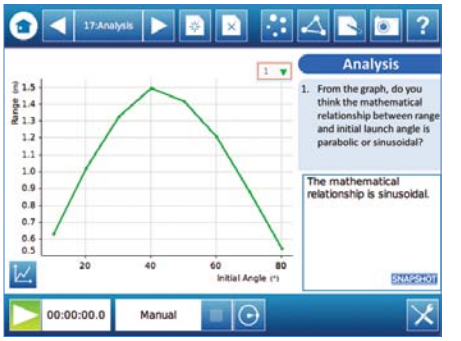
A central theme of SPARKscience is the integration of the scientific process with the learning process. Each SPARKlab includes:

- background science content
- setup guidance
- seamless integration with data collection and analysis
- embedded assessment and reflection prompts

What's more, you can even modify SPARKlabs or author your own using the SPARKlab authoring tools. Tune this exactly to the needs of your state, district, or classroom.



SPARKlabs incorporate background content, reflection prompts, and process support… everything in one place. Keep students focused on learning.



By analyzing the graph, with the help of the embedded questions, students will determine the mathematical relationship between range and launch angle.

The SPARKlab Online Library

A growing collection for 21st century science learning

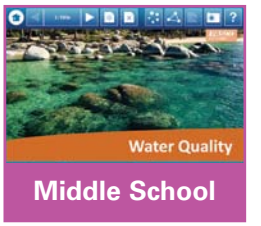
The SPARKlab Online Library is a rich collection of downloadable lab activities created by the educational team at PASCO, plus a growing set of other publishers, including Sally Ride Science, Horizon Fuel Cell Technologies, and Carolina Biological.

SPARKlabs work on SPARK Science Learning System or on your computers running SPARKvue.

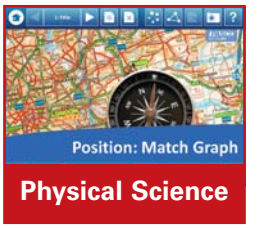
New! Run SPARKlabs on your iPad with our new SPARKvue® HD, coming spring 2012! See page 234 for more information.

See and purchase the downloadable SPARKlabs online at **pasco.com/sparklabs**

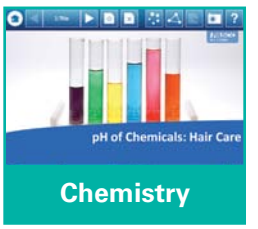
NEW! Plant Metabolism & the Carbon Cycle, Toxicology Using Yeast, and Biofuels from Fermentation



NEW! Yeast Growth, Water Quality, & Exploring Motion Graphs



NEW! pH of Household Chemicals: Hair Care & Position: Match Graph



NEW! pH of Chemicals: Hair Care, Emission Spectra: Bohr's Model, & Reaction Rates: Glucose Concentration

NEW! Diffusion, Fermentation in Yeast, & Heart Rate

NEW! Greenhouse Gases, Earth's Magnetic Field, & Seafloor Dynamics

SPARKlabs for Physics

FREE…

10 FREE Physics SPARKlabs

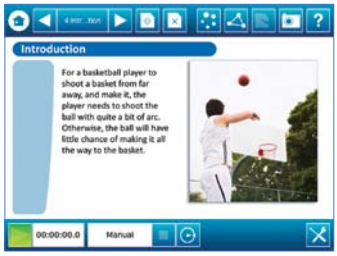
We want you to see first-hand how effective the learning experience is with SPARKscience, so we include over 60 free SPARKlabs with every SPARK Science Learning System or SPARKvue license.

The 10 free Physics SPARKlabs are shown here. For the whole list of free SPARKlabs, see page 11 or visit **pasco.com/sparklabs**

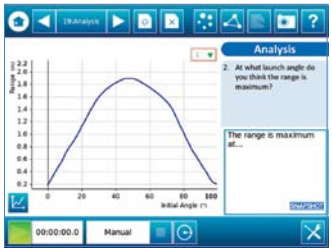
- Acceleration
- Archimedes' Principle
- Conservation of Energy
- Electromagnetic Induction
- Magnetism
- Newton's First Law
- Newton's Second Law
- Ohm's Law
- Speed and Velocity
- Voltage

Inside a SPARKlab

All background information, materials lists, safety notes and procedures are provided, keeping students in the flow of the lab, not flipping back and forth with paper reference materials.



Integrated data collection and analysis means that students immediately draw meaning from the measurements and connect them to the science concept being investigated.



New Additions to the SPARKlab Online Library!

Projectile Motion

Teacher License PS-2082
One per teacher (one license for all your classes).

Students measure the range of a projectile as a function of launch angle, and then use their data and knowledge of 2D kinematics to predict what will happen with a new set of data.

Electronic Delivery.
Upon purchase, download to your computer.

Position: Match Graph

Teacher License PS-2081
One per teacher (one license for all your classes).

Students measure back and forth motion and explore the differences between distance, position, *and* displacement. *Then, in groups, they conduct their own motion tests and display their results graphically, using a motion sensor.*

Electronic Delivery.
Upon purchase, download to your computer.

Radiation

Teacher License PS-2083
One per teacher (one license for all your classes).

Using a Geiger-Müller tube, students measure the effectiveness of different shielding materials against radioactive exposure. Then they create their own experiment to reduce radioactive exposure.

Electronic Delivery.
Upon purchase, download to your computer.

Physics Starter Sensor Bundle for SPARKlabs

Get the sensors needed to conduct the 10 free Physics SPARKlabs included with your SPARK Science Learning System or SPARKvue license.

10 Free Physics SPARKlab Activities

- Acceleration
- Archimedes' Principle
- Conservation of Energy
- Electromagnetic Induction
- Magnetism
- Newton's First Law
- Newton's Second Law
- Ohm's Law
- Speed and Velocity
- Voltage

Physics Starter Sensor Bundle

PS-2923

1. Motion Sensor PS-2103A
2. Voltage/Current Sensor PS-2115
3. Magnetic Field Sensor PS-2112
4. Force Sensor PS-2104

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Ordering Guide

The 10 Physics SPARKlab activities are designed for use with the sensors above and with the SPARK Science Learning System or with SPARKvue and SPARKlink on your own computers.

1 Order your sensor bundle.

- To perform the 10 free SPARKlab activities, order the **Physics Starter Sensor Bundle** (PS-2923); which contains the 4 sensors shown above.
- Or build your own bundle from our over 70 sensors (see page 184). We recommend one bundle per lab station (3-4 students).

2 Select your data collection and analysis tool.

- **Get the SPARK Science Learning System** (PS-2008A), a fully integrated science solution, which can be used in the classroom or in the field. Use stand-alone or connect to your own computers. Order one per lab station. (See pp. 8-9 for more SPARK info.)

OR: *Use our SPARKvue software on your own computers.*

- **Order SPARKvue and SPARKlink** and connect your sensors to your own computers. Works great on interactive whiteboards and LCD projectors, too.

  Order one SPARKvue Site License (PS-2400) per K-12 campus and install on every computer.

  Order one SPARKlink (PS-2009) per lab station.

  (See pp. 6-7 for more info on SPARKvue and SPARKlink.)

Using the PAStrack with low-friction PAScars and a Motion Sensor, students get highly accurate, repeatable results when studying motion.

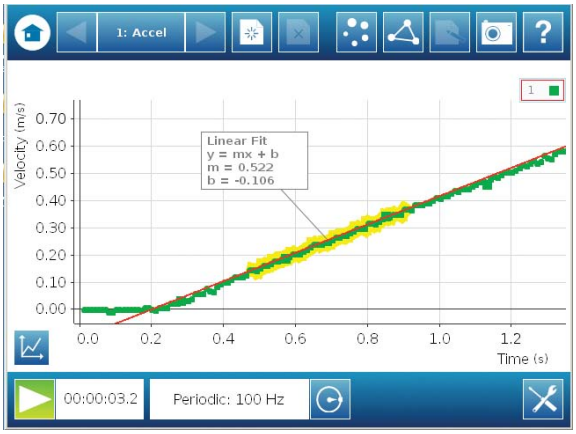
Sample SPARKlab Activity: Acceleration

Students will use a cart and track to explore the concept of acceleration. In addition to helping students gain the understanding that acceleration is the rate of change in velocity, this activity will also explore the vector-nature of acceleration and frames of reference.

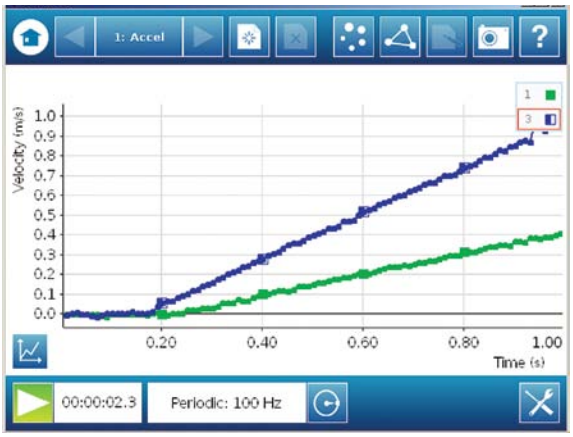
Releasing a cart down a track outfitted with a Motion Sensor will yield a velocity vs. time graph that can be analyzed by finding the acceleration as slope of a linear fit curve. Investigate what happens if the car is instead pushed up the track, reaching its peak height and then allowed to fall back down?

Students should recognize that the car changing direction means the velocity is both positive and negative at different points during its travel. What about the acceleration?

By analyzing the graph students will come to understand that the acceleration is constant for the entire trip.



The slope of a velocity vs. time graph yields the cart's acceleration.



Multiple trials at various angles show that acceleration increases as the incline does.

The PAStrack Basic System is a must for your physics lab, providing a foundation for your lab activities throughout the year.

PAStrack Dynamics Systems – a versatile set of equipment for your physics classroom

Want a 6 meter track for a massive momentum demonstration? Or just a 0.5 m section of track for an optics experiment? This PAStrack system gives you all the flexibility you need in the physics lab. Your PAStrack system starts at a 1.0 m track length (2 half-meter track lengths—great for storage). Grow it when you need to—just snap together additional track segments.

PAStrack is designed for lab experiments. Measure distances right on the track with its built-in scale—no need for students to fumble with meter sticks or struggle to release carts from the same position over multiple runs. Motion Sensor mounts right to the track—just slide onto the end. And leveling feet make good results easy to achieve.

PAStrack also stands up to the demands of the high school environment. Rugged and tough, the molded plastic tracks will survive years and years of use. And the light weight, low-friction PAScars feature spring-loaded suspensions to protect them from drops or being stepped on.

Extend the capabilities of your PAStrack system with a wide range of accessories, from friction, ballistic and sail carts to an optics kit. (Yes, this doubles as an optics bench! See page 174 for details.) This PAStrack system is one piece of equipment that will be used throughout the year.

Basic PAStrack Dynamics System

ME-6962

Includes two 0.5m lengths of PAStrack, leveling feet, 2 track connectors, two adjustable end stops, two PAScars (one red, one blue), two 250g masses.

Also Available:

PAStrack (track only) ME-6960

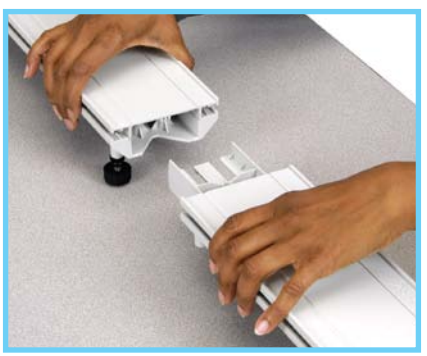
Extend your track an extra 1.0 m or more in 0.5 m increments.

Leveling feet

Built-in scale

TYPICAL APPLICATIONS

- Predicting acceleration
- Sliding friction
- Newton's Second Law
- Collisions (see the next page)
- Conservation of Energy
- And many more!

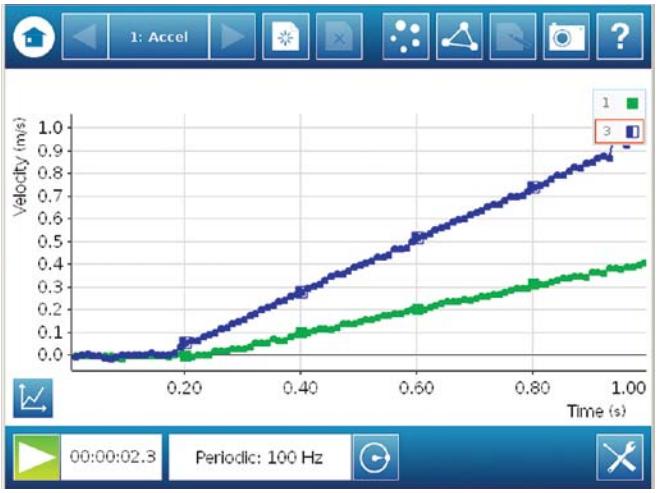


The inclined plane accessory allows students to easily change and precisely measure the angle of the incline.

Simplify inclined planes

The Inclined Plane Accessory for the PAStrack system allows students to convert their PAStrack into an inclined plane and establish the angle with complete accuracy.

A far cry from a wooden plank on stacks of books, the PAStrack Inclined Plane Accessory is simple, secure and accurate. By adding a PASPORT Motion Sensor the motion (acceleration, position, velocity) of a cart can be monitored and graphed with precision.



Students can easily measure the difference in acceleration at various angles and even extrapolate to find "g".

PAStrack Inclined Plane Accessory

ME-6965

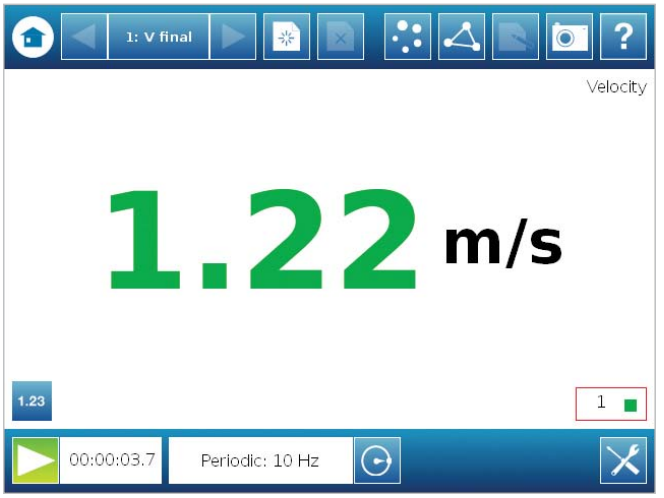
Setup shown above includes:

Basic PAStrack Dynamics System ME-6962
PAStrack (extra 1.0 m track) ME-6960
Motion Sensor PS-2103A

Will the PAScar be going any faster at the bottom if a mass is added? With the Curved PAStrack and a low friction PAScar, students can investigate the conservation of energy and answer that question.

Use your PAStrack system for Conservation of Energy

A recent addition to the long line of accessories and components for the PAStrack system, the Curved Track gives your students the ability to create an ideal hill for conservation of energy experiments. By placing a photogate at the bottom of the hill, the final velocity of a PAScar can be determined. By measuring the initial height and using the mass of the PAScar, the initial potential energy and final kinetic energy can be calculated. Because the PAStrack is designed for use with the low friction PAScars, energy lost to heat will be minimal.



Finding the velocity of the PAScar at the bottom of the track allows students to compare initial potential energy with final kinetic energy.

Photogate Head

ME-9498A

Also required for this set-up:

Digital Adapter PS-2159
Photogate Bracket (2-pack) ME-9806
Cart Picket Fences (2) ME-9804

PAStrack Curved Track

ME-6841

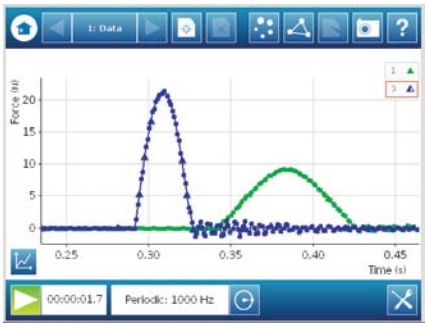
Includes 2 pieces of curved track, (1 convex, 1 concave) and 2 connectors.

For measurement, add the Photogate Head and required parts at left.

A Simple Accessory for Elastic Collision Studies

The PASCO Discover Collision Bracket provides an easy way to increase the functionality of your PAStrack set. Built to connect to the Force Sensor, the Discover Collision Bracket is easily mounted on the end of your PAStrack. Students can roll a PAScar into the spring bumpers—one soft, one firm—and the sensor will measure the force and impulse of the collision. Add mass to the cart, change the spring, or adjust the cart's initial velocity to see how those factors affect the data collected and the graph display. Adding a Motion Sensor gives the full picture of how an impulse causes a change in momentum.

Dramatically demonstrate force and duration using the Discover Collision Bracket.



Visibly different curve shapes for different springs develop understanding of impulse.

Discover Collision Bracket

ME-8973

Includes 2 springs with different spring constants.

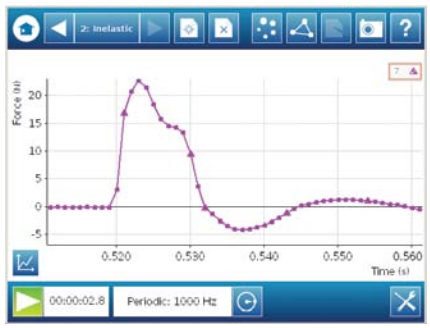
Or Study Both Elastic and Inelastic Collisions

Similar to the Discover Collision Bracket, the PASCO Force Accessory Bracket also provides the ability to mount a Force Sensor to a PAStrack. But this accessory gives a much greater wealth of options for studying impacts using PAScars.

TYPICAL APPLICATIONS

- Spring bumpers for partially elastic collisions
- A rubber bumper used to dampen a collision
- Collision cup and clay for an inelastic collision
- Magnetic bumpers for a completely elastic collision

Both accessories are great options for studying forces and impulse during collisions.



Students see the deformation of the clay and how it changes the force of stopping the cart.

Force Accessory Bracket

CI-6545

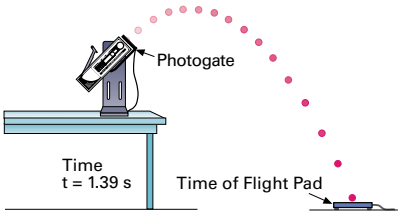
Includes 2 spring bumpers (different spring constants), magnetic bumper, rubber bumper, clay cup and clay (for inelastic collisions), and Phillips head screwdriver.

Projectile Motion that hits the mark

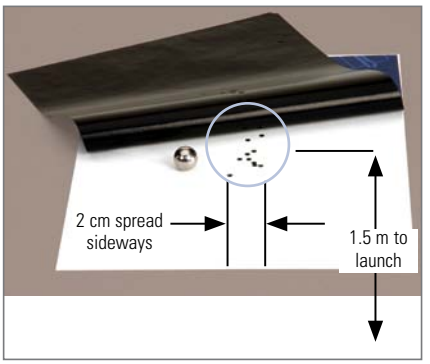
Why suffer the frustration of projectile launchers that fail to achieve consistent results? The PASCO Mini Projectile Launcher provides a low-cost way to thoroughly investigate projectile motion. With three highly repeatable launch velocities, precise launch-angle measurement, and even the ability to shoot downward, students can study the exact motion of a projectile. Mount two Photogate Heads to the end of the launcher and students can get an accurate measurement of launch velocity as well as launch angle. Perform any range of projectile activities including complementary launch angles and the ever-popular hit-the-target challenge.

Time of Flight

Get a precise measurement for the time a projectile ball from the Mini-Launcher is in the air. When the ball is launched or dropped, a Photogate starts the timing. When the ball hits the plate of the Time-of-Flight Accessory, a signal is sent to the interface to stop the timer.



Add the Time-of-Flight Accessory and a Photogate head and all of the aspects of projectile motion can be studied.



Students get accurate and repeatable results with the Mini Projectile Launcher.

Mini Projectile Launcher

ME-6825A

Includes launcher base, projectile balls, loading rod, safety glasses, 2-D collision accessory and manual.

Photogate Head

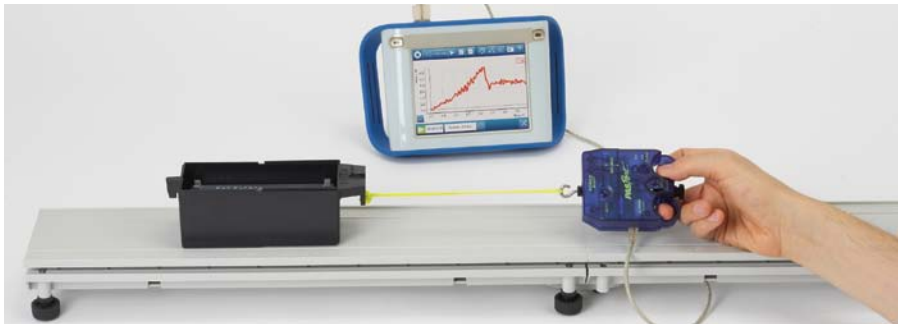
ME-9498A

Also Requires:
Digital Adapter PS-2159
To Attach to Launcher:
Photogate Mounting Bracket ME-6821A

Time-of-Flight Accessory

ME-6810

Also Requires:
Digital Adapter PS-2159



Students observe the graph to see that force increases until the block starts moving, after which it stays constant as the block slides.

See static and dynamic frictional forces at work

Simple and effective, pairing a Force Sensor and the Discover Friction Set allows students to investigate static and kinetic friction and display the results graphically. They will see that the force increases until the tray finally moves, but then it stays constant once moving. The different surfaces on the friction trays provide different coefficients of friction.

Compare static and kinetic friction or investigate the coefficients of friction for different surfaces.

Discover Friction Accessory

ME-8574

Includes 4 Friction Trays (1 felt, 1 cork, 2 plastic).

Force Sensor

PS-2104

Finger holes are provided for hand-held use.

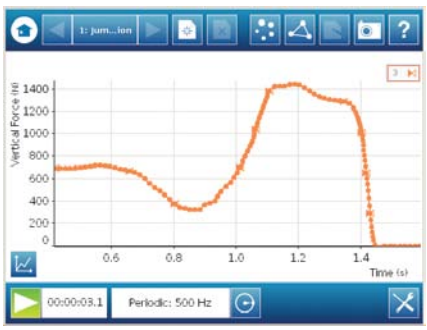
Bumper and Hook not shown

Get students involved! Using the Force Platform makes a fun and instructive way to study force and impulse.

Force Platform

PS-2141

Includes 2 loops on the side to hang it on the wall.



Using SPARKvue students can clearly identify all parts of a jump and the forces associated with them.

Measure the Force and Impulse of Jumping

Students can learn the concepts of force, acceleration, momentum and impulse in a very direct way – with an experiment that actively involves them. By using the Force Platform students can study the physics involved in jumping and instantly see a detailed graph showing the forces exerted over time. Easily calculate the impulse, maximum force or even a student's hang time.

The force platform can also be used to:

- Investigate Newton's Third Law using a pair of platforms pushed against one another.
- Measure the normal force of a person riding in an elevator.
- Perform a full Impulse-Momentum activity with a bouncing ball and a Motion Sensor.

What are the factors that influence the force needed to keep an object in circular motion? With the Discover Centripetal Force Kit and a Force Sensor students will be able to answer that question for themselves.

A Swinging Good Time

Dramatic, effective and fun – the Discover Centripetal Force Kit is all things that good science education is all about. This low-cost kit allows students to directly investigate how the factors of mass, radius and radial velocity affect the amount of centripetal force needed to keep an object moving in a circle.

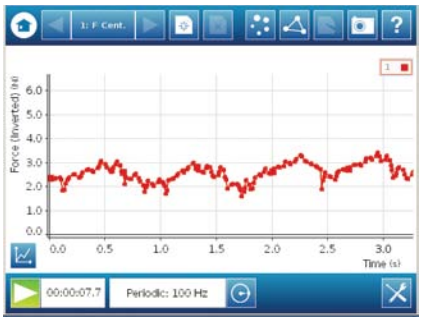
As the rubber stopper is swung about in a horizontal circle, students will quickly and intuitively find the correct speed to keep it moving uniformly. From that speed, the weight needed to balance the rotation, and the radius, the relationships of all the variables can be determined. Add a Force Sensor for even more accurate data and to create graphs for further analysis. (Use with your SPARK Science Learning System or with SPARKlink and SPARKvue on your own computer.)

Discover Centripetal Force Kit

ME-9837

Includes rubber stoppers (5 sizes), plastic ties, yellow string, hollow tubes.

Recommended for Quantitative Measurement of Forces:
Force Sensor PS-2104



By changing variables such as the mass of the stopper or the radius of the circle, students can see how the centripetal force changes.

Force Sensor

PS-2104

The Bicycle Gyroscope with the Rotating Chair gives you a perfect demonstration of the conservation of angular momentum.

Demonstrate Kinematics – with Gyroscope Physics

The newly redesigned Bicycle Gyroscope is perfect for getting your students engaged in understanding rotational motion. Unlike other bicycle gyroscopes, the PASCO model is extremely rugged for years of use, but also lightweight at just 6 lbs. Cushioned hand-grips, a pull-cord with handle, and an included suspension cord (for demonstrating precession) make it simple and easy to use.

FEATURES:

- Cushioned hand-grips
- Precision ball bearings for low friction
- Non-marking rubber tire

Bicycle Gyroscope

ME-6837

Includes Bicycle Gyroscope and 2 cords with handles.

Rotating Chair

ME-6856

Includes chair and rotating platform with leveling feet.

Ask two students to rotate seemingly identical wands as rapidly as they can. No matter how strong the students are, the one rotating the red wand will always be faster.

Experience Rotational Inertia

These two wands have the same mass and the same dimensions, and yet the red wand is easier to rotate. Why? The red wand has two metal slugs near its center, while the blue wand has two similar slugs at its ends.

Students get to experience for themselves that rotational inertia depends not only on the mass, but also on how that mass is distributed relative to the axis of rotation. Small openings in the wands allow students to see where the masses are located and solve the mystery.

Rotational Inertia Wand

ME-9847

Includes 1 red wand
1 blue wand

SPECIFICATIONS

Length: 1 m

Ratio of blue rotational inertia to red: Approx. 6

Measure Tension and Angles to Teach Vectors

Students will finally see the relationships you've diagrammed on the board.

A spring scale and protractor cleverly integrated into one device, the Tension Protractor is ideal for teaching vectors. When students can see the change in string tension as the angle of the support strings change, they truly begin to understand the relationships. The precise scale can be used for conceptually understanding whether the tension increases or decreases as the angle changes, and it also allows for calculations and mathematical analysis. Either way, vector analysis will become easy for your students when using the Tension Protractor.

Since the Tension Protractor is supported on a rod, it has an advantage over other spring scales, which tend to weight down the string, changing the angle. The string is wrapped once around a small pulley that is spring-loaded. The torsion spring scale is carefully calibrated at the factory and can be zeroed by the user with a thumb screw on the back. The red arrow indicates tension and is color-coded to match the Newton scale.

Even if the mounting rod is not plumb, the Tension Protractor's degree scale can be adjusted to read 90 degrees vertically. Just rotate the outer ring until the string with a hanging mass aligns with the 90 degree indicator.

Tension Protractor®

ME-6855

Shown with:
Large Table Clamp ME-9472
90 cm Stainless Steel Rod ME-8738
Multi-Clamp ME-9507
Hooked Mass Set SE-8759

FEATURES

- Conveniently measure both tension and angle
- Large scale for viewing demonstrations
- Zero-adjust for torsion spring scale
- Built-in rod clamp for quick horizontal or vertical mounting

SPECIFICATIONS

Force Range: 0 N to 10 N
Angle Range: -90° to +90°

The New Statics System

The new Statics System is a versatile lab system for demonstrating the basic concepts of vector forces, torques, center of mass, simple machines, and more. With magnetic mounting, setup is easy, as is storage. Included in the system are all the components you need for 15 experiments, including a comprehensive manual.

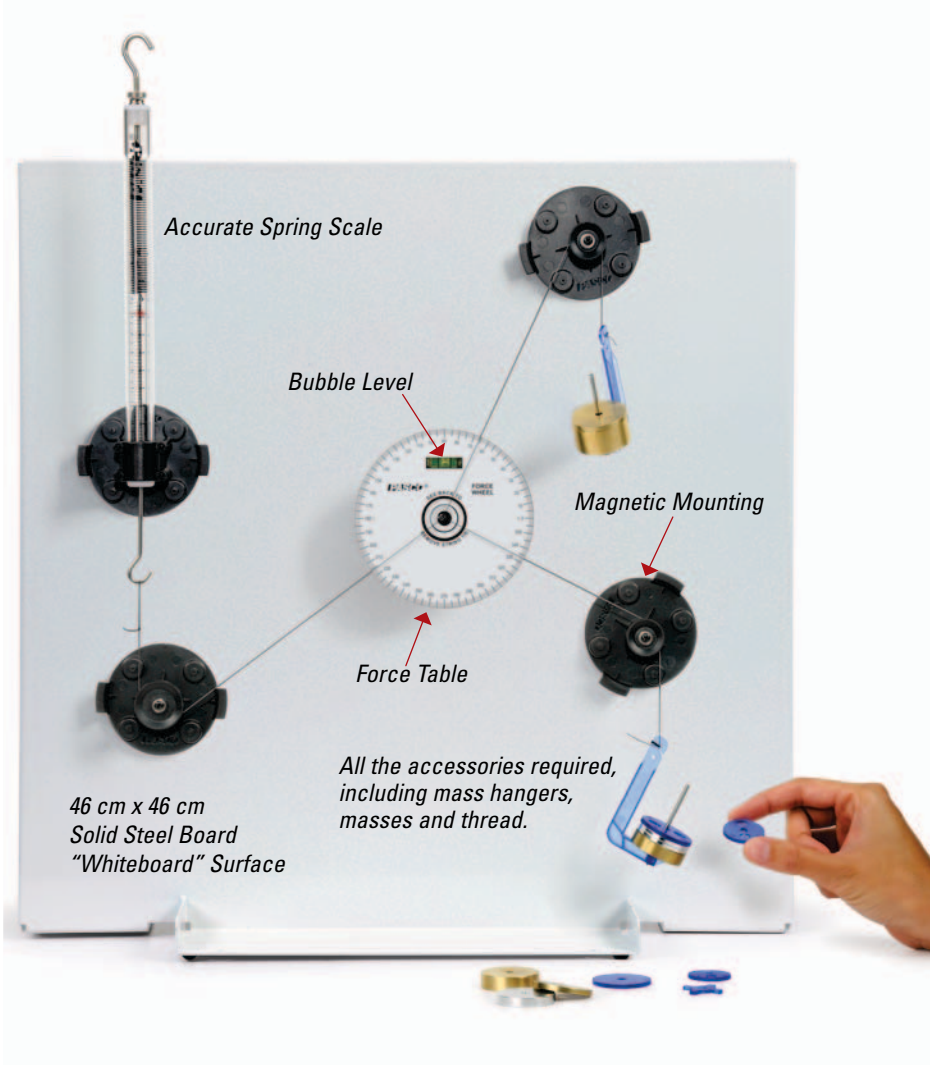
Students can analyze forces on an inclined plane or use the balance beam to investigate torque. You can vary the force, the lever arm, and the angle. Built-in scales make measurement easy.

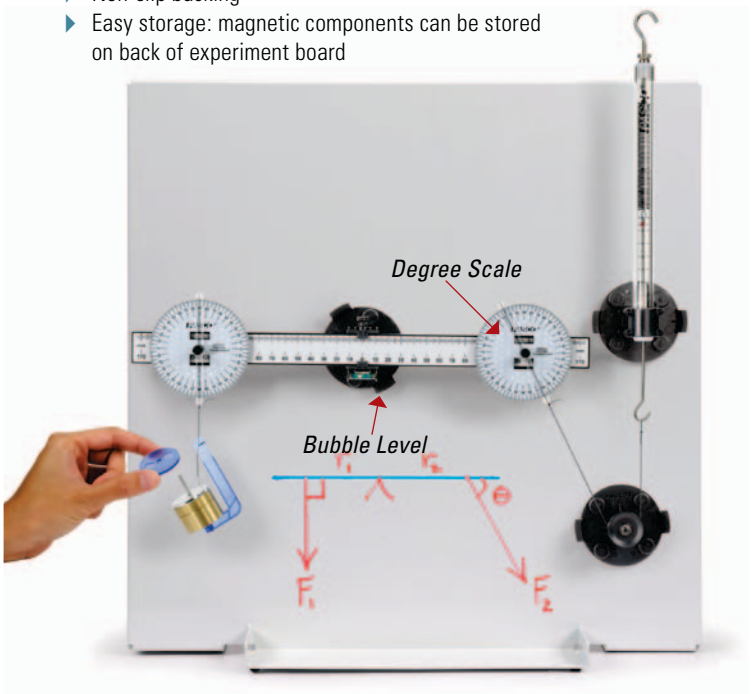
THE STATICS SYSTEM INCLUDES

- Solid steel experiment board (46 cm x 46 cm) with whiteboard-type surface
- Comprehensive manual
- Mass set
- Neodymium magnets
- Accurate spring scale
- Degree scale
- Bubble level
- Magnetic mounting
- Friction block
- Low-friction cart
- Force table
- Mass hangers
- Masses
- Thread

FEATURES

- Low-friction ball bearings
- Handle for easy placement and removal
- Non-slip backing
- Easy storage: magnetic components can be stored on back of experiment board





Statics System

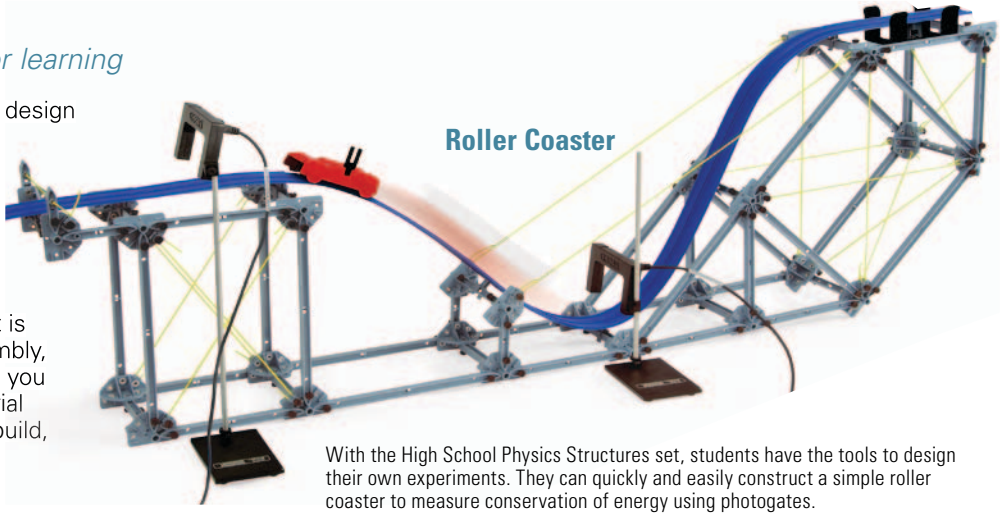
ME-9502

Includes experiment board, components, mass set, and comprehensive manual.

Project-Based Physics

A structures set designed for learning

Give your students the flexibility to design and build engineered structures – almost unlimited flexibility leads to roller coasters, catapults, shake towers, bridges, booms and much more. Many times a project results in just a single build and it either works or doesn't. The High School Physics Structures Set is designed not just for ease of assembly, but also ease of adjustment. When you want your students to learn from trial and error, use this set to let them build, adjust and retest.



Roller Coaster

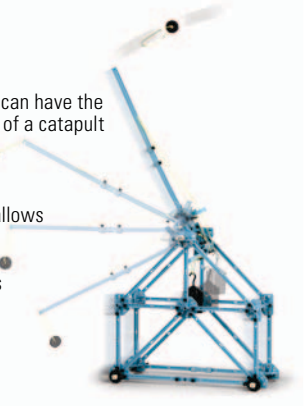
With the High School Physics Structures set, students have the tools to design their own experiments. They can quickly and easily construct a simple roller coaster to measure conservation of energy using photogates.

Ski Jump Assembly

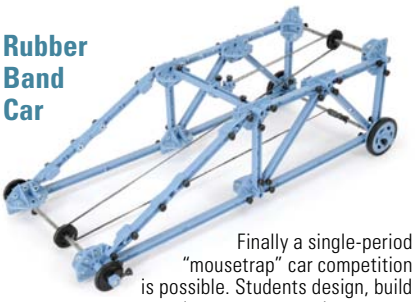
A classic physics competition when studying projectiles is challenging students to hit a specific target. Go one step further and have them design their own ramp.

Catapult

Now your students can have the fun and excitement of a catapult competition without a huge investment of time. Rapid prototyping allows students to learn from experience and change designs quickly.



Rubber Band Car



Finally a single-period "mousetrap" car competition is possible. Students design, build and test a car to explore energy storage, efficiency and losses.

There's really no limit to what can be built

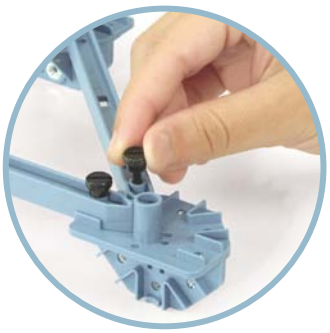
Use the Structures Set for fun and instructive student competitions. See which group can build the catapult that launches the farthest, the rubber-band car that travels fastest, or the ramp that launches a car closest to a target.

Or study more traditional physics concepts. Create a teeter-totter to investigate torque or bring a classic textbook diagram to life by investigating the frictional force on a ladder leaned against a wall.

At the heart of the set is a large number of solidly constructed I-beams of various sizes, and connectors that allow them to be quickly screwed in place at a variety of angles. There are also sliding connectors, a road bed and car, drive wheels and more. Construction and changes to any design are quick and simple.

Once your structures are built, add sensors to measure force, position, velocity and acceleration. Literally in minutes, students can create their own unique apparatus to explore and measure physical quantities.

I-beams fit into the connector slots and secure with thumb screws.



Thumb screws are slotted – secured by hand or with screwdriver.

Measure forces in your structures! Add a Load Cell to measure tension and compression. See page 169 for details.

Ladder

Put your students to work testing and solving the "ladder problem" on their own. A great way to internalize a tough concept.

The High School Physics Structures Set allows students to construct a nearly limitless array of structures and even measure forces at any point in their design.

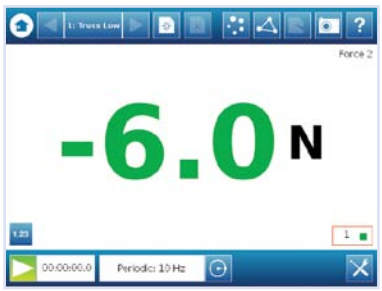
Setting Up a Testing Station

One way to save money and maximize equipment in the classroom is to have one or two sets of Load Cells and Amplifiers and use them to create testing stations. Rather than equip every group of students with sensors, you can have them build their structures and then bring the individual designs to a designated area to use the Load Cells and Amplifier for data collection. Once their force data is recorded, it can be analyzed with SPARKvue software.

From Qualitative to Quantitative

Building a structure is one thing but being able to measure the forces acting on it at any location is quite another. It is this feature that separates PASCO's Structure System from any other product on the market. PASCO Load Cells are designed to be inserted anywhere in a structure and measure tension and compression of both static and dynamic loads. Because a Load Cell can be quickly and easily substituted for any I-beam, there is no need to disassemble the structure to add instrumentation or change the location of a Load Cell. Students can even use multiple Load Cells and simultaneously measure forces at more than one point.

A cost-effective way to get started is using the Load Cell and Dual Amplifier Set shown below.



Display tension and compression data from anywhere in a structure.

Fastened with thumb screws directly to I-beams, Load Cells can be placed at any location.

For many more PASCO Structures options, see www.pasco.com/structures

High School Physics Structures Set

ME-7000

Includes 74 I-Beams of various sizes, connectors, road bed and car, axles and instruction manual. For complete list of parts see pasco.com/structures

Patents Pending

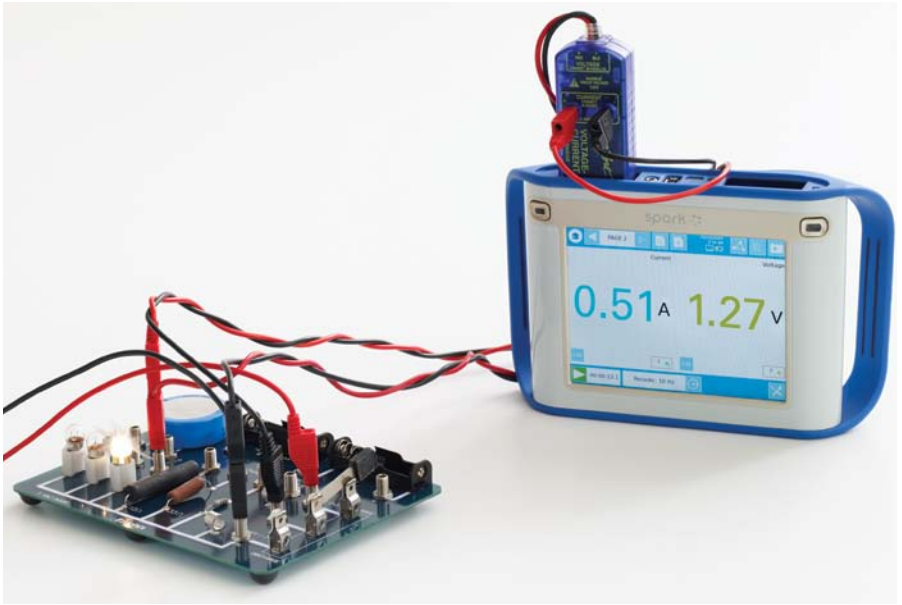
Load Cell and Dual Amplifier Set

PS-2206

Add a second Load Cell:

100N Load Cell PS-2200

Patents Pending

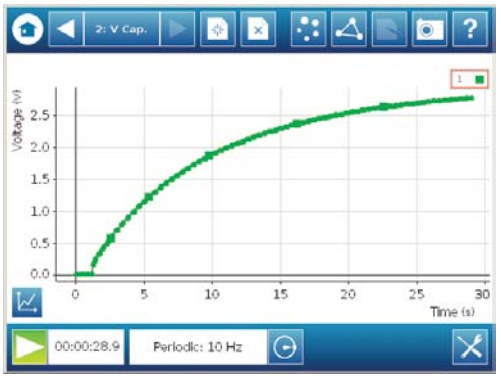


It's easier for students to focus on concepts when they can create circuits quickly.

Observe and measure the behavior of DC circuits

The Charge/Discharge Circuit provides a convenient way to build and test circuits using batteries, capacitors, light bulbs and resistors with an open slot to insert the component of choice.

Students can charge the capacitor with batteries, then discharge through a resistor or light bulb. They measure the voltage and current as the capacitor discharges, and can use the graph display to analyze the relationship between voltage and current for various components.



Students can build and test a circuit, displaying their results graphically.

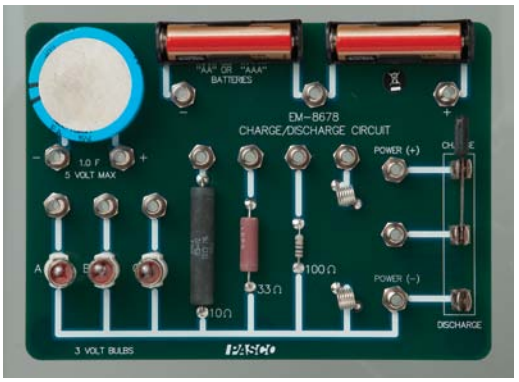
Measure Voltage, Current and Power

The Voltage/Current Sensor measures all three electronic properties simultaneously making it a great solution for studying parallel circuits, exploring Ohm's Law, measuring the power used by an electrical device, and investigating capacitor charge and discharge.

Charge/Discharge Circuit

EM-8678

Includes circuit board, 1 Farad Capacitor, 3 light bulbs, 3 resistors (10 Ω, 33 Ω, 100 Ω), battery holders, double throw knife switch and instruction manual.



Requires AA or AAA batteries (not included)

Voltage/Current Sensor

PS-2115

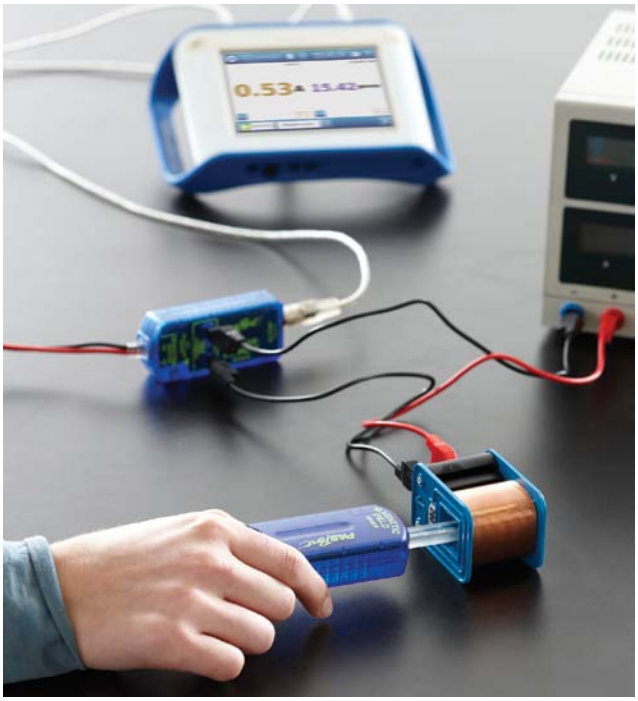
Includes 2 pairs of voltage leads and 1 pair of alligator clips.

Recommended:
Alligator Clip Leads (set of 10) EM-8634

Study the Magnetic Field Strength of a Coil

Using a Magnetic Field Sensor and a Voltage/Current Sensor, students will measure the current in a coil of wire and the magnetic field in the coil. Comparing the strength of the fields of different coils, students will create a graph to display their results, allowing them to discover the linear relationship between current and the induced magnetic field.

Students can monitor data as they measure field strength within the coil.



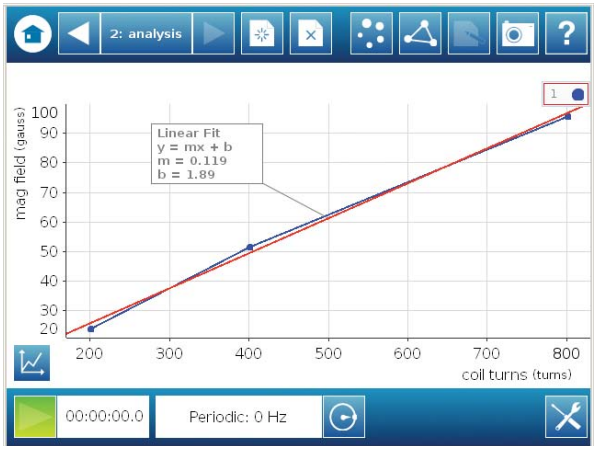
Students can easily measure the magnetic field in different coils with the Magnetic Field Sensor.

Coil (200 turn)

SF-8609

Additional Coils Available:

Coil (400 Turn) SF-8610
Coil (800 Turn) SF-8611
Coil (1600 Turn) SF-8612
Coil (3200 Turn) SF-8613



With real data the relationship between number of windings and magnetic field strength is clear.

Student Power Supply (18 VDC, 3 A)

SE-8828

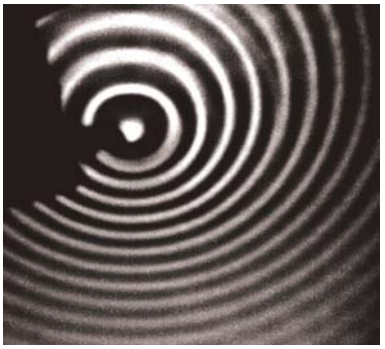
This high quality, compact power supply provides the DC voltage and current levels necessary for most introductory student labs.

Magnetic Field Sensor

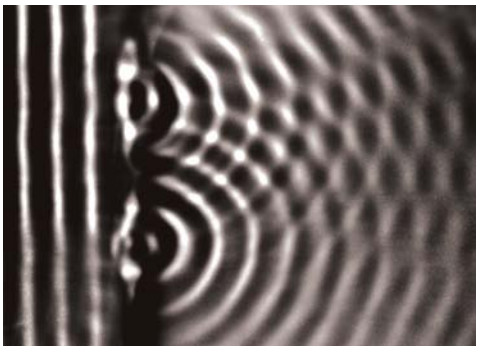
PS-2112

Recommended:

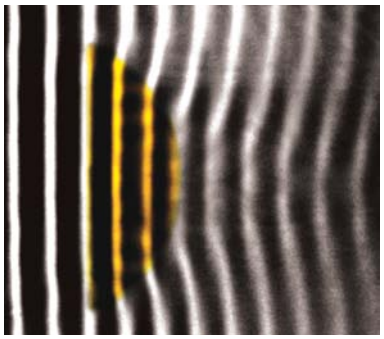
Sensor Extension Cable PS-2500



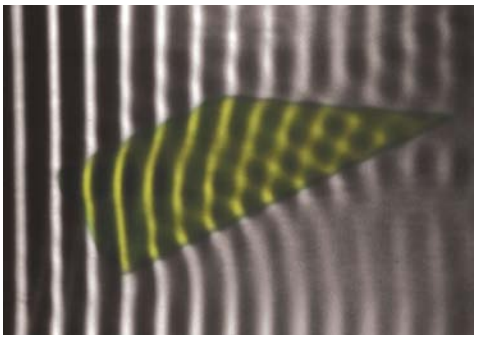
The Doppler Effect becomes visible as the source moves.



Patterns from a double slit help students understand the mechanics of interference.



Refraction over a lens shape shows how waves are focused.



Refraction over a rhomboid shape.

Making waves and making their properties easy to see

Whether you use the PASCO Ripple Tank for demonstrations or for student exploration, the bright display and small volume of water make it an ideal addition to your lab equipment. Using the ripple generator, strobe light and viewing screen, students will be able to see the motion of waves and how they interact with each other and their surroundings. Students can explore wave speed, reflection, refraction, the Doppler Effect, diffraction and interference to understand wave motion. They get a conceptual framework for studying those same properties when discussing sound or light.

The completely redesigned PASCO Ripple Tank System is now easier to use, more reliable, more flexible, and more affordable.

FEATURES

- Integrated strobe/ripple generator for simplified operation
- A frequency range that includes important low frequencies to make refraction more prominent
- White LED light source remains cool during use, producing a bright clear wave pattern

Ripple Tank System

WA-9899

Includes tank, ripple generator, light source, mirror, projection screen, strobe mounting rod, reflectors, refractors, barriers, storage case and more. For complete information, see pasco.com

Shed some light on standing waves or any other fast-moving objects

Standing waves are a concept that students really need to see to fully understand. Using a ring stand, clamp and the PASCO Sine Wave Generator and String Vibrator, it is easy to generate and precisely control patterns of constructive and destructive interference. Allow students to find the fundamental frequency and then discover – individually or in a group – the pattern for all the additional harmonic frequencies.

With the new PASCO Strobe System you can slow down or "freeze" these waves for close examination. Its modular nature and low cost separate it from traditional strobes. Being LED-based, the PASCO Strobe Modules are more easily focused on their actual target while still being bright enough for viewing in a large classroom or lecture hall.

FEATURES

- Adjustable light intensity
- Use up to four strobes per controller
- External trigger to daisy-chain multiple controllers together
- Trigger strobe using external input such as a photogate

Strobe

ME-6978

Includes control box and one modular LED strobe.

Also Available:

Additional LED Strobe Module ME-6982

String Vibrator

WA-9857

Includes string vibrator unit, constant frequency power supply (60 Hz), and wave cord (3m).

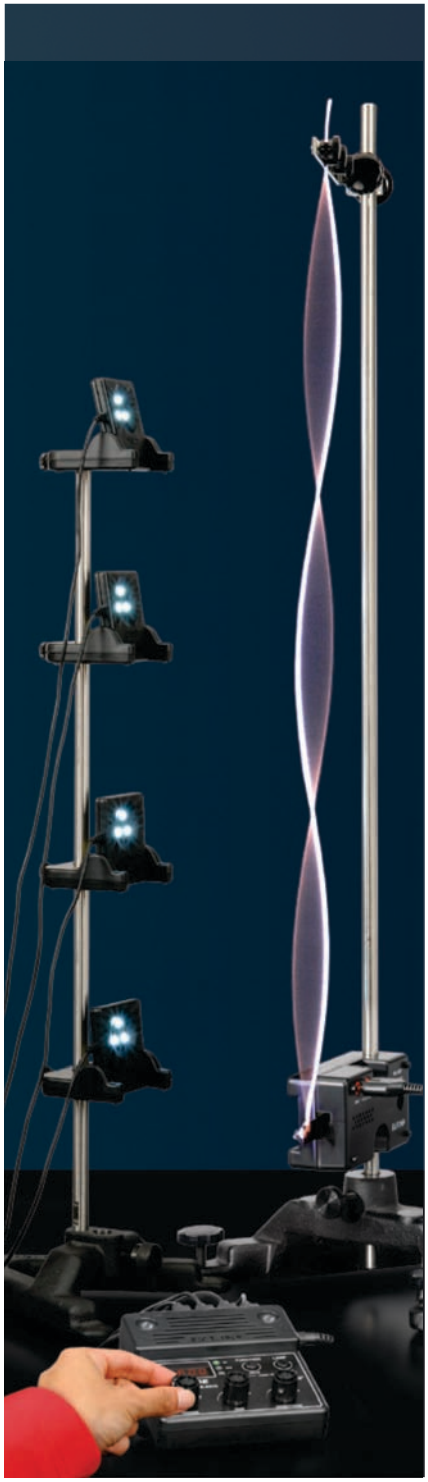
Recommended:

Sine Wave Generator WA-9867

Sine Wave Generator

WA-9867

Includes power supply



Bright LED lamps let students see the relationship between string length, tension and resonant frequencies of standing waves.

MORE PHYSICS FROM PASCO

See our 2012 Physics & Engineering Catalog for an extensive offering of physics teaching equipment and apparatus. Request your catalog today online at:

pasco.com/catalog

See, test and understand how lenses work using the Dynamics Track Optics Kit.

Seeing the Light

Optics at an affordable price

There is no need to break the bank to bring high-quality optics equipment into your physics classroom. Existing PAStracks can double as an optics bench simply by adding the Dynamics Track Optics Kit. Components snap directly onto the track and slide for positioning anywhere along the track. The versatile light source can be used on the track or as a table-top ray box for studies of reflection, refraction, color-addition and Snell's Law.

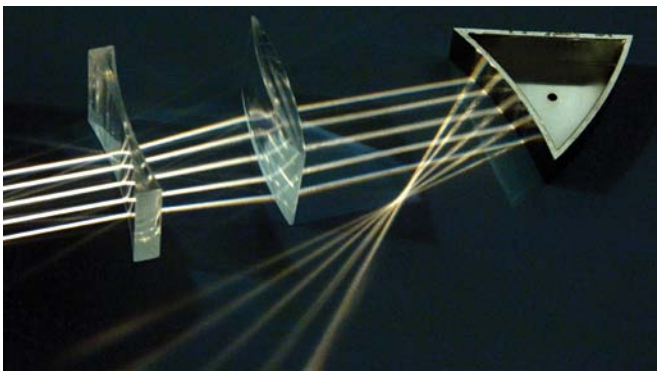
For tabletop ray optics studies, use the Light Source (OS-8470) and Ray Optics Kit lenses and mirrors without a PAStrack.

Dynamics Track Optics Kit

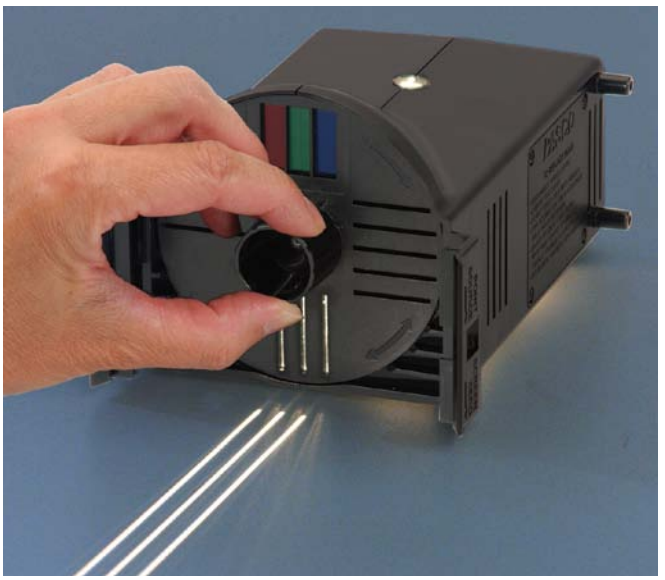
OS-8471A

Includes Basic Optics Light Source (Point, Object, Rays, Primary Colors), 2 adjustable lens/mirror holders, Geometric Lens Set (+100mm, +200mm and -150mm focal length), Viewing Screen, three Optics Carriages.

Required for mounting on a PAStrack:
PAStrack Basic System ME-6962



There is no substitute for students actually seeing light rays interact with lenses and mirrors. This affordable set lets them do just that.

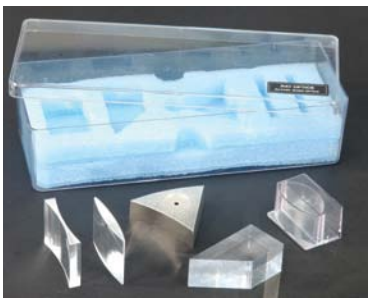


Students can use the light source with or without the track to explore optics.

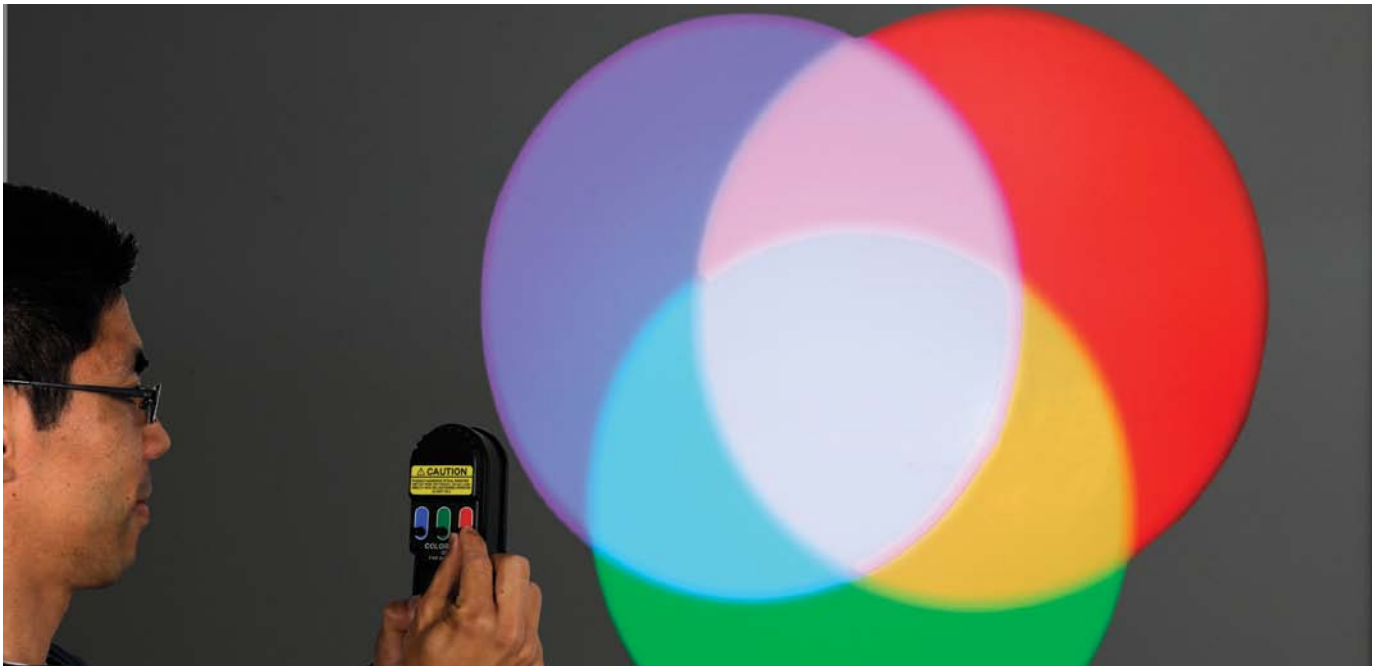
Ray Optics Kit

OS-8516A

Includes Double-Convex Lens, Double Concave Lens, Rhomboid Triangular Mirror with Concave, Convex and Plane Reflective Surfaces, Hollow Lens to fill with air, water or other liquid.



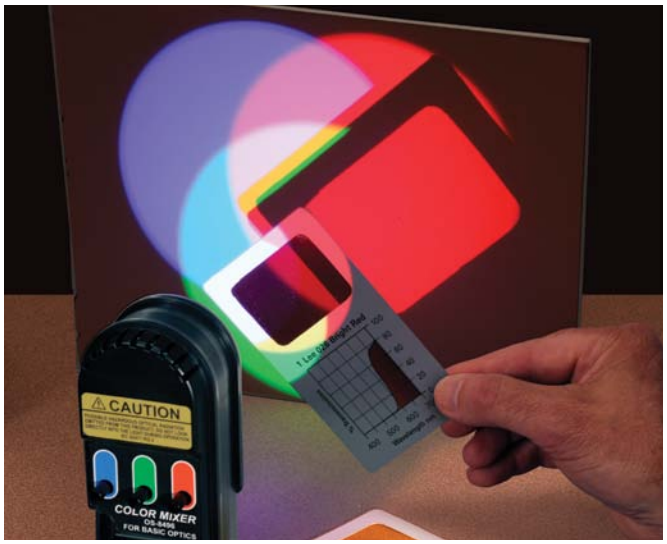
Recommended:
Basic Light Source OS-8470
(Included with Dynamics Track Optics Kit OS-8471A)



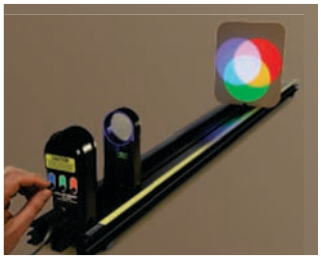
Use the Color Mixer as a projector in classroom demonstrations.

Innovative Optics for the Classroom

PASCO's Color Mixer is the ideal instrument to demonstrate additive color mixing in the classroom. The mixer has separate controls for each of the red, blue, and green LEDs, which allows brightness to be adjusted from off to full output. And the Color Mixer Accessory Kit is the perfect complement to the Color Mixer. Each card in the accessory kit includes a graph showing its transmitted or reflected spectrum.



The red filter's spectral chart shows it transmits only red light. Students observe the blue and green circles disappear and the overlapping areas of magenta, yellow, and white become red.



The Color Mixer is a great addition to your existing optics system.

Color Mixer

OS-8496

The Color Mixer has separate controls for each of the red, blue and green LEDs that allow brightness to be adjusted from off to full output.

Includes: a tri-color light source, a power supply, and individual adjustments for the intensity of the super bright red, green, and blue LEDs.

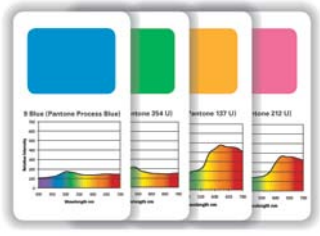
For use with track:

Dynamics Track Optics Carriage OS-8472

Color Mixer Accessory Kit

OS-8495

Includes: 7 Filter Cards, 11 Printed Color Cards, and a Manual with 9 Lab Activities

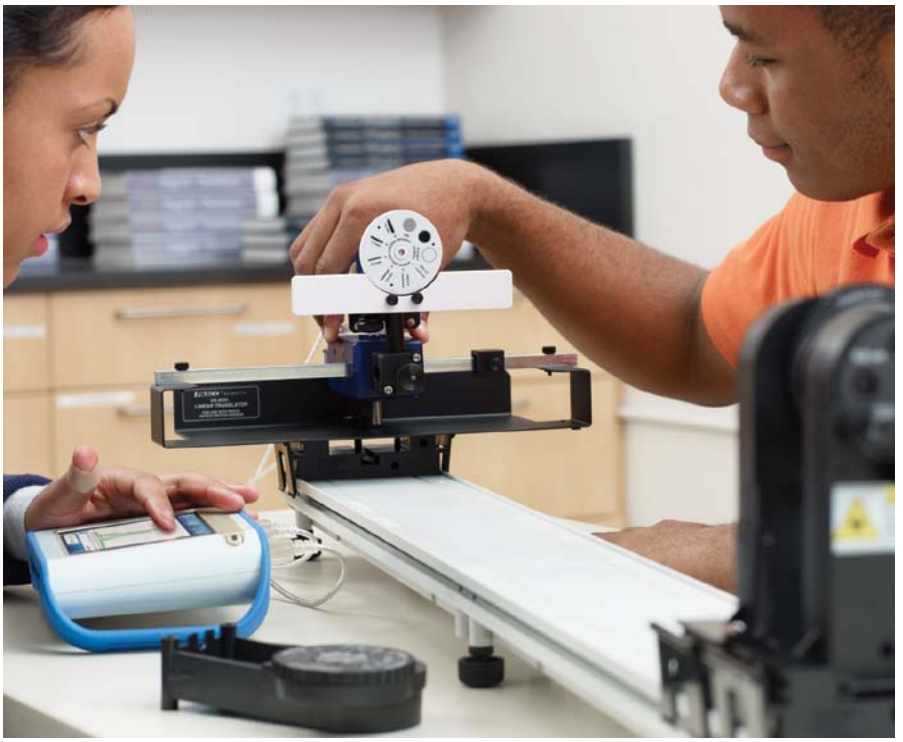


Interference and Diffraction

Learning good laboratory technique and working with high-quality equipment is an integral part of the Advanced Placement Physics experience. AP® students can achieve excellent results in interference and diffraction labs using this equipment that is compatible with the PAStrack.

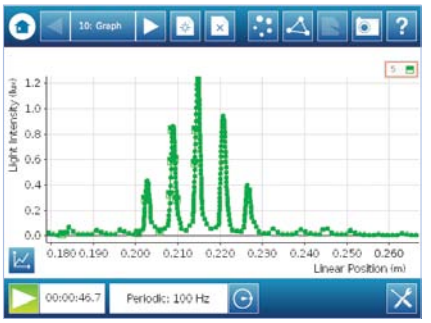
With a wide choice of apertures, single slit and double slit, you can challenge students to explore the differences between red and green laser light. When a High Sensitivity Light Sensor is used in conjunction with a Rotary Motion Sensor, students can easily acquire data past the 15th maxima in a double-slit experiment.

Take advantage of the versatile nature of PASCO Dynamics Tracks! In this case, the same PAStrack system that is invaluable for teaching kinematics, Newton's Laws and much more can be quickly (and affordably) converted into an optics bench for experiments dealing with light. The specially-designed components easily snap into place anywhere along the Dynamics Track. Ideal for investigating interference and diffraction, as well as reflection, refraction, Snell's law, colors and many other activities in optics.



With the added accessories a PAStrack makes an ideal optics bench for advanced studies of the properties of light.

Easy to use even in the dark. Just rotate to next "click."



With SPARKvue patterns created by double slit interference are displayed clearly for students to see.

Sensor-based Diffraction Kit

OS-8455A

Includes:
High Precision Diffraction Slits OS-8453
Red Diode Laser OS-8525A
Linear Translator OS-8535
Aperture Bracket OS-8534A

CLASS 2 LASER PRODUCT
LASER LIGHT – DO NOT STARE INTO BEAM

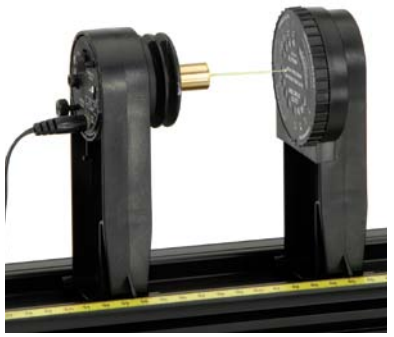
Also Required:
PAStrack Basic System ME-6962 (see pages 162-163)
Dynamics Track Optics Kit OS-8471A (see page 168)

Required for Data Collection:
High Sensitivity Light Sensor PS-2176
Rotary Motion Sensor PS-2120
Sensor Extension Cable PS-2500

Green Diode Laser

OS-8458

CLASS 2 LASER PRODUCT
LASER LIGHT – DO NOT STARE INTO BEAM



Real Spectrometry at a reasonable price

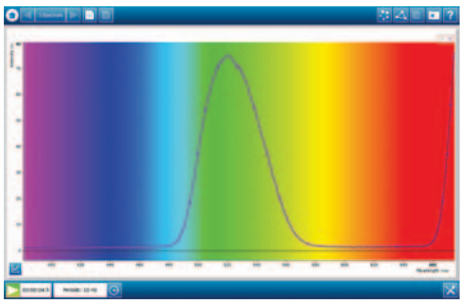
Measure absorbance, emission and fluorescence!

This affordable Amadeus spectrometer from Ocean Optics is designed for ease of use at high schools. From the tungsten light source to the included fiber optic cable, this system is a great value!

Now compatible with SPARKvue software and SPARK Science Learning System.

THE TEACHING ADVANTAGE

- Spectral Range: 350 to 850 nm
- Resolution: 3 nm (FWHM) with a total of 300 datapoints



Students collect full absorption spectra to determine the concentration of species in the solution.

Quick quantitative identification of emission peaks from elemental and molecular species.

Amadeus Spectrometer System

SE-7183

Includes Amadeus spectrometer, tungsten light source with power supply, 1.8 meter fiber optic probe, USB cable, 10 cuvettes. Now compatible with SPARKvue software and SPARK Science Learning System.

Spectral Tube Power Supply and Mount

SE-9460

Spectral Tubes not included – select from list below.

Spectral Tubes available:

Argon SE-9463
Carbon Dioxide SE-9464
Helium SE-9462
Hydrogen SE-9461
Krypton SE-9465
Mercury SE-9466
Neon SE-9467
Water Vapor SE-9468

Use the pupil aperture to reduce the pupil size…

… or to change the shape to a cat's eye.

Human Eye Model

PASCO's 3-D Human Eye Model is a great tool to use to study optics. It includes two lenses (the crystalline eye lens and the corneal lens) that are used to form images on the retina. The sealed tank holds water to simulate the vitreous humor. And the size and orientation of illuminated objects can be easily measured.

With the Human Eye Model you can:

- Study the optics of normal vision and vision correction.
- Change the crystalline lens so the eye can focus on both near and far objects.
- Demonstrate near-sightedness, far-sightedness, and normal vision with the movable retina.
- Vary the pupil size so students can observe the change in brightness and clarity of an image as the pupil size is reduced.

The Human Eye Model can image any illuminated picture.

Use the included syringe and water filled lens

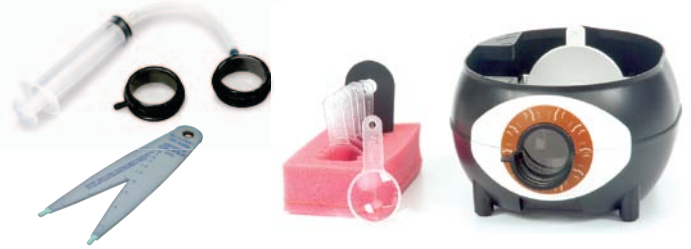
Demonstrate accommodation: Show how the eye lens changes focal length by changing its surface curvature

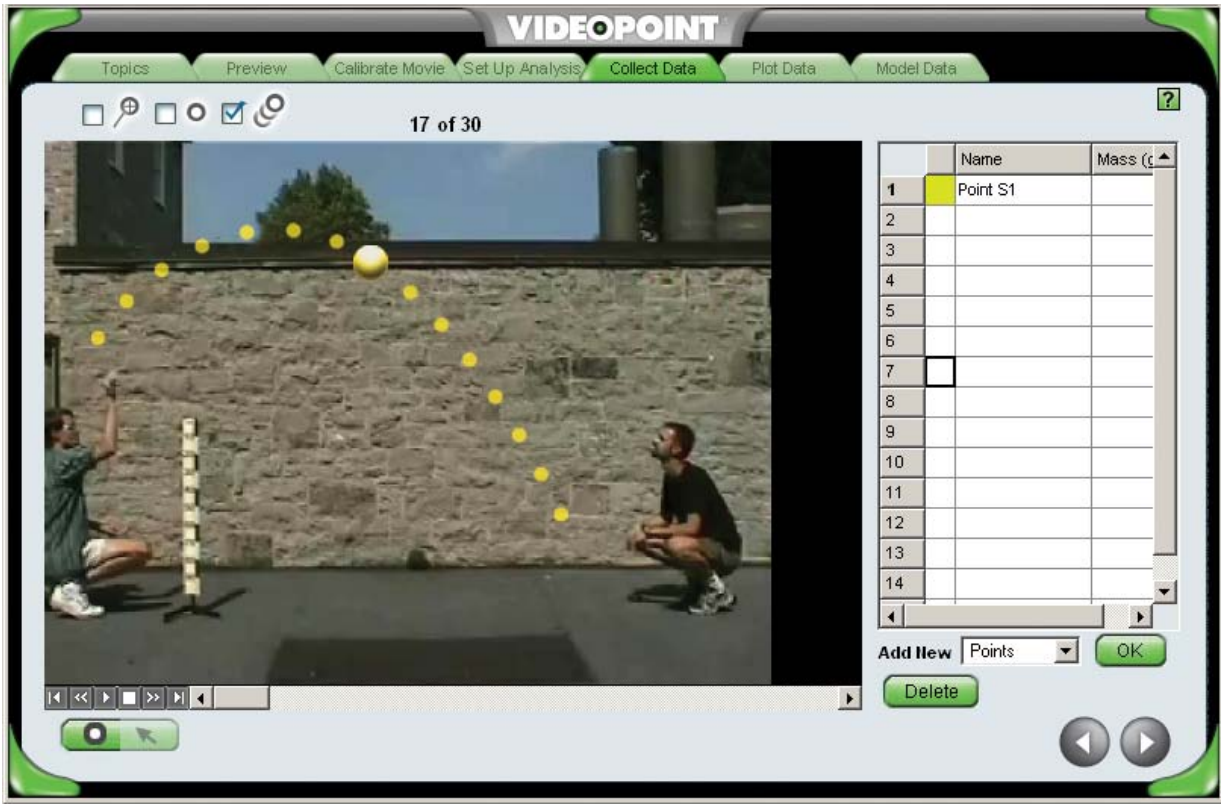
Human Eye Model

OS-8477A

Includes molded plastic eyeball, plastic lenses (two sets of 6), pupil aperture, adjustable focal lens, retina screen, optics caliper (1), syringe, and experiment manual.

A great accessory to any basic optics system





Visually explore a wealth of physics topics using the power of video-based motion analysis — from parabolic motion to collisions to even rocket launches. Pull from the VideoPoint library or record your own videos.

Video-Based Motion Analysis

Instantly graph position, velocity and acceleration data of objects in the real world.

Capture position vs. time data for one or more objects and investigate parabolic motion, conservation of momentum, and many more key physics concepts.

Engage students by analyzing their own videos of diving, snowboarding — or any object in motion in the world around them. VideoPoint Physics Fundamentals provides strong visual and quantitative analysis tools for the meaningful exploration of the physics of motion.

Includes VideoPoint Capture 2.1 to create your own movies, and free access to online Resource Library with additional movies, analyses and activities.

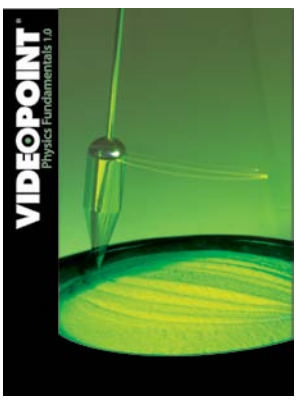
Lead engaging interactive lectures and discussions on key physics topics.

VideoPoint Physics Fundamentals

Single User (MAC) SE-7531

Single User (Windows) SE-7533

System Requirements:
Windows: Microsoft Windows 98SE, 2000, XP 500 MB disk space, 64 MB of RAM, 600x800 minimum screen resolution
Macintosh: Mac OS X 10.2 or higher, 500 MB disk space, 64 MB of RAM, 600x800 minimum screen resolution



Site Licenses Also Available:
Site License (MAC) SE-7537
Site License (Windows) SE-7535

More options at pasco.com

New PASCO STEM Modules

PASCO's new STEM modules integrate the four components of STEM through an engineering design challenge in the life or physical sciences, with a tangible product or process as the outcome.

- Guided by the national standards
- Incorporates a problem-based learning approach, emphasizing inquiry
- Incorporates both independent and collaborative work
- Includes both formative and summative assessments
- Features an engineering design challenge as the culminating project

Each PASCO STEM module is centered on an open-ended Challenge in which students are given the task of designing, constructing, and implementing the solution to an engineering problem. The Challenge is based on fundamental science concepts in one or more of the sciences and simulates a real-world problem that a modern engineer might encounter, with similar design constraints. For an illustration, see the example on page 181 of our STEM Air Bag module.

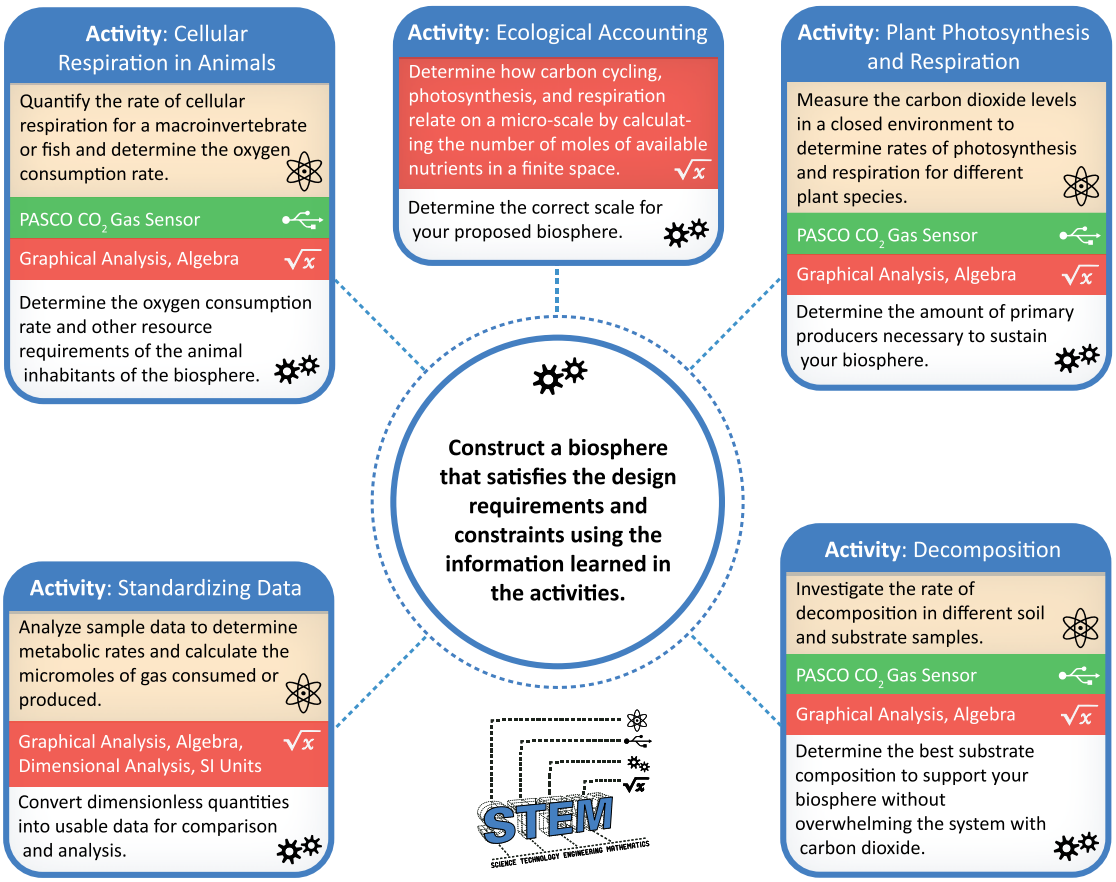
Each STEM module includes:

- Student handouts and information to assist the teacher in presenting, guiding, and assessing the students' work
- A Research section that contains science and math activities (both student handouts and teacher notes)
- Challenge and Activity handouts, which are designed to be copied and used for multiple classes
- The Concluding the Module section with wrap-up questions for discussion and Post-assessment handouts for the students with answer key for the teacher

4 STEM Modules:

- Air Bag
- Biosphere
- Egg Drop
- Collisions

For details, see pages 182-183.



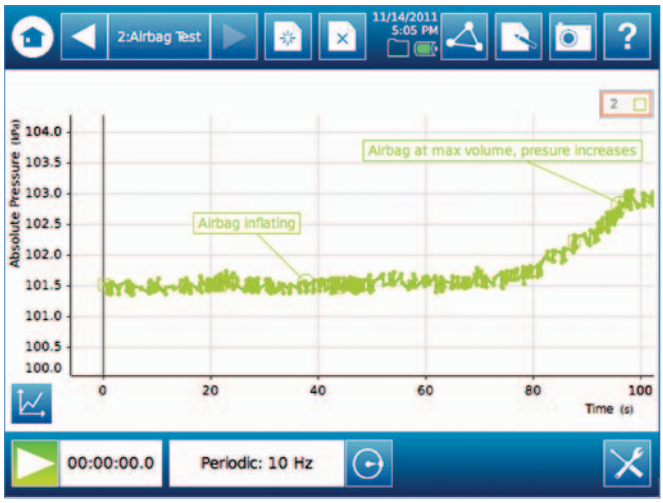
An In-Depth Look at the STEM Air Bag Module

Do your students struggle with stoichiometry? Are they asking, "Why do we have to do this?" PASCO's Air Bag Module gives students a meaningful application of chemical reactions, stoichiometry, reaction rates, and gas laws.

In PASCO's Air Bag Module, students are challenged to build an air bag that, when triggered, will inflate to a given pressure as quickly as possible. Students are limited by a set of constraints, including being able to use only sodium bicarbonate and acetic acid as the reactants inside their air bag. The module guides students through an engineering process to learn about, design, build, and test their air bags.

Students start the module by writing down their initial ideas. Once their ideas are recorded, they are guided through a series of research activities designed to teach them the core chemistry concepts needed to calculate the amount and concentration of each reactant they must use to inflate their air bag to the specified pressure. After each activity, students reassess their air bag design and make any necessary changes.

After the research phase, each student will finalize their own air bag design and then they will get into groups to create the best possible group design. Each group will construct one air bag and test it to see how well it meets the design requirements. After testing their air bags, students will evaluate their design and suggest ways to improve it.



Students notice that the pressure does not change while the airbag inflates and increases once the maximum volume had been reached.

STEM: Air Bag

Chemistry: Grades 9-12

This module guides students through the engineering design process, culminating in the construction of an air bag. Activities in the module are designed to help students make important decisions including the variables that affect pressure, amounts and concentration of reactants, and the factors that affect the rate of a chemical reaction.

- Understanding Pressure
- Pressure and Chemical Reactions
- Volume
- Reactions Rates

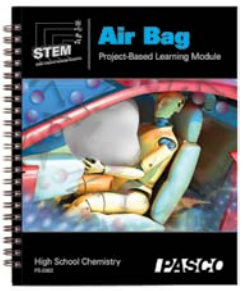
In these activities students will explore pressure and volume. They will perform research activities around stoichiometry and reaction rates. After overcoming the design challenges of constructing an airbag and attaching a pressure sensor, they will determine the stoichiometric ratio of reactants to produce the correct amount of pressure to inflate their air bag in the shortest time possible. After testing their air bags, students will suggest ways to improve their design.

Understanding Pressure SPARKlab activity, one of 4 in the Air Bag module.

Air Bag Module

Teacher License PS-2983
One per teacher (one license for all your classes).
Includes spiral-bound teacher manual.

Air Bag Module Flash Drive only
PS-2984



For required sensors and other materials, see pasco.com/STEMmodules

STEM: Biosphere

Biology/Life Sciences: Grades 9-12

In this module, students are challenged to create a model ecosystem indefinitely sustain an ecosystem consisting of physical and biological components of their choosing. To assist students in developing a data-driven design, there are five activities that address a conceptual component or skill required to construct a successful model:

- Standardizing Data
- Plant Photosynthesis and Respiration
- Cellular Respiration in Animals
- Decomposition
- Ecological Accounting

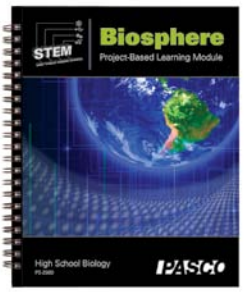
In these activities students measure the carbon dioxide levels in a closed environment and then calculate the appropriate balance of producers and consumers to build a stable micro environment. Finally, they construct and observe their biosphere for several days to validate their design.

Cellular Respiration in Animals SPARKlab, one of 5 in the Biosphere module.

Biosphere Module

Teacher License PS-2980
One per teacher (one license for all your classes).
Includes spiral-bound teacher manual.

Biosphere Module Flash Drive only
PS-2981



For required sensors and other materials, see pasco.com/STEMmodules

STEM: Egg Drop

Physics/Physical Science: Grades 6-8

This module gives students a problem-based engineering project to design and build an apparatus protecting a raw egg from cracking when dropped from 6 meters. This challenge is supported by 5 sensor-based math and physical science lab activities, where students gain knowledge of the fundamental math and physical science topics involved:

- Reading Graphs
- Acceleration and Gravity
- Force
- Air Drag
- Impact Force

Through these activities, students explore objects in free fall and learn to calculate the theoretical final velocity of their egg drop apparatus at impact. Using their theoretical final velocity and Newton's Second Law, they determine the force the egg will experience when it hits the ground (the force they need to reduce!). The remaining activities give students the background to minimize the forces of impact. Combining this knowledge, students build their apparatus based not only on intuition, but on real empirical results and informed science-based ideas.

Acceleration and Gravity SPARKlab activity, one of 5 in the Egg Drop module.

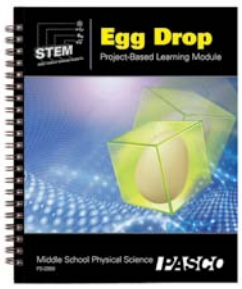
Egg Drop Module

Teacher License PS-2989

One per teacher (one license for all your classes).

Includes spiral-bound teacher manual.

Egg Drop Module Flash Drive only
PS-2990



*For required sensors and other materials, see **pasco.com/STEMmodules***

STEM: Collisions

Physics: Grades 9-12

Students are challenged to engineer a mock automobile bumper that will absorb the most force in an impact, while maintaining the smallest footprint (size and weight) possible. Designing a bumper that can absorb impact is simple, but designing a bumper that must also conform to specific design constraints such as size and mass is not. Through four activities, students will develop the conceptual foundation and mathematical approach to meet the design challenge. These activities include:

- Area Under a Curve
- Momentum
- Momentum-Impulse
- Peak Force

Through their "engineering research" gained from these activities, students will have acquired the tools and knowledge necessary to design and build a successful prototype bumper.

Momentum SPARKlab activity, one of 4 in the Collisions module.

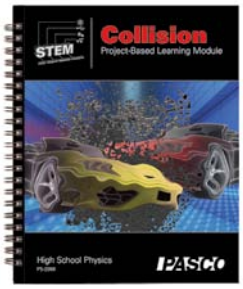
Collisions Module

Teacher License PS-2986

One per teacher (one license for all your classes).

Includes spiral-bound teacher manual.

Collisions Module Flash Drive only
PS-2987



*For required sensors and other materials, see **pasco.com/STEMmodules***

PASPORT Sensors Index


Temperature
28.9 °C
Dissolved Oxygen

MultiMeasure™ sensors

Only from PASCO

MultiMeasure Sensors incorporate several sensors into one case. Just plug in a MultiMeasure Sensor and instantly you can take all the measurements for one experiment or activity.

- Less expensive than individual sensors
- Eliminate the tangle of cords when using several sensors
- Save precious time in managing and inventorying sensors (it's much easier to manage a classroom set of 8 sensors than 32 sensors)

Chemistry Sensor

PS-2170

Includes Stainless Steel Temperature Probe, pH Probe, Voltage Probe, built-in Pressure Sensor, 60cc syringe, tubing and quick-release connectors.

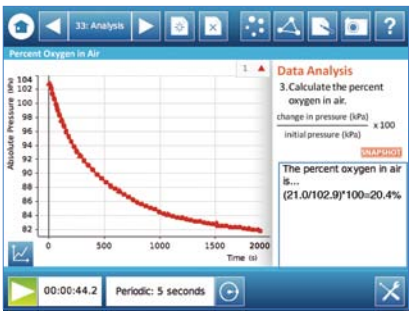
The all-in-one Chemistry Sensor measures temperature, pH, gas pressure, and voltage, and all measurements can be made simultaneously. This sensor provides a convenient solution for exploring gas laws, performing acid–base investigations, studying oxidation–reduction reactions, and more. Easy-to-use design requires no calibration.

THE TEACHING ADVANTAGE

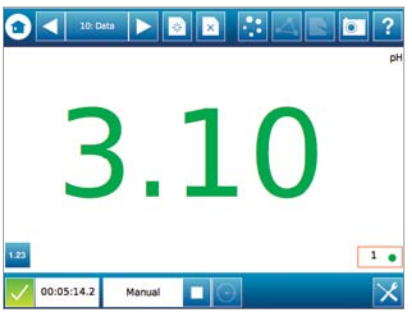
- Versatile combination of sensors makes this a good overall solution for Physical Science or Chemistry labs
- Combines the most used sensors for Chemistry into one convenient and affordable package
- Use each probe individually or combine in any combination

Steel wool captures oxygen molecules to form iron (III) oxide (rust), and illustrates partial pressures.

Students of all ages can quickly and easily determine the pH of different solutions.



Removing the oxygen from the air removes the pressure caused by the oxygen molecules.



Capture quick point measurements of pH, or graph pH changes over time.

General Science Sensor

PS-2168

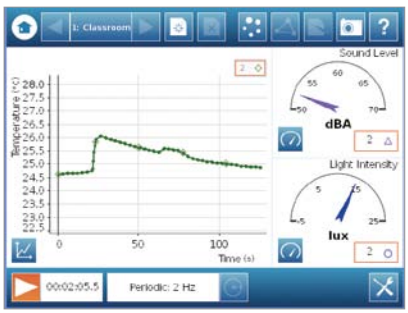
Includes built-in Light and Sound Sensors, Stainless Steel Temperature Probe and Voltage Probe.

Simultaneously measure temperature, light, sound level and voltage — all with just one sensor! Measure the change in temperature of a cooling liquid, monitor noise levels in the classroom or in the field, or study the electrical discharge of capacitors.

THE TEACHING ADVANTAGE

- Easy-to-use design requires no calibration
- Versatile combination of sensors makes this a good overall solution for a General Science lab

Sensor has 3 selectable ranges for low, indoors, and outdoor measurements.



Collect and view different measurements at the same time.

Temperature/Sound Level/Light Sensor

PS-2140

Includes Ambient Temperature, Light and Sound Level Sensors.

Three popular sensors in one! Simultaneously measure temperature, sound and light levels. Study how light, heat and sound relate to energy and compare environmental conditions among various species of plants. The possibilities are endless.

THE TEACHING ADVANTAGE

- Use with our GPS Position Sensor to map data and correlate with locations
- Measure each quantity individually or any combination of the three

Designed for introductory level explorations of the physical environment.

Display how the sensor reads your world.

Water Quality Sensor

PS-2169

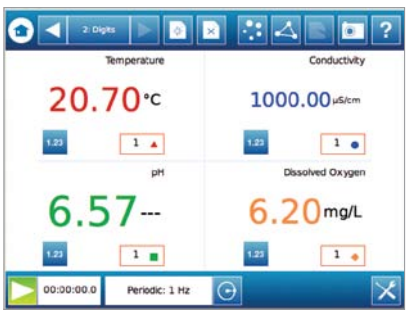
Includes Stainless Steel Temperature Probe, pH Probe, Dissolved Oxygen Probe, and Conductivity Probe.

Practically a one-piece water quality lab, this sensor measures water temperature, pH (acidity), dissolved oxygen, and conductivity simultaneously. It provides a convenient solution for studying water quality or aquatic biology. Investigate drinking-water purity, study the acid rain or study photosynthesis.

THE TEACHING ADVANTAGE

- Use each component separately or in any combination you choose
- Ideal for Environmental Science or Biology classrooms

Use a single sensor to understand an estuary.



All four parameters can be measured together over time to see how the estuary changes during a day.

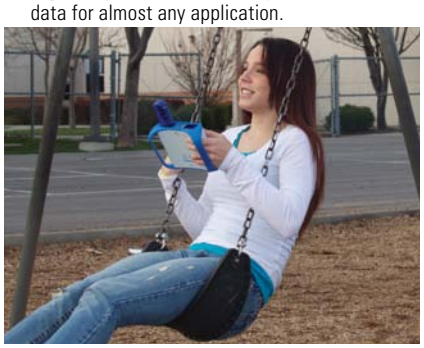
3-Axis Acceleration/Altimeter

PS-2136

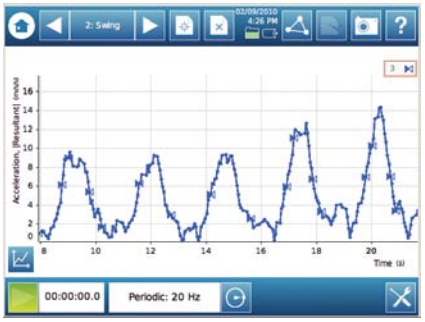
Simultaneously measure changes in altitude and capture acceleration data in all three spatial dimensions. Analyze amusement park rides using real data and explore the physics behind other recreational activities such as skiing. Use with our GPS Position Sensor to further enrich the analysis.

THE TEACHING ADVANTAGE

- Measures in m/s^2 or g's and calculates the overall acceleration resultant.
- Altimeter can measure altitude changes as small as 30 cm.
- High sample rate (20Hz max) provides useful data for almost any application.



How much acceleration do you experience on a swing?



Capture all the subtleties of motion such as increase in acceleration as the swing increases in amplitude.

Acceleration Sensor (3-Axis)

PS-2119

Includes mounting bracket to attach to PAScars and sensor extension cable.

Acceleration in 3D! Measure acceleration in all three dimensions of space at once and automatically calculate strength of the resulting overall acceleration. Explore Newton's Laws of Motion, study accelerations in collisions, and introduce and enhance the understanding of vectors.

THE TEACHING ADVANTAGE

- High sensitivity and fast response rate means even low-impact actions can be studied.
- Response rate can be slowed at the push of a button to provide smoother data.
- Can be easily mounted to PASCO carts.

Collect X-, Y- and Z- ASAP. All three axes can be collected simultaneously at 100 samples per second.

The faster sampling rate lets you see all the details of a complex, fast phenomenon.

Acceleration Sensor (2-Axis)

PS-2118

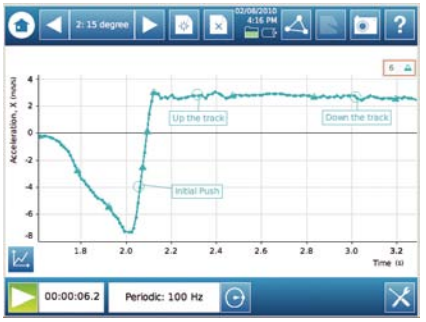
Includes mounting bracket to attach to PAScars and sensor extension cable.

High sensitivity for small accelerations and fast response for collisions – only PASCO offers students both with just the touch of a button. Attach this sensor to a cart to study Newton's Laws, or investigate centripetal acceleration on a rotating platform. Even measure the acceleration of a hand while tossing a ball.

THE TEACHING ADVANTAGE

- Wider range than most accelerometers for a greater variety of experiments
- Always mounted in the correct orientation

Mount to dynamics cart to help students understand how acceleration changes with track angle.



Directly measure the acceleration experienced by a cart due to gravity.

Visual Accelerometer

PS-2128

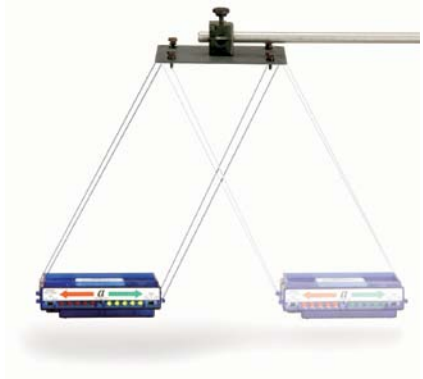
Includes plastic screws for attaching to a PAScar, sensor extension cable, and 3 AA batteries.

What can be hard to explain can be easy to show with the Visual Accelerometer. Introduce acceleration, study centripetal acceleration and forces, and learn about simple harmonic motion. Take it in the field and study acceleration while riding in a car or an elevator.

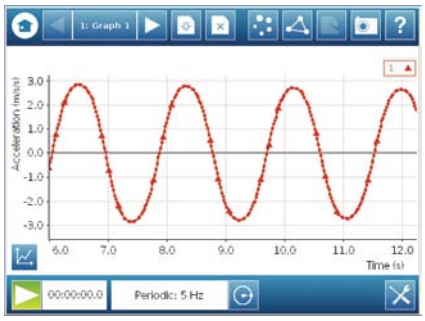
THE TEACHING ADVANTAGE

- Measures in three ranges so gentle and sudden accelerations can both be analyzed.
- Sensor auto-scales for maximum sensitivity.
- Sensor can retain its peak value for accelerations that occur too quickly for the eye to see.
- Tare (zero) button compensates for the orientation of the sensor and makes sure only actual accelerations are measured.

Mounts directly to PASCO dynamics carts.



See and measure the lateral acceleration involved in simple harmonic motion.



Clear data combined with the built-in visual cues to reinforce student understanding.

Visual Accelerometer Accessory Kit

PS-2516

Includes 4 string pendulum plate, plastic rod clamps (2), 1/4-20, 5cm long thumbscrews with nuts (4) and a roll of thread.

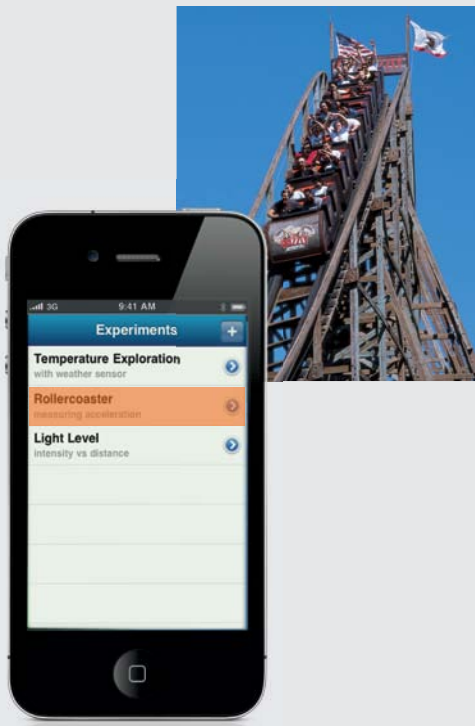
SPARKvue for your iPhone

Ready to ride a roller coaster?

With PASCO's free iPhone app, collecting roller coaster data has never been simpler.

Want to graph acceleration and altitude change data from your Amusement Park Physics Day? Now you can connect PASPORT sensors via Bluetooth to your iPhone or iPod touch. Just download our free iPhone app, and use our 3-Axis Acceleration/Altimeter Sensor with the PASPORT AirLink 2 interface (on page 228).

For more on our iPhone app, see **pasco.com/iPhone.**



PASCO's SPARKvue for iOS is available free in the App Store – providing you real-time data collection and analysis on your iPad, iPhone or iPod Touch. Graphs, digits, meters, statistics. It's all there. For more information, see pages 234-235.

Barometer/Low Pressure Sensor

PS-2113A

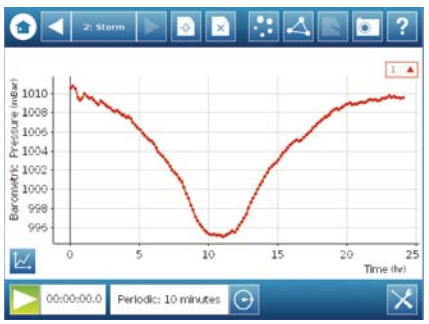
Includes tubing and quick-release connectors (for low pressure experiments).

This highly sensitive sensor detects very small changes in pressure. Measure changes in air pressure as weather changes, open a door to change room pressure or compare pressure at a room's ceiling and floor to see how elevation affects air pressure.

THE TEACHING ADVANTAGE

- Sensor is sensitive down to ±0.001 in Hg
- Measure the rate of plant transpiration with air pressure using included accessories

Catch a storm – and monitor it quantitatively



Show the barometric pressure change as a low pressure front passes through.

Blood Pressure Sensor

PS-2207 (Standard Cuff)
PS-2208 (Small Cuff)
PS-2209 (Large Cuff)

All models include a sensor and an arm cuff with inflation bulb. Most students use standard sized cuff. ***For size assistance, see pasco.com***

Our Blood Pressure Sensor allows students to quickly and easily measure both systolic and diastolic arterial blood pressure as well as heart rate. Use this sensor to help students gain a contextual understanding of the physiology of blood pressure.

THE TEACHING ADVANTAGE

- Students determine blood pressure using familiar methods
- Visualizing measurements simultaneously gives students a better understanding of blood pressure in their body

Students determine blood pressure using familiar methods.

Visualizing measurements simultaneously gives students a better understanding of blood pressure.

Breath Rate Sensor

PS-2187

Includes Masks (10) and Clips (10).

Also Available:
Replacement Masks (10 Pack) PS-2567
Replacement Clips (10 Pack) PS-2568

Measuring breathing rate is as easy as breathing. Study physical fitness by measuring breathing rate before, during, and after exercise. Add our Hand Grip Heart Rate Sensor and Blood Pressure Sensor for a more complete study of exercise physiology.

THE TEACHING ADVANTAGE

- Clip the end of the sensing tube to a common dust mask worn by test subject for easy use
- Sensor provides stable output even during exercise for ease of analysis

Determine breath rate while exercising.

Track breath rate before, during, and after activity.

Carbon Dioxide Gas Sensor

PS-2110

Includes Sensor Extension Cable and 250ml sampling bottle with cap.

The topic is in the news, and now you can study it in your classroom. Measure the concentration of carbon dioxide, or CO_2 gas in a closed system or in your environment. Study many topics with this versatile probe, such as CO_2 uptake during photosynthesis, indoor vs. outdoor CO_2 levels or air quality, and CO_2 output of combustion engines.

THE TEACHING ADVANTAGE

- Calibrates easily and instantly with the push of a button
- Wide range (from 0 to 300,000 ppm) allows data collection in low or high-concentration situations
- Large vent-hole design means faster response times and quicker data collection

Charge Sensor

PS-2132

Includes 0.9m shield cable with alligator clips.

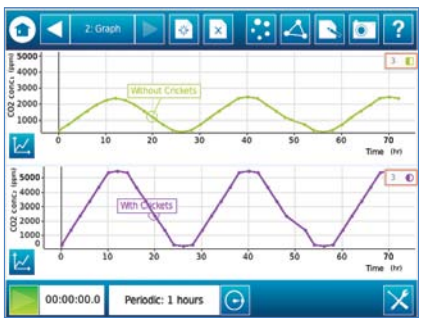
Measure the amount and the polarity of electric charge present. Demonstrate and measure charging by induction, use this sensor as a replacement for an electroscope, or explore the distribution of charge across a surface.

THE TEACHING ADVANTAGE

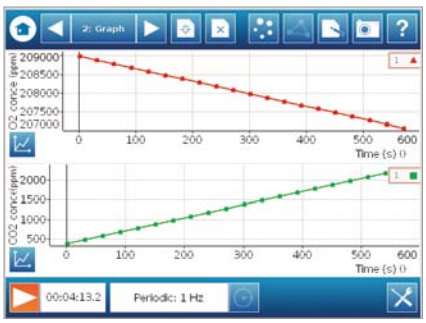
- No guessing – the polarity of the charge is shown automatically
- Built-in push-button tare
- High input impedance means repeatable results

Directly compare separate controlled environments.

Illuminate the process of germination.



Measure the influence of crickets on two otherwise identical systems.



See the whole picture by observing CO_2 production and oxygen consumption together.

Immediately see the polarity and the quantity of charge present on an object.

Colorimeter

PS-2121

Includes 5 glass cuvettes, storage case and Sensor Extension Cable.

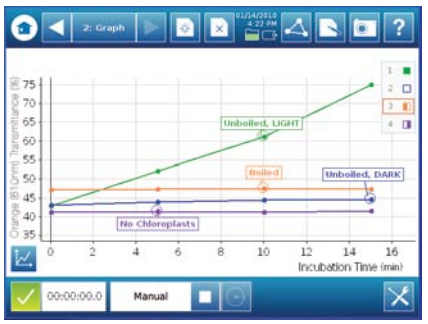
Also available:
Cuvette and Caps (Set of 6) PS-2509

Determine the concentration of a solution with ease! Study absorbance vs. concentration to explore Beer's Law, and measure chemical rates of reaction.

THE TEACHING ADVANTAGE

- Simultaneous data collection in four wavelengths (colors) of light increases accuracy of results and reduces frustration caused by missing data
- Sensor calibrates in all wavelengths automatically in one step
- Rates of reaction experiments can be conducted easily due to five readings per second sample rate

Set up in seconds and collect individual measurements with ease.



The College Board-recommended photosynthesis lab has never been more straight-forward.

Conductivity Sensor

PS-2116A

Includes Conductivity Probe, 10x

Measure the electrical conductivity of a solution. Investigate the purity of drinking water and compare how fresh water and salt water conduct electricity.

THE TEACHING ADVANTAGE

- Three different ranges are selectable at the push of a button without recalibration, allowing a wide variety of experiments to be performed
- Sensor has a platinum probe, giving more accurate and reliable results and reducing uncertainty and frustration

The sensor automatically indicates when a range is exceeded to give you optimum performance.

Quickly and clearly determine the conductivity of a water sample in the lab or in the field.

High Current Sensor

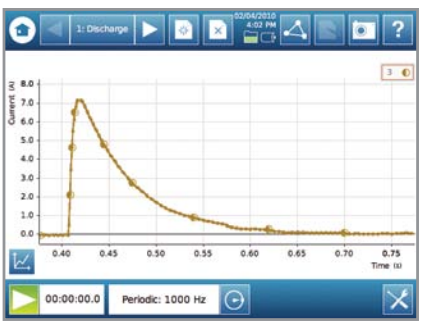
PS-2193

The High Current Sensor has a low resistance-sensing element (0.01 Ω). It can measure up to 10 A, and it has an LED over-current indicator. Use with large Farad capacitors or in other high-current situations.

THE TEACHING ADVANTAGE

- Dynamic variable over-sampling reduces measurement noise at low sample rates
- Resolution of 0.5 mA allows incredibly accurate data collection

The wide range gives you great flexibility in the circuits you can measure.



Capture peak current output of a capacitor discharge.

Dissolved Oxygen Sensor

PS-2108

Includes Dissolved Oxygen Probe.

Measure how much oxygen is dissolved in a solution. Study water quality and many biological processes such as photosynthesis. This sensor allows even small changes to dissolved oxygen concentrations to be observed.

THE TEACHING ADVANTAGE

- Temperature compensation assures consistent measurements over the course of an experiment
- Wide sensitivity range (0 to 20mg/L) means data measurements will not exceed the maximum possible reading level before the experiment is over

High-Accuracy Drop Counter

PS-2117

Includes Micro Stir Bar plus a stainless steel sensor rod for easy attachment to a ring stand.

A great sensor for experiments where every drop counts—literally! Use the Drop Counter in tandem with our pH Sensor to accurately determine the equivalence point in an acid–base titration. It works equally well with large or small, fast or slow drops.

THE TEACHING ADVANTAGE

- UV filter assures accurate counts because room lighting cannot affect results
- Sensor unit can suspend up to two other sensors in solution, simplifying many experiments
- Wider drop window (18x13mm) for better drop detection and easier alignment with burettes

The Photosynthesis Tank provides an isolated system perfect for the dissolved oxygen probe..

Integrated probe-management makes titration set up a snap.

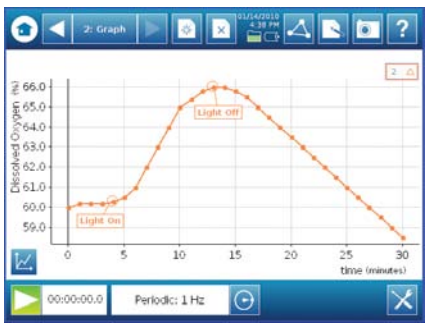
Micro Stir Bar (5-Pack)

PS-2565

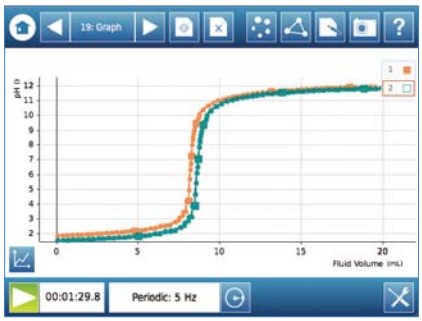
The Micro Stir Bar maintains a constant flow of solution over the end of an electrode, such as the pH and Conductivity Probes. For use with a standard magnetic stir plate and cylindrical probes of about 13 mm diameter.

TEACHING ADVANTAGES

- Magnet is completely sealed to prevent damage from chemicals
- Allows study of solutions in micro-quantities



Clearly see the change of dissolved oxygen over time during photosynthesis.



High-accuracy volume data gives you clear consistent data and allows for multiple trials.

EKG Sensor

PS-2111

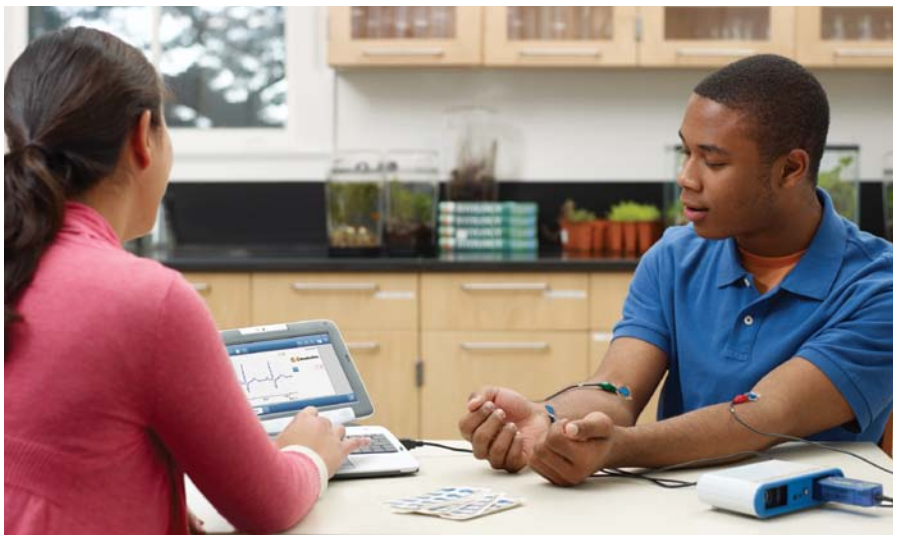
Includes 100 self-adhesive electrode patches.

Also Available:
EKG Sensor Electrode Patches (100-pack) CI-6620

Take the mystery out of that old medical show staple by letting students measure and record the electrical signals produced by the heart themselves. Students can use it to measure their heart rate, and then explore the effects mild exercise has on heart rate.

THE TEACHING ADVANTAGE

- Three-electrode design is easy to use.
- Electrodes are contained in disposable stick-on pads eliminating the need for messy gels.



Easy set up and quick data collection makes it possible for every student to see their heartbeat in a class period.

Clear data helps students better understand the electrical signals of the heart.

EXPLORE BLOOD PRESSURE

Round out your exploration of the circulatory system with our Blood Pressure Sensor.

For information, see page 190.

Ethanol Sensor

PS-2194

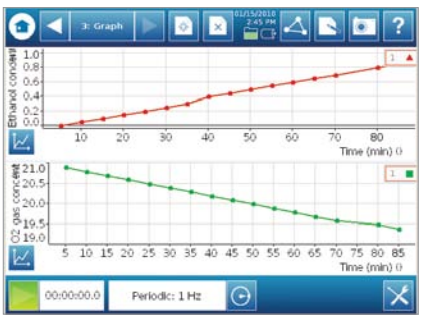
Includes probe and PTFE tape.

This sensor measures the concentration of ethanol in a gas, up to 3%. Explore the effects of temperature on ethanol production during yeast fermentation using a PASCO EcoChamber, or study combustion and its byproducts.

THE TEACHING ADVANTAGE

- Easy to calibrate

Directly measure the products of fermentation.



Compare ethanol production to oxygen uptake over time.

Flow Rate/Temperature Sensor

PS-2130

Measure the temperature and flow rate of streams, rivers, and other flowing bodies of water. Explore how geographic features can affect water flow, determine sediment transport rate, or map out flow rates and temperatures at different locations and depths in a stream.

THE TEACHING ADVANTAGE

- Telescoping handle allows taking data at greater depths.
- Rugged construction reduces chance of losing pieces during use in the field.

Collect data safely from the shore due to the telescoping handle.

The built-in temperature sensor is located next to the impeller to better correlate temperature and flow rate data.

Force Platform

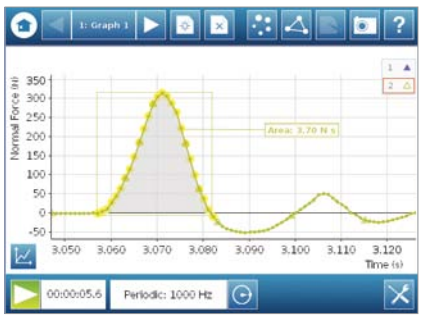
PS-2141

Measure large forces applied over a large area. Explore the physics of jumping and hang time or study the impulse imparted by a bouncing ball. Examine the forces acting on a person riding an elevator or use two to verify Newton's 3rd Law.

THE TEACHING ADVANTAGE

- Large surface for jumping and landing.
- High data rate provides a smooth data set to ease analysis.

Fast response, wide range and durability make a variety of experiments possible.



Use the area under the curve to determine the impulse of the initial impact.

2-Axis Force Platform

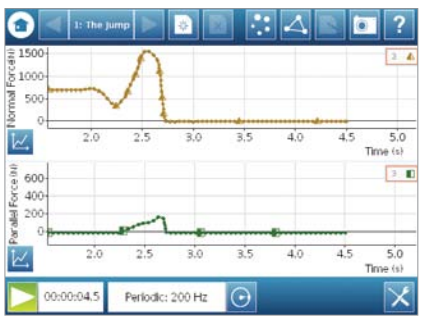
PS-2142

Go beyond models and simulation and get force data from the "real world." Study friction by dragging objects across the surface and measure normal and friction forces. Explore the physics of a broad jump, and introduce vectors and force components. Use one on the floor and another on the wall and study the static equilibrium of a ladder leaning on a wall.

THE TEACHING ADVANTAGE

- 2-Axis measures both normal and parallel forces
- Perfect for measuring forces on the human body

Add a new dimension to study more complex motion.



Get the complete picture by viewing the normal force and parallel force together.

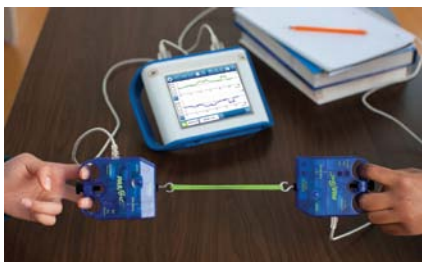
Force Sensor

PS-2104

Ideal for the student lab: Finger holes support hand-held applications, or mount it to a cart or 1.2 cm diameter rod. An overload stop and polycarbonate case protect the unit from student abuse. Measure collision forces or investigate Newton's Third Law.

THE TEACHING ADVANTAGE

- Probe can be zeroed with the touch of a button to save time in the lab.
- Measures forces in the direction of the sensor with minimal side forces.



When students are the force, Newton's Third Law is no longer a leap of faith.

Directly compare action and reaction of forces.

High Resolution Force Sensor

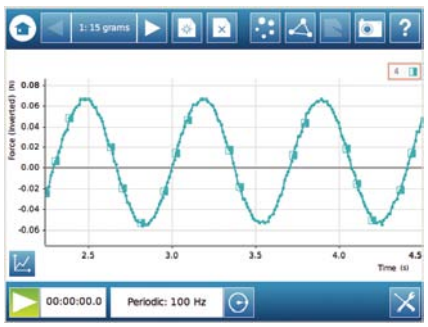
PS-2189

This higher-resolution Force Sensor allows the student to measure smaller changes in force. Measure forces exerted by an oscillating mass, the force of a swinging pendulum, or use it as a pan balance for long-term experiments such as in the evaporation of liquids.

THE TEACHING ADVANTAGE

- 0.002 N resolution with force overload protection
- Measures changes in force less than 0.01N with very little drift.

Study simple harmonic motion



High resolution means even the smallest oscillations in force are captured with high fidelity.

Force Accessory Bracket

CI-6545

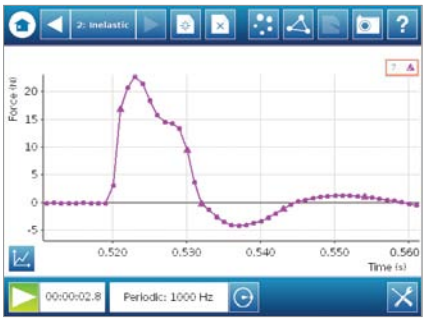
Includes bracket, 2 spring bumpers (different spring constants), magnetic bumper, rubber bumper, clay cup and clay, and Phillips head screwdriver.

The optional Accessory Bracket with bumpers mounts a Force Sensor directly to a Dynamics Track. Can be used for elastic and inelastic collisions.

THE TEACHING ADVANTAGE

- Excellent support or target for collision studies
- All attachments store on the bracket to save space and keep them together.

This versatile bracket provides the tools for inelastic and elastic collisions

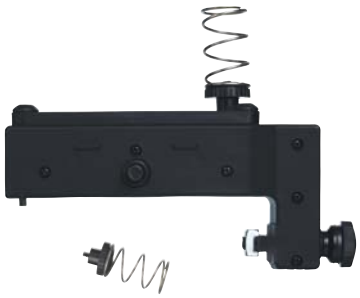


PAScar collision with clay bumper.

Discover Collision Bracket

ME-8973

Includes bracket and 2 springs (different spring constants).

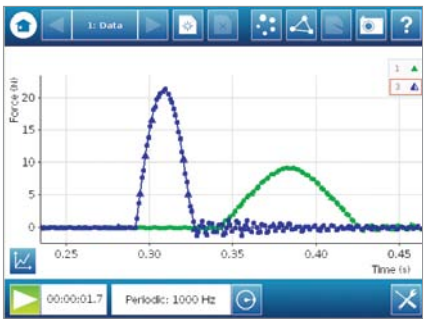


The collision bracket fastens to the T-slot of a dynamics track and securely holds the Force Sensor for measuring collisions with a cart. Includes two different springs, one soft and one firm. In conjunction with a Force Sensor the force and impulse of a cart's collision can be measured.

THE TEACHING ADVANTAGE

- An affordable and useful accessory for your existing Dynamics Track
- SPARKvue creates ideal graphs for impulse during a collision.

Connects quickly to PASCO Dynamics Tracks, for instant collision labs.



Compare and contrast the impulse of the soft and firm spring bumpers.

Force Sensor Balance Stand

CI-6460

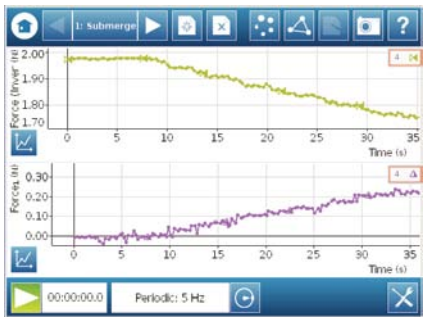
Includes force sensor stand and balance pan. Force sensor sold separately.

Connect a Force Sensor to this stand and students have a convenient electronic balance for a wide variety of physics experiments. Connect an Acceleration Sensor for studies of angle vs. normal force. Use it as a pan balance or to measure buoyant force.

THE TEACHING ADVANTAGE

- Mounting screws and balance pan can be stored on the pan when not in use.

The Force Sensor Balance Stand lets you observe buoyant force from the perspective of the fluid.



The buoyant force exerted on the object is equal to the additional force experienced by the beaker.

Rocket Engine Test Bracket

ME-6617

Rocket Engine not included.

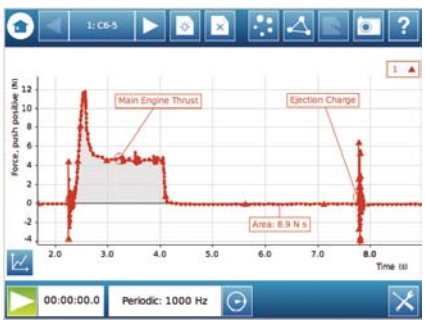
For outdoor use only!

With the Rocket Engine Test Bracket securely attached to a Force Sensor, students can measure, and graphically display, the impulse of Estes™ and other model rocket engines. A perfect supplement for rocketry studies.

THE TEACHING ADVANTAGE

- Accommodates rocket engine sizes A, B, C and D.
- Finds both the impulse and the maximum force exerted by rocket engines.

Yes, this really is rocket science



Measure the force vs. time profile of a Rocket Engine.

Galvanometer

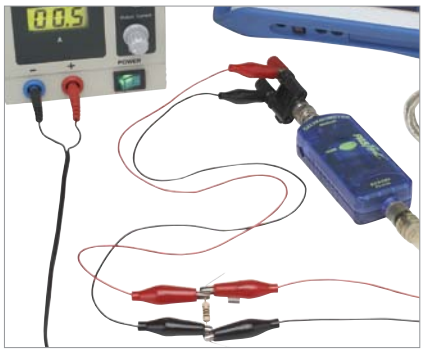
PS-2160

Includes BNC to banana plug cable and jack adapter, and 2 resistors (0.1 ohm and 10 ohm)

Measure extremely small voltages with high resolution. Study sensitive circuits involving low voltages and currents, and even measure the voltage drop along a simple length of wire. This sensor is perfect for resistivity experiments.

THE TEACHING ADVANTAGE

- Measures with 0.1 Volt resolution for precise results.
- Designed to reduce measurement noise and deliver clean data.



Find out if that really is a 1% resistor with the precision of the Galvanometer.

Rock-solid performance lets you measure the smallest changes in voltage and current with confidence.

Goniometer Sensor

PS-2137

Includes an Angle Sensor and 1 Goniometer Probe with Velcro® connection kit.

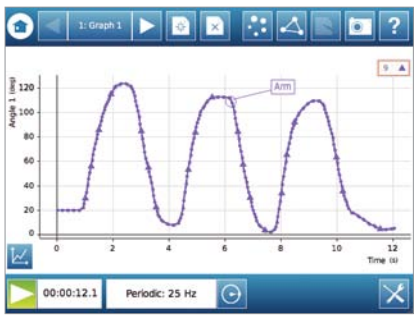
Measure two joints simultaneously. Just add an additional probe:
Goniometer Probe PS-2138
Includes probe and Velcro® connection kit.

Measure how far and how fast human limbs bend. Study how arms and legs move, and compare normal motion to that of moderate exercise and athletic activity. Use with a force sensor to analyze energy expenditure when lifting weights or climbing stairs.

Sensor simply straps on with Velcro®, making it easy to put on and take off. It allows the motion of several people to be compared in a short time. Can be used without calibration with good accuracy, however, calibration can reduce uncertainty to less than 1% of measured values.

See every flex and extension as your students become part of the experiment.

Study the motion of the knee while walking with the variety of Velcro® straps included with the sensor.



Measure the extent of movement and changes in velocity during normal actions.

WE CAN HELP

We offer support, training and customer service by email or phone and through self-directed online tutorials, live webcam feeds, or in-person training in your school.

Visit PASCO.com for details

GPS Position Sensor

PS-2175

Includes Sensor Extension Cable

Recommended:

My World GIS Classroom (10-seat) License SE-7364

For additional license options see page 236.

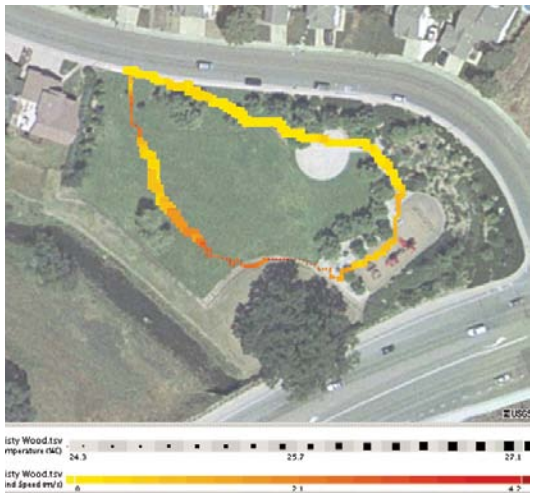
Your students can easily compare different types of environments around your school.

Use this sensor when you need to know where you are and where you are going – exactly. Record data with a wide variety of PASCO sensors to explore relationships in measurements between different locations or conditions. Study the motion of a car around a highway loop, accurately correlate weather observations with locations, and reliably locate water quality measurements along the length of a stream. Use with My World GIS software to accurately plot data and overlay aerial photos for even more enriching and in-depth analysis.

THE TEACHING ADVANTAGE

- Determine exact latitude, longitude, altitude, and velocity of user.
- Sensor automatically syncs with GPS satellites quickly – typically within a minute of activation – for a quick start to data collection.
- Unit receives signals even through heavy tree cover, enabling the collection of reliable and comprehensive data sets.

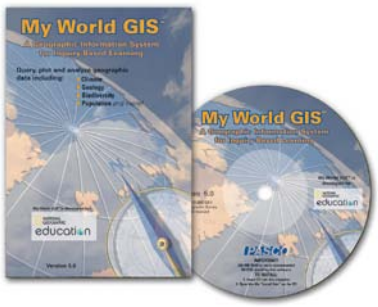
Seamlessly combine weather and location data.



Collect data at a track then import it into My World GIS software to see the output on a map.

My World GIS 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



High volume and district licenses also available. See www.pasco.com for more license options.

See pages 122-123 for more information.

Collect data at the same points throughout the year to look for seasonal trends.

Exercise Heart Rate Sensor

PS-2129A

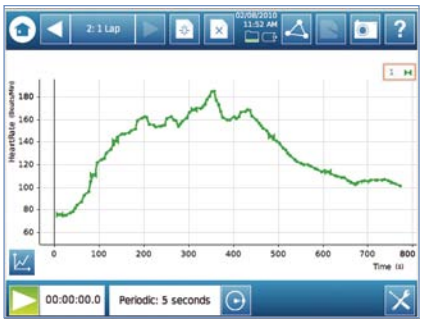
Includes wireless transmitter and belt.

This sensor measures and records a student's heart rate before, during and after exercise. A belt worn around the ribcage transmits the signal generated by the cardiac muscle and the heart-rate graph provides immediate feedback.

THE TEACHING ADVANTAGE

- Wireless sensor allows free and easy movement
- Elastic belt provides convenient hands-free use
- Investigate a variety of external influences on heart rate

Students can easily see if they achieved their target heart rate during exercise.



A single data set show heart rate before, during and after exertion.

Hand-Grip Heart Rate Sensor

PS-2186

Includes 2 hand-grip paddles.

Measure and compare resting, exercise and recovery heart rate to determine physical fitness levels. This sensor allows students to measure their heart rate without the restrictions and inconvenience of belts or clips. Simply grab the handles while the sensor records cardiac muscle contractions and displays them in beats per minute.

THE TEACHING ADVANTAGE

- Easy to use: just grip the handles.
- Extra-long cables allow free movement during activity
- AP® Biology lab 10: Physiology of the Circulatory System

The Hand Grip Heart Rate Sensor is easy to use for students of all ages, shapes, and sizes.

Compare your heartbeat during a variety of different activities.

Dual Humidity Sensor

PS-2156

Includes 2 probes, to measure humidity and temperature in two locations at the same time.

The Dual Humidity/Temperature/ Dew Point Sensor measures relative humidity (in units of percent RH) and air temperature (in °C and °F). From these measurements, it calculates absolute humidity (in units of g/cm^3) and dew point (in °C and °F). The sensor comes with two probes that can measure humidity and temperature in two locations at the same time.

THE TEACHING ADVANTAGE

- Measure humidity at two locations at the same time such as in the EcoZone™ System
- Compare humidity, dew point and temperature as they change over time
- Compare indoor and outdoor environments

Create stand-alone environments or interconnected environments. Here, this single EcoChamber is monitored by the Dual Humidity and Soil Moisture Sensors.

Humidity/Temp/Dew Point Sensor

PS-2124A

Simultaneously measure temperature, dew point (water condensation temperature), or absolute and relative pressure. Study the weather, or monitor atmospheric conditions inside a terrarium or greenhouse.

THE TEACHING ADVANTAGE

- Rugged construction can be used in a variety of environments
- High data sampling rate allows real-time monitoring of weather conditions
- Take single point readings or collect data continuously

Clearly see how changes in temperature will affect relative humidity and dew point.

Ion Selective Electrodes

CI-6717 Ammonium
CI-6726 Carbon Dioxide
CI-6727 Calcium
CI-6732 Chloride
CI-6736 Lead
CI-6728 Fluoride
CI-6735 Nitrate
CI-6733 Potassium
CI-6734 Sodium

Each Ion Selective Electrode (ISE) includes a 2m cable.

Required:
Chemistry Sensor PS-2170
or
Precision pH/ISE/ORP Amplifier PS-2147

Measure the concentration of a specific ion in water. Perform sophisticated chemical analysis of water quality or monitor chemical reactions in detail.

THE TEACHING ADVANTAGE

- Probes available for measuring the concentration of nine different ions
- Measures oxygen reduction potential

CHEMISTRY CAUTION

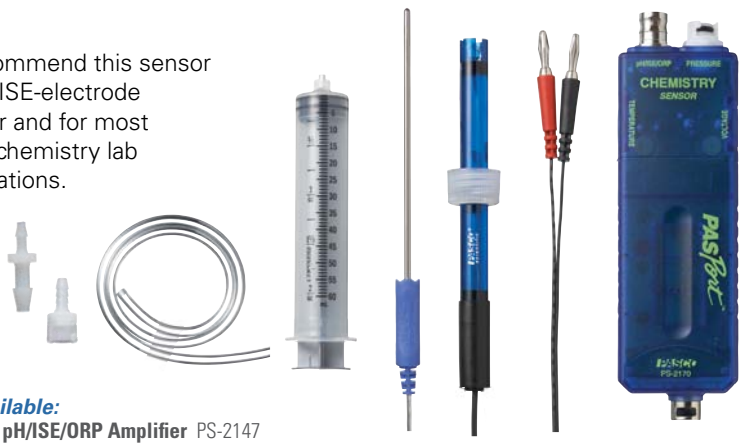
Ion Selective Electrodes require a significant amount of chemistry to use accurately, and measurements need to be conducted in a stable environment. For detailed information on these electrodes and a list of chemicals required for their operation, contact PASCO Teacher Support at:

support@pasco.com

Chemistry Sensor

PS-2170

We recommend this sensor as your ISE-electrode amplifier and for most of your chemistry lab investigations.



Also Available:
Precision pH/ISE/ORP Amplifier PS-2147

Light Level Lux Sensor

PS-2177

The Light Level Sensor measures illuminance in lux. The readings of this sensor mimic the wavelength sensitivity of the human eye, which is most sensitive in the green portion of the spectrum. This is achieved with a green filter in the light sensor.

THE TEACHING ADVANTAGE

- Three ranges allow collection of data from candle–level intensities all the way up to full sunlight
- Range can be changed with the push of a button, with no need to recalibrate
- Accurately measure environmental light levels.

Light Sensor

PS-2106A

Star light, star bright…but how bright? Measure the intensity, or brightness, of light. Study how distance from a light source affects light intensity, and the differences between polarized and non-polarized sunglasses.

THE TEACHING ADVANTAGE

- Three ranges allow collection of data from candle–level intensities all the way up to full sunlight
- Range can be changed with the push of a button, with no need to recalibrate
- High resolution and a small sensor allows the study of complex phenomena, such as interference and diffraction patterns

Broad Spectrum Light Sensor

PS-2150

Measure light intensity from the far infrared to the far ultraviolet. This sensor is design specifically for use with our OS-8539 Educational Spectrophotometer System and OS-8543 Prism Spectrophotometer Accessory for Black Body experiments. The Broad Spectrum Light Sensor uses a thermopile and window combination that respond to both the near infrared and visible light necessary for the Black Body Experiment.

THE TEACHING ADVANTAGE

- Ideal for the Black Body Spectrum
- For use with Spectrophotometer

Which light sensor is right for you?

"I want to measure ambient environmental light."

- The **PASPORT Light Lux Sensor PS-2177** is designed to approximate the wavelength sensitivity of the human eye, providing results similar to hand-held light meters used in photography.

"I want to run experiments on a PASCO Optics Benches."

- The **PASPORT Light Sensor PS-2106A** is designed specifically for use with PASCO optics equipment and has an integrated snout for more directional measurements.

Upper-level Physics Teachers

You may be interested in our 2012 Physics & Engineering Catalog, which offers our full line of physics and engineering apparatus and supplies.

To request a copy,
Visit PASCO.com
or call us at 800.772.8700

High Sensitivity Light Sensor

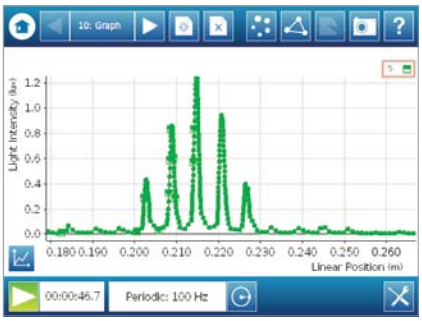
PS-2176

Measure small changes in light intensity in low intensity conditions. Conduct spectrophotometric studies on glowing gases, analyze interference and diffraction patterns. Use with our Rotary Motion Sensor to collect precise position data for more accurate results.

THE TEACHING ADVANTAGE

- Sensor works in three ranges from very low intensity candle light to overcast daylight
- Change ranges at the push of a button
- Detect changes in brightness as low as 0.0005 lux for finely detailed analysis

The light sensor combines with the rotary motion sensor for the diffraction of light experiment.



High sensitivity makes it possible to see the second order of the diffraction pattern.

Infrared Light Sensor

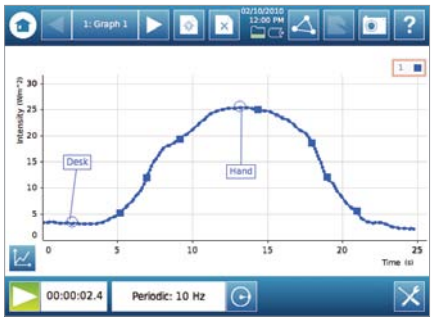
PS-2148

You can't see it, but you can feel it–and now, you can measure it: infrared radiation. Introduce and explore blackbody radiation, estimate surface temperatures without contact, study energy received from the sun as heat, and explore radiation emitted as heat from common objects.

THE TEACHING ADVANTAGE

- Probe is sensitive over a vast range of wavelengths, allowing a comprehensive study of the topic at hand
- Contains a built-in thermistor to measure temperature on the "cold" side of the thermopile
- Sense wavelengths from 580 nm to 40,000 nm

Capture light beyond the visible spectrum.



Clearly see the infrared light radiating from your own hand.

Ultraviolet Light Sensor

PS-2149

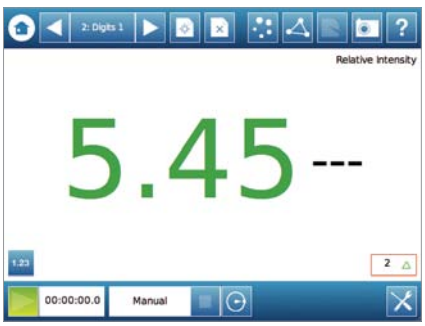
Includes 5 Different materials that block UV radiation-in a convenient storage canister

Measure the intensity of ultraviolet light in the UVA band. Investigate the effectiveness of regular windows, sunglasses, and sunscreen in reducing ultraviolet light transmission. Or conduct a sky survey of UV light.

THE TEACHING ADVANTAGE

- Intensity can be measured in any of three ranges, from low to high levels of intensity, and the range can be selected with the push of a button
- Included collimator eases measurement from small sources across a narrow angle
- Spectral response of 315 nm to 400 nm (with filter)

How much protection does that pair of sunglasses offer from ultraviolet light?



Quickly determine the effectiveness of your eye protection.

Load Cell & Dual Amplifier Set

PS-2206

Also Available:
Load Cell and Amplifier Set PS-2199
(Includes 4 100N Load Cells and 6-Port amplifier)

The Load Cells are designed to be inserted directly into our Structures Systems to provide compression and tension measurement points in a student's design. The Dual Amplifier can measure the forces of one or two Load Cells, such as at the top and bottom of a roller-coaster loop, or on one cell moving to different parts of a bridge. Expand this set by adding another load cell.

THE TEACHING ADVANTAGE

- Perfect for applications requiring only one or two load cells
- Expand this set with an additional load of a 5 N or 100 N Load Cell

Measure the stress and strain experienced by a structure in-line with the load cell amplifier.

100N Load Cell

PS-2200

Also Available:
5N Load Cell PS-2201

Displacement Sensor

PS-2204

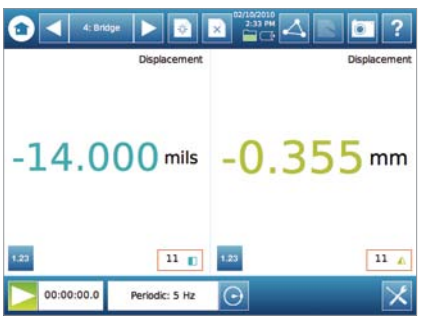
Includes digital indicator, pivot rod clamp, Phillips screw driver, and storage box.

Measure small displacement with amazing accuracy using this sensor – even the smallest deflection from a load applied to a truss, bridge, or other PASCO Structure System construction. Use the Digital Indicator as a stand-alone device to measure displacements and read them on the LCD display.

THE TEACHING ADVANTAGE

- Use the sensor and your PASCO interface to input and analyze collected data

- Easily mounts to a support rod with included pivot rod clamp



Detect even the smallest flex when your structure is put under load.

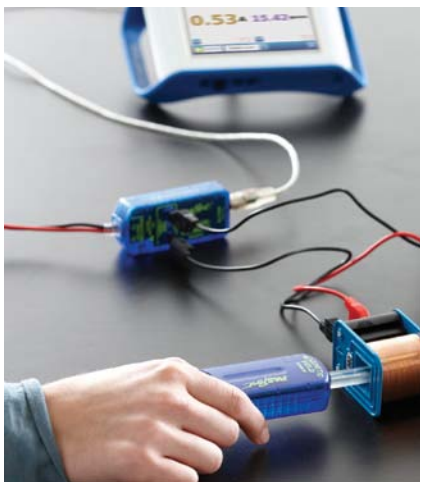
Magnetic Field Sensor

PS-2112

Make a magnetic field "visible". Use this sensor to map the magnetic field around a bar magnet, explore how the strength of a magnetic field is related to the distance from the source magnet, and explore magnetic fields formed by coils and loops.

THE TEACHING ADVANTAGE

- Single-range sensitivity: ±1000 Gauss
- Align sensor with magnetic field along length of probe until highest field strength displays



Measure the magnetic field generated by a current passing through a coil.

2-Axis Magnetic Field Sensor

PS-2162

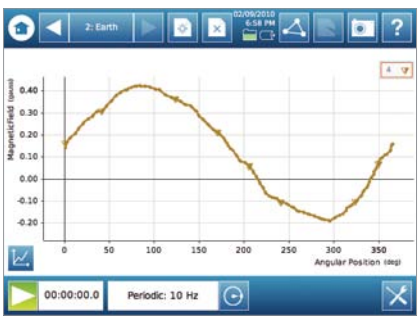
Includes Sensor Extension Cable.

Recommended:
Zero Gauss Chamber EM-8652

Simultaneously measure radial and axial field strengths. Map magnitude and direction from a bar magnets or a coil, explore magnetic fields generated by alternating current, and measure the Earth's magnetic field. Combine with a Rotary Motion Sensor to collect precise position data at the same time for more accurate field maps.

THE TEACHING ADVANTAGE

- Designed to reduce noise at low sampling rates
- Simple Tare button to zero (uses Zero Gauss Chamber)
- 0.01 Gauss Resolution @ 10 Hz



Reveal the naturally occurring magnetic field of the earth.

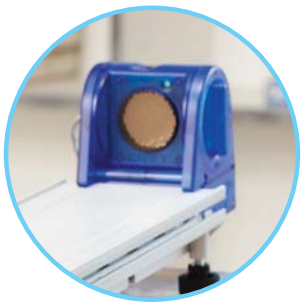
Zero Gauss Chamber

EM-8652

This double-walled, high permeability metal chamber produces a zero-Gauss field within the chamber. By placing the Magnetic Field Sensor probe into the chamber and pushing the "Tare" button, the sensor may be zeroed. Highly recommended for measurement of the earth's magnetic field.

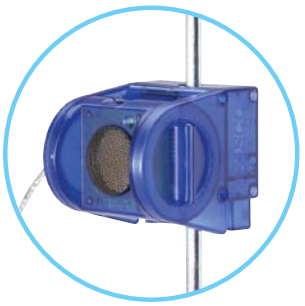
Motion Sensor

PS-2103A



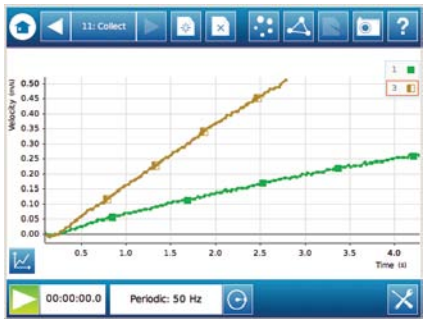
Locked onto the end of our dynamics track

Standing flat on a table top



Mounted on a rod stand

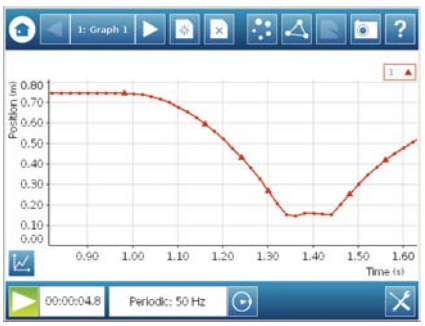
Integration of sensor and equipment makes changing the angle of incline a breeze.



Comparing the acceleration of a cart down a track at different angles takes no time at all.

Motion Sensor Guard

SE-7256



Use a Motion Sensor Guard to see the motion of an object falling toward the Motion Sensor.

Motion Sensor

Need to know distance, velocity or acceleration? Explore linear motion in detail with this sensor. Students can study the back-and-forth motion of a cart on a track or the movement of their own bodies in the classroom. Even acceleration of a falling object due to gravity can be studied with relative ease.

THE TEACHING ADVANTAGE

- Tight beam allows collection of data over a greater range of distance
- Probe detects and filters out false target readings, eliminating spikes and misreadings
- Automatic determination of distance, velocity, and acceleration allows students to focus on the motion and not on tedious calculations

Magnetic Motion Sensor Bracket

PS-2546

Combine with the Force Sensor to explore simple harmonic motion or Newton's Second Law.

Rotary Motion Sensor

Put a new spin on many common experiments with this highly versatile sensor. Use it to study not only rotary motion, pendulum motion, and angular momentum, but a surprising variety of other topics as well. With the right accessories it can be used to determine the acceleration of gravity, to study linear velocity and acceleration, and it can be used in an optics lab to study interference and diffraction patterns.

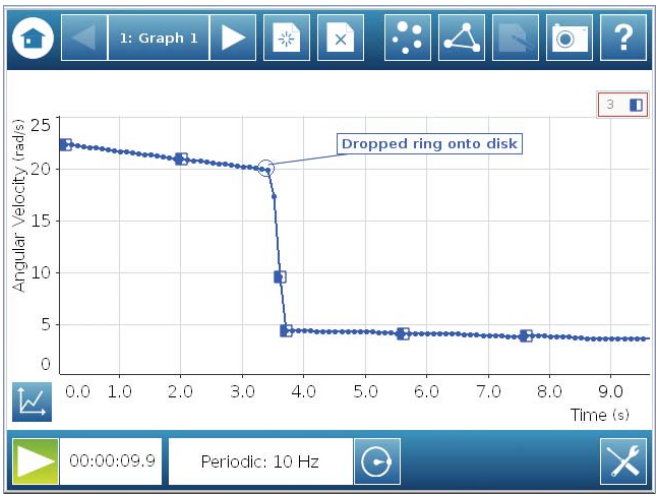
THE TEACHING ADVANTAGE

- Sensor's 0.09 degree resolution (about 4,000 points per revolution) allows highly precise angular measurements
- Sensor measures reliably up to 30 revolutions per second (which translates to a maximum linear speed of about 4.5 m/s)
- Attached rod clamp allows sensor to be mounted in almost any orientation

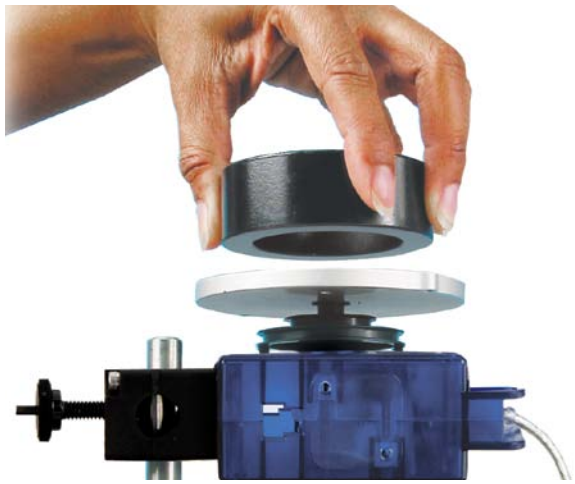
Rotary Motion Sensor

PS-2120

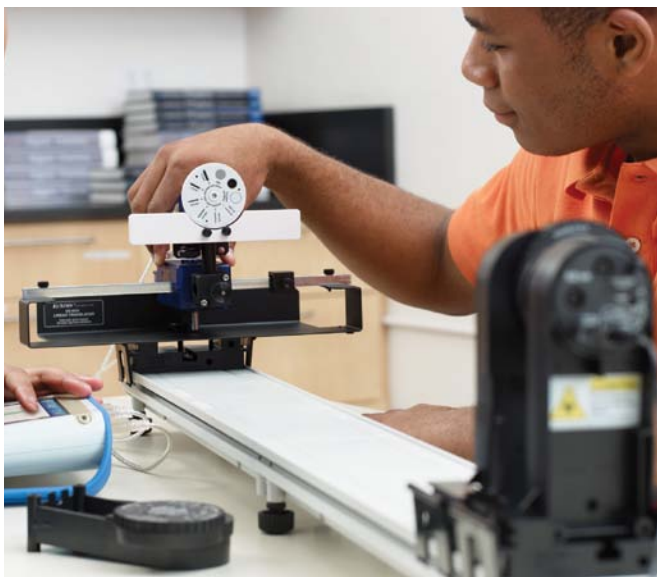
Recommended:
Linear Motion Accessory CI-6688
Mini Rotational Accessory CI-6691
See applications below.



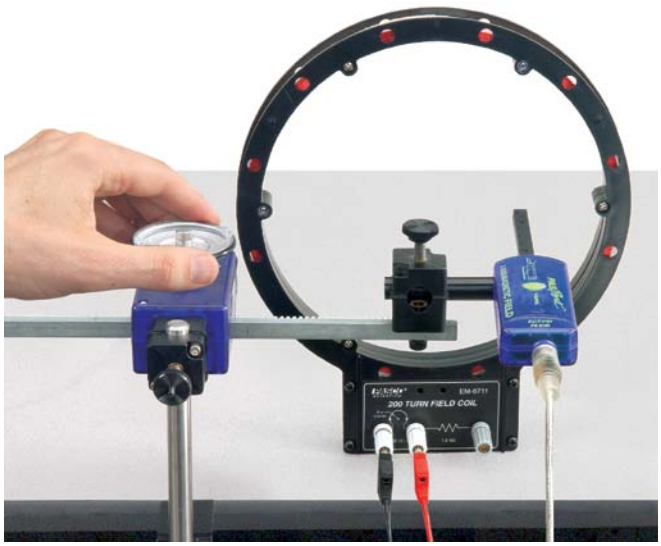
The graph captures angular velocity before and after the collision. Knowing the mass and dimensions of the ring and disk, students will find that angular momentum is conserved.



Investigate what happens to angular momentum when a ring is dropped on a spinning disk.



Combined with the Linear Translator from the Sensor-based Diffraction Kit, the Rotary Motion Sensor controls and measures linear position during optics labs.



Add the Linear Motion Accessory to your Rotary Motion Sensor for precise distance measurements.

Oxidation Reduction Potential Probe

CI-6716

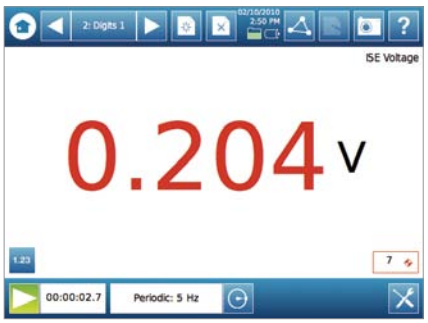
Required:
Chemistry Sensor PS-2170
or
Precision pH/ISE/ORP Amplifier PS-2147

Just how effective is that solution as an oxidizing or reducing agent? Use this probe to monitor solutions during oxidation-reduction titrations, perform water quality studies, and study the effects of water chlorination.

The ORP Probe is not a standalone sensor. It connects to and requires an amplifier.

THE TEACHING ADVANTAGE

- Determine the ability of a species in a solution to act as an oxidizing agent or a reducing agent



Quickly determine the overall tendency of a solution to gain or lose electrons.

Oxygen Gas Sensor

PS-2126A

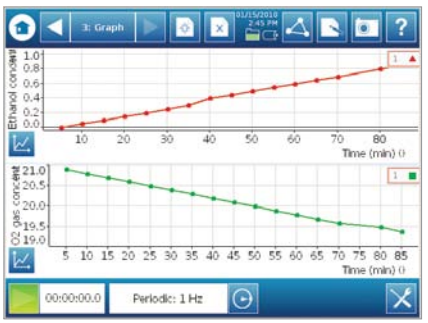
Includes integrated rubber stopper and 250 ml sampling bottle with cap.

Use this sensor for any experiment requiring the measurement of oxygen levels, such as the study of photosynthesis, animal and insect respiration, and gas production during chemical reactions. Combine with our CO_2 sensor to also monitor conditions within a classroom terrarium or perform simple physiological studies.

THE TEACHING ADVANTAGE

- Automatically compensates for temperature
- Calibrates in one step with the touch of a button

Include the Oxygen Gas Sensor with the Ethanol Sensor to fully investigate fermentation.



Students can now see production and consumption as each occurs.

pH Sensor

PS-2102

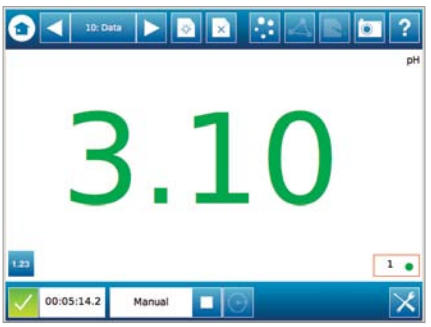
Includes pH Electrode.

This sensor measures the pH or acidity, of a solution as discrete measurements or continuous reading. Use the probe to study water quality, or perform high-resolution acid-base titrations with ease.

THE TEACHING ADVANTAGE

- High resolution with low noise allows even subtle pH changes to be observed
- Calibration-free design lets students get right to the data collection with minimal frustration
- Uses gel-filled Ag-Ag Cl combination electrode

Quickly distinguish acids from bases



Students don't have to guess how pink their pink indicator is when they can get a reading instantly.

Chemistry Sensor

PS-2170

Includes Stainless Steel Temperature Probe, pH Probe, Voltage Probe, built-in Pressure Sensor, 60cc syringe, tubing and quick-release connectors.

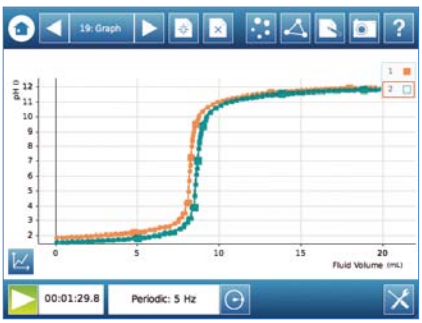
It's a pH Sensor and much, much more!

This all-in-one chemistry sensor measures temperature, pH (acidity), gas pressure, and voltage simultaneously. It provides a convenient solution for exploring gas laws, performing acid–base investigations, studying oxidation–reduction reactions, and more. The optional ISE and ORP electrodes are also supported.

THE TEACHING ADVANTAGE

- Easy-to-use design requires no calibration
- Versatile combination of sensors makes this a good overall solution for a physical science or introductory chemistry lab

Classic classroom titration meets the 21st century.



Quick and efficient data collection allows students to collect multiple runs and focus on analysis and learning.

High Accuracy Drop Counter

PS-2117

See page 183 for full description

Micro Stir Bar (5-pack)

PS-2565

Flat pH Electrode

PS-2182

Connects to and requires a pH Sensor.

Recommended:
Chemistry Sensor PS-2170
pH Sensor PS-2102

From gels to soil to…cheese? This pH probe gives you the freedom to measure where you want, what you want. Study pH levels in different kinds of food, investigate the pH of common skin and hair care products, and easily collect pH data when doing soil analysis.

Check soil pH in the field.

Whether your flat surface is a Petri dish or a slice of cheese, find the pH with a minimum of fuss.

Clear display makes it easy to share your pH data with classmates.

Photogate Head

ME-9498A

Required:
Digital Adapter PS-2159
To Attach to Track:
Photogate Brackets (set of 2)ME-9806

Start and stop digital timers with high precision. Get reliable data when studying linear motion, conservation of momentum, or anything requiring highly accurate time data. Requires Digital Adapter PS-2159 for use with SPARK or SPARKvue or any other PASPORT systems.

THE TEACHING ADVANTAGE

- Can measure times as short as 0.1 ms and resolve distances just under 1 mm
- Can be mounted in any orientation for a variety of uses

Use the Photogate with the PAScars using the specially designed picket fence "flag".

When studying motion, timing is everything. Help your students understand the root concept of velocity, and acceleration.

Photogate and Pulley System

ME-6838A

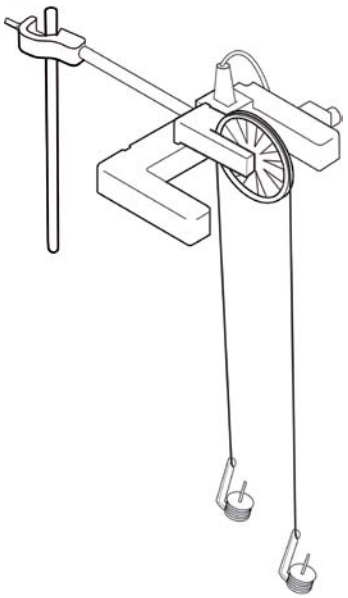
Includes Photogate Head and Super Pulley with Rod.

Required:
Digital Adapter PS-2159

Measure position, velocity, and acceleration with high resolution. Explore Newton's Second Law of Motion with precise acceleration data, study the motion of objects on inclined planes, and more.

THE TEACHING ADVANTAGE

- Pulley is designed to be extremely low-friction so it has almost no effect on measurements
- Time resolution can be as fine as 0.1 ms
- Pulley can be removed for use as a more traditional photogate



Use a classic Atwood's machine to study net forces and acceleration.

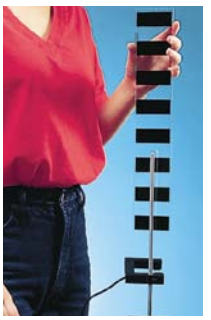
Large Picket Fence

ME-9377A

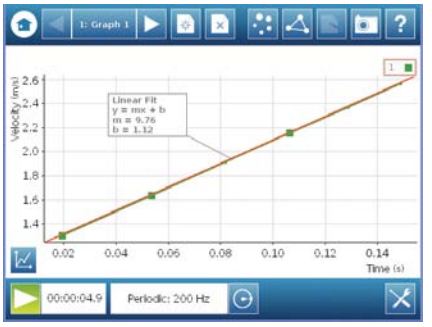
An easy and highly accurate way to determine the acceleration due to gravity (g) experimentally. Conduct free-fall experiments by dropping this Picket Fence through the PASCO Photogate. As it falls, the black bars block the photogate beam. Knowing the distance between them and the time it takes them to fall through the acceleration can be found.

THE TEACHING ADVANTAGE

- Reinforces concepts of acceleration, rate of change and graphical analysis
- Picket fence is 40 cm long and bars are 5 cm apart



The picket fence becomes your high-tech apple for determining the acceleration due to gravity.



A linear fit is all you need to determine how velocity is changing when your acceleration is constant.

Time-of-Flight Accessory

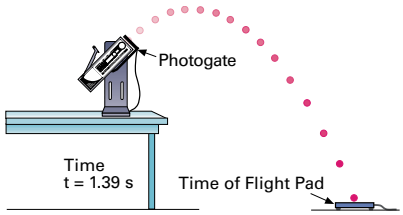
ME-6810

Required:
Digital Adapter PS-2159
Recommended:
Phone Jack Extender Cord (6m) PI-8117

Designed primarily for freefall or projectile experiments. Measure the time a projectile or a free-falling object is in the air. Study projectile motion and the acceleration of gravity. Requires Digital Adapter (PS-2159) for use with PASPORT systems.

THE TEACHING ADVANTAGE

- Large surface area is easy to hit
- Automatic timing provides more reliable data leading to more accurate results



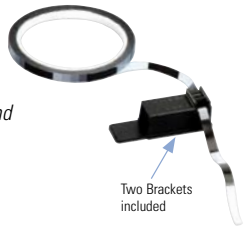
Timing begins when the photogate beam is broken and ends when the projectile hits the pad and the signal is sent to the interface.

Get the full picture of projectile motion with a Photogate Head and the Time-of-Flight Accessory.

Photogate Tape Set

ME-6664

Includes Photogate Tape (30m), 2 tape guides, double adhesive tape and Velcro® strips, Photogate Head sold separately.



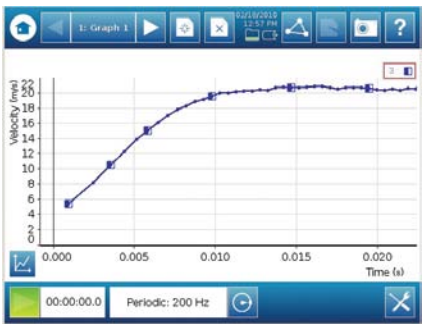
Replacement Tape Available:
Photogate Tape (30m) ME-6663
High Resolution Photogate Tape (30m) ME-6666

Measure speeds and accelerations of objects that move too freely, too quickly, or over larger distances than can be measured manually or with a Motion Sensor. Determine the acceleration of gravity using objects dropped from an upper story window, study the acceleration of a sprinter starting a race, and determine the launch speed and acceleration of a model rocket.

THE TEACHING ADVANTAGE

- Mylar tape is light, flexible, and rugged, so it can withstand lots of use in the field while having minimal impact on the motion being studied

Ideal for measuring the acceleration of fast moving objects like air rockets.



Measuring the acceleration of the rocket during the first 0.01 seconds is a job for the Photogate Tape Set.

Digital Adapter

PS-2159

Use the PASPORT Digital Adapter to connect timing/counting devices (such as Photgates and the Time-of-Flight Accessory) to SPARK Science Learning System, SPARKlink or other PASPORT interfaces.

Have some of our ScienceWorkshop Sensors?

If so, you can connect most of these sensors to SPARK Science Learning System or SPARKlink by using either the Digital Adapter or Analog Adapter.

For more information, see page 225.

PASCO 5 YEAR WARRANTY

Absolute Pressure Sensor

PS-2107

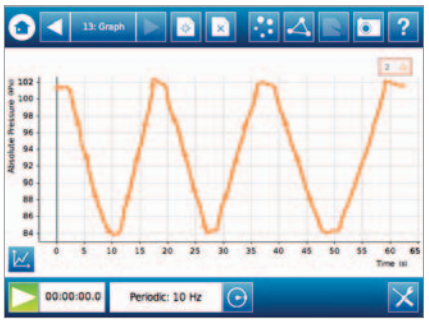
Includes 60cc syringe, tubing and quick-release connectors.

Make accurate and consistent measurements of gas pressure, regardless of ambient conditions and explore how chemical reactions affect gas pressure. In combination with a temperature probe study the Ideal Gas Law, Boyle's Law, and Charles' Law.

THE TEACHING ADVANTAGE

- Measures pressure relative to an internal, sealed reference vacuum, allowing the collection of reliable data even when the pressure within the system drops below ambient pressure
- Collect data measured in N/m2 or PSI as appropriate

Model systems like the human lung.



Capture pressure changes in real time to help students understand cause and effect relationships.

Chemistry Sensor

PS-2170

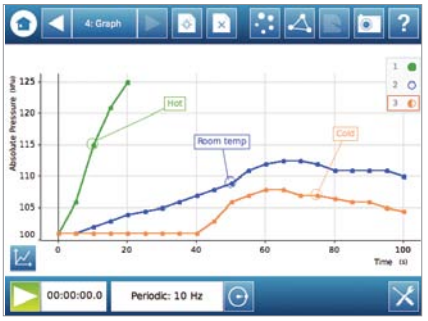
Includes Stainless Steel Temperature Probe, pH Probe, Voltage Probe, built-in Pressure Sensor, 60cc syringe, tubing and quick-release connectors (not shown).

This all-in-one Chemistry Sensor measures temperature, pH (acidity), gas pressure, and voltage simultaneously. It provides a convenient solution for exploring gas laws, performing acid–base investigations, studying oxidation–reduction reactions, and more.

THE TEACHING ADVANTAGE

- Easy-to-use design requires no calibration
- Versatile combination of sensors makes this a good overall solution for a Physical Science or introductory Chemistry lab

Find the rate of a reaction that evolves a gas by observing the change in pressure.



Determine the effect of temperature on the rate of a reaction.

Absolute Pressure/Temperature Sensor

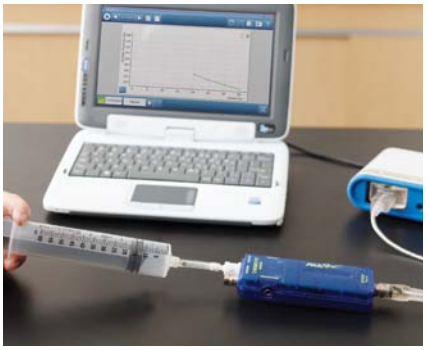
PS-2146

Includes Fast Response Temperature Probe, 60cc syringe, tubing and quick-release connectors.

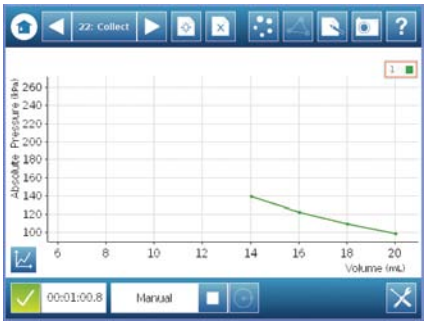
Get accurate temperature and absolute gas-pressure measurements when studying the gas laws, such as Ideal Gas Law and Boyle's Law. This sensor can be used to estimate absolute zero in the common ˚C and ˚F scales.

THE TEACHING ADVANTAGE

- High-pressure data resolution and fast response time ensure accurate results
- Temperature and pressure data reported in several common units eliminate the need to perform conversions



Ideal for studying gas laws such as Boyle's Law.



Plot pressure versus volume to better understand their relationship.

Barometer/Low Pressure Sensor

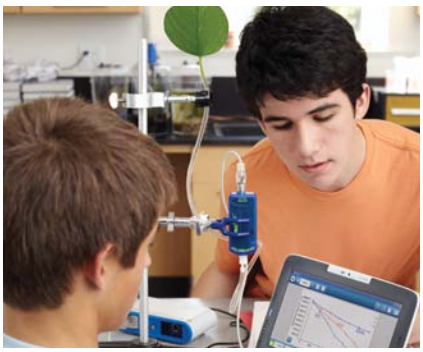
PS-2113A

Includes 60cc syringe, tubing and quick-release connectors.

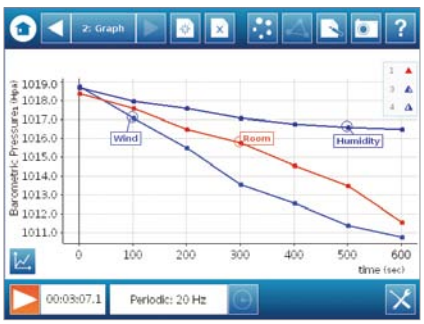
This air pressure sensor detects changes in barometric pressure as small as plant transpiration. To better understand pressure in your environment, record weather events, a door opening in a room, and investigate how elevation influences air pressure between a ceiling and a floor.

THE TEACHING ADVANTAGE

- High-sensitivity down to ±0.001 mm Hg
- Precise readings from 0 up to 1 kPA
- Includes accessories to measure plant transpiration



Investigate transpiration using the tubing and connectors that come with the sensor.



Collect multiple runs in a single class period to compare different environmental conditions.

Dual Pressure Sensor

PS-2181

Includes 60cc syringe, tubing and quick-release connectors.

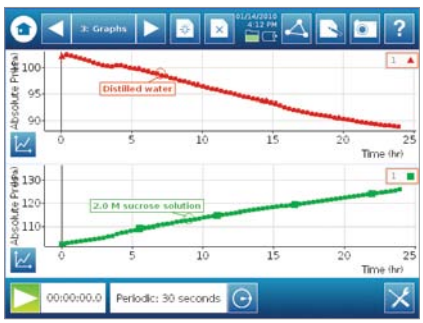
Also Available:
Quad Pressure Sensor PS-2164

This sensor measures difference in gas pressure between two inputs. Compare absolute pressures to a vacuum or ambient air pressure. Observe pressure changes in a heat engine, study air pressure on and under an airplane wing, or collect data to determine respiration rates.

THE TEACHING ADVANTAGE

- Relative heat-engine pressure records below zero
- Selection of units reduces the need to calculate conversions
- High-sensitivity, smooth data with little noise is easier to analyze

The dual pressure sensor is perfect for use with the Diffusion/Osmosis Apparatus.



Measure the pressure on both sides of the membrane simultaneously.

Relative Pressure Sensor

PS-2114

Includes 60cc syringe, tubing and quick-release connectors.

This sensor measures gas pressure compared to atmospheric pressure, often called gauge pressure. Quick-connect tubing supports a variety of pressure activities. The sensor's limited pressure range provides excellent accuracy and resolution for measuring small pressure changes.

THE TEACHING ADVANTAGE

- Conduct water-pressure experiments in the classroom

Changes in water pressure relative to water depth can be studied in the classroom.

Use curve fits to determine the nature of the relationship between pressure and depth.

Alpha Beta Gamma Radiation Sensor

PS-2166

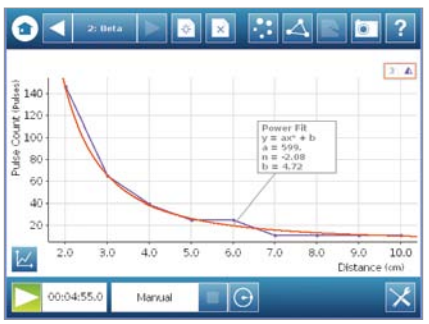
Includes Digital Adapter

Measure alpha, beta, and gamma radiation levels. Discover the relationship between radiation intensity and distance from the source. Use Alpha Beta Gamma Radiation Sensor in conjunction with our Radiation Sources, Isotope Generator Kit and/or Absorbers.

THE TEACHING ADVANTAGE

- Produces clear audible beep when a count is registered
- Designed for easy mounting

Determine how activity changes with distance from a radioactive source.



Students can compare their individual data to mathematical models.

Radiation Sources

SN-8110

Includes three sources: alpha (Po-210), beta (Sr-90), gamma (Co-60). The sources are USNRC License Exempt (US only).

Isotope Generator Kit (BA-137m)

SN-7995A

Includes generator, syringe, tube, 250 ml. solution and storage case.

Safely study properties of radioactive decay with the short-lived BA-137m isotope generated with this kit (half-life of just 2.6 min). Contains one USNRC License Exempt (US only) quantity of CS-137.

Recommended:

Planchets (100-pack) SN-9799

Absorbers (Set of 20)

SN-8111A

Includes 20 calibrated absorbers: 4 epoxy-coated lead, 2 plastic, 10 aluminum sheets, 2 polyethylene and 2 aluminum foil absorbers.

Respiration Rate Sensor

PS-2133

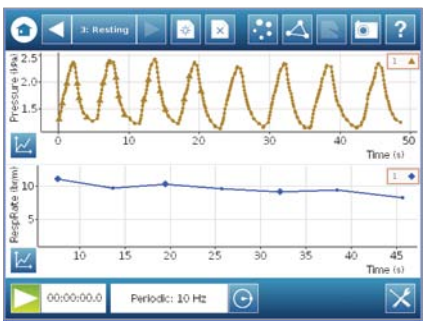
Includes respiration belt and sensor.

Explore human respiration, or breathing rate. Study how respiration rate is affected by exercise, temperature variation, and other factors. Use in combination with the Heart Rate Sensor PS-2129 to explore correlations between heart rate and respiration rate.

THE TEACHING ADVANTAGE

- Pressure sensor worn on inflatable belt around ribcage or waist provides convenient hands-free use
- Measures changes in pressure caused by expansion and contraction of the chest cavity

How does your respiration rate change during physical activity?



Build your own calculation: find breath rate or measure the time between breaths.

Salinity Sensor

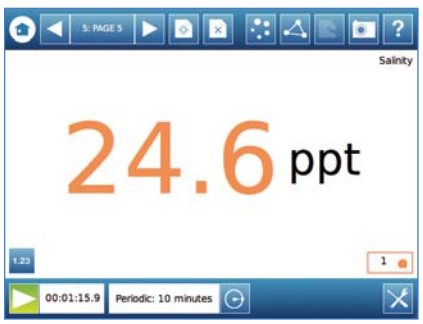
PS-2195

The Salinity Sensor works with the 10X Conductivity/Temperature Probe to measure salinity, conductivity and temperature, and determines salinity based on electrical conductivity. Great for exploring the salinity of local water sources or measuring the change in salinity of saltwater as it evaporates.

THE TEACHING ADVANTAGE

- Built-in calculation to compensate for the change in conductivity due to temperature change

Measure the salinity of a sample of water directly in the field or in the classroom.



Compare fresh and brackish samples quickly and easily.

Soil Moisture Sensor

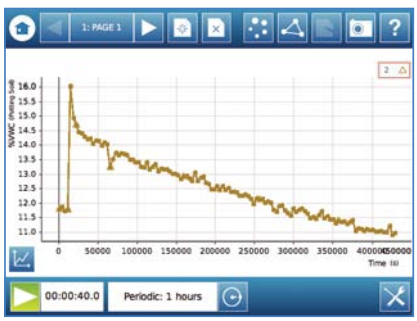
PS-2163

Just how dry is that soil sample and how does it affect your vegetation? Measure the water content of soil in percent. Measure changes in soil moisture around plants over time, study evaporation, and determine optimum moisture conditions for different species of plants.

THE TEACHING ADVANTAGE

- Pre-calibrated for common soil types
- Ideal for environmental science, agricultural science or biology

Quickly determine the moisture in your soil or leave for a time to see how quickly soil moisture changes.



Soil moisture data over time shows evaporation.

Built to Last

Since its inception, PASCO has earned the reputation for producing innovative products specifically engineered to survive the rigors of student use.

SUPERIOR CABLES

Compare our cables to the typical telephone cord-type cable and connector offered by others. Our high quality material and durable design include strain relief.

NO BROKEN PINS

Look closely at PASCO's connection design. We engineer our connections so there is just one way to insert—it can't be forced. Once inserted, our design prevents twisting. No broken pins!

SENSOR CASING

Our sensors are protected by high-quality, damage-resistant materials specifically selected by our engineers for their application. Most are constructed of high impact polycarbonate.

PASCO 5 YEAR WARRANTY

General Science Sensor

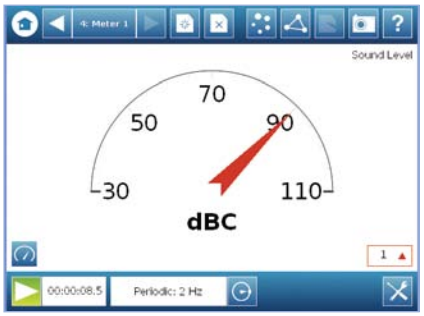
PS-2168

Includes built-in light and sound sensors, stainless steel temperature probe and voltage probe.

Measure temperature, light levels, sound levels, and voltage simultaneously. Observe the change in temperature of a cooling liquid, monitor noise levels in the classroom or in the field, discover the relationship between brightness and distance from a light source or study the discharge of capacitors.

THE TEACHING ADVANTAGE

- Easy-to-use design requires no calibration
- Versatile combination of sensors makes this a good overall solution for a general science lab



Engage your students with a metered record of their own sound level.

Sound Level Sensor

PS-2109

How loud is too loud? Study noise pollution, explore the difference between loudness and intensity, and determine how distance from a sound source affects loudness.

THE TEACHING ADVANTAGE

- Three ranges allow data collection from quiet whispering to the loudness of a jet aircraft
- Measures sound in dB, with the dBA scale for quieter sounds and the dBC scale for louder sounds
- Measures both level (loudness in dB) and intensity (energy over a given area in microwatts per square meter)

Use a musical instrument to distinguish between sound level and pitch.

A graph of sound level shows minimal change even though the pitch slides up and down the scale.

Temperature/Sound Level/Light Sensor

PS-2140

Includes built-in ambient temperature, light and sound level sensors.

Recommended:

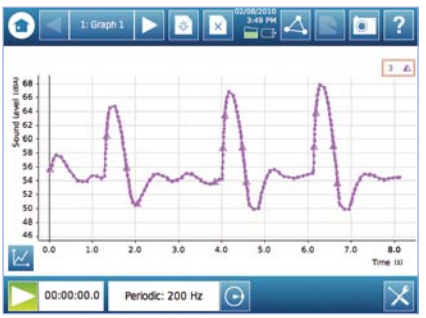
Stainless Steel Temperature Probe
PS-2153

Simultaneously measure temperature, sound levels, and light levels. Determine the light level on a sunny vs. a cloudy day or compare sound levels of students whispering, singing or applauding. Students can build a comprehensive data map of the physical characteristics of their surrounding environment.

THE TEACHING ADVANTAGE

- Use with our GPS Position Sensor to map data and correlate measurements with locations
- Add an optional Stainless Steel Temperature Probe for water studies and more

Find the sound level generated by common activities.



Measure the sound level of discrete events and even find the frequency of those events.

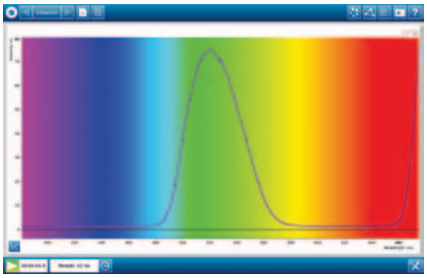
Amadeus Spectrometer System

SE-7183

Includes Amadeus spectrometer, Tungsten light source with power supply, 1.8 meter fiber optic probe, USB cable, 10 cuvettes. Now compatible with SPARKvue software and SPARK Science Learning System.

This affordable spectrometer from Ocean Optics is designed for ease of use at high schools. From the Tungsten light source to the included fiber optic cable, this system is a great value!

Now compatible with SPARKvue software and SPARK Science Learning System.



THE TEACHING ADVANTAGE

- Measure absorbance, emission and fluorescence!
- Spectral Range: 350 to 850 nm
- Resolution: 3 nm (FWHM) with a total of 300 datapoints

Students collect full absorption spectra to determine the concentration of species in the solution.

Quick quantitative identification of emission peaks from elemental and molecular species.

Spirometer

PS-2152

Measure volume of airflow during breathing. Compare breathing patterns before and after exercise, measure lung capacity, and compare the breathing characteristics of athletes and non-athletes.

THE TEACHING ADVANTAGE

- Simple easy-to-use one-piece sensor
- Disposable mouthpieces increase student safety and encourage participation.
- Designed to minimize resistance to airflow for more accurate results.

Capture breath rate and volume at the same time.

Temperature Sensor

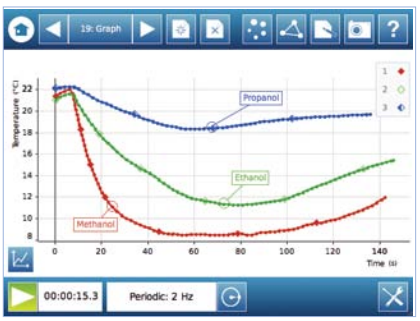
PS-2125

This durable, high-resolution sensor covers many temperature experiments. With the Stainless Steel Temperature Probe it supports small but significant temperature changes produced by chemical reactions, convection currents and even skin temperatures.

THE TEACHING ADVANTAGE

- Interchange additional probes – Fast Response or Surface Temperature
- Fast sampling rate for small temperature changes
- No calibration required – just plug in and measure

Investigate intermolecular bonding by exploring the evaporation rates of different alcohols.



Students see that evaporation rates vary widely among alcohols with different intermolecular forces.

Non-contact Temperature Sensor

PS-2197

This sensor detects infrared light and records the temperature of objects without having to touch them. Compare different surfaces and compare the temperature results based on composition and amount of direct sunlight, even record the temperature as ice warms and melts.

THE TEACHING ADVANTAGE

- Quick-response time speeds data collection
- Wide temperature range and 0.5 °C resolution allows a wide variety of surfaces to be studied

Students create a temperature profile of a building with the Non-contact Temperature Sensor.

Temperature profile provides a great foundation for discussion of insulation, energy conservation and more.

Temperature your way

Measuring temperature and understanding temperature-related concepts is so fundamental to science that PASCO offers many ways to measure it.

Choice of probes

We offer 3 temperature probes (page 219) to provide you the greatest flexibility in measurement, and we know you will find compelling uses for each of them.

- Fast Response Temperature PS-2135
- Skin/Surface Temperature PS-2131
- Stainless Steel Temperature PS-2153

These temperature probes can be freely used with any sensor, interface or datalogger with a standard PASCO temperature port.

Where can you use these temperature probes?

The following PASCO Sensors, Interfaces & Dataloggers all include the standard temperature port:

PASPORT Temperature Sensors:

- Temperature Sensor PS-2125
- Quad Temperature Sensor PS-2143
- Temperature Array PS-2157

PASPORT MultiMeasure Sensors:

- Chemistry Sensor PS-2170
- General Science Sensor PS-2168
- Precision pH/Temperature Sensor PS-2147
- Water Quality Sensor PS-2169

PASPORT Interfaces & Dataloggers:

- SPARK Science Learning System PS-2008A
- SPARKlink PS-2009
- Xplorer GLX PS-2002

Skin/Surface Temperature Probe

PS-2131

Use this sensor when you need to know just how warm "warm to the touch" is. Compare skin temperature before and after exercise, map out temperature variations across the skin's surface, or perform heating and cooling experiments with solids.

THE TEACHING ADVANTAGE

- Wide temperature range allows a wide variety of surfaces and situations to be studied.
- Flat surface area assures good contact and accurate readings.

Just press the probe against a surface to get an accurate reading of the surface, not the surrounding air.

Report surface temperatures using degrees Celsius and Fahrenheit simultaneously.

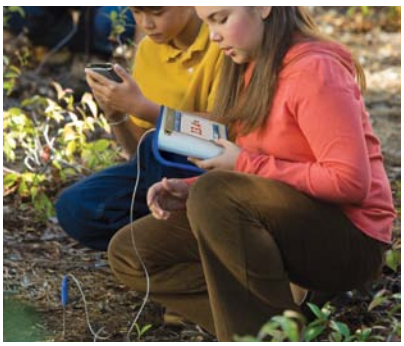
Stainless Steel Temperature Probe

PS-2153

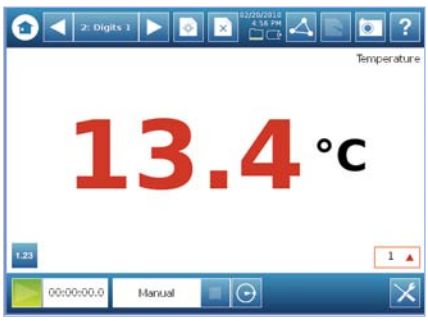
Simple and effective. Investigate melting & freezing points or measure rapid temperature changes found in endothermic or exothermic reactions. Connects to PASPORT temperature sensors, and the built-in temperature ports on the SPARK or SPARKlink.

THE TEACHING ADVANTAGE

- Teflon® covers to protect the probe from aggressive chemicals are available (CI-6549).
- A range of -35 to +135 °C covers most classroom needs



Measure temperatures in the ground below the surface.



Compare temperature at the soil surface to temperature below the surface

Fast Response Temperature Probes

PS-2135 (3-pack)

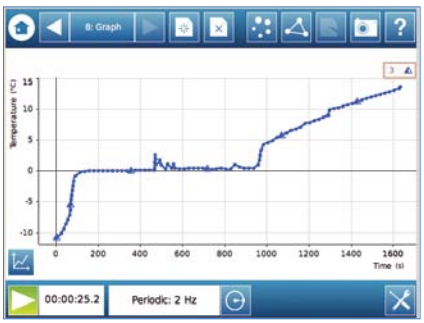
Includes 10 adhesive patches.

Use with a Temperature Sensor to measure temperature in sensitive and fast-changing conditions and study air convection, evaporative cooling, or endothermic and exothermic reactions. Temperature data displays immediately.

THE TEACHING ADVANTAGE

- Does not require calibration – plug it in and go.
- Probe has a 1-meter-long lead, allowing use with long-necked flasks and tall graduated cylinders.

The Fast Response Temperature Probe is ideal for small, hard to reach spaces – here frozen in ice.



Investigate phase change (melting point of water).

Quad Temperature Sensor

PS-2143

Includes 2 Stainless Steel Temperature Probes, 3 Fast Response Temperature Probes, and adhesive disks.

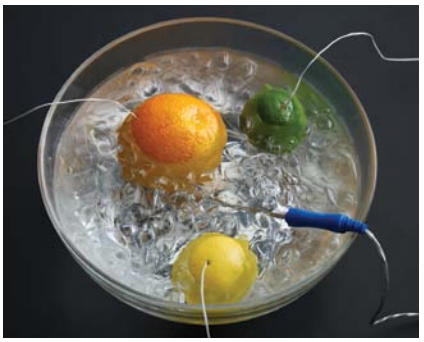
Also Available:

Temperature Array (8) PS-2157
Teflon® Sensor Covers (10-pack) CI-6549

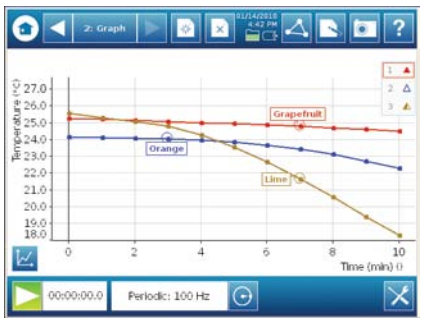
Up to four temperature probes can simultaneously collect different temperatures. Conduct experiments by heating or cooling different materials in identical conditions, collect data from chemical reactions, and study the flow of heat through different kinds of materials.

THE TEACHING ADVANTAGE

- Use 4 different Temperature Probes in any combination in the classroom or the field
- No need for calibration – just plug in the probes and start taking data
- Temperature range of -35° C to +135° C at ± 0.5° C



Students use Fast Response Probes embedded in different fruit to capture the cooling rates.



Students use cooling rate of fruit to model the relationship of cell size and surface area/volume ratio.

Temperature Type K Sensor

PS-2134

Includes Type K Thermocouple Probe.

Also Available:

Type K 4-Port Temperature Sensor PS-2127

This sensor works in conditions severe enough to break a common thermometer or melt a temperature sensor. It is ideal for experiments that range from very cold to very hot. The Type K can measure the temperature of liquid nitrogen and it can map the temperatures within a candle flame.

THE TEACHING ADVANTAGE

- Vast temperature range of -200° C to +1000° C
- Long probe protects students in extreme conditions and supports use in hard-to-reach places

Study temperature extremes with this wide-range Type K Temperature Sensor.

Temperature of a candle flame.

Thermocline Sensor

PS-2151

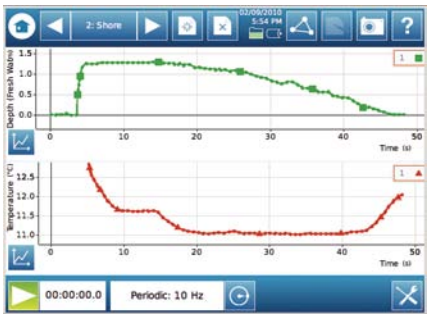
Includes Thermocline Sensor head.

Measure temperature as a function of depth in local streams and lakes while both data points are recorded automatically. Create temperature profiles for different bodies of water, compare temperature variations of fresh water vs. salt water environments, and study ocean tides.

THE TEACHING ADVANTAGE

- Automatically-recorded temperature and depth eliminates the need for manually marking a line, resulting in greatly-increased accuracy of results
- Weighted base keeps sensor lead stable
- Works up to 10.5 meters with a 0.03 m resolution

Study temperature vs. depth profiles of bodies of water – measure up to 10.5 m deep.



Show how temperature changes with depth even for small, relatively shallow bodies of water.

Turbidity Sensor

PS-2122

Includes Hach calibration standard (100 NTU), 5 empty glass cuvettes, and plastic storage case.

Take the guesswork out of measuring a solution's turbidity (cloudiness). Perform water quality studies, compare local water samples to national standards, and measure the rate of precipitate formation in chemical reactions.

THE TEACHING ADVANTAGE

- Stable light source ensures consistent, accurate data measurements
- Easy to calibrate using a simple, 15-second process

Compare turbidity of water samples from local water sources.

The simple built-in calibration – just 15 seconds – means your data is as accurate in the classroom as in the field.

Voltage/Current Sensor

PS-2115

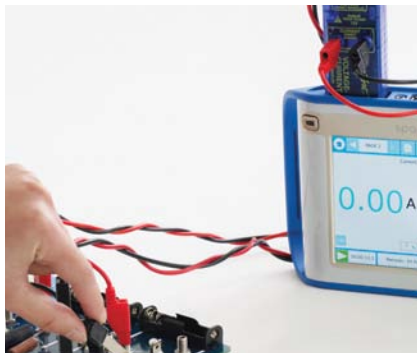
Includes 2 pairs of voltage leads and 1 pair of alligator clips.

Recommended:
Sensor Extension Cable PS-2500
Alligator Clip Leads (set of 10) EM-8634

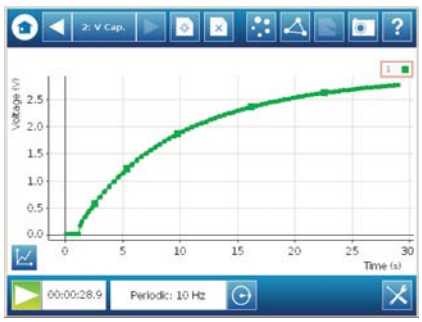
Simultaneously measure voltage and current within an electric circuit. Study the charging and discharging of a capacitor to find the relationship between voltage and current in a circuit (Ohm's Law), and, to determine the power consumed by electrical devices.

THE TEACHING ADVANTAGE

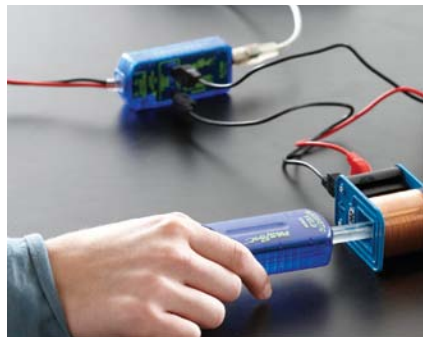
- Measures voltage and current, simultaneously
- Calculates power (power = voltage * current)
- Sensor automatically shuts down and emits an alarm to prevent damage when current gets too high



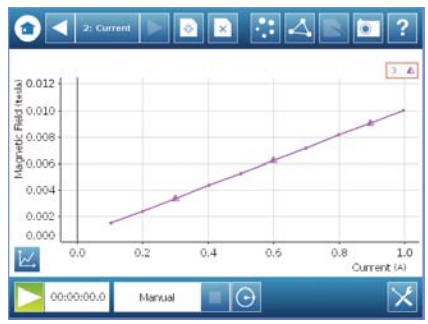
Measure the voltage and current as a simple RC circuit is charged and discharged.



Use a graph of voltage versus time to determine the RC time constant.



Use with the magnetic field sensor for electromagnetism studies.



Find the relationship between the current flowing through a coil and the magnetic fields in the coil.

ezSample™ Snap Vial Kits

Ammonia EZ-2334
Chlorine EZ-2339
Iron EZ-2331
Nitrate EZ-2333A
Phosphate EZ-2337

Required:
Water Quality Colorimeter PS-2179

Chemical Water Quality Test Kits

Conduct colorimetric tests in the field and avoid the mess and tedium of mixing chemicals. These ezSample Snap Vials contain a pre-formulated reagent to test a variety of water-quality parameters. No more guessing at color variations – simply drop the vial into the Water Quality Colorimeter and read the concentration.


Snap the tip of the vial and...

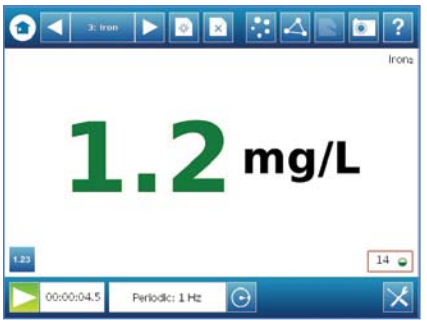

...the sample instantly flows into tube, mixing with the reagent.


Place the vial in your Water Quality Colorimeter and read the results.

Water Quality Colorimeter

PS-2179

Designed specifically to support chemical analysis of water samples using the ezSample Snap Vial Water Quality Test Kits. Test kits include built-in calibration curves. Reports concentration value.



Iron concentration using ezSample Snap Vial and Water Quality Colorimeter

Titration in the field

PASCO also simplifies measurements that require a titration method. The ezSample Field Titrator Kits contain a vacuum-sealed quantity of titrant. The entire process requires only a minute or two, is completely portable, and avoids all the setup and cleanup associated with ordinary titrations.


Begin titrating by gently squeezing the lever to draw in your sample.


In this titration for Alkalinity, color initially changes to pink.


On final color change, turn titrator over and measure concentration using the built-in scale. That's it!

ezSample™ Field Titrator Kits

Alkalinity EZ-2340
Carbon Dioxide EZ-2341
Total Hardness EZ-2338

Required:
Water Quality Colorimeter PS-2179

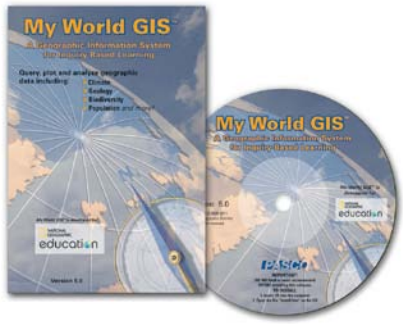
Water Quality Sensor

PS-2169

Includes Stainless Steel Temperature Probe, pH Probe, Dissolved Oxygen Probe, and Conductivity Probe.

My World GIS™ 5.0

Classroom (10-seat) License SE-7364
35-seat License SE-7365
K-12 Campus Site License SE-7366



High volume and district licenses also available.
See pasco.com for more license options.

See pages 122-123 for more information.

THE TEACHING ADVANTAGE

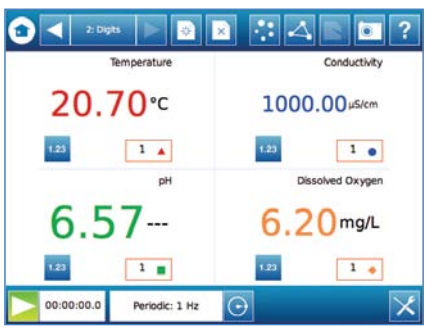
- Use each probe separately or in any combination you choose
- Ideal for Environmental Science or Biology classrooms
- Simultaneous measurement of pH, dissolved oxygen and conductivity

Map your water quality data

When collecting water quality data out in the field you can also view it on a map.

Use our GPS Position Sensor (page 199) to collect GPS data simultaneously with your water quality measurements, automatically synching the data to your latitude, longitude, and altitude. As soon as you are ready to view your results, just open your data in My World GIS and visualize your outcome overlayed on topographic maps, aerial photos, and more.

Use a single sensor to understand an estuary.



All four parameters can be measured together over time to see how the estuary changes during a day.

Samples of ammonia collected along a creek running from a golf course and through a development. Note the high concentrations of ammonia begin to dissipate as the creek leaves the development for open space.

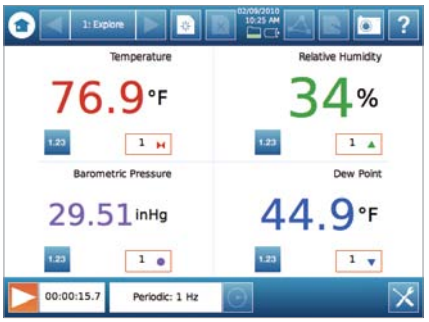
Weather Sensor

PS-2154A

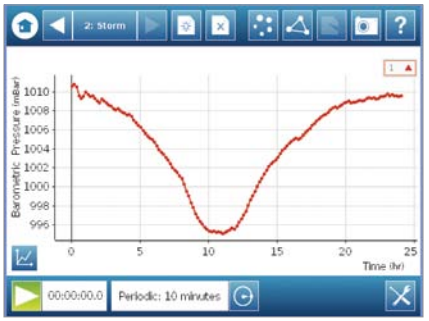
Simultaneously measure atmospheric barometric pressure, absolute humidity, relative humidity, dew point, air temperature, and relative altitude. Study weather and climate or explore microclimates. Use with our GPS Position Sensor for a thorough investigation of weather over an extended area.

THE TEACHING ADVANTAGE

- All-in-one design collects comprehensive data set for studying most aspects of local weather
- Simultaneously identify corresponding events and conditions and evaluate atmospheric variables



Just plug in a sensor to find your local weather conditions.



Better understand the weather you see on television by showing barometric pressure during a passing storm.

Weather/Anemometer Sensor

PS-2174

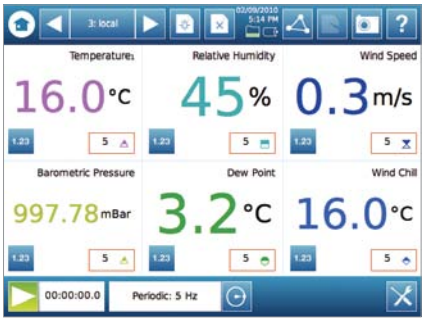
Includes Sensor Extension Cable

More advanced than the Weather Sensor, this hand-held weather station also measures wind speed and wind chill, wind gusts and humidity index. Use it to monitor conditions during a passing storm. By adding the GPS Position Sensor weather patterns can be investigated over an extended area.

THE TEACHING ADVANTAGE

- All-in-one design greatly simplifies the collection of a comprehensive data set for studying all aspects of local weather
- Students can connect weather phenomenon they physically feel with quantitative measurements

Catch a storm with data collected over a 24-hour period.



Display just the weather parameters that are important to you or display them all.

Sensor Extension Cable

PS-2500

2 meters in length.

Two meters in length, this cable is useful in the field, when an experiment involves liquids or chemicals or any time you need a bit more distance.

Sensor Handles (4-pack)

CI-9874

Replacement Items

Breath Rate
Replacement Masks (10 pack) PS-2567
Replacement Clips (10 pack) PS-2568

Colorimeter
Cuvettes and Caps (set of 6) PS-2509

Conductivity
Conductivity Probe, 10x PS-2571

Dissolved Oxygen
Membrane Replacement Kit CI-6541
Dissolved Oxygen Probe PS-2572

EKG
Electrode Patches (100 pack) CI-6620

Exercise Heart Rate
Replacement Strap (XS-S) PS-2519
Replacement Strap (M-XL) PS-2524
Transmitter PS-2512A

Oxygen Gas
Oxygen Gas Probe PS-6524

pH
pH Electrode PS-2573

Photogate Tape
Photogate Tape (30m) ME-6663
High Resolution Tape (30m) ME-6666

Respiration
Respiration Belt CI-9842

Spirometer
Mouth Pieces (10 pack) PS-2522

Temperature
Teflon Sensor Covers (10 pack) CI-6549

Fast Response Temperature
Fast Response Probes (3 pack) PS-2135
Adhesive Patches (100 pack) PS-2525

Turbidity
Cuvettes and Caps(set of 6) PS-2509
100 NTU Standard PS-2511
Silicone Oil, 0.24 oz PS-2510

Voltage
Voltage Probe PS-2165

Digital Adapter

PS-2159

Connect ScienceWorkshop "digital" sensors and other PASCO counting/timing devices (such as Photogates) to SPARK Science Learning System, SPARKlink or other PASPORT interfaces. The PASPORT Digital Adapter has two ports, connecting any two PASCO sensors or timing/counting devices with ¼" stereo phone plugs to any PASPORT interface, including SPARK Science Learning System and SPARKlink.

- Connect ScienceWorkshop Sensors: Motion Sensor II (CI-6742A), Rotary Motion Sensor (CI-6538), Flow Rate (CI-6730A), Drop Counter (CI-6499)
- Connect Timing/Counting Devices: Photogates, Photogate/Pulley System, Time-of-Flight Accessory

For a complete list of sensors that connect with the Digital Adapter, see pasco.com

Analog Adapter

PS-2158

Now connect most ScienceWorkshop sensors to our PASPORT interfaces, including the SPARK Science Learning System and SPARKlink.

The Analog Adapter works with any ScienceWorkshop Sensor with a 5-pin or 8-pin DIN connector. Please note that some ScienceWorkshop Sensors (Motion Sensor II, Rotary Motion Sensor, Flow Rate, and Drop Counter), plus our timing/counting devices such as Photogates and Time-of-Flight Accessory, require the Digital Adapter PS-2159 (shown at left).

For a complete list of sensors that connect with the Analog Adapter, see pasco.com

Older sensors holding you back?

Maybe we can help. We offer an adapter kit for older analog sensors that use a British Telecom Connector, including many Vernier sensors. If you would like to see how this would work for you, please contact our Teacher Support team:

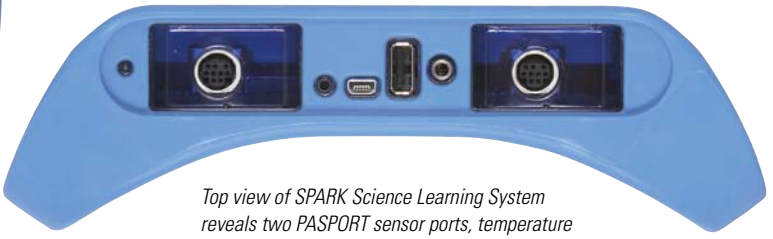
support@pasco.com

All-In-One Hand-Held Solution

A fully integrated SPARKscience solution

The SPARK Science Learning System is a fully integrated SPARKscience solution, providing students a portable stand-alone hand-held device for anytime, anywhere science discovery. With rugged handles for passing back and forth and a large full-color touchscreen, the SPARK Science Learning System was specifically designed with collaborative learning in mind — the entire student lab group can actively participate in the learning process.

- Powered by SPARKvue — shares the same user experience as students on computers or teacher at the electronic whiteboard.
- Preloaded with over 60 SPARKlabs — interactive discovery-based lab activities (see pages 10-11).
- Includes 2 sensors (fast response temperature and voltage).



Top view of SPARK Science Learning System reveals two PASPORT sensor ports, temperature probe and voltage probe ports, and USB ports.

SPARK Science Learning System™

PS-2008A

Includes Fast Response Temperature Probe, Voltage Probe and more than 60 pre-installed, guided inquiry SPARKlabs.

Completely portable hand-held device with 2 sensor ports – a fully integrated SPARKscience solution, featuring a rugged ergonomic design, native SPARKvue software and embedded SPARKlab collection. For more information, see pages 8-9.

SPARK Charging Station

PS-2570

Conveniently store and charge up to 10 SPARK Science Learning Systems with a single power source.

SPARKs sold separately.

Computer-Based Solution

SPARKscience for Windows, Mac, Netbook

Have computers for your science program and just need to connect sensors?

No problem. We have the simple answer. It's the same solution for your Windows, Mac and netbook computers.

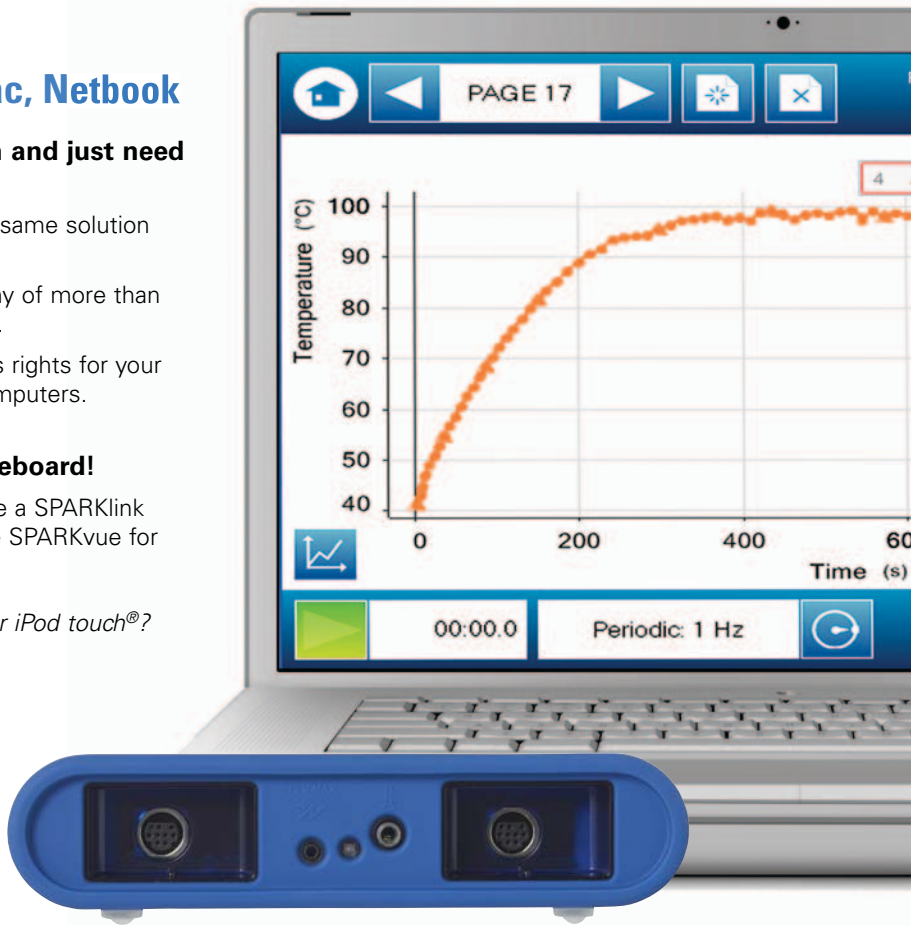
Select our SPARKlink or USB Link and connect any of more than 70 PASPORT Sensors to your existing computers.

Then add our SPARKvue Site License—it provides rights for your entire K-12 campus to install SPARKvue on all computers.

Use SPARKvue with your interactive whiteboard!

Create a teacher demonstration station—just have a SPARKlink or USB Link connected to your computer and use SPARKvue for interactive lectures, demonstrations and more.

Looking for our solution for your iPad®, iPhone® or iPod touch®? See pages 234-235.



SPARKlink®

PS-2009

Includes two sensor ports, Built-in Temperature and Voltage Sensors with Probes, USB connection, and rugged polycarbonate case.

Two sensor ports for connecting sensors to your computer. Ideal for schools with sufficient computers available for science.

USB Link

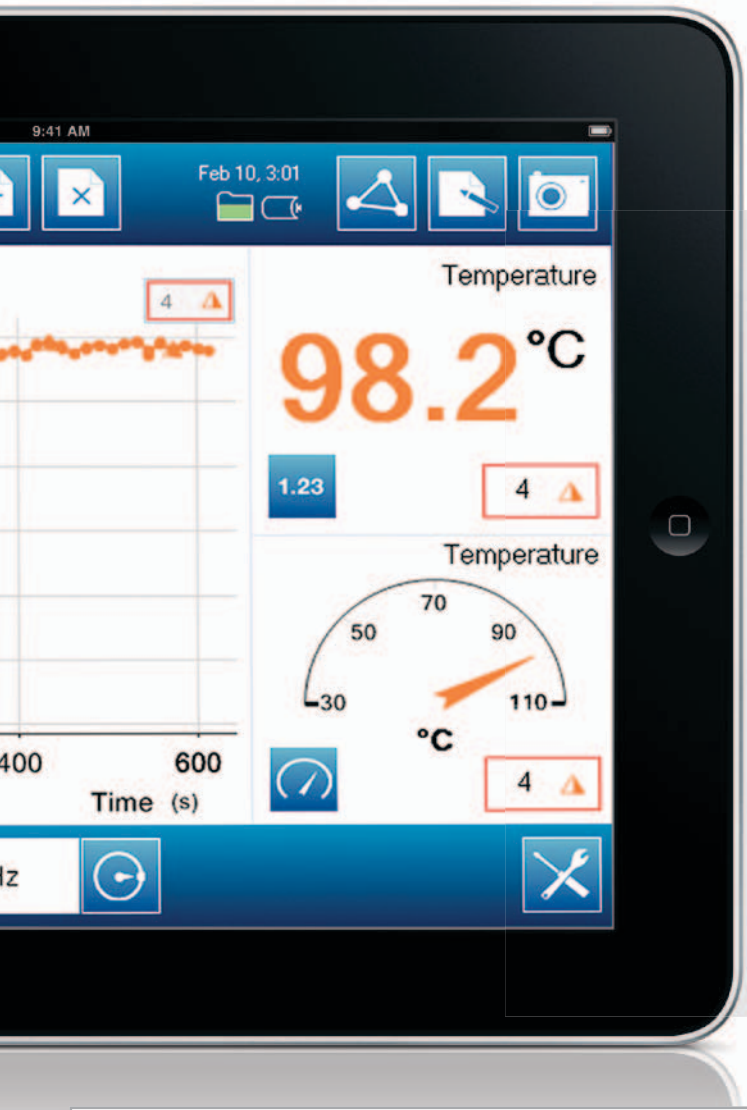
PS-2100A

Single sensor port connection to your computer.

SPARKvue®

Site License PS-2400

Generous Site License includes rights to install SPARKvue on all computers on your K-12 campus.



SPARKscience for your iPad®

From our current free app to our full SPARKvue HD app available this spring, we have you covered.

NEW! AVAILABLE SPRING 2012

SPARKvue® HD

Science Application for the iPad®

Now bring the full-featured version of SPARKvue to your iPad.

- Get the full advantage of SPARKlabs.
- The full capabilities of SPARKvue.
- And, of course, wireless sensing with over 70 PASPORT Sensors.

Chances are, you have a mix of technologies in your school. No need to worry.

It's the same award-winning experience of SPARKvue whether on your Mac or Windows computer, interactive whiteboard, or now on your iPad!

SPARKvue HD will be available Spring 2012.

Sign up for a product alert at **pasco.com/alerts**

Can't wait?

Get started now with our current version of SPARKvue for iOS—free. See below for details.

Get Started with our FREE SPARKvue for iOS

Our current version of SPARKvue for iOS is available now on the App Store—and for free.

Available on the App Store

This app provides anytime, anywhere science measurement using the range of PASPORT Sensors, plus the built-in accelerometer on the iPhone®, iPod touch® and iPad®. Just connect any PASPORT Sensor to your iOS device with our Bluetooth sensor link, the PASPORT AirLink 2.

- Graphs
- Digits
- Meters
- Statistics

PASPORT AirLink 2

PS-2010

Sensor port for wireless connection to your Bluetooth-enabled iPad, iPod Touch, and iPhone with SPARKvue for iOS.

Dedicated Physics Instrumentation

Graphing and Analysis Hand-held

Xplorer GLX Features

- Large 320 x 240 backlit transflective LCD grayscale display
- 8 sensor ports total – 4 dedicated for included sensors and 4 open ports
- Includes 2 temperature, sound and voltage sensors
- 12 MB Internal Memory – Useful for high data collection rates and storing multiple data files.
- Real-time graphing and calculations from Floating Point Processor – even instant calculations on live data as it is collected
- Built-in graphing calculator with expression editor
- Built-in dual independent function generators
- Built-in speaker for sound output

Xplorer GLX Power Amplifier

PS-2006

Includes power adapter.

SPECIFICATIONS

Output Power: ± 1A @ ± 10 V
DC Offset: ± 10 V
Waveform Maximum Frequency: 5000 Hz
Waveform Maximum Period: 1 Hour

Waveforms:

- DC
- Sine
- Square
- Triangle
- Ramp

1 MHz 2-Channel Voltage Sensor

PS-2190

Turn your Xplorer GLX into a 2-channel oscilloscope. Measure two channels at sample rates up to 1 MHz.

SPECIFICATIONS

Two differential channels
1 MHz max sample rate
± 10 V max input
Three gain settings
Overvoltage protection

Requires:

Xplorer GLX PS-2002

Xplorer GLX Replacement Items

Power Adapter PS-2529
Voltage Probe PS-2165
Fast Response Temperature Probes PS-2135
Rechargeable Battery PS-2527

Xplorer GLX®

PS-2002

Includes 2 Fast Response Temperature Probes, Voltage Probe, built-in Sound Sensor/Microphone, Power Adapter/Charge, USB-on-the-go Cable.

Xplorer GLX 20-Unit Charging Station

PS-2557

Includes one 20-unit charging station. Xplorer GLXs sold separately.

The Intel® convertible classmate PC is the result of research conducted worldwide to ensure relevance to all learning environments—this convertible classmate PC is designed for education, wherever it may occur.

Classmate PC

Netbooks designed for learning – and collaboration

These Intel-powered convertible classmate PCs are an exciting, cost-effective education solution designed to meet the needs of 21st century teachers and students. Part of the Intel® Learning Series, the classmate PCs are based on best practices in education and product design—drawn from extensive ethnographic research carried out in classrooms around the world.

PASCO offers these classmate PCs bundled with the science applications you need, providing you a rugged, affordable, full-featured netbook for interactive, collaborative science learning.

BUILT FOR STUDENTS AND SCHOOLS:

- Swiveling touch-screen and tablet-mode meets the needs of mobile learners.
- Integrated handle and tablet form factor supports mobility in and out of the classroom, encouraging collaboration and sharing of work with peers and teachers.
- Built-in rotating camera presents students with new ways to input and interact with their world.
- Includes both classroom management software and collaboration software.
- Features 2 integrated speakers, microphone jack and headphone jack.

LOADED FOR SCIENCE:

- SPARKvue software
- My World GIS
- Over 60 SPARKlab activities
- Preinstalled and ready for science discovery

The Intel® convertible classmate PC features water resistant keyboard, touchpad, and touchscreen—designed to survive the realities of hands-on learning.

Features the Intel® Atom™ processor—built for low power consumption—and reliable Intel® architecture with "real PC" performance.

PASCO Convertible Classmate PC Science Education Bundle

PS-2616A

Preinstalled science applications include SPARKvue software and My World GIS, plus over 60 SPARKlab activities.

Other touch-optimized applications include camera application, eReader, note-taking and painting-drawing applications.

Features 1 GB memory, 60 GB hard drive, 2 USB ports and ships with Windows 7 operating system. For complete product information, see pasco.com/cmpc

Required to connect your sensors:
SPARKlink PS-2009

Ready for Science

THIS CONVERTIBLE CLASSMATE PC INCLUDES:

- SPARKvue—PASCO's award-winning software for data collection, interactive visualization and analysis. *For more info, see pages 232-233.*
- My World GIS—the award-winning geographic information system designed specifically for school learning environments. *For more info, see pages 122-123.*
- SPARKlabs—over 60 guided-inquiry science lab activities spanning life, earth and physical sciences at elementary, middle and high school levels. *For more info, see pages 10-11.*

Designed for collaboration—swivel screen supports sharing and group reflection.

And the touch capabilities of both SPARKvue and this convertible classmate PC keep the focus on the task.

Practical—sometimes a desk or lab bench isn't available, but that's where the science is. Tablet mode keeps the student—and the science—going.

Rotating Camera

Wow!

That's all we can say.

Too late for print, see the latest entry in the Intel Learning Series featured online at:

pasco.com/intel

You won't want to miss it. See it now.

Right now.

Yet another great way to bring the SPARKscience solution to your school.

Seriously, what are you waiting for?

Intel® Learning Series

Advancing Education Worldwide

SPARKvue®

Software for interactive visualization and analysis

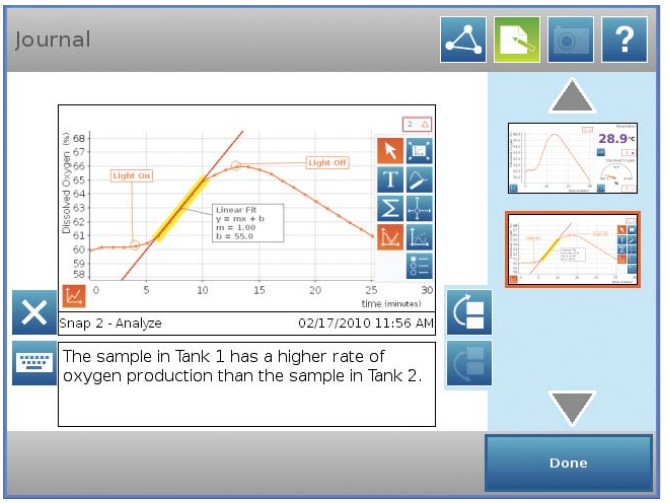
SPARKvue fully supports the learning process.

SPARKvue software is a science tool and state-of-the-art learning environment all in one. SPARKvue offers a full suite of display options, from graphs and meters to digits and tables. Powerful analysis tools are always available at the touch of a finger…but never in the way.

And SPARKvue creates opportunities for student reflection at every step, with the option to save a journal snapshot of work, including written observations, with just a touch of a finger.

SPARKvue is plug-and-learn.

Simply connect any of the more than 70 PASPORT Sensors to your SPARKlink or SPARK Science Learning System and immediately begin collecting data and seeing live measurements. It's powerful, yet simple—the way all probeware should be.



SPARKvue fully supports the learning process. Prompt student reflection with embedded questions, capture student response — even capture 'snapshots' of work, automatically stored in the electronic journal.

SPARKvue...
It's really different.

- Fully supports the learning process.
- Seamlessly integrates content and reflection prompts.
- Finger-touch design keeps students in the flow.
- Integrated electronic student journal

SPARKvue adapts to your technology

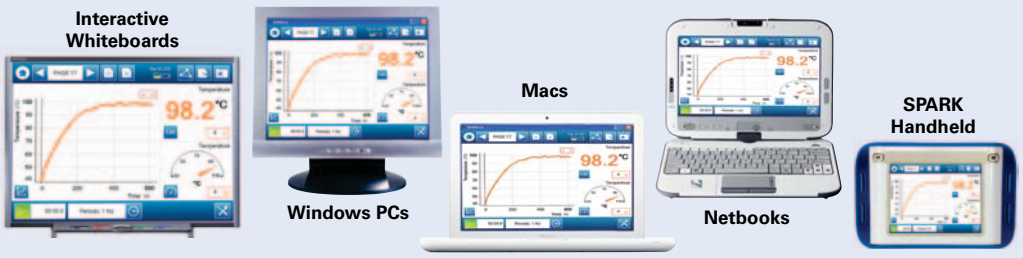
Chances are, you have a mix of technologies in your school. But there's no need to worry. It's the same award-winning experience of SPARKvue, whatever your environment!

- Interactive whiteboards
- Windows computers
- Mac computers
- Netbooks
- SPARK Science Learning System

One common science learning environment.

And coming this spring, SPARKvue HD supports the full SPARKscience experience on the iPad. (See page 234-235.)

And future-proof.... supporting platforms of today and tomorrow.



iPad

See new SPARKvue HD for iPad on page 234-235.

What Teachers Can Do with SPARKvue

- Give interactive lectures using live data and rich media
- Hold collaborative reviews of students' results and findings
- Prompt student reflection with embedded questions
- Assess student learning at any time in process
- Select your own measurements and display data your way

What Students Can Do with SPARKvue

- Make predictions before collecting data
- Display the results of their tests
- Graph their data
- Analyze their data
- Compare actual results with predicted results
- Reflect on the unexpected
- Save a snapshot of work
- Journal

SPARKvue® Site License

PS-2400

SPARKlink®

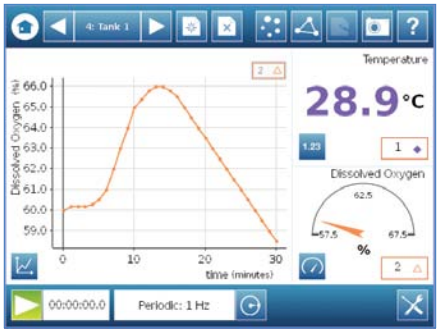
PS-2009

Includes two sensor ports, Built-in Temperature and Voltage Sensors with Probes, USB connection, and rugged polycarbonate case.

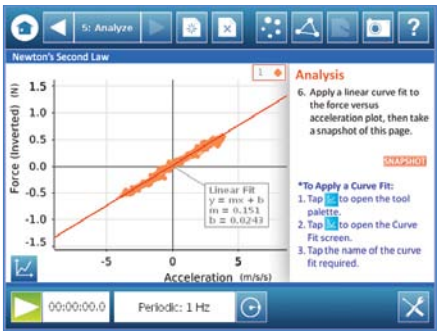
System Requirements: Available for both Windows (Windows XP or higher) and Mac (Mac OS X v10.5 or greater). 300 MHz processor, 128 MB RAM, 100 MB available disk space.

Languages: Arabic, Chinese (simplified), Chinese (traditional), Czech, Danish, Dutch, English, French, German, Italian, Japanese, Kazakh, Korean, Norwegian, Portuguese, Russian, Spanish, Swedish, Turkish.

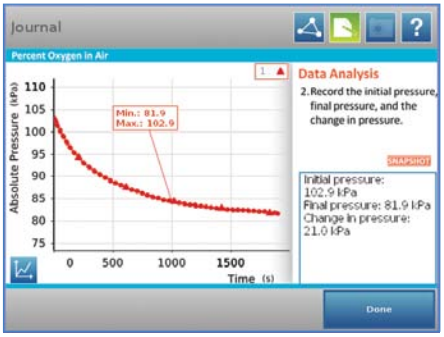
For the most current information, see pasco.com/sparkvue



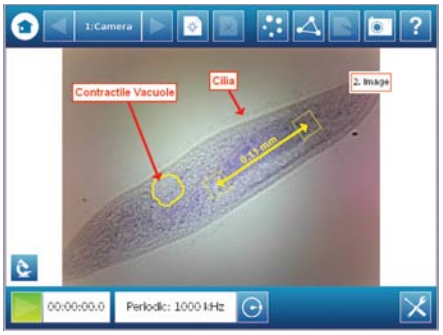
Display data your way.



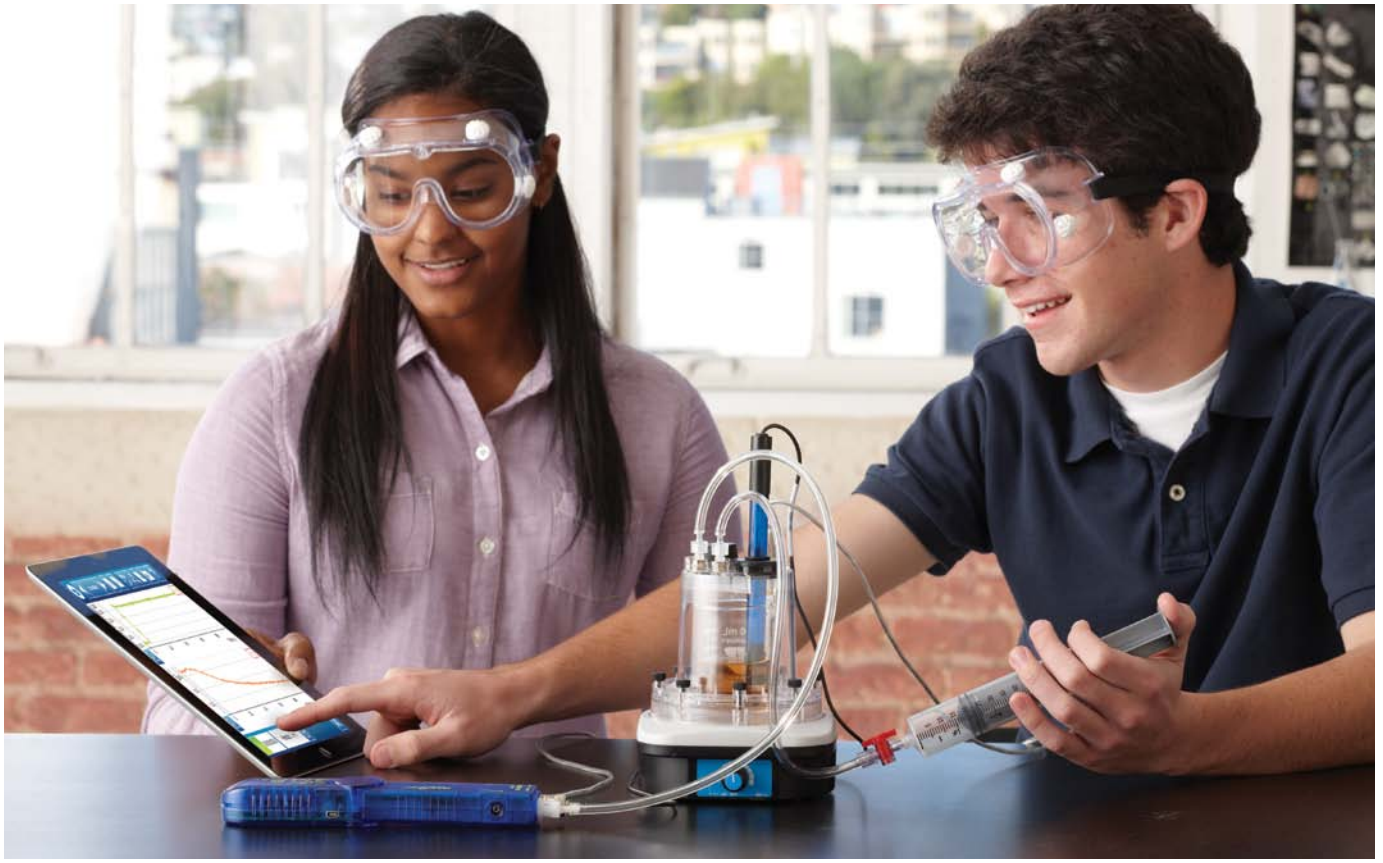
SPARKvue boasts powerful analysis tools – right there when you need them but never in the way.



SPARKvue fully supports the learning process with built-in SPARKlabs.



USB microscope and video support with image analysis tools.



SPARKvue® HD

Science Application for the iPad®

The full-featured version of our SPARKvue software is coming to your iPAD — Spring 2012

The new SPARKvue HD will support the growing collection of SPARKlabs, integrating rich content with live data collection and analysis.

SPARKvue HD offers the full suite of display and analytical tools , all within an integrated learning environment—including reflection prompts, journaling and more.

SPARKscience for your iPad®

From our current free app to our full SPARKvue HD app available this spring, we have you covered.

NEW! AVAILABLE SPRING 2012

SPARKvue® HD

Science Application for the iPad®

Now bring the full-featured version of SPARKvue to your iPad.

- Get the full advantage of SPARKlabs.
- The full capabilities of SPARKvue.
- And, of course, wireless sensing with over 70 PASPORT Sensors.

Chances are, you have a mix of technologies in your school. No need to worry.

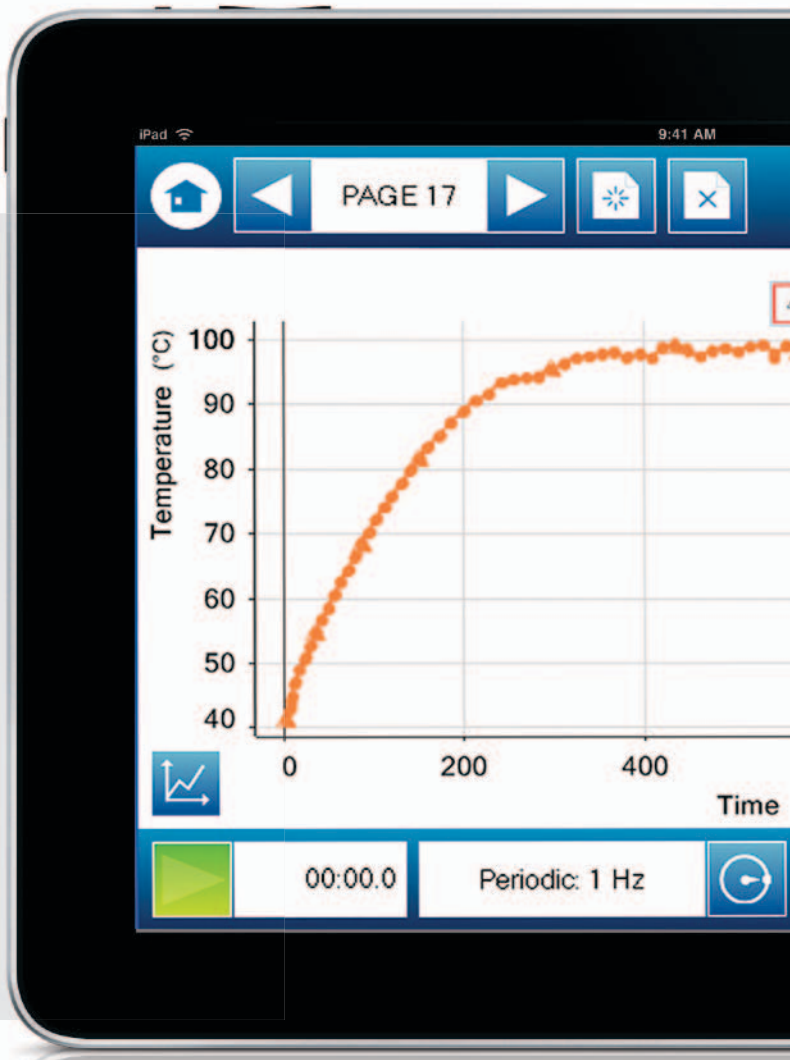
It's the same award-winning experience of SPARKvue whether on your Mac or Windows computer, interactive whiteboard, or now on your iPad!

SPARKvue HD will be available Spring 2012.

Sign up for a product alert at **pasco.com/alerts**

Can't wait?

Get started now with our current version of SPARKvue for iOS—free. See below for details.



Get Started with our FREE SPARKvue for iOS

Our current version of SPARKvue for iOS is available now on the App Store—and for free.

Available on the App Store

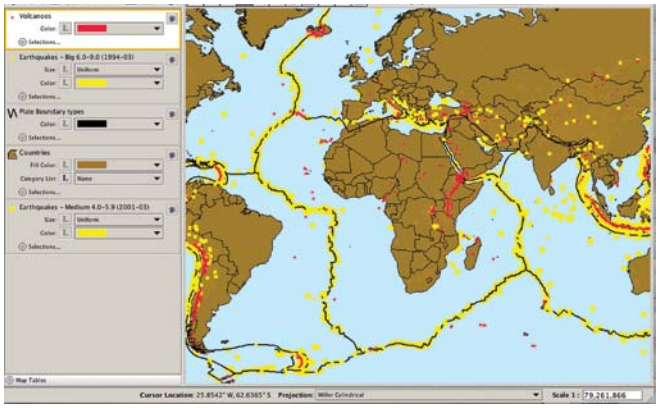
This app provides anytime, anywhere science measurement using the range of PASPORT Sensors, plus the built-in accelerometer on the iPhone®, iPod touch® and iPad®. Just connect any PASPORT Sensor to your iOS device with our Bluetooth sensor link, the PASPORT AirLink 2.

- Graphs
- Digits
- Meters
- Statistics

PASPORT AirLink 2

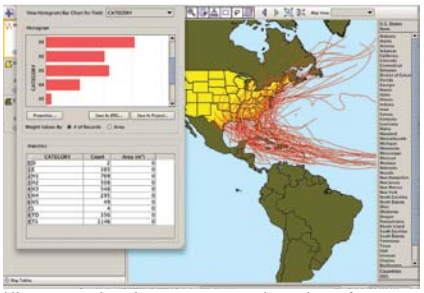
PS-2010

Single sensor port for wireless connection to your Bluetooth-enabled iPad, iPod Touch, and iPhone with SPARKvue for iOS.



Explore plate tectonics with included earthquake and volcano datasets.

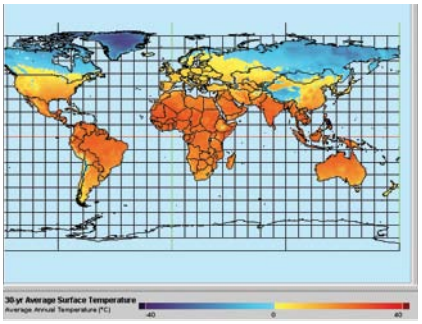
AWARD
eSchool News
Readers' Choice
WINNER



Histogram showing category and number of Atlantic Hurricanes. My World's built-in analysis tools allow students to investigate how many and what category of hurricanes made landfall over the last 150 years.

My World GIS, Version 5.0

My World GIS is an award-winning geographic information system designed specifically for schools, featuring drag-and-drop simplicity and over 50 data libraries to get you started. Right out of the package, you can explore earthquakes, volcanoes, climate, glaciers, country populations, literacy and mortality rates, and much, much more.



30 year average surface temperature and lines of latitude and longitude – Hot areas are red, cool are yellow, and cold are blue. Connect climate data to specific areas of the globe.

What's the value of a GIS in the classroom?

Whether teaching science, history or social sciences, much of the data we use is spatial – referenced to a location. With a GIS, teachers and students have the opportunity to interact with that data visually via maps – and have the power to query the wealth of data behind those maps. Ideal for:

- Oceanography
- Climatology
- Biology
- Earth Science
- Environmental Science
- Physics
- Social Studies
- History

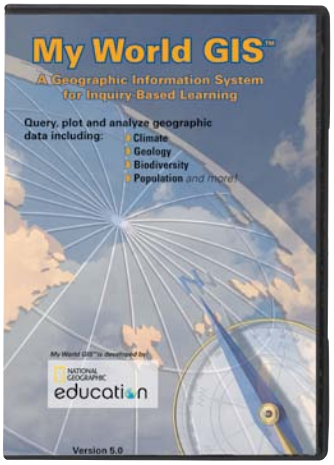
My World supports 'hot linking' images and video to data points – here on a map of US tornados. Hot links are indicated by flags.

My World GIS 5.0

Classroom (10-seat) License
SE-7364

35-seat License
SE-7365

K-12 Campus Site License
SE-7366



High volume and district licenses also available. See www.pasco.com for more license options.

System Requirements:
Windows 95/98/NT/2000/XP/Vista/Windows 7, Mac OS X (Universal Binary), Linux and Solaris. Minimum of 128MB of RAM (256MB recommended).

My World GIS™ is developed by:

NATIONAL GEOGRAPHIC education

For a complete list of new features and for upgrade information, see page 122 or visit pasco.com/myworld

***Free 45-day trial version and GIS activity.* Get them now at pasco.com/myworld**

Great for lectures or student projects

Online Academy for Science and Math

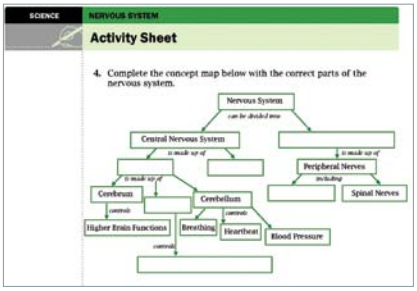
PASCO's Online Academy is a web-based learning environment focused on providing discovery-based learning and assessment. Powered by Adaptive Curriculum and coordinated to State, NSES and NCTM standards, the more than 300 "Activity Objects" provide interactive lessons in Math and Science with rich visualization.

These virtual science labs and real-world simulations in math are ideal for introducing topics, complementing hands-on activities, and reinforcing difficult concepts.

Because they are web-based, the Activity Objects are perfect for:

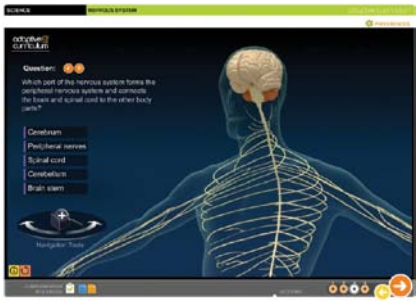
- Interactive classroom lectures
- Small group activities
- Individualized study
- Homework and remote learning

In this activity students explore cell theory and the differences between prokaryotic and eukaryotic cells. One of more than 80 science lessons in high school Biology, Chemistry and Physics. Over 130 lessons in Middle School Life, Earth and Physical Science.



Activity Sheets are available for each activity such as this concept map of the parts of the nervous system.

Using an interactive whiteboard and a teacher subscription, the whole class can explore a topic.



This animation allows students to explore major organs of the nervous system. Assessment is embedded tests their understanding.

3D Simulations – The life-like virtual environment in most Activity Objects allows students to explore concepts in a way that traditional methods can't. They can simulate weather data to see if a hurricane forms, launch a probe into a black hole, or take a close up look at the nervous system.

With over 300 Activity Objects – covering high school and middle school science and math topics, students can develop and test their own hypothesis, experiment in a safe environment and learn by doing. Because they are web-based, students see results in real-time and each activity can be repeated to increase comprehension.

Tools for Teachers – Integrate Online Academy into your curriculum seamlessly. Online tools show you how to combine Activity Objects into documents, PowerPoint® presentations and more. Assign Activity Objects to a class or individual students via email and generate a report once the assignment is completed.

Activity Sheets Included – Many Activity Objects include Activity Sheets with a variety of question strategies for homework and formative assessments. A teacher version of the Activity Sheet is also included.

Online Assessment – At the conclusion of most activities students complete an Online Assessment section to demonstrate their grasp of the core concepts. Teachers can see a student-by-student view of responses to check for comprehension — all online.

Online Academy for Science and Math

Teacher Subscription WD-3009

Includes 12-month online access to all science and math lessons for one teacher.

Student subscriptions also available. For all licensing options, see pasco.com/OnlineAcademy

featuring activities by adaptive curriculum

FREE 30-DAY TRIAL!

Request your free trial now.
Visit pasco.com/OnlineAcademy

Ready SMART Board

PROMETHEAN ACTIVBOARD ENABLED

Magnetic Stirrer

SE-7700

Includes stir bar, removable rod and power adapter.

The Stir Station is a "must-have" piece of lab equipment. The white top makes it easier to distinguish solution color changes.

Also Available:
Micro Stir Bar (5 pack) PS-2565

Hot Plate

SE-8830

This compact and durable hot plate can reach up to 400 °C in minutes. The cast aluminum top plate provides an even heating surface, and it even has a built in support rod holder.

kena® Digital Microscope

SE-7236

Includes a removable camera/magnification head, touch tube (for placing the microscope flush against specimens), sturdy metal base, and convenient carry/storage bag. Magnification: 20X, 40X, 100X

The new kena Digital USB Microscope performs in the classroom or in the field. With the removable camera/magnification head you can even capture or modify images or video.

For use with SPARKvue:
Requires a SPARK Science Learning System or a USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.

ken-a-vision® Digital Monocular Comprehensive Scope 2

SE-7246

Includes 10X eyepiece; 4X, 10X, 40X, and 100X objectives lenses (the 40X and 100X objectives are spring-loaded to avoid crushing slides and damaging optics); USB cable; calibration slide; and charger.

For use with SPARKvue:
Requires a SPARK Science Learning System or a USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.

pH Buffer Capsule Set

SC-2321

Includes 10 capsules each of pH 4.0, pH 7.0 and pH 10.0, plus preservative solution.

Create buffer solutions of pH 4.0, pH 7.0, and pH 10.0. 30 capsules, each sufficient to make 100 mL buffer solution. Included preservative solution which contains a pH indicator and colors each buffer solution for easy identification.

Student Power Supply (18 VDC, 3 A)

SE-8828

This high quality, compact power supply provides the DC voltage and current levels necessary for most introductory student labs.

Ohaus Scout Pro Balance (400 g)

SE-8756A

Also Available:

Scout Pro Balance (200 g) SE-8823
Scout Pro Balance (2000 g) SE-8757A
Scout Pro Balance (6000 g) SE-8758A
Scout Pro USB Connection Kit SE-8788

Mass and Hanger Set

ME-8979

Includes 27 masses, four mass hangers and storage case.

Features precision 5 gram mass hangers with steel posts, and "holed" masses that will not fall off the hanger – and hanger holds up to 250 g. 27 masses in all.

Brass:	3 100g, 3 50g, 6 20g (each +/- 1%)
Aluminum:	3 10g, 3 5g (each +/- 1%)
Plastic:	3 2g, 3 1g, 6 1/2g (each +/- 2%)

Hooked Mass Set

SE-8759

Includes 9 masses and storage box: 1000 g, 500 g, two 200 g, 100 g, 50 g, two 20 g, and one 10 g.

This rugged Hooked Mass Set is made of cast iron and coated with enamel.

PASCO Stopwatch

ME-1234

PASCO designed this stopwatch specifically for timing events, not as a clock or alarm. No annoying alarms going off at odd times of the day! Fits in your hand or sits at a convenient viewing angle on a table. Up to nine event times can be stored in memory. The standard AA battery is long-lasting and easily replaceable.

Also Available:

Stopwatch (10-Pack) ME-1235

Metric Measuring Tape

SE-8712A

This 30-meter woven fiberglass measuring tape reads metric units on one side and English units on the other.

High Quality Meter Sticks (6-Pack)

SE-8827

Hardwood meter stick with metric graduations. Scale reads left to right on one side, right to left on the other.

Large Table Clamp

ME-9472

When experiments require extra stability, this PASCO-designed 4 kg cast-iron base delivers. The A-frame design provides a wide base to support one or two rods, and the large mass provides stability that simply can't be achieved any other way. The rod mounting holes have a special three contact-point design to assure stability. Rods from 9 to 12 mm (3/8 to 1/2 inches) can be supported. Two adjustable feet provide the necessary leveling capability.

Pendulum Clamp

ME-9506

Hang up to three pendula from precisely the same height. Suspension points are 54 mm apart. Fits rods up to 16 mm (5/8 inch) in diameter.

Three-finger Clamp

SE-9445

Clamp tubes, rods and irregularly-shaped objects. The jaws extend 19 mm, open to 57 mm, rotate 360° and lock securely at any angle. Fits rods up to 19 mm (3/4 inch) in diameter.

Adjustable Angle Clamp

ME-8744

This unique clamp fits any rod up to 12.7 mm (1/2 inch) diameter and can lock the rod in place at any angle.

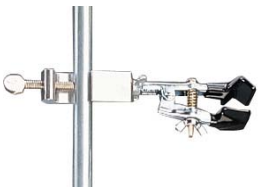
Universal Table Clamp

ME-9376B

Attach this Universal Table Clamp to tables or shelves up to 6.0 cm (2 3/8 inch) thick. Can also be mounted on a ring stand. Mount rods in the clamp either vertically or horizontally. The rods are held securely by stable 3-point contacts. Use standard unthreaded lab rods — 9.5 mm (3/8 inch) to 12.7 mm (1/2 inch) — vertically or horizontally. Use 1/2-13 threaded lab rod vertically.

Buret/Utility Clamp

SE-9446



The V-shaped, plastic-coated jaws of this Buret Clamp open from 5 to 35 mm, rotate 360° and lock in position at any angle. Fits rods up to 16 mm (5/8 inch) in diameter.

Double Rod Clamp

ME-9873 (3 pack)

Holds any two rods (up to 12.7 mm (1/2 inch) in diameter) either parallel or perpendicular to one another.

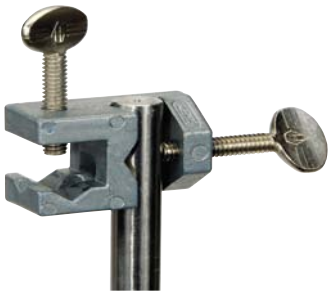
Right Angle Clamp

SE-9444

This standard right angle clamp fits rods up to 18 mm (11/16 inch) in diameter.

Multi Clamp

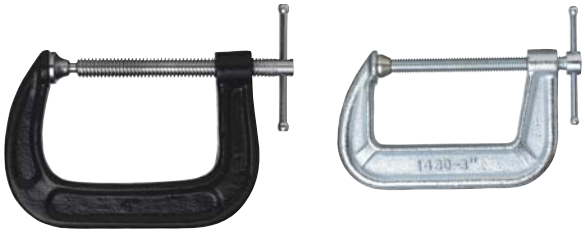
ME-9507



Holds two rods either parallel or at right angles. Fits rods up to 12.7 mm (1/2 inch) in diameter.

"C" Clamps

Large "C" Clamp (6 pack) SE-7285
Small "C" Clamp (6 pack) SE-7286



These rugged clamps are perfect for attaching a variety of objects to a table. Available in 8 cm and 10 cm sizes.

Braided Physics String

SE-8050

This braided Dacron string is tough, resists stretching and won't unravel. Withstands up to 133 Newtons of force (equivalent to 13.6 kg). Each roll provides 320 meters of string.

Glow String (2-pack)

SE-8690

⚠ WARNING
CHOKING HAZARD
Small parts. Not for children under 3 years.

This stretchy "string" glows in the dark after being exposed to light. Use it to demonstrate wave motion, including resonance and standing wave patterns. Two rolls are included, totaling over 15 meters of string.

Large Rod Base

ME-8735

Certain experimental setups require extra stability. The PASCO ME-8735 is designed for just such experiments. This sturdy 4 kg cast-iron base provides stability that just can't be achieved any other way than with a large mass. The A-frame design provides a wide base to support one or two rods. Rods from 9.5 to 13 mm (3/8 to 1/2 inches) can be supported. (See below). The rod mounting holes have a special three-point contact design to assure stability. Two adjustable feet provide the necessary leveling capabilities.

Also Available:

Small "A" Base ME-8976

Stainless Steel Rods

Non-threaded:
45 cm Stainless Steel Rod ME-8736
90 cm Stainless Steel Rod ME-8738
120 cm Stainless Steel Rod ME-8741

Threaded:
60 cm Stainless Steel Rod ME-8977

All rods 12.7 mm (1/2 in.) in diameter.

These non-threaded stainless steel rods do not mar like aluminum rods. They are non-magnetic, very rigid, and durable.

Base and Support Rods

Large Base and Support Rod ME-9355
Small Base and Support Rod SE-9451

Large Base and Support Rod includes built-in leveling screws and a 45 cm threaded aluminum rod. Small Base and Support Rod does not include leveling screws and comes with a 50 cm threaded steel rod.

Instructional Resources

SPARKlabs

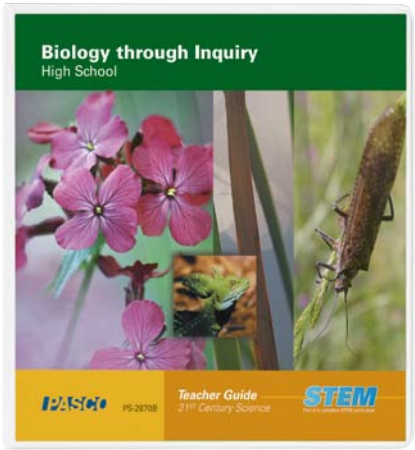
SPARKlabs are educator-designed interactive lab activities that guide students through the process of inquiry and investigation, promoting critical thinking and group discussion.

For the latest information, visit **pasco.com/SPARKscience**

- Elementary School Science
- Middle School Science
- Physical Science
- Biology
- Chemistry
- Earth Science
- Environmental Science
- Physics

See more about these instructional materials in the science sections:

K-8 ..... page 14
Physical Science ..... page 50
Biology ..... page 62
Chemistry ..... page 90
Earth Science ..... page 114
Environmental Science ..... page 128
Physics ..... page 148



Teacher Guides

PASCO Teacher Guides include a Flash Drive and printed manual. The manual contains the detailed teacher version, complete with standards-based guided inquiry lab activities, background materials, tips, suggested answers and much more. Student handouts (editable Word document) and full teacher edition (PDF) are available on the Flash Drive.

- Elementary School Science
- Middle School Science
- Physical Science
- Biology
- Advanced Biology
- Chemistry
- Advanced Chemistry
- Earth Science
- Advanced Environmental Science
- Physics
- Advanced Physics

Partners & Community

Educational publishers, non-profits, school districts and individual educators are actively developing instructional resource materials for SPARKscience today.

For the latest news, visit **pasco.com/SPARKscience**

- Sally Ride Science
- Carolina Biological
- Horizon Fuel Cell Technologies
- Alabama Math, Science, and Technology Initiative
- Laying The Foundation
- *...and more on the way!*

Professional Development

We are here to help you be successful! Our professional development team includes over 100 current and former teachers passionate about science and science teaching. We offer several programs:

Free Online Training

Join our trainers live online in a virtual classroom for free interactive training on the use of PASCO probeware, lab activities, and software solutions.
Register at pasco.com/pd

Workshops at Your Site

Have PASCO come to you! Schedule a workshop at your site and we will tune it to meet your needs: grade level, subject matter, guided inquiry lab activities, and specific PASCO technology. Extend your workshop with a one-day co-teaching session, where the PASCO professional works with you in the classroom to implement lab activities and PASCO technology.

- Learn through an effective mix of demonstrations and hands-on activities.
- Learn how to create probeware-based lab activities or convert your existing lab activities to take advantage of probeware.
- Conduct classroom-ready experiments.
- Integrate an inquiry approach in your teaching.
- Bring STEM education into your classroom.

Contact us today to begin discussing your needs.

PASCO sessions at your site give you professional development attuned to the needs of your school.

Web-delivered Sessions

Schedule live, interactive online training sessions that offer you the convenience of PASCO experts right at your desk.

- Series of three 90-minute sessions
- Delivered by PASCO in an interactive, live online format.
- Learn essentials of using PASCO technology with hands-on, skill-building activities.
- Join training sessions from school or from the convenience of home.

See our current schedule at pasco.com/pd

The PASCO professional development team includes over 100 current or former educators passionate about teaching science.

Want more?
Free online tutorials, experiment videos, and more — **online at pasco.com/pd**

Looking for Something Else?

This catalog features SPARKscience and related products, including the PASPORT line of sensors.

Many more products are available online, including our *ScienceWorkshop* line and our full catalog of physics products.

Our 2012 Physics and Engineering catalog features the new 850 Universal Interface, the world's premier interface for advanced physics labs. To request a copy:

visit pasco.com/catalog

The PASCO Promise of Learning (90-day Satisfaction Guarantee)

We are confident that PASCO solutions will help your students achieve more in science. At the end of 90 days, if you are not satisfied that your students are more engaged and learning more effectively, return your purchase for a refund. We don't want you spending precious budget dollars on something you don't use. (We are sorry but we must exclude non-PASCO software that has been opened, radioactive products and products that contain perishables.) See instructions for Returns below.

Products Built to Last PASCO 5-Year Limited Warranty for Education

PASCO products are built to survive. PASCO-manufactured products are covered by a limited warranty for a period of 5 years from delivery date against defects in material and workmanship. Products manufactured by anyone other than PASCO are subject to the conditions of the warranty supplied by the manufacturer (generally 1 year). The PASCO warranty does not extend to any product, including touch screens, which have been subject to abuse, neglect, accident, improper installation or application, any use other than education, or products which have been repaired or altered outside of our factory. Consumables and limited-life products (such as pH probes, membranes, fast response temperature probes, batteries, chemical solutions, printed materials, etc.) are excluded. Additional warranty information is available upon request.

Free Teacher and Technical Support

We want teachers to be successful with PASCO solutions. Please contact our support team with any questions via phone or email. We are here to help. See our contact information below.

Contact PASCO

Mail:
PASCO scientific
10101 Foothills Blvd.
Roseville, CA 95747-7100 U.S.A.

E-mail:
sales@pasco.com
support@pasco.com

Phone:
+1 916-786-3800

Fax:
+1 916-786-7565

Web Site:
pasco.com

Business Hours:
Monday - Thursday: 7:00 a.m. - 4:30 p.m.
Friday: 7:00 a.m. - 2:00 p.m. Pacific Time

SPARKvue Licenses

SPARKvue software may be purchased as a Single License for use with one computer or as a Site License for use on all computers on a K-12 campus or in a college/university department.

Shipping

Items in stock will normally be shipped in less than seven working days from receipt of the order. Specific request for air shipments or special carriers will be honored at additional cost.

Returns

Please contact the authorized PASCO representative in your country for assistance in returning equipment for repair. PASCO's International Customer Service team can be reached at +1-916-786-3800 or at custserv@pasco.com. Out-of-Warranty products must be shipped prepaid, door-to-door. Returns for credit or exchange must be in new condition and packaged in original shipping cartons or packaging sufficient to prevent damage during international transport.

Trademarks:

More Product Information

Designed for education. PASCO products are designed for education; they are not intended for use in graduate research or industry, and should not be used in any apparatus involved with life support, patient diagnosis, or industrial control.

PASCO reserves the right to change the specifications of any product without prior notice. If a product is no longer available, PASCO reserves the right to substitute a product of equal, or higher, value and functionality.

FCC

Where appropriate, electrical products are marked to indicate that they conform to Federal Communications Commission (FCC) standards. Most commonly, FCC Part 15, Class A.

CE MARK

Where appropriate, products carry the CE marking which indicates that they conform to the applicable European standards . This almost exclusively applies to products which are designed to meet the following applicable directives:

2004/108/EC	for electromagnetic compatibility (EMC)
2006/95/EC	for low voltage electrical equipment

Other Regulations May Apply

Local, national, and international regulations may restrict the purchase, storage, transport, use or disposal of certain products such as chemicals, radioactive sources, and specialty products and wireless transmission devices. Please consult your local regulations to ensure compliance.

Unless Otherwise Specified:

– Operating Temperature Range: 0 °C – 40 °C (32 °F to 104 °F).

– Maximum Altitude (Operational): 10,000 feet

Quality

PASCO scientific Meets the Highest Quality Standards, and our Quality Management System is Registered to ISO 9001.

PASCO and the Environment

PASCO is committed to be in compliance with all laws and requirements in the countries in which our products are sold. PASCO is a responsible steward of the environment and as such, continually seeks to minimize the impact that our manufacturing, distribution, and consumption practices make on the planet's natural resources.

Miscellaneous

The European Union (EU) WEEE (Waste Electrical and Electronic Equipment) symbol (left) and on the product or on its packaging indicates that this product must not be disposed of in a standard waste container.

RoHS

All applicable products supplied by PASCO Scientific to the EU meet the requirements as specified in the RoHS directive either by substance limits or by product exemptions.

The battery or batteries used in PASCO products are marked with the European Union symbol for waste batteries (left) to indicate the need for separate collection and recycling.

PASCO®

Since 1964

The Global Leader in 21st Century Science Education

Supporting educators in over 100 countries around the globe.

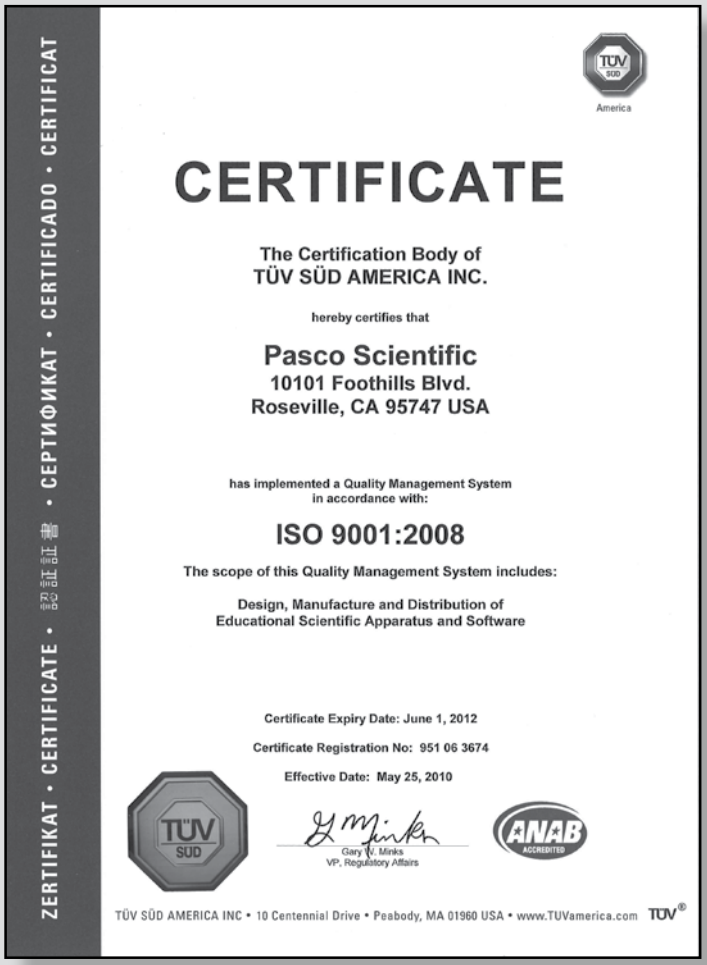
When you have questions or need service, we want someone who understands your local needs. We carefully select, train and support local Science Education Partners to serve our customers in each country.

When you work with a PASCO Science Education Partner, have confidence that the entire company here in California is ready to assist our Partner – and you, our Customer.

Designed in California.
Guaranteed by PASCO.
Supported locally.
Serving science educators.

PASCO 5 YEAR WARRANTY

ISO 9001:2008 Certified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CERTIFICATE

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hereby certifies that

Pasco Scientific
10101 Foothills Blvd.
Roseville, CA 95747 USA

has implemented a Quality Management System
in accordance with:

ISO 9001:2008

The scope of this Quality Management System includes:

Design, Manufacture and Distribution of
Educational Scientific Apparatus and Software

Certificate Expiry Date: June 1, 2012

Certificate Registration No: 951 06 3674

Effective Date: May 25, 2010

Gary V. Minks
VP, Regulatory Affairs

ANAB ACCREDITED

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PASCO STEM EDUCATOR AWARD

PASCO is the proud sponsor of the STEM Educator Award:
Recognizing excellence and innovation in the field of STEM education.

The PASCO STEM Educator Awards, sponsored by PASCO scientific in partnership with the National Science Teachers Association, recognizes excellence and innovation in the field of STEM education at the elementary, middle school, and high school levels. A total of five awardees will be selected annually. Each awardee will receive up to $1500 to cover travel expenses to attend the NSTA national conference and be part of a STEM share-a-thon workshop, a $1000 monetary gift, and a $2000 certificate for PASCO scientific products. The recipients of the awards will be honored during the awards banquet at the NSTA national conference.

Learn more: www.pasco.com

Award Prize

Each of the five awardees will receive a prize worth approximately $4,500, which comprises a monetary gift, a certificate for PASCO scientific products, and expenses for the awardee to attend the national NSTA conference.

NSTA National Science Teachers Association

Recognized by the EdNET Community as a potential **"game changer"** in education.

EdNET'S BEST for 2011 SHINING STARS

The list of leading education products and services for EdNET'S BEST was shaped by the EdNET community, and final selections were made by the EdNET's Best panel.

2010 SIIA //CODiE// WINNER

TECH & LEARNING WINNER AWARDS OF EXCELLENCE 2009

Award 2010

AWARDS of winner! EXCELLENCE TECH\LEARNING

PASCO Support

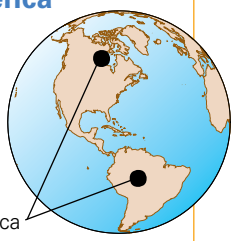
Making decisions on what equipment best meets your needs? PASCO has fully trained Science Education Partners all around the world – ready to work with you on equipping your science lab in the most cost effective manner. If you would like an introduction to the Science Education Partner in your country, please contact the regional manager below for more information.

Kevin Mather
Vice President,
International Business
mather@pasco.com
+1 916-786-3800, ext. 220

PASCO Mission

Providing educators worldwide with innovative solutions for teaching science.

Canada & Latin America



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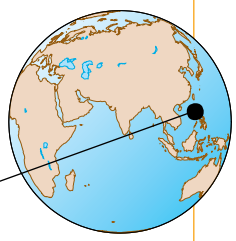

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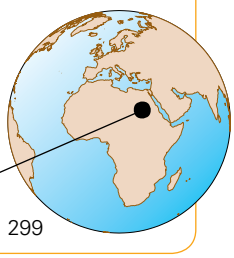

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