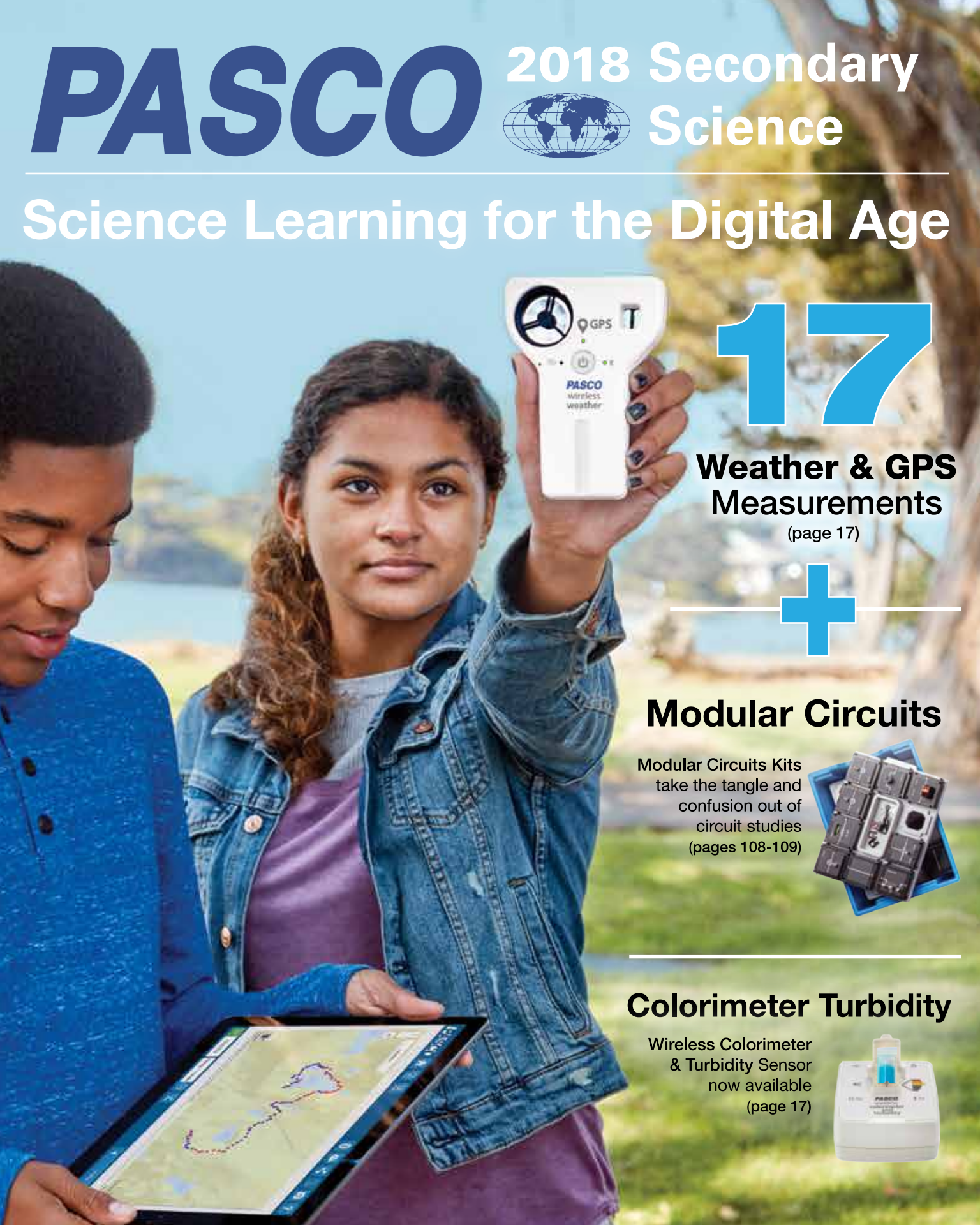
PASCO

2018 Secondary Science

Science Learning for the Digital Age



17

Weather & GPS Measurements
(page 17)

+

Modular Circuits

Modular Circuits Kits take the tangle and confusion out of circuit studies
(pages 108-109)

Colorimeter Turbidity

Wireless Colorimeter & Turbidity Sensor now available
(page 17)


1.4
1.09
0.7
Yellow
Orange
Red
1: Colorimter
PASCO
Wireless
colorimeter
and
turbidity

Table of Contents

PASCO... science learning for the digital age

PASCO Scientific has been designing, developing, and supporting innovative teaching and learning solutions for K-12 and higher education since 1964. As the world leader in wireless datalogging technology, software, and curriculum, PASCO transforms science education by promoting science inquiry and 21st century readiness skills. Today teachers and students in over 100 countries use PASCO solutions on their own devices for physics, biology, chemistry, earth and environmental sciences, as well as programming and robotics.

PASCO Science Solutions

Probeware and Sensing Technology Our innovative sensors, including our award-winning wireless sensors, are low-cost, rugged, and easy-to-use.

Standards-Based Curriculum and Labs These support Biology, Chemistry, Earth & Environmental Sciences, Physical Science, and Physics, as well as AP® Biology, AP® Chemistry, and AP® Physics.

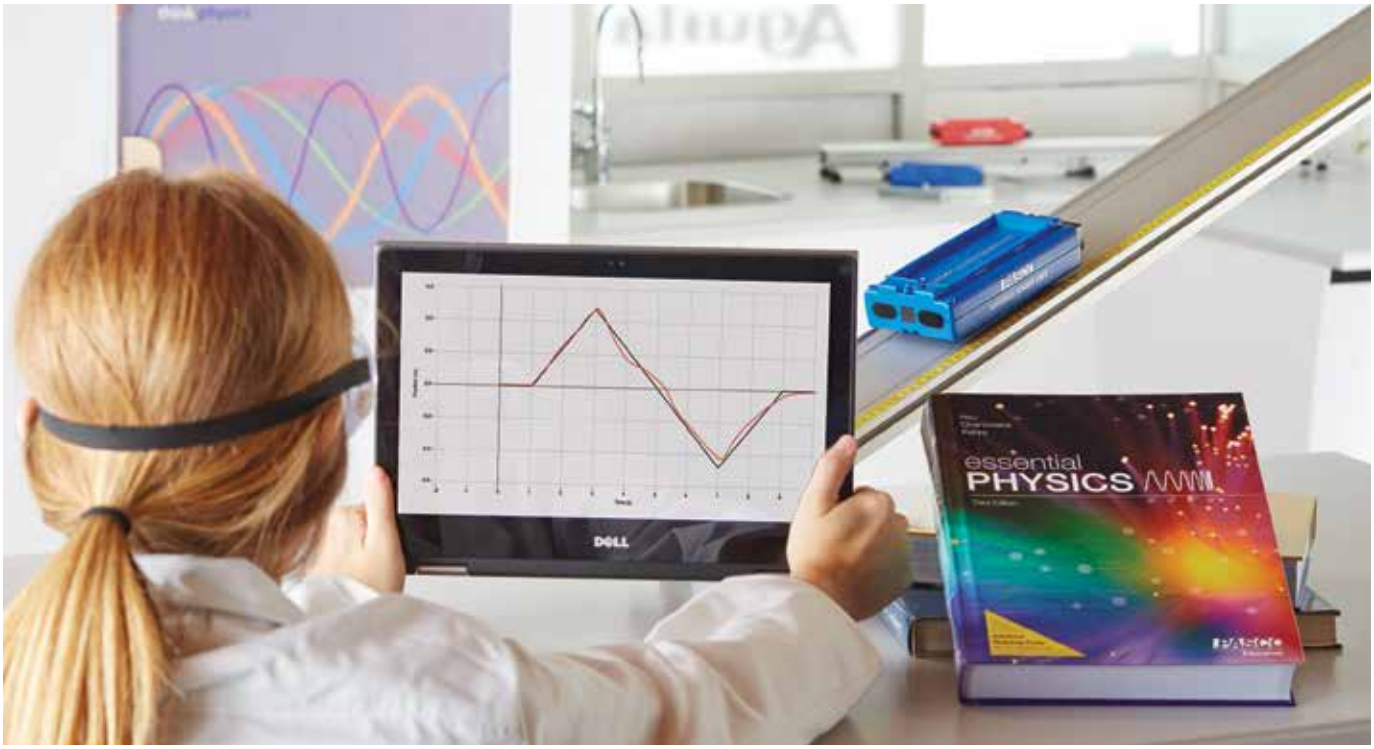
Data Collection Software on Your Devices Intuitive SPARKvue works on iOS, Android™, and Chrome™, as well as Mac® and Windows® computers.

Lab Equipment and Apparatus PASCO is the premier developer of tools for your science lab, including our Molecular Modeling Kit, the latest water quality tools, our Smart Cart, and more.

Professional Development Our PD is relevant for teachers at all grade levels, is fully customizable, and includes ongoing teacher support.

GESS EDUCATION AWARDS WINNER 2017

Plus, our award-winning products... Including our Wireless Temperature Sensor, Smart Cart, and Spectrometer.



These are tomorrow's scientists

and engineers...

Let's give them the tools to make a difference.

Try our award-winning SPARKvue software for FREE!

Get Started Today

The full and complete version of SPARKvue is now available as a FREE app for iPad® and Android™ tablets, Chromebook™, as well as free apps for iPhone and Android phones.

Download on the App Store | ANDROID APP ON Google play | available in the chrome web store

We also offer free 60-day trials for PC and Mac®* at **pasco.com**

Smart Phones: Android phone, iPhone

Tablets: Android tablet, iPad

Laptops/Desktops/2-in-1s: Windows tablet, Chromebook, PC, Mac

SPARKvue (single user license)

PS-2401

SPARKvue (site license)

PS-2400

SPARKvue App

Download:

Download on the App Store | available in the chrome web store | ANDROID APP ON Google play

Essential Physics and *Essential Chemistry*

Complete and Affordable Curriculum Solutions for Chemistry and Physics that include Textbook, e-Book, Digital Teacher Edition, and Equipment

The *Essential Chemistry and Essential Physics* curricula **cover 100% of your state standards** for honors and general chemistry and physics programs.

- **Rigorous yet accessible content**
- **Interactive simulations and equations**
- **Lessons follow the 5E design**
- **Access to the Infinite Test Bank**
- **Award-winning PASCO lab equipment**
- **Works seamlessly with your LMS and Google Classroom**

Multiplatform

iOS, Android™, Chrome™, Windows®, PC, and Mac®

- ***24/7 online/offline access***
- ***No Internet required***

Complete Curriculum Solutions

Both *Essential Physics* and *Essential Chemistry* are affordable curriculum solutions that include a Textbook, e-Book, Digital Teacher Edition, and PASCO's award-winning equipment.

About the Author

Dr. Tom Hsu, former research physicist at MIT, is author of seven science textbooks including *Essential Physics* and *Essential Chemistry*. His teaching methods have been used successfully across the United States since 1991. He also develops physics apparatus that promotes discovery through active hands-on investigations.

Package Options

PASCO offers a variety of attractively priced package options that are suitable for your school or district, such as:

Essential Physics Class Set

Package includes:

- 25 textbooks
- 75 e-Books
- Standard Equipment Package that includes 6 Forces & Motion and 6 Modular Circuits kits to complete 25 labs in Essential Physics.

Essential Chemistry Class Set

Package includes:

- 25 textbooks
- 75 e-Books
- Standard Equipment Package that includes 6 sets of wireless sensors and support materials to complete 42 labs in Essential Chemistry.

Call and ask about more package options at 877-373-0300, or visit pasco.com

And get your **free student e-Book evaluation at** pasco.com/essentialchemistry or pasco.com/essentialphysics

PASCO's Sensor-based Solutions for Biology

Quantifying biological processes can be challenging, but with PASCO sensors, wireless technology, and SPARKvue software, it's easy to collect reliable data. Using PASCO for Biology makes it easy to study topics such as photosynthesis, cellular respiration, enzymatic reactions, diffusion and osmosis, human physiology, and more.

Biology Index

The latest sensors for Biology!

Wireless CO_2 Sensor

PS-3208 *(page 15)*

Includes 250-ml sampling bottle and USB charging cable.

Use this wireless sensor to measure the concentration of CO_2 gas in a closed system or open environment. Study core topics (including photosynthesis, respiration, and carbon cycling) with this versatile probe. CO_2 data can be logged directly on the device for long-term life science and environmental science studies.

Wireless Weather Sensor with GPS

NEW

PS-3209 *(page 16)*

Includes USB charging cable.

Use this multimeasure sensor to monitor 17 different measurements including common weather, location, and light. Study microclimates, monitor environmental conditions during indoor or outdoor labs, or place the sensor outside for extended monitoring, because of its durable, water-resistant design and internal memory.

Wireless Hand-Grip Heart Rate Sensor

NEW

PS-3206 *(page 19)*

Includes hand-grips and Bluetooth® heart rate module with one coin-cell battery.

With these wireless hand grips, conducting physiology labs on the cardiovascular system or homeostasis is easier than ever before. Continuously monitor heart rate during exercise, or use the sensor to take initial and final measurements with fast and reliable heart-rate detection.

Wireless Colorimeter and Turbidity

NEW

PS-3215 *(page 17)*

Includes USB charging cable, 9 cuvettes, 1 Turbidity Calibration Standard, and 2 cuvette racks.

The Wireless Colorimeter and Turbidity Sensor simultaneously measures the absorbance and transmittance of six different wavelengths. The colorimeter can be used to study enzyme activity, photosynthesis, and the rates of chemical reactions. Using turbidity cuvettes and a calibration standard, the colorimeter can also function as a turbidimeter for water quality analysis.

Most computing devices will connect directly to PASCO Bluetooth® 4.0 wireless products. Please go to pasco.com/compatibility to determine your direct-connect compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

USB Bluetooth® 4.0 Adapter

PS-3500

10-port USB Charging Station

PS-3501

FREE Advanced Biology Inquiry Labs for AP® & IB® Courses

available at pasco.com

These advanced biology labs have been redesigned to take advantage of wireless sensors! There are **19** labs available for **FREE** in the **PASCO Digital Library**. The labs are specifically designed to support student inquiry and the College Board AP Biology curriculum framework*.

- Most labs can be completed in 45-minute blocks with readily available materials.
- The flexible format provides teachers and students with guided-inquiry opportunities and scaffolding to successfully move students toward creating experiments of their design.
  1. *Structured:* Initial introduction includes step-by-step procedure, questions, and analysis.
  2. *Guided:* A set of questions for students to design a lab and organize their planning process
  3. *Open:* Includes Student Experiment Planning worksheet to organize, plan, and enable quick teacher assessment.
- Easy and meaningful data collection leads to increased time for data analysis and open inquiry. Labs integrate high-order analysis questions and synthesis questions.
- Includes sample data for investigations and inquiry, answers to analysis and synthesis questions, an assessment rubric, teacher tips and lab preparation information, and more.

These labs are available for **FREE** in the **PASCO Digital Library**. Each lab includes an editable student lab, SPARKvue configuration file, and teacher notes with lab prep.

Experiment	Wireless Sensors									AP® Big Ideas*	IB® Standards**
	CO_2 Gas	Temperature	Pressure	pH	Conductivity	Colorimeter	Weather/GPS	Oxygen	Ethanol		
1. Enzyme Activity			●					▲		1, 2, 4	2.5
2. Diffusion				●	▲					2	1.4, 10.3
3. Osmosis						●				2, 3	1.4
4. Plasmolysis					●					2	1.4
5. Cell Size					●					1, 2	1.1
6. Homeostasis		●								3, 4	N/A
7. Cellular Respiration	●							▲		1, 2, 4	2.8
8. Fermentation								▲	●	2, 4	2.1, 2.8
9. Photosynthesis	●						▲	▲		2, 4	2.9
10. Plant Pigments						●				2, 4	2.9
11. Transpiration			●				●			2, 4	9.1
12. Energy Dynamics	●						▲	▲		2, 4	4.2
13. Artificial Selection				▲	▲		▲			1	N/A
14. Mitosis				▲	▲					3	1.6
15. Meiosis	*No sensors required.*									3	3.3, 10.1
16. BLAST Bioinformatics										1	3.1, B.5
17. Population Genetics										1	10.3
18. Mathematical Modeling of Evolution										1	10.3
19. Animal Behavior										2, 4	A.4

● **Required for use in this experiment.**
▲ **Suggested for student inquiry.**

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

**IB is a registered trademark of the International Baccalaureate Organization, which was not involved in the production of, and does not endorse, this product. Students in Group 4 Experimental Sciences are required to use datalogging in an experiment and software for graph plotting.

Advanced Biology through Inquiry Teacher Guide

PS-2852

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

FREE General Biology & Physiology Lab Activities

available at pasco.com

These general biology labs have been redesigned to take advantage of wireless sensors. The labs are **FREE** to download in the **PASCO Digital library**. They include an editable student lab, SPARKvue configuration files, and teacher notes with prep instructions. Each lab gives students critical background information, a structured-inquiry procedure, analysis questions, and inquiry extensions.

	Wireless Sensors							Requires AirLink
Experiment	CO_2 Gas	Temperature	Pressure	pH	Conductivity	Colorimeter	Weather/GPS	Oxygen
Biology								
Energy Content of Food		●						
Buffers in Biological Systems				●				
Membrane Permeability				●				
Osmosis			●					
Cellular Respiration in Yeast								●
Plant Respiration and Photosynthesis	●							
Respiration of Germinating Seeds	●							
Photosynthesis of Aquatic Plants								●
Water and pH				●	●			
Organisms and pH				●				
Acid Rain				●				
Metabolism of Yeast	●							
Soil pH				●				
Transpiration			●					
Water Purification				●	●			
Weather in a Terrarium							●	

	Wireless Sensors			Require AirLink		
	Temperature	Hand-Grip Heart Rate	Pressure	Spirometer	Blood Pressure	EKG
Physiology						
EKG: Factors That Affect the Heart						●
Exercise and Heart Rate		●				
Muscle Fatigue			●			
Regulation of Body Heat	●					
Volume of Breath				●		
Blood Pressure					●	

Prefer to order a printed manual?

Biology through Inquiry Teacher Resources

PS-2870C

The electronic content includes lab preparation information, teacher tips, assessment, an editable Word® version of student handouts, answer key, and much more.

Biosphere Module Teacher License

PS-2980

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

*For required sensors and other materials, see **pasco.com/STEMmodules***

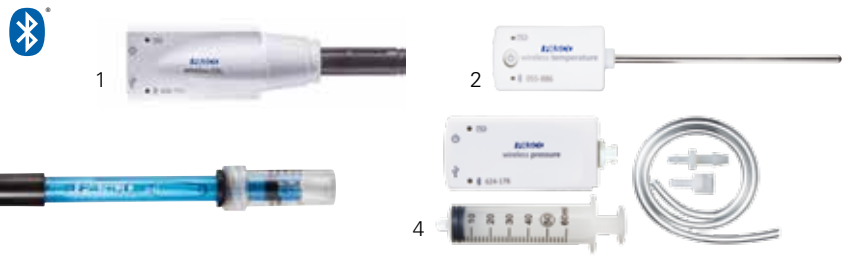
Biology Solutions

The tools you need to teach the free digital labs for Biology

Wireless Biology Starter Bundle

PS-7614

1. Wireless CO_2 PS-3208
2. Wireless Temp PS-3201
3. Wireless Pressure PS-3203
4. Wireless pH PS-3204



Advanced Biology Extension Bundle

PS-7615A

1. Wireless Weather with GPS PS-3209
2. Optical Dissolved Oxygen Sensor PS-2196
3. Wireless Conductivity PS-3210
4. Wireless Colorimeter and Turbidity PS-3215
5. EcoChamber ME-6667
6. AirLink PS-3200

Physiology Extension Bundle *(allows you to perform all the physiology labs in the teacher guide)*

PS-2935B

1. Wireless Hand-Grip Heart Rate PS-3206
2. EKG Sensor PS-2111
3. Spirometer PS-2152
4. Spirometer Mouth Pieces PS-2522
5. Blood Pressure PS-2207
6. AirLink PS-3200

Most computing devices will connect directly to PASCO Bluetooth® 4.0 wireless products. Please go to pasco.com/compatibility to determine your direct-connect compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

USB Bluetooth® 4.0 Adapter

PS-3500

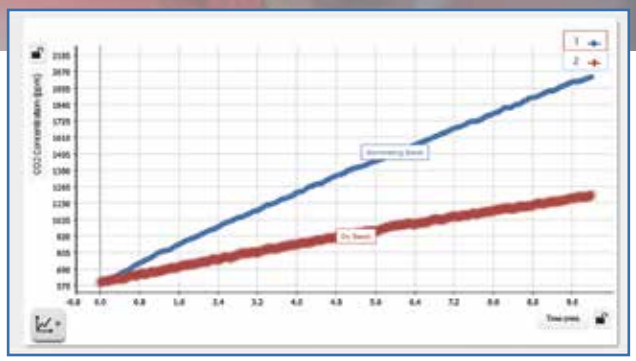
10-port USB Charging Station

PS-3501

Wireless CO_2 Sensor

PS-3208

2017 AWARDS of EXCELLENCE TECH & LEARNING



Compare the respiration rate of germinating and dry seeds.

Use this wireless sensor to measure the concentration of CO_2 gas in a closed system or open environment. Study core topics (including photosynthesis, respiration, and carbon cycling) with this versatile sensor. CO_2 data can be logged directly on the device for long-term studies and monitoring.

Wireless CO_2 Sensor

PS-3208

Includes 250-ml sampling bottle and USB charging cable..

NEW

Dissolved CO_2 Waterproof Sleeve

PS-3545

The Wireless CO_2 Sensor can be equipped for aqueous measurements using this semipermeable sleeve. The sleeve is waterproof but allows CO_2 gas to pass through the membrane, creating a headspace around the sensor. Monitor photosynthesis and respiration of aquatic plants or animals with the sample bottle or with other chambers. (Please note: Improper use will void sensor warranty.)

Dissolved CO_2 Waterproof Sleeve

PS-3545

Includes 5 sleeves and 5 O-rings

Wireless Weather Sensor with GPS

PS-3209

Includes USB charging cable

The Wireless Weather Sensor is an all-in-one instrument for monitoring environmental conditions. By incorporating several sensing elements into a single unit, the sensor provides up to **17 different measurements!** Use the sensor in logging mode with the Weather Vane Accessory for long-term monitoring, or use it as a hand-held instrument to study microclimates and record ambient conditions relevant to many biological and environmental phenomena.

Specifications:

Battery: Rechargeable
Water-resistance: IP-64 splash-proof
(Please see pasco.com for detailed specifications.)

Measurements

Weather
1. Ambient Temperature
2. Barometric Pressure
3. Wind Speed
4. Wind Direction (true)
5. Relative Humidity
6. Absolute Humidity
7. Dew Point
8. Wind Chill
9. Heat Stress Index

Light
10. Ambient Light (lux)
11. UV Index

GPS
12. Latitude
13. Longitude
14. Altitude
15. Speed
16. Magnetic Direction
17. True Direction

Weather Vane Accessory

PS-3553

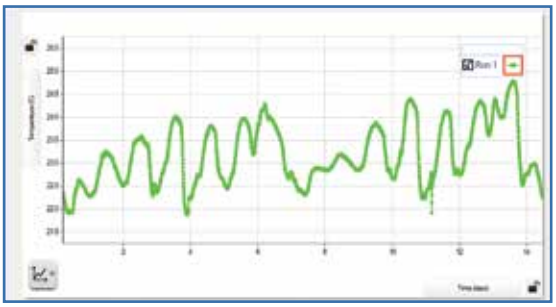
Equip your Wireless Weather Sensor for extended environmental monitoring with the Weather Vane Accessory. Once deployed the sensor will freely rotate to capture wind speed and direction, whether you are monitoring data in real time or using the sensor in logging mode to capture hours (or days!) of data for later analysis.

Includes tripod, tripod adapter, and weather vane.

Wireless Temperature Sensor

PS-3201

Welcome to the modern thermometer. With its waterproof, rugged design, this sensor functions in the lab or out in the field. Study evaporative cooling, homeostasis, monitor a water bath, or store weeks of environmental data on the sensor with this one device.



Monitoring ambient temperature in a classroom terrarium over two weeks with datalogging

The versatile Wireless Temperature Sensor works well, both in the lab and out of doors.

Specifications:

Range: -40°C to 125°C
Resolution: 0.05°C
Accuracy: 0.5°C
Waterproof: IP-67 (1 m for 30 min)
Battery: Coin cell (expected life >1 yr)

Wireless Temperature Sensor

PS-3201

Includes 1 coin cell battery.

Wireless Colorimeter and Turbidity

PS-3215

The Wireless Colorimeter simultaneously measures the absorbance and transmittance of six different wavelengths. The sensor can be used to study enzyme activity, photosynthesis, and the rates of chemical reactions. By using the accessory cuvettes and a calibration standard, the colorimeter also functions as a turbidimeter for water quality analysis.

Specifications:

Color detection/peak wavelengths detected: 650 nm (red), 600 nm (orange), 570 nm (yellow), 550 nm (green), 500 nm (blue), 450 nm (violet)
Detector ranges: +25 nm from peak
Absorbance: 0-3 Abs units; useful range (0.05 -1.5 Abs)
Transmittance: 0-100%
Turbidity range: 0-400 NTU
Accuracy: +5% NTU

Wireless Colorimeter and Turbidity

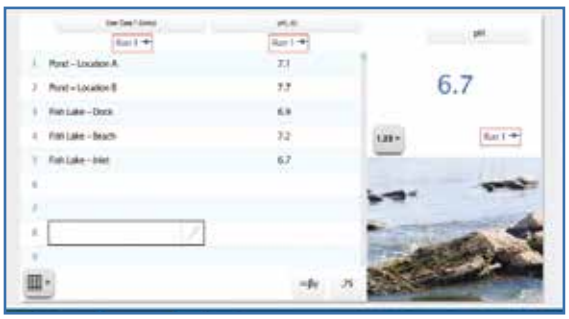
PS-3215

Includes USB charging cable, 9 cuvettes, 2 cuvette racks, and one 100 NTU calibration cuvette.

Wireless pH Sensor

PS-3204

Here's the best tool for measuring pH since litmus paper. Students can quickly obtain accurate pH readings but also log data to their connected device and even program the sensor to collect data autonomously for hours or weeks. Use the sensor to study water quality, environmental monitoring, test solutions, and monitor chemical reactions.



Measure the pH in the lab or field.

Specifications:

Range: 0-14 pH units
Resolution: 0.02 pH
Accuracy: 0.1 pH units
Waterproof: IP-67 (1 m for 30 min)
Battery: Coin cell (expected life >1 yr)

With the Wireless pH Sensor, students can collect data anywhere!

Wireless pH Sensor

PS-3204

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

Electrode Support

PS-3505

Wireless Conductivity Sensor

PS-3210

Use the Wireless Conductivity Sensor to measure the electrical conductivity or Total Dissolved Solids (TDS) of a solution. Investigate diffusion, osmosis, chemical reactions, and monitor water quality.

Specifications:

Range: 0 to 20,000 µS/cm
Accuracy: ±10% of value from 200 µS/cm to 20,000 µS/cm
Resolution: 0.1 µS/cm
Battery: Coin cell (expected life >1 yr)
Waterproof: IP-67 (1 m for 30min)
Temperature compensated

Wireless Conductivity Sensor

PS-3210

Includes 1 coin cell battery.

Wireless Pressure Sensor

PS-3203

With the new Wireless Pressure Sensor you can make accurate and consistent measurements of gas pressure, and explore transpiration, enzyme activity, osmosis and more!

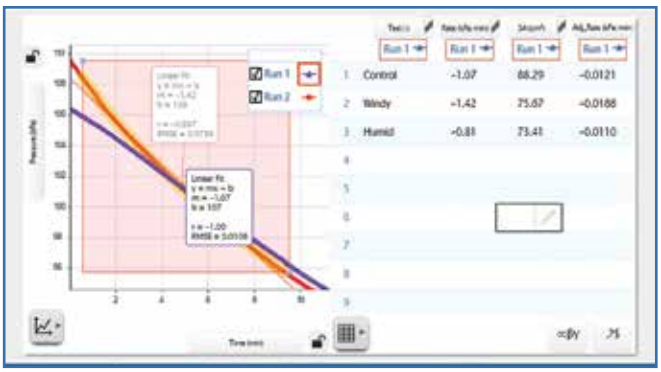
Features

- Measures pressure relative to an internal sealed reference vacuum, which allows the collection of reliable data even when the pressure within the system drops below ambient pressure.
- Supports common units (kPa, atm, psi, mmHg,or N/m2) for many applications.
- Features Bluetooth® wireless connectivity and long-lasting rechargeable battery.

Wireless Pressure Sensor

PS-3203

Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barbed luer locks, 1 female barbed luer lock, 1 60cc syringe, a lithium-ion battery, and a USB cable.



Investigate transpiration under different conditions using a potometer setup

Specifications:

Range: 0-400 kPa
Resolution: 0.1 kPa
Accuracy: 2 kPa
Battery: Rechargeable

Wireless Light Sensor

PS-3213

The Wireless Light Sensor is a great addition to any biology lab to study the relationship between light intensity or color and photosynthetic activity, transpiration, or investigate UV radiation. This single sensor has two different detectors for a variety of applications and measurements: Spot Detector (measures red, green, blue, and white relative intensities) and Ambient Detector (measures Illuminance/lux), UVA, UVB, UV index, solar PAR, and solar irradiance).

Specifications:

Spectral response: 300 nm to 1100 nm
Range: 0–130,000 lux
Battery: Coin cell (expected life >1 yr)

Monitor light conditions when investigating photosynthesis, transpiration, and more!

Wireless Light Sensor

PS-3213

Includes 1 coin cell battery.

NEW Wireless Hand-Grip Heart Rate and Exercise Heart Rate Sensors

Using the new wireless Hand-Grip Heart Rate Sensor, it's easier than ever before to conduct physiology labs on the cardiovascular system or homeostasis. Use this sensor for a quick and easy way to acquire wireless measurement for either continuous monitoring or initial vs. final data points. When the activity requires students to use their hands, the Wireless Exercise Heart Rate Sensor has a chest strap and will transmit data wirelessly up to 10 m away!

Wireless Hand-Grip Heart Rate Sensor NEW

PS-3206

Includes hand-grips and Bluetooth® Heart Rate Module with one coin-cell battery.

Wireless Exercise Heart Rate Sensor NEW

PS-3207

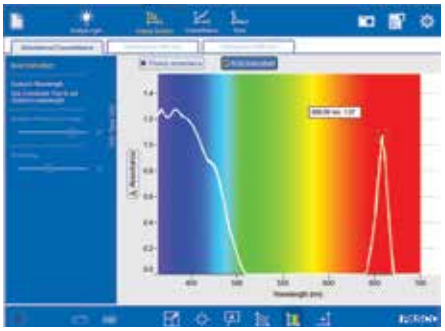
Includes Bluetooth® Heart Rate Module with one coin-cell battery and chest strap (M-XXL).

Award-Winning Wireless Spectrometry

for iOS®, Android™, Chrome*, PC, and Mac®

Wirelessly measure intensity, absorbance, transmittance, and fluorescence. The Bluetooth® and USB connectivity enable use with your tablets and computers, which makes this a powerful and intuitive tool for your spectrometry needs.

*Go to pasco.com to see our ever-expanding list of supported Chromebooks™.



Absorbance spectrum of chlorophyll

Perform these labs with the PASCO Spectrometer:

- Photosynthesis with DPIP
- Absorption spectra of plant pigments
- Concentration of proteins in solution
- Rate of an enzyme-catalyzed reaction
- Growth of a cell culture

Specifications:

- Bluetooth® and USB connectivity
- 2–3 nm FWHM resolution
- 380–950 nm range
- 2 fluorescence excitation wavelengths at 405 nm and 500 nm
- LED-boosted tungsten light source

winner! 2016 AWARDS of EXCELLENCE TECH & LEARNING

//CODiE// 2017 SIIA CODiE WINNER

bett AWARDS 2017 FINALIST

The PASCO Spectrometer comes with **PASCO's FREE Spectrometry software.**

- Windows® and Mac® versions included with purchase.
- FREE for iOS®, Android™ , and Chrome™.
- Designed specifically for introductory spectrometry experiments.

Wireless Spectrometer

PS-2600

Includes Wireless Spectrometer, 10 cuvettes, and Spectrometry software.

Also available:

Optional Fiber Optic Cable
PS-2601

Cuvettes & Caps
SE-8739

Cuvette Rack
SE-8777

Optical Dissolved Oxygen Sensor

PS-2196

PASCO's Optical Dissolved Oxygen Sensor makes it easier than ever before to measure dissolved oxygen in the field or in a lab environment. The luminescent technology has several advantages over a galvanic dissolved oxygen sensor including:

- There is no warm-up time.
- No calibration is required.
- It is low maintenance (no filling solution and electrode polishing).
- There is a built-in temperature and pressure compensation.
- No flow dependency
- Optional salinity compensation
- Measure oxygen gas in air (O_2%) in sample bottle or similar high-humidity enclosure.

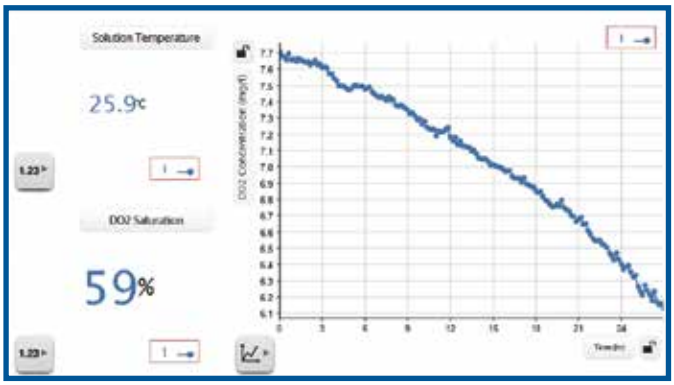
Perform these labs with the Optical Dissolved Oxygen Sensor:

- Photosynthesis, Respiration, and Fermentation Labs
- Monitoring Water Quality
- Measuring Net Primary Productivity
- Modeling Ecosystems

Simultaneously measures dissolved oxygen, percent saturation, temperature, and barometric pressure, making it easier than ever before to measure dissolved oxygen in the field or in the lab.

Specifications:

Cable Length: 3 m
Response Time: 90% in 25 sec
Operating Temperature: 0–50°C
Operating Pressure: 375–825 mmHg
Range: 0–20 mg/L or 0–300% saturation
Accuracy:
±0.6 mg/L or ±3.0% out of box
±0.1 mg/L or ±1.0%, whichever is greater after calibration
Above 200% ± 10%



Optical Dissolved Oxygen Sensor

PS-2196

Also available:

Optical Dissolved Oxygen Sensor Metal Guard

The metal guard protects the probe tip from damage and weighs down the probe for making measurements at depth. It is made of stainless steel and resists corrosion.

PS-2588

Optical Dissolved Oxygen Sensor Cap

This replacement sensor cap for optical dissolved oxygen sensor has a 12-month warranty.

PS-2587

Oxygen Gas, CO_2, and Ethanol Sensors

The Wireless CO_2 Sensor and the Oxygen Gas Sensor are ideal for photosynthesis experiments, respiration, and fermentation. Both provide high resolution and accuracy and are simple to use, not only with the Metabolism Chamber, but also with the EcoZone™ System or your own enclosure.

Wireless CO_2 Sensor

PS-3208

Includes 250-ml sampling bottle and USB charging cable.

Also available:
Dissolved CO_2 Waterproof Sleeve PS-3545

See all the details about the Wireless CO_2 Sensor on page 15.

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.

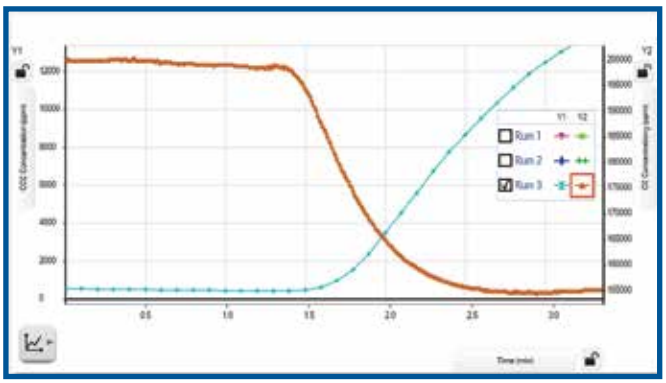
Oxygen Gas Sensor

PS-2126A

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

Get the full picture on cellular respiration.

Because of their small size, germinating peas are ideal to use to study cellular respiration. To give a full representation of the activity of the peas, both a CO_2 Sensor and 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.



Use the Metabolism Chamber to study cellular respiration and monitor CO_2 and O_2 simultaneously.

Ethanol Sensor

PS-2194

Includes PTFE tape for membrane replacement.

Make all your sensors wireless.

AirLink

PS-3200

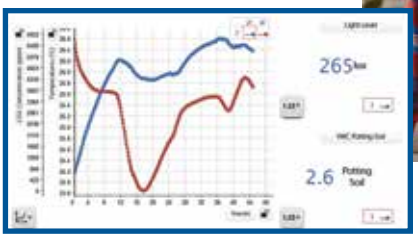
Includes one PASPORT sensor port, USB and Bluetooth connectivity, and USB cable.

EcoZone™ System

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 PASCO sensors, students will collect accurate data with minimal impact on the ecosystem.

Use the traditional terrestrial, aquatic, and decomposition arrangement to create your unique ecosystem 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.



Students observe carbon cycling in the EcoZone, which is taking place through photosynthesis, decomposition, and respiration.

Features

- Connect three chambers to model interactions between environments (e.g., terrestrial, aquatic, and decomposition chamber).
- Add small animals such as insects or annelids to see how nutrient cycling is altered.
- Outfit each chamber with three (or more!) sensors.
- Here's an excellent way to model nutrient and energy cycling and engage students in inquiry.

EcoZone™ System

ME-6668

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

Photosynthesis Tank

With this 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 fluctuations. 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.

Photosynthesis Tank

PS-2521B

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

EcoChamber

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 ecosystem. In addition to being used as a fermentation chamber, it can serve to conduct larger scale photosynthesis and respiration experiments.

Metabolism Chamber

ME-6936

Includes 250 mL sampling bottle with cap.

Also available:

Metabolism Chamber
4-pack
SE-6938

Includes four 250 mL sampling bottles with caps.

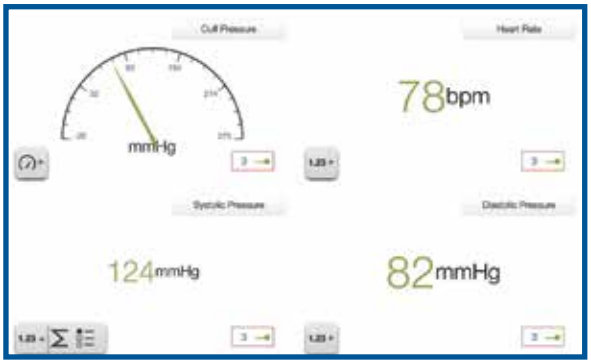
EcoChamber

ME-6667

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

Blood Pressure Sensor

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 cuff pressure from the real-time graph moves blood pressure from a simple measurement to a way to help students truly understand the physiology of the circulatory system.



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

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

Blood Pressure Sensor

PS-2207

All models include a sensor and a standard size arm cuff with an inflation bulb.

Breath Rate Sensor

The Breath Rate Sensor measures breathing rate by detecting the air pressure in a mask worn by the student and measuring the time between exhalations. The sensor has two modes: one reading for every breath, and one for a running average over the last four breaths.

Student's breath rate before, during, and after exercise

With the Breath Rate Sensor, students can use a sensor instead of simply counting the number of breaths per minute.

Breath Rate Sensor

PS-2187

Includes 10 masks and 10 clips

Also available:

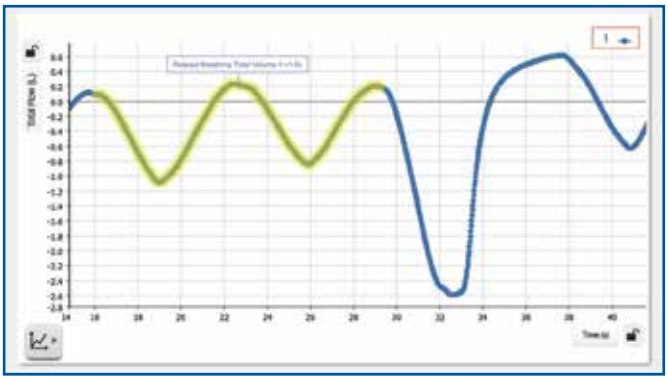
Replacement Masks (10 pack)
PS-2567

Replacement Clips (10 pack)
PS-2568

Be sure and see our NEW Wireless Hand-Grip Heart Rate Sensor and Wireless Exercise Heart Rate Sensor on page 19.

Spirometer Sensor... test your lung power and learn about the respiratory system.

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



The volume of the lungs increases when inhaling air into the lungs.

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

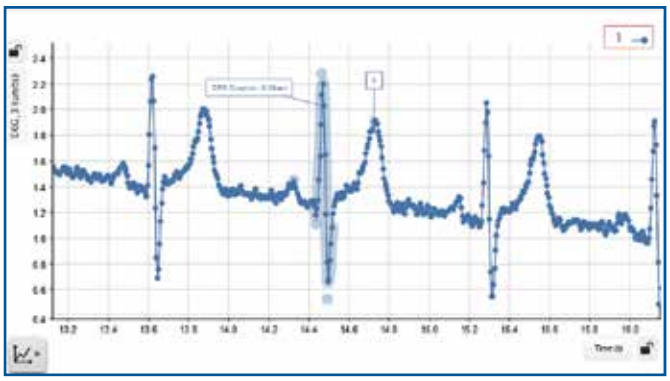
Also available:
Replacement Mouth Pieces (10)
PS-2522

Measure EKG in a heartbeat

Take the mystery out of an EKG test by letting students measure and record the electrical signals produced by the heart. Students can use this sensor 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.



Clear data helps students better understand the electrical signals of the heart.

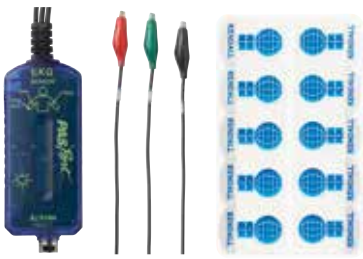
Easy setup and quick data collection make it possible for students to see their heartbeat in a class period.

EKG Sensor

PS-2111

Includes 100 self-adhesive electrode patches.

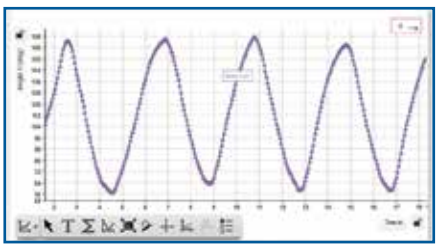
Also available:
EKG Sensor Electrode Patches (100-pack; one-year shelf life)
CI-6620



Goniometer Sensor

Use the Goniometer Sensor to study how arms and legs move. Compare normal motion to that of moderate exercise and athletic activity. Use it 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.

See every flex and extension as your students become part of the experiment.



Measure the extent of movement and changes in velocity during normal actions.

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.

Human Arm Model

The Human Arm Model simulates the muscles and motion of an actual human arm. To activate the arm motion, students pull on the cord with a Force Sensor. Changes in position are measured at the shoulder and elbow using the two built-in potentiometers plugged into one Angle Sensor (PS-2139), included with PS-2611.

Human Arm Model

PS-2611

Includes Human Arm Model and Angle Sensor PS-2139

SPARKvue supports digital microscopes

SPARKvue is PASCO's award-winning data collection and analysis software. Features include:

- Real-time, quantitative measurement and analysis
- Works on ALL major platforms
- Same look-and-feel for all devices
- Optimized for PASCO wireless sensors

SPARKvue's digital imaging capabilities support a wide variety of USB imaging devices including webcams and ken-a-vision® digital microscopes. Use with your Mac®, Windows®, iOS, Android™ and Chromebook™ devices and get all the advantages of digital microscopy. No need for your students to learn a new software just for microscopy. They can collect sensor data and capture and analyze images, all in SPARKvue.

Make measurements right on the screen.

Use digital zoom for even more magnification.

Add labels using the text tool.

Annotate, highlight, and more!

Award-winning SPARKvue is available for download at pasco.com/sparkvue or ***get the app for free:***

Download on the App Store | ANDROID APP ON Google play | available in the chrome web store

SPARKvue (single user license)

PS-2401

SPARKvue (site license)

PS-2400

ken-a-vision® Digital Microscopes

The ken-a-vision® Digital Monocular 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.

This ken-a-vision® Digital Monocular Comprehensive Scope 2 connects directly to your computer running SPARKvue.

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 USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.

kena® Digital Microscope

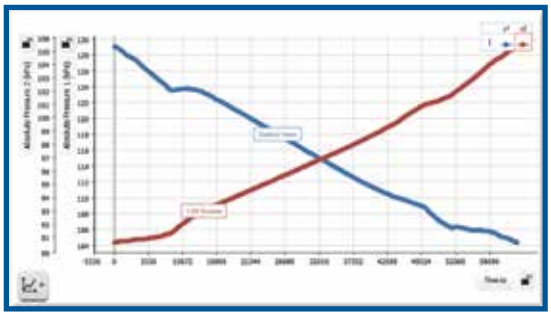
SE-7236

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 USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.

Diffusion/Osmosis Kit

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 allow students to explore the rate of water movement. Students can quantify pressure changes accurately and easily compare solute concentration at the end of the experiment.



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

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

PASCO's Sensor-based Solutions for Chemistry

PASCO now has a complete Chemistry curriculum: *Essential Chemistry*! All our Chemistry solutions combine inquiry-based, hands-on activities with the latest educational technology tools to keep students engaged and increase science literacy. From our wireless sensors to the intuitive SPARKvue software, data collection and analysis have never been easier or more meaningful.

Chemistry Index

Essentials for Chemistry you can't do without!

Wireless pH Sensor

PS-3204 *(page 38)*

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

Instantly collect pH data with this wireless sensor. Use the probe to test household solutions, perform high-resolution acid-base titrations, or study water quality.

Perform these labs with the Wireless pH Sensor:

- **Explore acid-base titrations**
- **Investigate the chemistry of buffers**
- **Monitor water quality**

NEW Wireless Colorimeter and Turbidity

PS-3215 *(page 40)*

Includes USB charging cable, 9 cuvettes, 1 Turbidity Calibration Standard, and 2 cuvette racks.

The Wireless Colorimeter and Turbidity Sensor simultaneously measures the absorbance and transmittance of six different wavelengths. The colorimeter can be used to study colored solutions, concentrations, and the rates of chemical reactions. The colorimeter can also function as a turbidimeter for water quality analysis.

Wireless Pressure Sensor

PS-3203 *(page 44)*

Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barbed luer locks, 1 female barbed luer lock, 1 60cc syringe, a lithium-ion battery, and a USB connector.

With this wireless sensor you can make accurate and consistent measurements of gas pressure, and explore Gas Laws and chemical reactions.

Perform these labs with the Wireless Pressure Sensor:

- **Explore gas laws**
- **Investigate absolute zero**
- **Measure chemical reaction rates**

Wireless Temperature Sensor

PS-3201 *(page 42)*

Includes 1 coin cell battery.

This durable, high-resolution sensor covers many temperature experiments. From chemical changes to thermochemistry, this is a lab essential. Real-time temperature measurements can be tracked in a graph, table, or digits display.

Perform these labs with the Wireless Temperature Sensor:

- **Explore heats of reaction and solution**
- **Study the evidence of a chemical reaction**
- **Investigate varying reaction rates**

winner! 2016 AWARDS EXCELLENCE TECH&LEARNING

See PASCO's New *Essential Chemistry* Curriculum on pages 30-33.

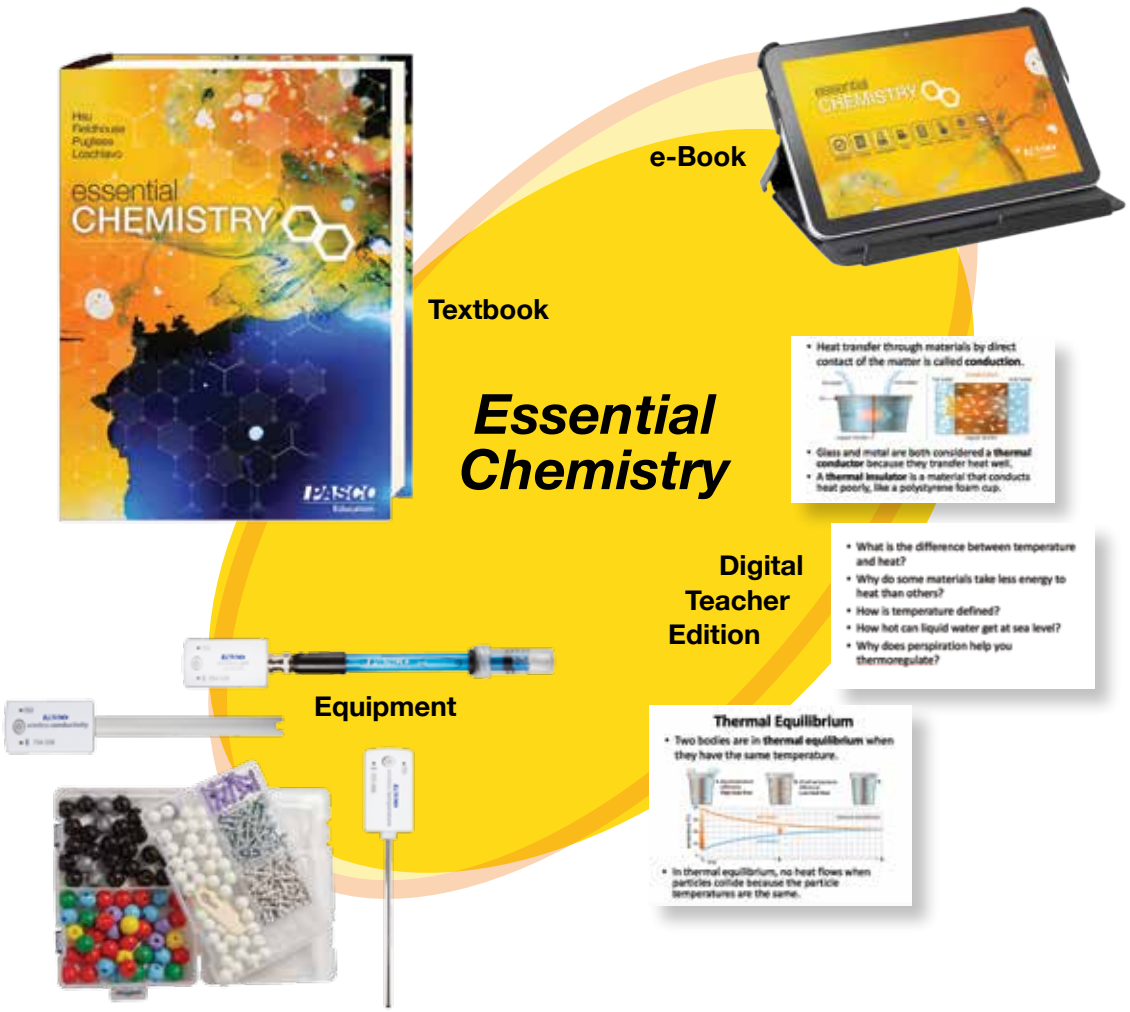
Essential Chemistry Curriculum

This complete chemistry solution includes Textbook, e-Book, Digital Teacher Edition, and Equipment!

Essential Chemistry is a comprehensive, full-color textbook paired with PASCO equipment and the only e-Book for chemistry on the market. The program includes over 100 interactive tools that increase student engagement and understanding. *Essential Chemistry* is focused on practical applications that connect students to the chemistry of nature as well as technology.

About the program:

- Rigorous yet accessible design
- Interactive simulations and equations
- Lessons follow the 5E design
- Strong mathematics scaffolding
- Formative and summative assessment tools
- Differentiation for advanced, below-level, and ELL students
- Works seamlessly with your LMS and Google Classroom
- Includes 24/7 online/offline access. No Internet required!



Essential Chemistry is multiplatform: iOS, Android™, Chrome™, Windows®, PC, and Mac®!

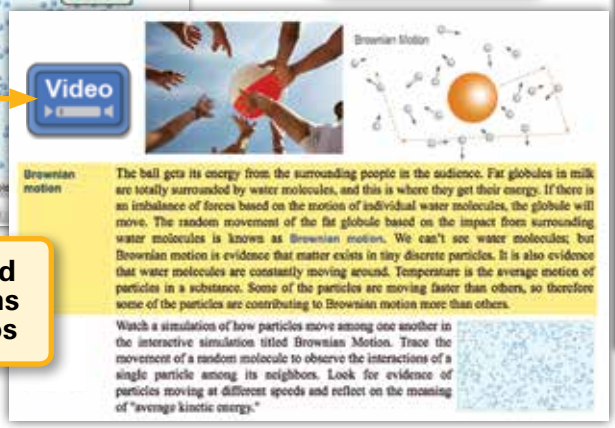
877.373.0300 (inside US) 916.462.8383 (outside US)

A textbook and an e-Book for all your students

What sets *Essential Chemistry* apart is the complete and interactive e-Book. Animations, videos, and interactive equations and simulations bring concepts to life for students in ways that text and static images cannot. Combined with digital resources for teachers, formative and summative assessment, and equipment for lab investigations, *Essential Chemistry* forms a seamless learning system for mastering chemistry.

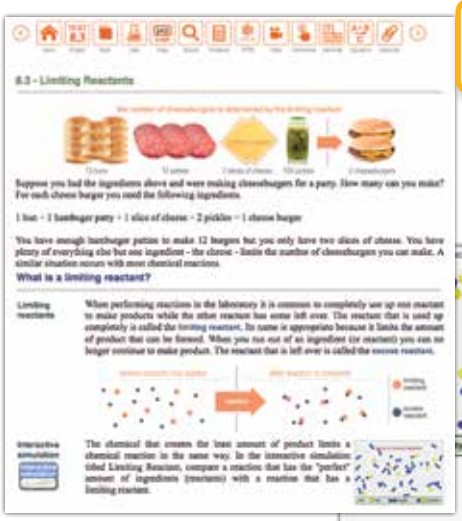
Interactive tools include:

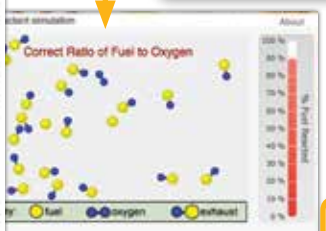
Interactive Equation Solver



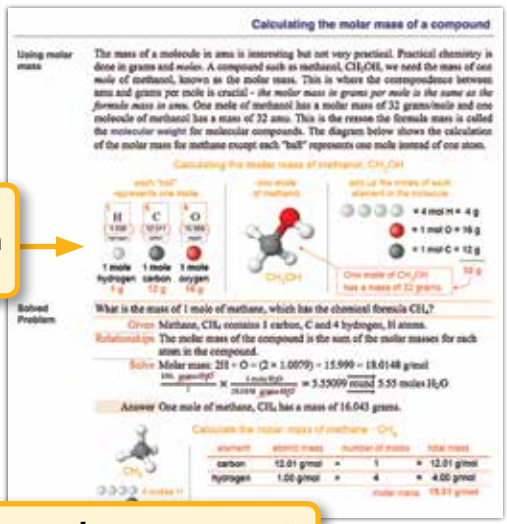
Embedded animations and videos

Interactive simulations

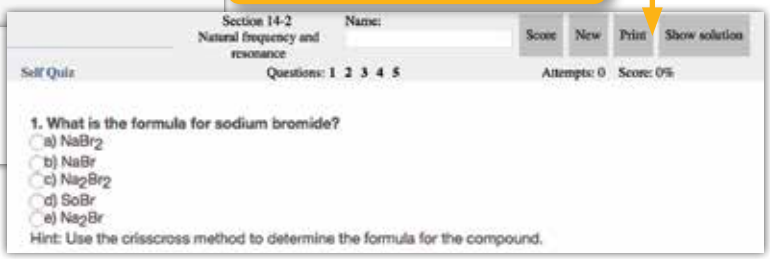


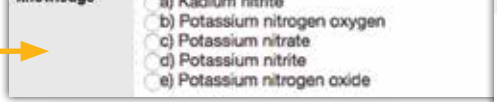


Embedded solved problem with practice



Summative assessment: The Infinite Test Bank





Formative assessment

Essential Chemistry meets 100% of your state standards and supports STEM and NGSS!

The Digital Teacher Edition includes lesson plans, slide presentations, student work, and answer keys, all at point-of-use.

Get a textbook, an e-Book, and equipment for the price of most textbooks!

Essential Chemistry Student Resources

EP-6350

Purchasing options include:
- *Hardbound student textbook*
- *e-Book with 24/7 online/offline access*
- *Lab manual*

Essential Chemistry Student e-Book only

EP-6350-EBK

Includes: e-Book with 24/7 online/offline access

Equipment Kits

Basic Equipment Kit *30 labs are designed to use this equipment set.*

EP-6360

Includes 1 of each of the following:
- Wireless Temperature Sensor, PS-3201
- Wireless pH Sensor, PS-3204
- Wireless Conductivity Sensor, PS-3210
- Molecular Model Kit, PS-3400
- Electrode Support, PS-3505
- Storage Case (free with adoption)
- SPARKvue Single User License Digital Download, PS-2401-DIG

Included, but not shown:
- Periodic Trend Cards, EC-3405
- Periodic Table, EC-3404
- Spectrum Cards, EC-3403
- Extra Coin Cell Battery, PS-3504

Standard Equipment Kit *42 labs are designed to use this equipment set.*

EP-6361

Includes 1 of each of the following:
- Wireless Temperature Sensor, PS-3201
- Wireless pH Sensor, PS-3204
- Wireless Conductivity Sensor, PS-3210
- Wireless Pressure Sensor, PS-3203
- Wireless Voltage Sensor, PS-3211
- Wireless Colorimeter and Turbidity, PS-3215
- Molecular Model Kit, PS-3400
- Electrode Support, PS-3505
- SPARKvue Single User License Digital Download, PS-2401-DIG
- Storage Case (free with adoption)

Included, but not shown:
- Periodic Trend Cards, EC-3405
- Periodic Table, EC-3404
- Spectrum Cards, EC-3403
- Condenser, PS-3402
- Charger, PS-3501
- Extra Coin Cell Batteries, PS-3504

For complete pricing information go to pasco.com/essentialchemistry

FREE Digital POGIL Labs for Advanced Chemistry

Suitable for AP® and IB® classes*, available at pasco.com

Advanced Chemistry Experiments and Sensors	Starter Bundle					Extension Bundle					
Experiment	pH	Temperature	Conductivity	Pressure	Voltage	Colorimeter	High Accuracy Drop Counter	Current	Oxygen Reduction Potential Probe**	IB Standards***	Targeted AP Learning Objectives
1. Modeling Chemistry	●	●	●	●						1.1, 4.1, 4.4	3.10
2. Light, Color and Concentration						●				1.3	1.16
3. Gravimetric Analysis of a Precipitate										1.3	1.19
4. Stoichiometry in Solutions		●	●				●			1.3	3.4
5. Polar and Non-polar substances	●									4.4	2.8
6. Solubility			●							1.3	6.21
7. Empirical Formula						●				1.2	3.6
8. Measuring Vitamin C – A Redox Titration							●		●	9.1	3.9
9. Factors That Affect Reaction Rate		●		●						6.1	4.1
10. Measuring the Speed of a Reaction		●				●				16.1	4.2
11. Energy in Chemical Reactions		●								5.1-5.3	5.7
12. Chemical Equilibrium		●				●				7.1, 17.1	6.9
13. Shapes of Titrations	●						●			1.3, 8.1-8.4, 18.2, 18.3	6.12
14. Weak Acid Titration	●						●			1.3, 8.1-8.4, 18.2, 18.3	6.13
15. Introduction to Buffers	●									18.3	6.20
16. Buffer Properties	●									18.3	6.18
17. Moving Electrons					●			●		9.1, 9.2, 19.1	3.13

* AP is a registered trademark of the College Board, which was not involved in the production of, and does not endorse, this product.
** The ORP Probe requires a pH sensor.
*** IB is a registered trademark of the International Baccalaureate Organization, which was not involved in the production of, and does not endorse, this product. Students in Group 4 Experimental Sciences are required to use datalogging in an experiment and software for graph plotting.

Looking for more teacher resources?

PASCO's New Advanced Chemistry Teacher Guide + POGIL is the perfect combination to help you teach AP®, IB®, Advanced Chemistry, and guided-inquiry labs!

Advanced Chemistry through Inquiry Teacher Resources

PS-2828

Includes a print lab manual.

The electronic content includes lab preparation information, teacher tips, assessment, an editable Word® version of student handouts, answer key, and much more.

FREE Digital Labs for Chemistry available at pasco.com

Experiments and Sensors Used

Experiments	Starter Bundle: pH	Starter Bundle: Temperature	Starter Bundle: Conductivity	Starter Bundle: Pressure	Starter Bundle: Voltage	Extension Bundle: Colorimeter	Extension Bundle: High Accuracy Drop Counter	Extension Bundle: Current	Extension Bundle: Oxygen Reduction Potential Probe	No Sensor Required
Structure and Properties of Matter										
Boyle's Law				●						
Concentration of a Solution (Beer's Law)						●				
Conservation of Matter										●
Electrochemical Battery					●					
Electrolyte vs. Non-Electrolyte Solutions*			●							
Guy-Lussac's Law and Absolute Zero		●		●						
Heat of Fusion		●								
Intermolecular Forces		●								
pH of Household Chemicals	●									
Phase Change		●								
Properties of Ionic and Covalent Compounds*			●							
Specific Heat		●								
Chemical Reactions										
Acid-Base Titration	●						●			
Diprotic Titration	●						●			
Double Replacement Reactions										●
Evidence of a Chemical Reaction		●				●				
Heats of Reaction and Solution		●								
Hess's Law		●								
Ideal Gas Law		●		●						
Le Châteliers Principle	●									
Molar Mass of Copper*								●		
Rates of Reaction				●						
Single Replacement Reactions						●				
Stoichiometry		●								
Lab Skills										
Density**										●
Graphing Mass vs. Volume to Determine Density***										●
Percent Oxygen in Air				●						
Significant Figures***										●

* Requires Standard Sensor Bundle ** Requires Density Set (ME-8569); sold separately, see page 54. *** Requires Discover Density Set (SE-9719A); sold separately, see page 54.

Looking for more teacher resources?

Our collection of Chemistry through Inquiry Teacher Resources is electronic and downloadable. It includes editable student handouts, SPARKvue configuration files, and more. And the student version is FREE at pasco.com!

Chemistry through Inquiry Teacher Resources

PS-2871C

The electronic content includes lab preparation information, teacher tips, assessment, an editable Word® version of student handouts, answer key, and much more.

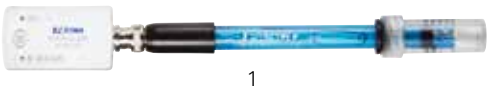
Chemistry Solutions

The tools you need to teach AP®, IB®, Advanced, and General Chemistry Labs

Wireless Chemistry Starter Bundle

PS-3302

1. Wireless pH PS-3204
2. Wireless Temperature PS-3201
3. Wireless Pressure PS-3203
4. Wireless Voltage PS-3211
5. Wireless Conductivity PS-3210



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Wireless Chemistry Standard Extension Bundle

PS-3303A

1. Wireless Current PS-3212
2. High Accuracy Drop Counter* PS-2117
3. Wireless Colorimeter and Turbidity PS-3215
4. ORP probe PS-3515
5. AirLink PS-3200

**Requires AirLink (included) for wireless connectivity.*

This bundle allows you to perform 17 labs in the Advanced Chemistry through Inquiry Teacher Guides, as well as all the free Chemistry labs.

1

2

3

4

5

Make any sensor wireless!

Our interfaces accept all PASPORT sensors and can send data directly to your devices via Bluetooth.

AirLink

PS-3200

Includes one PASPORT sensor port, USB and Bluetooth® connectivity, and USB cable.

Most computing devices will connect directly to PASCO Bluetooth® 4.0 wireless products. To determine your direct-connect compatibility, please go to pasco.com/compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

USB Bluetooth® 4.0 Adapter

PS-3500

10-port USB Charging Station

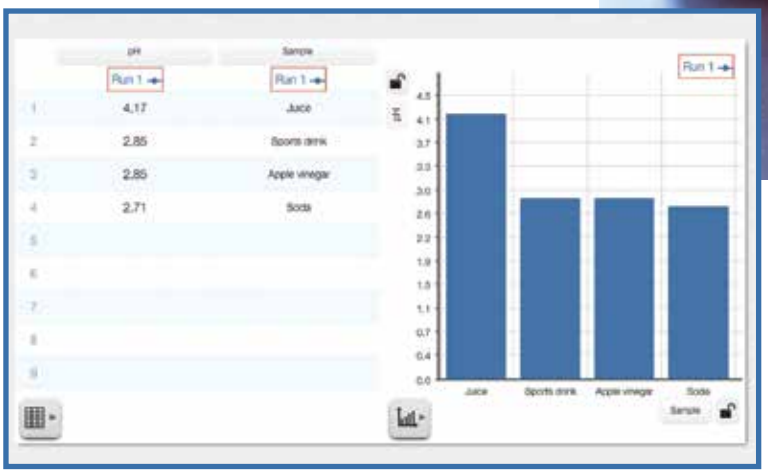
PS-3501

Wireless pH Sensor

Using PASCO's Wireless pH 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 readable, making it easy to compare the acidity of 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.

Measure the pH of different juices using the Wireless pH Sensor.



Display pH in digits, graphs, tables, or bar charts, so your students can get the most out of their measurements.

Specifications

- Excellent accuracy (0.01 pH) and resolution (0.02 pH)
- Dust-proof, sand-proof, and water-resistant (1 m for 30 min.)
- Battery life >1 year
- Also connect ORP or ISE electrodes

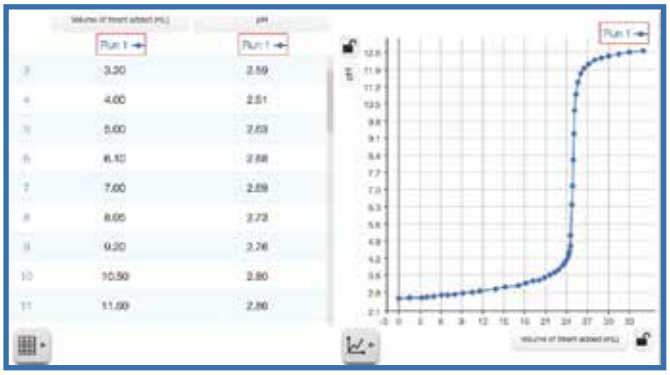
Wireless pH Sensor

PS-3204

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

The Wireless pH Sensor: perform acid-base titrations and more!

Using the Wireless pH Sensor, students can easily create acid-base titration curves. They can incorporate the High-Accuracy Drop Counter to collect more data in less time.



Easily perform pH titrations using the Wireless pH Sensor.

High-Accuracy Drop Counter

PS-2117

Includes Drop Dispenser and Micro Stir Bar plus a Stainless Steel Sensor rod for easy attachment to ring stand.

Also available:
Drop Dispenser PS-6935

Get even more measurements out of the Wireless pH Sensor by using these ORP or ISE electrodes.

Probes and Electrodes

Oxidation Reduction Potential Probe
PS-3515

Ion Selective Electrodes

Ammonium	PS-3516
Carbon Dioxide	PS-3517
Calcium	PS-3518
Chloride	PS-3519
Potassium	PS-3520
Nitrate	PS-3521

Each Ion Selective Electrode (ISE) includes a 2 m cable.

Requires one of these:
Wireless pH Sensor PS-3204
or
a PASPORT pH Amplifier

Also available:
Heater-Stirrer PS-3401

Electrode Support PS-3505

NEW Wireless Colorimeter and Turbidity

The Wireless Colorimeter can measure absorbance and transmittance at six different wavelengths. Each wavelength represents a region of the ROYGBV color wheel. Measure the colors of a solution to introduce the principles of spectroscopy, relate absorbance to concentration, and study reaction rates. The colorimeter also functions as a turbidimeter for water quality analysis by measuring the scattering effect of suspended particles.

Specifications:

Color detection/peak wavelengths detected: 650 nm (red), 600 nm (orange), 570 nm (yellow), 550 nm (green), 500 nm (blue), 450 nm (violet)

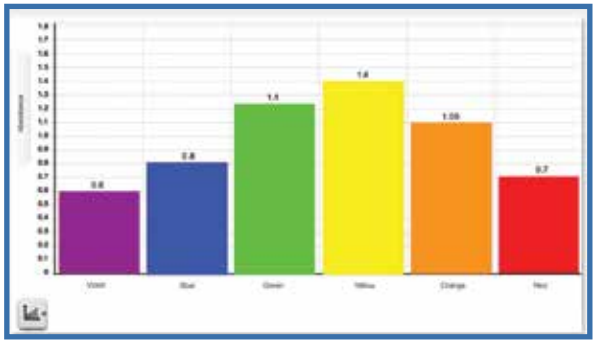
Detector ranges: ±25 nm from peak

Absorbance: 0-3 Abs units; useful range (0.05 -1.5 Abs)

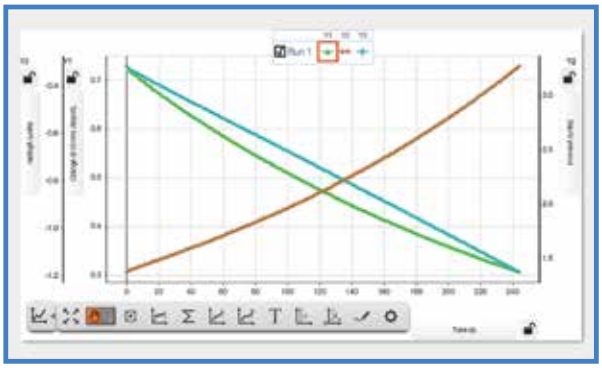
Transmittance: 0-100%

Turbidity range: 0-400 NTU

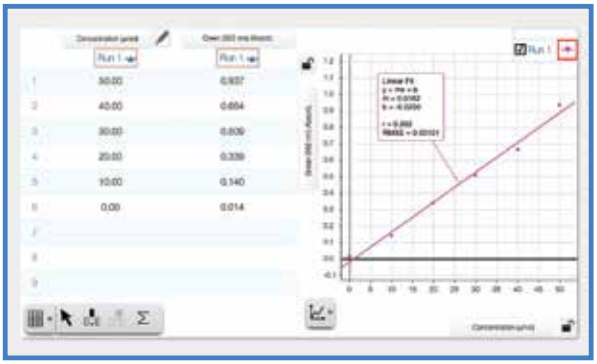
Accuracy: +5% NTU



Measure the absorbance and transmittance of a solution at six different wavelengths... simultaneously!



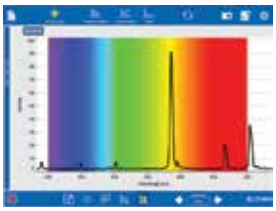
Graphically analyze how a reaction changes over time. Use SPARKvue to see multiple measurements on the same graph.



Create Beer's Law plots to help students understand the relationship between absorbance and concentration.

Need more?

Check out the Wireless Spectrometer on page 48.



Wireless Colorimeter and Turbidity

PS-3215

Includes USB charging cable, 9 cuvettes, 2 cuvette racks, and one 100 NTU calibration cuvette.

Wireless Spectrometer

PS-2600

Includes Wireless Spectrometer, 10 cuvettes, and Spectrometry software.

Also available:

Optional Fiber Optic Cable
PS-2601

Cuvettes & Caps
SE-8739

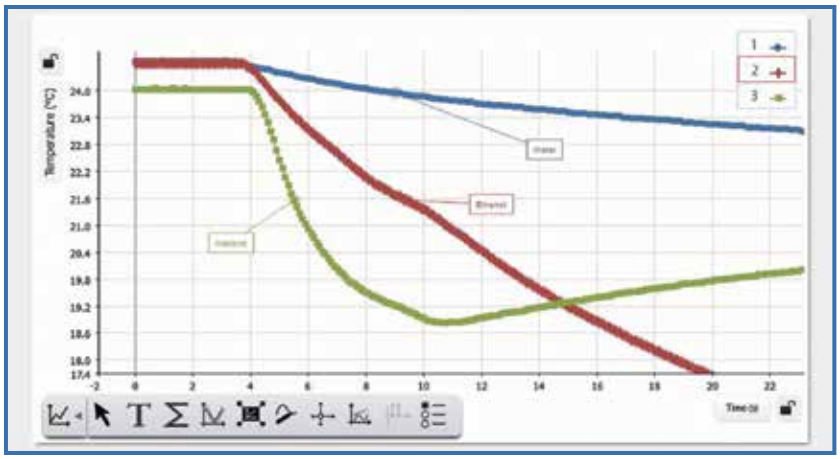
Cuvette Rack
SE-8777

Wireless Temperature Sensor

This durable, high-resolution sensor covers many temperature experiments. From chemical changes to thermochemistry, this is a lab essential. Real-time temperature measurements can be tracked in a graph, table, or digits display.

Specifications

- Range -40° to 125°C
- Leading resolution of 0.01°C
- Dust-proof, sand-proof, and water-resistant (1 m for 30 min)



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The Teaching Advantage

- Includes fast sampling rate for small temperature changes such as convection or skin temperature.
- No calibration required: just connect and measure.
- Features convenient Bluetooth® wireless connectivity and long-lasting coin cell battery.
- Logs temperature data directly onto the sensor for long-term experiments.

Wireless Temperature Sensor

PS-3201

Includes 1 coin cell battery.

Use the change in temperature to determine specific heat capacity of a metal sample.

Quantitatively measure exothermic and endothermic processes

Have your students explore concepts ranging from specific heat capacity to heats of solution and Hess' Law. Using PASCO's Wireless Temperature Sensor, Calorimetry Cups, Specific Heat Set, and Heater-Stirrer, your students will be outfitted with the necessary equipment to perform a wide range of thermochemistry experiments.

Heater-Stirrer:

This compact Heater-Stirrer is an essential for any lab! The white ceramic top is ideal for heating and for seeing color changes when mixing solutions. It has been designed to withstand spills. Its safety features include warning labels and indicator LEDs. The included rod makes it easy to support sensors.

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.

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.

Heater-Stirrer

NEW

PS-3401

Includes support rod.

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.

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.

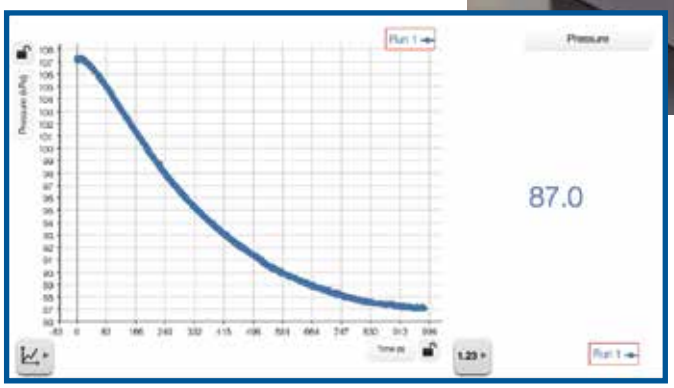
Wireless Pressure Sensor

With this wireless sensor you can make accurate and consistent measurements of gas pressure, and explore Gas Laws and chemical reactions.

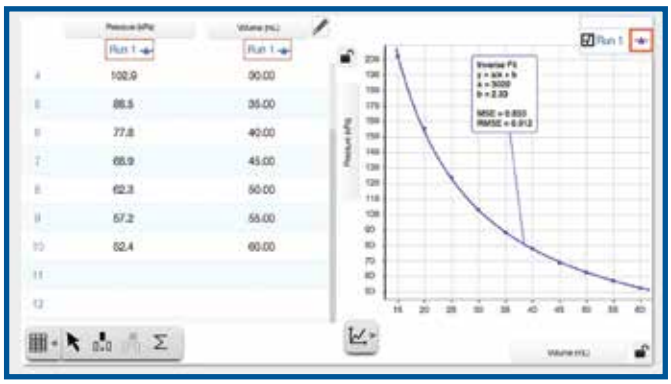
A test tube, piece of steel wool, and a Wireless Pressure Sensor are all your students need to calculate the amount of oxygen in the air.

Specifications

- Wide range 0-400 kPa for gas laws, reaction rates, osmosis, and more!
- Recharge battery just once a semester
- Includes syringe and tubing



Monitor the Pressure digit display while live data is graphed in real time as steel wool reacts with oxygen.



With the included syringe, your students can easily quantify the relationship between pressure and volume.

Wireless Pressure Sensor

PS-3203

Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barb connectors, 1 female barb connector, 1 60cc syringe, a lithium-ion battery, and a USB connector.

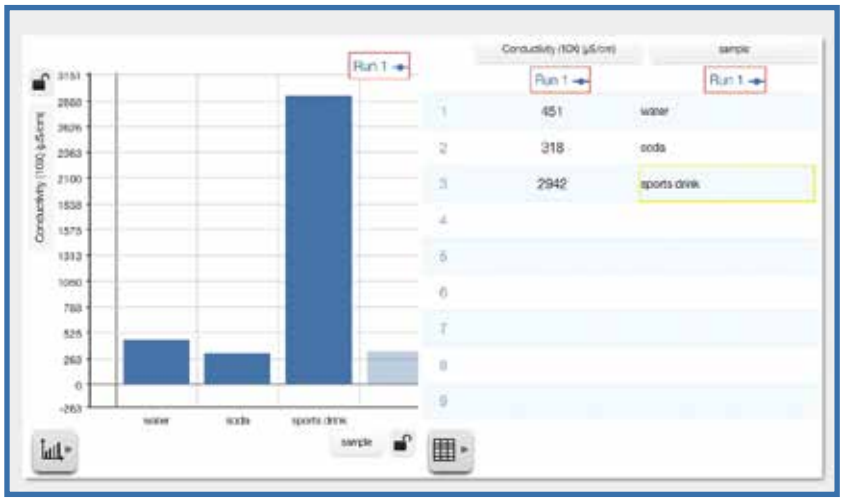
Wireless Conductivity Sensor

Use the Wireless Conductivity Sensor to measure the electrical conductivity of a water solution. With this wireless sensor you can investigate the properties of solutions, as well as model and measure water quality.

Measure the conductivity of water and other water-based solutions.

Specifications

- Measure both conductivity and total dissolved solids
- Automatic temperature compensation
- Dust- and sand-proof and water-resistant (1 meter for 30 minutes)
- Battery life >1 year



Compare the types of bonding or the concentration of electrolytes when measuring the conductivity of solutions.

The Wireless Conductivity Sensor can measure conductivity and total dissolved solids.

Wireless Conductivity Sensor

PS-3210

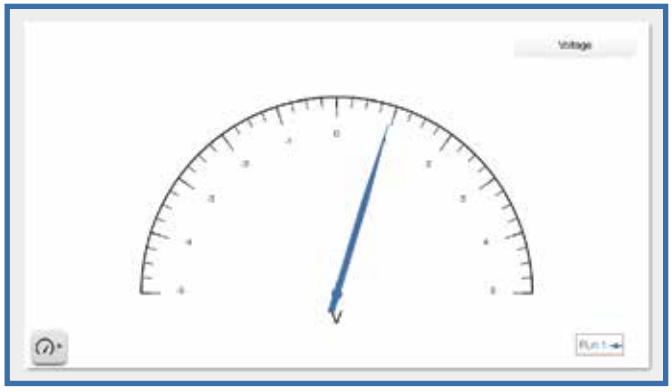
Includes 1 coin cell battery.

Electrochemistry made easy with the Wireless Current and Voltage Sensors

These wireless sensors provide the perfect solution for the electrochemistry portion of your curriculum. Using them during electrochemistry experiments, students will be able to measure voltage and current in voltaic and electrolytic cells.

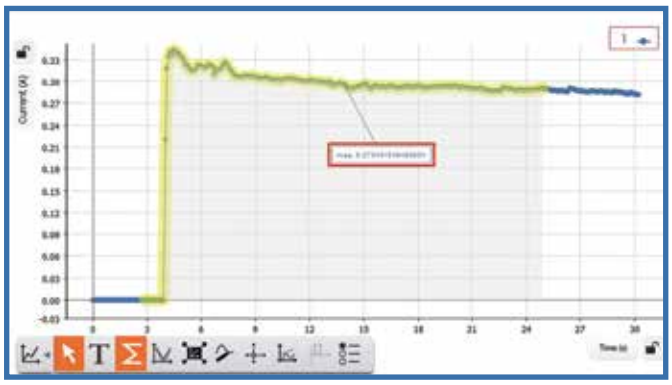
Help your students reach their "potential" by measuring the voltage of electrochemical cells within different metal combinations.

SPARKvue's analysis tools allow you to determine the area under the curve, which is equal to the charge used in the electrolysis experiment featuring the Wireless Current Sensor.



Specifications

- Range ±15 V
- Bluetooth® sampling rate of 1 kHz
- High-speed sampling via USB
- 100 kHz burst mode
- Recharge battery just once a semester



Specifications

- Range ±1A
- Bluetooth® sampling rate of 1 kHz
- High-speed sampling via USB
- 100 kHz burst mode
- Recharge battery just once a semester

Wireless Voltage Sensor

PS-3211

Includes 1 coin cell battery.

Wireless Current Sensor

PS-3212

Includes rechargeable battery and banana-clip cables.

Molecular Model Kit

The Molecular Model Kit is the perfect tool to help students understand core science concepts such as the conservation of mass, chemical formulas, and balancing equations. Anything is possible for students, from creating simple water or carbon dioxide molecules to complex biochemicals such as amino acids, as they make models while they study Chemistry and Biochemistry.

Molecular Model

PS-3400

Includes
86 atoms
and 153 bonds.

Two Density Sets from PASCO

The Discover Density Set (SE-9719) has 22 pieces and allows students to discover the relationship between density, volume, and dimensions.

The Density Set (ME-8569A) allows you to investigate irregular objects by water displacement and specific heat.

Discover Density Set

SE-9719A

Includes
Cylinders of same length and different diameters (4)
Cylinders of same diameter and different lengths (4)
Spheres with different diameters (4)
Rectangular shapes of various sizes and materials (10)
Instruction manual

Density Set

ME-8569A

Includes one irregular aluminum shape, two blocks, (aluminum and brass), three identically-sized cylinders (aluminum, brass and plastic).

Award-Winning Wireless Spectrometry for iOS®, Android™, Computers, and Chromebooks*

Measure intensity, absorbance, transmittance, and fluorescence.

This one apparatus allows you to measure these four parameters… all wirelessly. The Bluetooth® and USB connectivity enable use with your iPad, tablets, and computers, making this a powerful tool for your spectrometry needs.

**Our list of compatible Chromebooks is expanding rapidly. Check pasco.com for the latest updates.*

Now has the same functionality as the Spec 20, and more!

Spectrometer Specifications:

- Bluetooth and USB connectivity
- 2–3 nm FWHM resolution
- 380–950 nm range
- 2 fluorescence excitation wavelengths at 405 nm and 500 nm
- LED-boosted tungsten light source

You can perform these labs with the Wireless Spectrometer:

- Emission Spectra of Light
- Absorbance Spectra
- Beer's Law
- Kinetics
- Fluorescence

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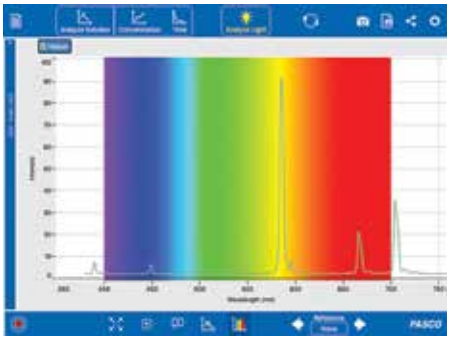
//CODiE// 2017 SIIA CODiE WINNER

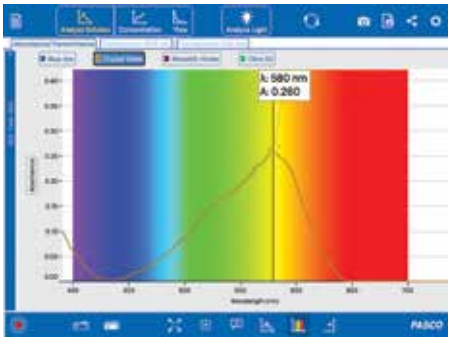
bett AWARDS 2017 FINALIST

The Wireless Spectrometer comes with **PASCO's FREE Spectrometry software.**

- Windows® and Mac® versions included with purchase.
- FREE for iOS®, Android™ , and Chrome™.
- Designed specifically for introductory spectrometry experiments.



Analyze light sources with the optional Fiber Optic Cable. Easily compare the spectrum to known reference lines in the software.



Full visible spectrum analysis of solutions with a large digits display helps set the wavelength and see the absorbance.

Wireless Spectrometer

PS-2600

Includes Wireless Spectrometer, 10 cuvettes, and Spectrometry software.

Also available:

Optional Fiber Optic Cable
PS-2601

Cuvettes & Caps
SE-8739

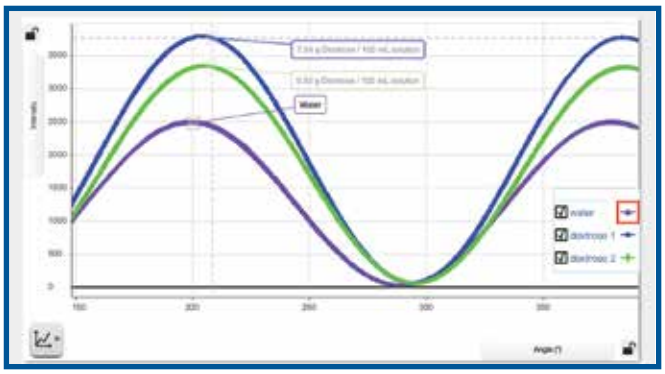
Cuvette Rack
SE-8777

PASCO Polarimeter for your Chromebook™, iPad®, Tablets, and Computers

Measure the optical rotation of chiral compounds.

PASCO's new Polarimeter has both Bluetooth® and USB connectivity, so it works on your iPad®, Chromebook™, tablets, and computers. It is ideal for introductory Organic and Biochemistry experiments with chiral compounds.

In this new device, plane polarized light is passed through a sample, which contains a chiral compound, to an analyzer and a detector. The degree of optical rotation of the plane polarized light is based on the type and amount of sample present. Determine the concentration of a sugar solution based on the optical rotation of plane polarized light.



Optical rotation of sucrose

Determine the concentration of a sugar solution based on the optical rotation of plane polarized light.

Specifications:

- Bluetooth® and USB connectivity
- 589 nm LED light source
- Accuracy = ± 0.09° optical rotation
- SPARKvue- and Capstone-compatible
- Industry-standard, horizontal polarimeter sample cell (100 mm)

Polarimeter

PS-2235

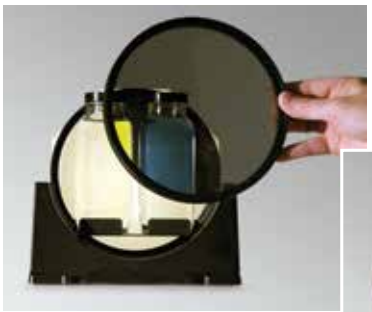
Includes 1 Sample Cell

Also available:

Polarimetry Sample Cell Replacement PS-2234

Polarizer Demonstrator

OS-9477A



Introduce the concept of polarization with this colorful and meaningful demonstration.

Includes two round polarizer discs with stands.

Also available:

Polarizer Demonstrator Accessory OS-8172

Linear Polarizer (2-pack) OS-8549

PASCO's Sensor-based Solutions for Earth and Environmental Sciences

PASCO sensors, wireless technology, and SPARKvue software make collecting reliable data in the field a breeze. Measuring water quality metrics, location data, and enhanced visual observation are all possible with our easy-to-use solutions. For controlled experiments, model ecosystems with the EcoZone™ that works with probeware.

Earth & Environmental Sciences Index

World Class Support & Professional Development
Committed to Your Success

For more details, see pages 180-181.

CONTACT US TODAY
www.pasco.com

NEW Wireless Weather Sensor with GPS

PS-3209 (page 55)

Use this multimeasure sensor to monitor 17 different measurements including common weather, location, and light. Study microclimates, monitor environmental conditions during indoor or outdoor labs, or place the sensor outside for extended monitoring, because of its durable, water-resistant design and internal memory.

Includes USB charging cable.

Wireless Conductivity Sensor

PS-3210 (page 57)

Use the Wireless Conductivity Sensor to measure the electrical conductivity or Total Dissolved Solids (TDS) of a solution. Monitor soil quality, water quality, and evaluate water treatment methods. This sensor is great for field or lab with a waterproof, temperature-compensated design that provides fast, accurate results.

Includes 1 coin cell battery.

Measure the conductivity of water and water-based solutions.

Wireless CO_2 Sensor

PS-3208 (page 54)

Use this wireless sensor to measure the concentration of CO_2 gas in a closed system or open environment. Study core topics (including photosynthesis, respiration, and carbon cycling) with this versatile probe. CO_2 data can be logged directly on the device for long-term life science and environmental science studies.

Includes 250-ml sampling bottle and USB charging cable.

Wireless pH Sensor

PS-3204 (page 56)

Wirelessly monitor pH in the field or lab with this durable, accurate sensor. Study water quality, pollution, and environmental monitoring with ease. Log data to the sensor for extended studies that can go for days or weeks before collecting your data (see page 68 for full details).

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

With the Wireless pH Sensor, students can collect data anywhere!

FREE Digital Labs for Earth & Environmental Sciences

available at pasco.com

There are 22 Earth and Environmental Science labs available for FREE in the PASCO Digital Library. Each lab includes an editable student lab, SPARKvue configuration files, and detailed teacher notes on preparation, background, and sample answers.

Experiments and Sensors Used

	Wireless Sensors Available!								Requires AirLink		
Experiments	CO_2 Gas	Temperature	Pressure	pH	Conductivity	Colorimeter & Turbidimeter	Light	Weather/GPS	Magnetic Field*	Oxygen*	Water Quality Colorimeter
1. Determining Soil Quality	●			●	●						
2. Insolation and the Seasons		●									
3. Investigating Specific Heat		●									
4. Monitoring Microclimates								●			
5. Sunlight Intensity and Reflectivity		●					●				
6. Tracking Weather								●			
7. Earth's Magnetic Field									●		
8. Radiation Energy Transfer		●									
9. Seafloor Spread Plate Tectonics									●		
10. Modeling an Ecosystem	●	●		●	●			●		●	●
11. Photosynthesis and Primary Productivity										●	
12. Photosynthesis and Cell Respiration	●	●								●	
13. Cellular Respiration and Carbon Cycle	●										
14. Energy Content of Food		●									
15. Weather in a Terrarium								●			
16. Yeast Respiration	●	●								●	
17. Properties of Water		●									
18. Air Pollution and Acid Rain				●							
19. Monitoring Water Quality		●		●	●	●		●		●	
20. Toxicology Using Yeast	●			●							
21. Water Treatment				●	●	●					
22. Greenhouse Gases		●									

* The Oxygen Gas Sensor and the Magnetic Field Sensor are not included in any bundle and may be purchased separately.

Earth & Environmental Teacher Resources

PS-2979

The electronic content includes lab preparation information, teacher tips, assessment, an editable Word® version of student handouts, answer key, and much more.

Water Quality Field Guide

PS-2829A

This handy guide includes a spiral bound field guide and a USB flash drive with editable Word® files.

Biosphere Module

Teacher License
PS-2980

One per teacher (one license for all your classes). Includes spiral-bound teacher manual.

Recommended:
Wireless CO_2 Sensor PS-3208

NEW *See our new Digital Ag Science Labs for Earth & Environmental Sciences on page 63.*

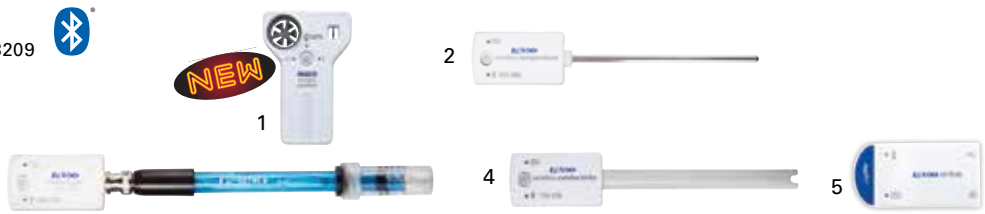
Earth and Environmental Sciences Solutions

The tools you need to teach the free digital labs for Earth and Environmental Sciences

Wireless Earth and Advanced Environmental Starter Bundle

PS-7616A

1. Wireless Weather with GPS PS-3209
2. Wireless Temperature PS-3201
3. Wireless pH PS-3204
4. Wireless Conductivity PS-3210
5. AirLink PS-3200



Wireless Advanced Environmental Science Extension Bundle

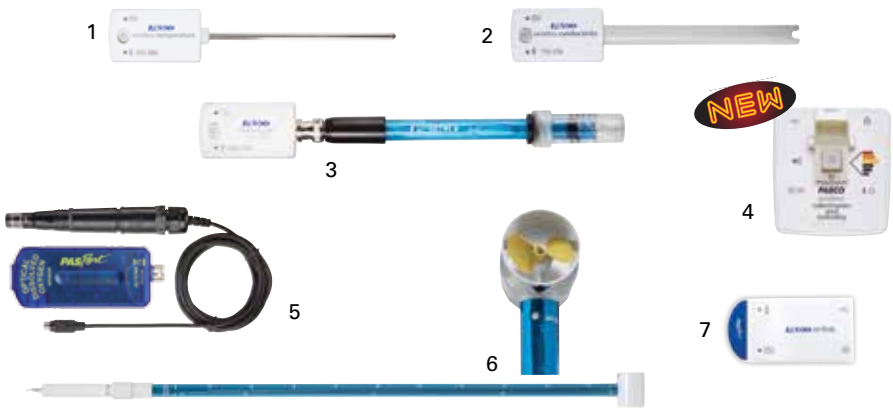
PS-7617A

1. Optical Dissolved Oxygen Sensor PS-2196
2. Wireless Light PS-3213
3. Wireless CO_2 PS-3208
4. Wireless Colorimeter & Turbidity Sensor PS-3215
5. EcoZone ME-6668
6. AirLink PS-3200

Water Quality Extension Bundle

PS-2612D

1. Wireless Temperature PS-3201
2. Wireless pH PS-3204
3. Wireless Conductivity PS-3210
4. Wireless Colorimeter & Turbidity Sensor PS-3215
5. Optical Dissolved Oxygen PS-2196
6. Flow Rate/Temperature PS-2130
7. AirLink PS-3200



Most computing devices will connect directly to PASCO Bluetooth® 4.0 wireless products. Please go to pasco.com/compatibility to determine your direct-connect compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

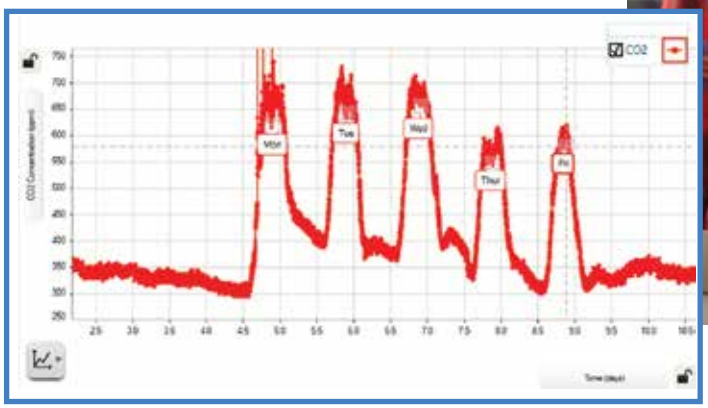
USB Bluetooth® 4.0 Adapter
PS-3500

10-port USB Charging Station
PS-3501

Wireless CO_2 Sensor

PS-3208

Use this wireless sensor to measure the concentration of CO_2 gas in a closed system or open environment. Study core topics (including photosynthesis, respiration, and carbon cycling) with this versatile probe. CO_2 data can be logged directly on the device for long-term life science and environmental science studies.



Using the logging function, CO_2 air quality was captured in PASCO offices for 24 days straight! When logging date for an entire work week, it's easy to see how the CO_2 levels increase as the days progress.

Wireless CO_2 Sensor

PS-3208

Includes 250-ml sampling bottle and USB charging cable.

NEW

Dissolved CO_2 Waterproof Sleeve

PS-3545

(shown with Wireless CO_2 Sensor; sold separately)

The Wireless CO_2 Sensor can be equipped for aqueous measurements using this semipermeable sleeve. The sleeve is waterproof but allows CO_2 gas to pass through the membrane, creating a headspace around the sensor. Monitor photosynthesis and respiration of aquatic plants or animals with the sample bottle or other chambers.
(***Please note***: Improper use will void sensor warranty.)

Dissolved CO_2 Waterproof Sleeve

PS-3545

Includes 5 sleeves and 5 O-rings

NEW Wireless Weather Sensor with GPS

PS-3209

Includes USB charging cable

The Wireless Weather Sensor is an all-in-one instrument for monitoring environmental conditions. By incorporating several sensing elements into a single unit, the sensor provides up to **17 different measurements!** Use the sensor in logging mode with the Weather Vane Accessory for long-term monitoring, or use it as a hand-held instrument to study microclimates and record ambient conditions relevant to many biological and environmental phenomena.

Measurements

Weather
1. Ambient Temperature
2. Barometric Pressure
3. Wind Speed
4. Wind Direction (true)
5. Relative Humidity
6. Absolute Humidity
7. Dew Point
8. Windchill
9. Heat Stress Index

Light
10. Ambient Light (lux)
11. UV Index

GPS
12. Latitude
13. Longitude
14. Altitude
15. Speed
16. Magnetic Direction
17. True Direction

This sensor can measure latitude, longitude, and other GPS functions!

Specifications:

Battery: Rechargeable
Water-resistance: IP-64 splash-proof
(Please see pasco.com for detailed specifications.)

NEW Weather Vane Accessory

PS-3553

Includes tripod, tripod adapter, and weather vane.

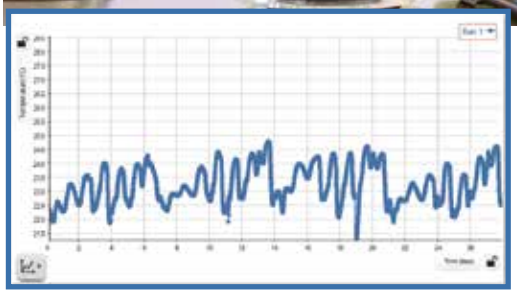
Equip your Wireless Weather Sensor for extended environmental monitoring with the Weather Vane Accessory. Once deployed the sensor will freely rotate to capture wind speed and direction, whether you are monitoring data in real time or using the sensor in logging mode to capture hours (or days!) of data for later analysis.

Weather Vane Accessory

PS-3553

Wireless Temperature Sensor

PS-3201



The versatile Wireless Temperature Sensor works well, both in the lab and out of doors.

See more than 4 weeks of data stored on the sensor!

Welcome to the modern thermometer. Students can access instant temperature readings but also continuously monitor, log, and plot temperature data in SPARKvue on nearly any connected device. When class-time ends but the experiment continues, students can set the sensor to log data autonomously for days or weeks and then download the data for analysis.

Specifications:

Range: -40°C to 125°C
Resolution: 0.05°C
Accuracy: 0.5°C
Battery: Coin cell (>500,000 samples)
Logging: Yes
Bluetooth: BT 4.0

Wireless Temperature Sensor

PS-3201

Includes 1 coin cell battery.

Wireless pH Sensor

PS-3204

Measure pH of water at different locations and annotate with text and images.

With the Wireless pH Sensor, students can collect data anywhere!

Here's the best tool for measuring pH since litmus paper. Students can quickly obtain accurate pH readings but also log data to their connected device and even program the sensor to collect data autonomously for hours or weeks. Use the sensor to study water quality, environmental monitoring, testing solutions, and chemical reactions.

Specifications:

Range: 0-14 pH units
Resolution: 0.02 pH
Accuracy: 0.1 pH units
Battery: Coin cell
Logging: Yes
Bluetooth: BT 4.0

Wireless pH Sensor

PS-3204

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

Electrode Support

PS-3505

Wireless Conductivity Sensor

PS-3210

Use the Wireless Conductivity Sensor to measure the electrical conductivity or Total Dissolved Solids (TDS) of a solution. Investigate diffusion, osmosis, chemical reactions, and monitor water quality.

Specifications:

Range: 0–20,000 µS/cm
Accuracy: ±10% of value from 200–20,000 µS/cm
Resolution: 0.1 µS/cm
Battery: Coin cell (expected life >1 yr)
Waterproof: IP-67 (1 m for 30 min)
Temperature compensated

Compare conductivity and TDS of water samples to investigate water quality at different sites.

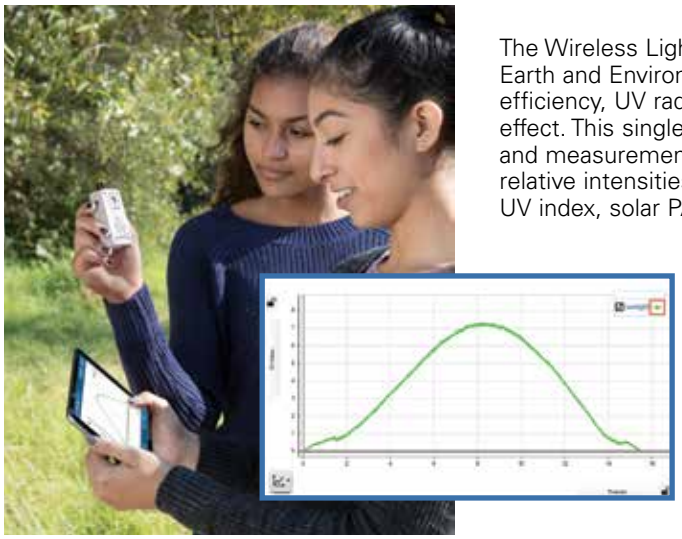
Wireless Conductivity Sensor

PS-3210

Includes 1 coin cell battery.

Wireless Light Sensor

PS-3213



The Wireless Light Sensor is a great tool for explorations of phenomena in Earth and Environmental Science. Study insolation and the seasons, solar panel efficiency, UV radiation, and the impact of light intensity on the greenhouse effect. This single sensor has two different detectors for a variety of applications and measurements: the Spot Detector measures red, green, blue, and white relative intensities; the Ambient Detector measures illuminance (lux), UVA, UVB, UV index, solar PAR, and solar irradiance.

Specifications:

Spectral response: 300 nm–1100 nm
Range: 0–130,000 lux
Battery: Coin cell (expected life >1 yr)

Monitor UV index over the course of a day using the sensor parallel to the horizon in logging mode. The same setup is a great way to compare daylight duration and intensity over the course of a year.

Wireless Light Sensor

PS-3213

Includes 1 coin cell battery.

NEW Wireless Colorimeter and Turbidity Sensor

The Wireless Colorimeter simultaneously measures the absorbance and transmittance of six different wavelengths. The colorimeter can be used to study concentrations of solutions and the rates of chemical reactions. Using accessory cuvettes and a calibration standard, the colorimeter also functions as a turbidimeter for water quality analysis. With the wireless, rugged design, it's easy to take this instrument into the field or use it in the lab.

Specifications:

Color detection/peak wavelengths detected: 650 nm (red), 600 nm (orange), 570 nm (yellow), 550 nm (green), 500 nm (blue), 450 nm (violet)
Detector ranges: +25 nm from peak
Absorbance: 0-3 Abs units; useful range (0.05 -1.5 Abs)
Transmittance: 0-100%
Turbidity range: 0-400 NTU
Accuracy: +5% NTU

Wireless Colorimeter and Turbidity

PS-3215

Includes USB charging cable, 9 cuvettes, 2 cuvette racks, and one 100 NTU calibration cuvette.

Make all your sensors wireless!

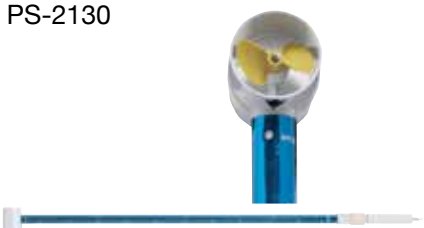
AirLink

PS-3200

Includes one PASPORT sensor port, USB and Bluetooth connectivity, and USB cable.

Flow Rate/Temperature Sensor

PS-2130

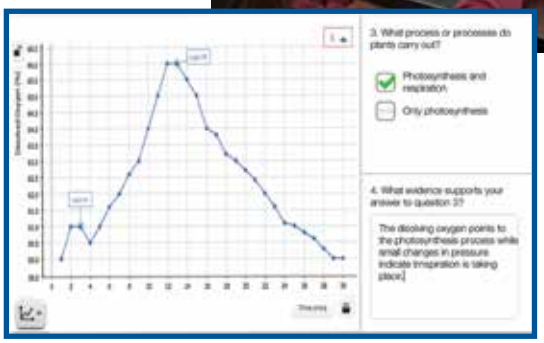


Optical Dissolved Oxygen Sensor

PS-2196

PASCO's Optical Dissolved Oxygen Sensor makes it easier than ever before to measure dissolved oxygen in the field or in a lab environment. The luminescent technology has several advantages over a galvanic dissolved oxygen sensor including:

- There is no warm-up time.
- No calibration is required
- It is low maintenance (no filling solution and electrode polishing).
- There is a built-in temperature and pressure compensation
- No flow dependency
- Optional salinity compensation



Perform these labs with the Optical Dissolved Oxygen Sensor:

- Photosynthesis, Respiration, and Fermentation Labs
- Monitoring Water Quality
- Measuring Net Primary Productivity
- Modeling Ecosystems

Specifications:

Cable Length: 3 m
Response Time: 90% in 25 sec
Operating Temperature: 0–50°C
Operating Pressure: 375–825 mmHg
Range: 0–20 mg/L or 0–300% saturation
Accuracy: ±0.6 mg/L or ±3.0% out of box
±0.1 mg/L or ±1.0% whichever is greater after calibration
Above 200% ± 10%

Optical Dissolved Oxygen Sensor

PS-2196

Also available:

Optical Dissolved Oxygen Sensor Metal Guard

The metal guard protects the probe tip from damage and weighs down the probe for making measurements at depth. It is made of stainless steel and resists corrosion.

PS-2588

Optical Dissolved Oxygen Sensor Cap

This replacement sensor cap for optical dissolved oxygen sensor has a 12-month warranty.

PS-2587

Salinity Sensor

PS-2195

With PASCO's 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.

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.

Salinity level of sample taken from a bay

Features

- Measures salinity, conductivity and temperature
- Automatically temperature-compensates based on Practical Salinity Standard

Salinity Sensor

PS-2195

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.

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.

Snap tip of the vial and...

...sample instantly flows into tube, mixing with the reagent.

Place in Water Quality Colorimeter and read your results.

Water Quality Colorimeter

PS-2179

Includes Sensor Extension Cable.

Iron concentration using ezSample Snap Vial and Water Quality Colorimeter.

ezSample™ Snap Vial Kits

Ammonia EZ-2334A
Chlorine EZ-2339A
Iron EZ-2331
Nitrate EZ-2333B
Phosphate EZ-2337

Each kit contains 30 tests.

Requires:

Water Quality Colorimeter PS-2179

ezSample™ Field Titrator Kits

Alkalinity EZ-2340
Carbon Dioxide EZ-2341
Total Hardness EZ-2338

Each kit contains 30 tests.

EcoZone™ System

The EcoZone System is designed specifically to accommodate PASCO sensors for effective 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 (see page 60).

Easily create interconnected ecosystems (aquatic, terrestrial and decomposition) with live, continuous sensor monitoring. See pages 54-55 for more information on the Wireless CO_2, pH, Temperature, and Conductivity Sensors shown.

EcoZone™ System

ME-6668

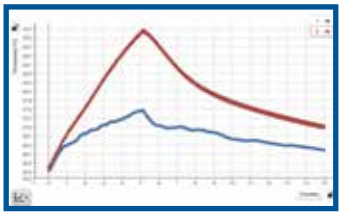
Includes 3 EcoChambers, tray, rubber stoppers, syringe, plastic tubing and wicking cord.

EcoChamber: Use it to build a greenhouse gas model.

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 "solar energy" is absorbed by the rocks, re-radiated into the chamber, and absorbed by the gas in the chamber.

Canned dust remover is an efficient greenhouse gas. By filling the EcoChamber, students can model the greenhouse effect caused by the earth/sun relationship.

Two trials – one control, one with greenhouse gas: The greenhouse-gas trial resulted in a higher temperature and a longer cooling-off period.



EcoChamber

ME-6667

Includes acrylic chamber, 7 stoppers of various sizes, 5 probe stoppers, 20 cc calibrated syringe and sample tube with connector.

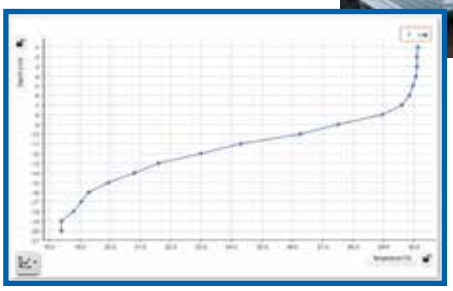
Density Circulation Model

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
- Tropical vs. polar water bodies
- Convection
- Upwelling
- Thermocline and haliocline
- 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).



As students open the valves, convection-driven circulation begins and the water types begin to layer—even for very small temperature/density differences.

Density Circulation Model

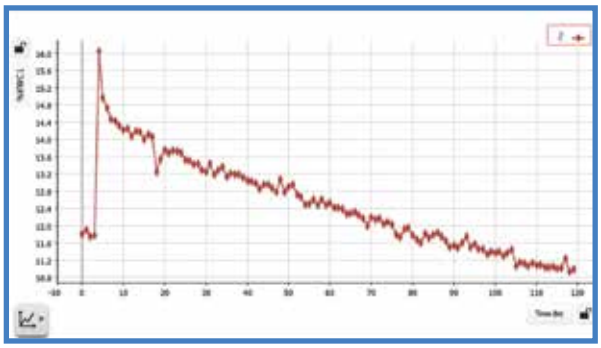
ME-6816

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 suppor 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 be 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.

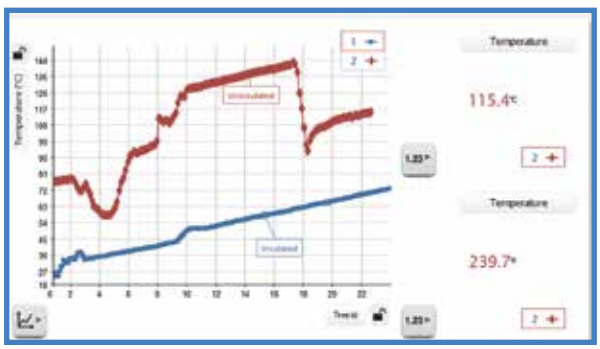
Soil Moisture Sensor

PS-2163

Non-Contact Temperature

The Non-Contact Temperature Sensor allows the measurement of surface temperatures without direct contact — for both safety and convenience. 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.

Students can create a temperature profile of a surface or a building with the Non-Contact Temperature Sensor.



Investigate the surface temperature of different materials and their impact on building insulation and efficiency.

Non-Contact Temperature Sensor

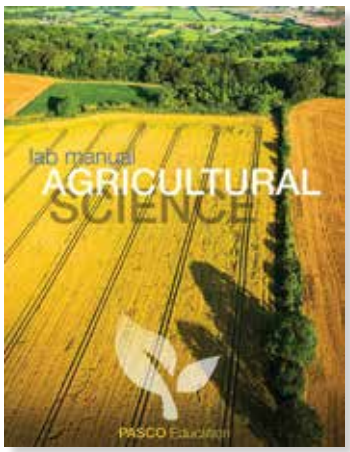
PS-2197

Recommended:
Sensor Extension Cable PS-2500

NEW FREE Ag Science Labs now in the PASCO Digital Library

There are twelve brand new labs that are designed to use wireless sensors and FREE to download. Each lab includes an editable student file and SPARKvue configuration file, which streamline data collection and enable students to spend more time on analysis and inquiry.

Experiments and Sensors Used	Wireless Sensors Available						
Experiments	CO_2 Gas	Temperature	pH	Conductivity	Colorimeter & Turbidimeter	Weather/GPS	Oxygen
1. Determining Soil Quality	●						
2. Water Treatment			●	●	●		
3. Freshwater Quality Monitoring		●	●	●			●
4. Water and pH			●	●			
5. Respiration of Germinating Seeds	●						
6. Plant Pigments and Photosynthesis					●		
7. Plant Respiration and Photosynthesis	●						
8. Modeling an Ecosystem	●		●	●	●	●	●
9. Greenhouse Gases		●					
10. Energy Content of Food		●					
11. Diffusion			●	●	●		
12. Soil and pH			●				



Ag Science Starter Bundle

PS-7621

1. Wireless pH PS-3204
2. Wireless Conductivity PS-3210
3. Wireless CO_2 PS-3208
4. Wireless Colorimeter PS-3215

Ag Science Extension Bundle

PS-7622

1. EcoZone ME-6668
2. Optical Dissolved O_2 Sensor PS-2196
3. Wireless Weather with GPS PS-3209
4. Weather Vane Accessory PS-3553
5. AirLink PS-3200

Most computing devices connect directly to PASCO Bluetooth® 4.0 wireless products. Please go to pasco.com/compatibility to determine your direct-connect compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

USB Bluetooth® 4.0 Adapter
PS-3500

10-port USB Charging Station
PS-3501

PASCO's Sensor-based Solutions for Physical Science

In today's Physical Science classroom, inquiry-based, hands-on activities combine with educational technology to keep students engaged and increase science literacy. PASCO's STEM-based Physical Science solutions do just that. Topics include mechanics, chemical reactions, properties of matter, energy transfer, and more.

Physical Science Index

MORE PHYSICS FROM PASCO

Get the latest Physics & Engineering Catalog for an extensive offering of physics teaching equipment and apparatus. Request your catalog today online at:

pasco.com/catalog

COOL!

MatchGraph Kit

UI-5822A *(page 66)*

Includes MatchGraph software, a Motion Sensor, and the AirLink.

MatchGraph!™ ... FREE App

for Windows®, Mac®, and iPad®

Engage your students with a kinesthetic experience that is centered on motion. Students gain a deeper understanding of how to interpret graphs by watching their motion graphed in real time. Choose between both position and velocity curves. Discuss with your students how the velocity graphs relate to their corresponding Position vs. Time graphs.

Smart Cart

ME-1240 (Red) *(page 67)*

ME-1241 (Blue) *(page 67)*

The wireless PASCO Smart Cart is designed to measure its own movement and the forces that are pushing or pulling on it. It is a dynamics cart with integrated force, acceleration, and position sensors that connect wirelessly through a single Bluetooth connection to a computer, tablet, or Chromebook™.

PASCO's Smart Cart connects to SPARKvue like any other PASCO wireless sensor.

Wireless Light Sensor

PS-3213 *(page 69)*

Includes 1 coin cell battery.

This wireless sensor is a great tool for explorations in Earth, Life, and Physical sciences. With its ambient light detector for illuminance and UV, and its directional detector for colors, your students can explore the electromagnetic spectrum, model planetary motion, and relate photosynthesis to light color and intensity.

Features

All these measurements in one!

- Illuminance (lux)
- UVA, UVB, and UV Index
- RGB color detection
- Battery life >1 year

Wireless Light (Back view)

NEW Wireless Weather Sensor with GPS

PS-3209 *(page 68)*

Use this multimeasure sensor to monitor 17 different measurements including common weather, location, and light. Study microclimates, monitor environmental conditions during indoor or outdoor labs, or place the sensor outside for extended monitoring, because of its durable, water-resistant design and internal memory.

Includes USB charging cable.

(Front view)

(Back view)

MatchGraph!™ FREE App

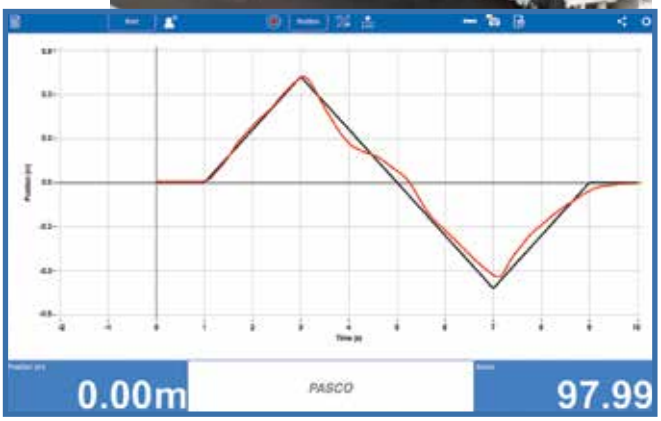
for Windows®, Mac®, and iPad®

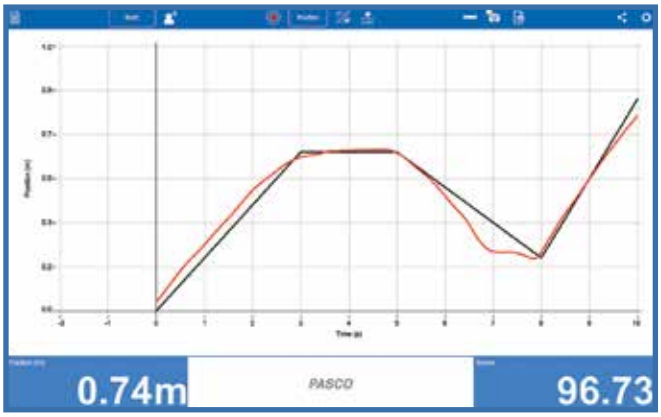
Now works with Smart Carts!

This software helps students interpret position and velocity.

With PASCO's state-of-the-art graphing app, you can engage your students with an experience that is centered on motion. Students gain a deeper understanding of how to interpret graphs by watching the motion of their Smart Carts graphed in real time. Choose between both position and velocity curves. Discuss with your students how the velocity graphs relate to their corresponding Position vs. Time graphs.

MatchGraph!™





MatchGraph features:

- **Students choose from position and velocity profiles** as they learn to relate motion to the graphs they make.
- **Students use their journals to capture images of matches**, which can be used in their lab reports.
- **Students can export their data** into SPARKvue® or PASCO Capstone™ for even more analysis.

MatchGraph Kit

UI-5822A

Includes MatchGraph software, a Motion Sensor, and the AirLink.

Shown in use with:

Smart Cart

(on opposite page; sold separately)

ME-1240 (Red)

ME-1241 (Blue)

Smart Cart

ME-1240 (Red) ME-1241 (Blue)

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GESS EDUCATION AWARDS WINNER 2017

PASCO brings Bluetooth® technology to the study of dynamics! The wireless PASCO Smart Cart is designed to measure its own movement and the forces that are pushing or pulling on it. It is a dynamics cart with integrated force, acceleration, and position sensors that connect wirelessly through a single Bluetooth connection to a computer, tablet, or Chromebook™.

PASCO's Smart Cart connects to SPARKvue like any other PASCO wireless sensor.

Our Smart Cart is patent pending. Get the full details on the Smart Cart at **www.pasco.com/smartcart**

Smart Cart

ME-1240 (Red)

ME-1241 (Blue)

Smart Cart Charging Garage

ME-1243

Charge up to five Smart Carts at once. Provides storage for the carts and accessory bumpers. Includes power adapter.

Smart Carts not included.

PAStrack

ME-6960

Includes two-piece track, two connector clips, and six leveling feet.

Two-piece track construction for easy storage. Snap-on connector clip holds sections straight and rigid. Use the second clip (included) to connect multiple tracks!

Also available:

Basic PAScar/PAStrack System ME-5701

End Stops (2)

ME-8971

NEW Wireless Weather Sensor with GPS

PS-3209

Includes USB charging cable

The Wireless Weather Sensor is an all-in-one instrument for monitoring environmental conditions. By incorporating several sensing elements into a single unit, the sensor provides up to **17 different measurements!** Use the sensor in logging mode with the Weather Vane Accessory for long-term monitoring, or use it as a hand-held instrument to study microclimates and record ambient conditions relevant to many biological and environmental phenomena.

Measurements

Weather	1. Ambient Temperature 2. Barometric Pressure 3. Wind Speed 4. Wind Direction (true) 5. Relative Humidity 6. Absolute Humidity 7. Dew Point 8. Windchill 9. Heat Stress Index
Light	10. Ambient Light (lux) 11. UV Index
GPS	12. Latitude 13. Longitude 14. Altitude 15. Speed 16. Magnetic Direction 17. True Direction

Specifications:

Battery: Rechargeable
Water-resistance: IP-64 splash-proof
(Please see pasco.com for detailed specifications.)

NEW Weather Vane Accessory

PS-3553

Includes tripod, tripod adapter, and weather vane.

Equip your Wireless Weather Sensor for extended environmental monitoring with the Weather Vane Accessory. Once deployed the sensor will freely rotate to capture wind speed and direction, whether you are monitoring data in real time or using the sensor in logging mode to capture hours (or days!) of data for later analysis.

Weather Vane Accessory

PS-3553

Wireless Light Sensor

This wireless sensor is a great tool for explorations in Earth, Life, and Physical sciences. With its ambient light detector for illuminance and UV, and its directional detector for colors, your students can explore the electromagnetic spectrum, model planetary motion, and relate photosynthesis to light color and intensity.

Features

All these measurements in one!

- Illuminance (lux)
- UVA, UVB, and UV Index
- RGB color detection
- Battery life >1 year
- Remote logging

Using wireless sensors to collect eclipse data

On August 21, 2017, a total solar eclipse occurred and was visible, in some degree, over much of the continental United States (see map). As the moon in its new phase passed directly in front of the sun, the moon cast a shadow on Earth. Using PASCO wireless sensors, many students across the United States viewed the total eclipse and measured the change in light level and temperature as the moon passed in front of the sun!

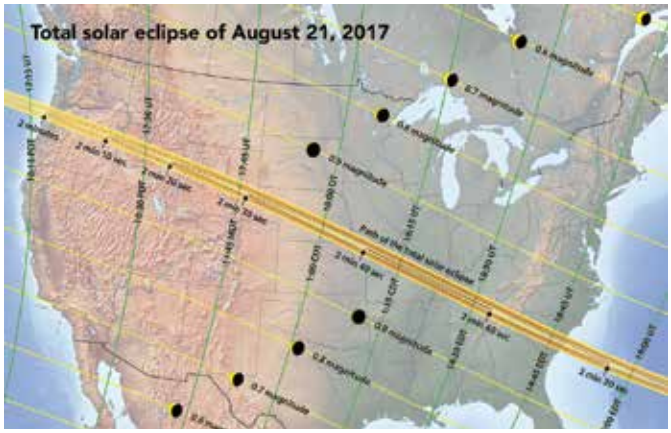


Image courtesy of GreatAmericanEclipse.com

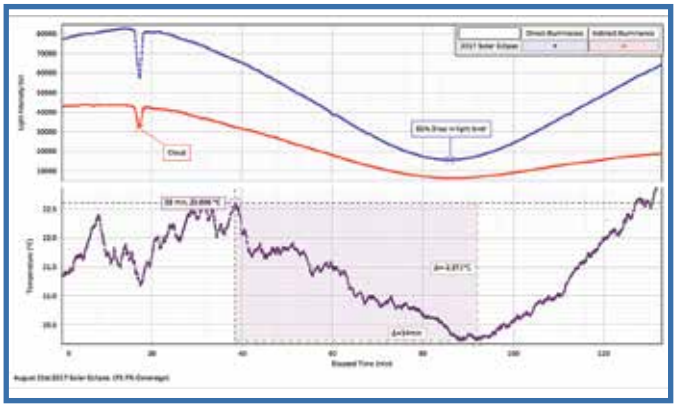
Wireless Light Sensor

PS-3213

Includes 1 coin cell battery.

Also available:

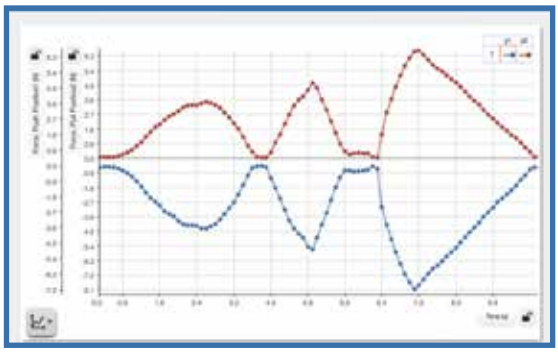
Wireless Temperature Sensor PS-3201



This eclipse data was collected at PASCO in Roseville, CA, on August 21, 2017.

Wireless Force Acceleration Sensor

Capable of measuring force, acceleration, and rotation, this sensor is ideal for experiments involving rotating platforms, moving carts, spring oscillations, collisions, and impulse. The wireless design offers improved measurements without a cable affecting experiment outcome. Finger-holes support handheld applications, or mount it onto a cart or rod.



The Wireless Force Acceleration Sensor can also be mounted on a cart.

Features

- Simultaneously measure force, acceleration and rotation!
- Force ±50N - Wireless sampling at 1 kHz, USB
- 3-axis accelerometer ±16 g + 3-axis gyro
- Recharge battery just once a semester
- Remote logging

Wireless Force Acceleration Sensor

PS-3202

Includes 1 eye bolt, 1 thumb screw, 1 bumper, a lithium-ion battery, and a USB connector.

Wireless Conductivity Sensor

Use the Wireless Conductivity Sensor to measure the electrical conductivity of a water solution. With this wireless sensor you can investigate the properties of solutions, as well as model and measure water quality.

Features

- Measure both conductivity and total dissolved solids
- Automatic temperature compensation
- Dust- and sand-proof and water-resistant (1 meter for 30 minutes)
- Battery life >1 year
- Remote logging

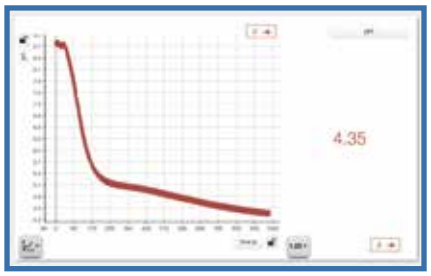
Wireless Conductivity Sensor

PS-3210

Includes 1 coin cell battery.

Wireless pH Sensor

Using PASCO's Wireless pH 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 readable, making it easy to compare the acidity of different samples.



Wireless pH Sensor

PS-3204

Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barb connectors, 1 female barb connector, 1 60cc syringe, a lithium-ion battery, and a USB connector.

Wireless Temperature Sensor

This durable, high-resolution sensor covers many temperature experiments. With the included Stainless Steel Temperature Probe, it measures small but significant temperature changes produced by chemical reactions, convection currents, and even skin temperatures.

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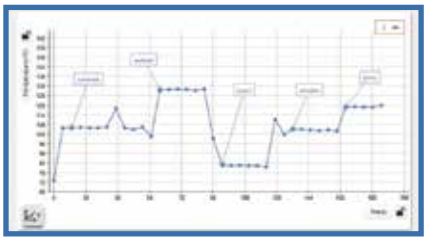


Measure temperature in the lab or in the field!

Features

- Range -40° to 125°C
- Leading resolution of 0.01°C
- Dust- and sand-proof and water-resistant (1 m for 30 min)
- Battery life >1 year
- Remote logging

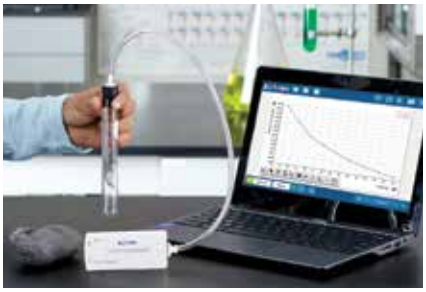
Wireless Temperature Sensor

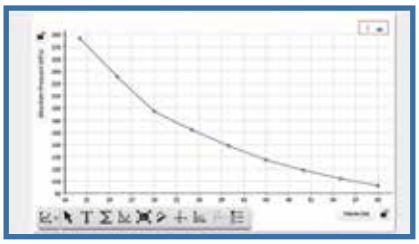
PS-3201

Includes 1 coin cell battery.

Wireless Pressure Sensor

With the new Wireless Pressure Sensor you can 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, you can study the Empirical Gas Laws.





The ideal sensor to study gas laws!

Features

- Wide range 0-400 kPa
  - Transpiration, osmosis, gas laws, and more
- Recharge battery just once a semester
- Includes syringe and tubing
- Remote logging

Wireless Pressure Sensor

PS-3203

Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barb connectors, 1 female barb connector, 1 60cc syringe, a lithium-ion battery, and a USB connector.

Molecular Model Kit

The Molecular Model Kit is the perfect tool to help students understand core science concepts such as the conservation of mass, chemical formulas, and balancing equations.

Anything is possible for students, from creating simple water or carbon dioxide molecules to complex biochemicals such as amino acids, as they make models while they study Life, Earth, and Physical sciences.

Molecular Model Kit

PS-3400

Includes 86 atoms and 153 bonds.

Ohaus Electronic Balances

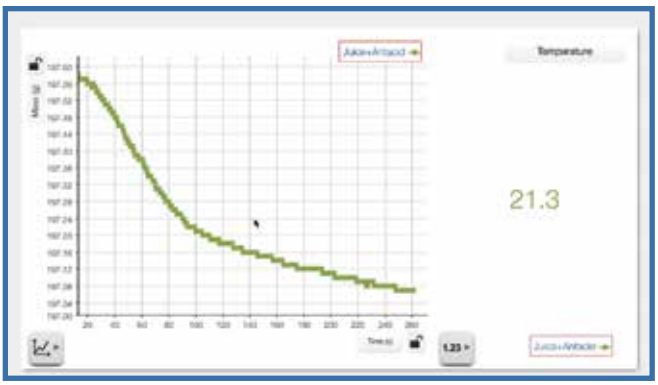
Ohaus Scout SKX digital electronic balances combine range, resolution, and low cost, making them ideal for the student lab.

Simple two-button operation and visual menu prompts allow students to begin weighing with minimal instruction. The large, crisp display is easily viewed from any angle, so teachers can quickly check student results.

A sealed front panel, molded spill ring, and removable stainless steel platforms provide protection from spills and make these balances easy to keep clean.

Specifications

Product #	SE-8823A	SE-8756B	SE-8757B	SE-8758B
Capacity:	0-220 g	0-420 g	0-2200 g	0-8200 g
Resolution:	0.01 g	1.0 g	0.1 g	0.1 g
Pan Size:	12 cm dia	12 c	16.5 x 4.2 cm	16.5 x 14.2 cm



Measure the change in mass during a reaction and apply the law of conservation of mass to see how much product was produced.

Ohaus Scout SKX Balances

SE-8823A (220 g)
SE-8756B (420 g)
SE-8757B (2200 g)
SE-8758B (8200 g)

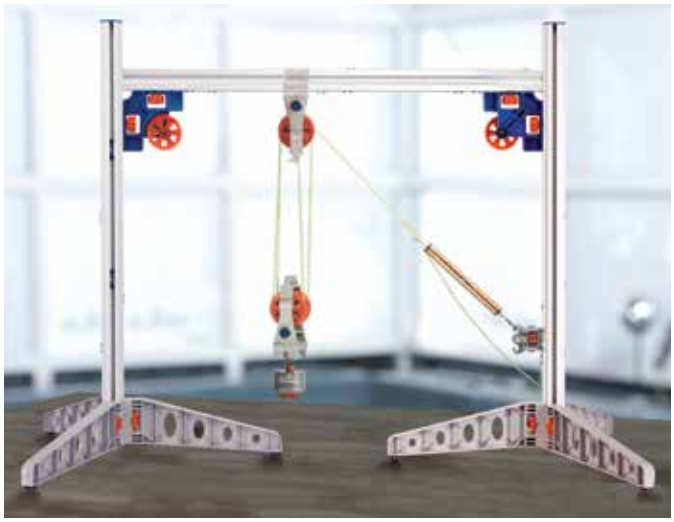
Also available:

Ohaus Bluetooth Device Adapter SE-8822

Ohaus USB Device Adapter SE-8821

Forces and Machines STEM Module

Our Forces and Machines STEM Module engages students in a wide range of physics, physical science, and engineering concepts. Two triple-pulley blocks make it easy to build machines with mechanical advantage up to 6:1. Build all three classes of levers with our pair of 20-cm levers, or combine gears, levers, and pulleys together to show how rotating machines work.



Forces and Machines Engineering Kit

EP-3577

Kit includes:
Extruded rail
10 N metal spring scales (2)
Tripod stand (2)
Universal spring hanger
Right-angle connector with pulley (2)
Fixed triple pulley block
Hanging triple pulley block
25 cm Hooke's law spring
Friction block
Quick-attach gear hubs (4)
Gear spacers (8)
20 cm levers (2)
60 tooth spur gears (2)
40 tooth spur gears (2)
20 tooth spur gears (3)
20 cm dia. large pulleys (2)
Weights

Forces and Machines Teacher Resources

EP-6483

See more STEM modules and kits on pages 120-127.

- **Light, Color, and Optics**
- **Oscillations, Waves, and Sound**
- **Programming and Robotics**

Free Digital Labs for Physical Science available at pasco.com

- This collection of labs is standards-based and STEM- and Common Core-focused.
- Collection covers core topics including mechanics, chemical reactions, properties of matter, energy transfer, and the geosphere.
- The labs engage students as they make predictions, collect real-time data, use critical thinking skills to solve sequencing challenges, and answer embedded questions.

Physical Science Experiments and Sensors Used

Experiments	Absolute Pressure	Conductivity	Force	Motion	pH	Stainless Steel Temperature	Voltage/ Current	No Sensor Used
Chemical Reactions								
Endothermic or Exothermic?	●					●		
Evidence of a Chemical Reaction						●		
Ecology								
Soil pH					●			
Electricity & Magnetism								
Faraday's Law							●	
Voltage							●	
Force & Motion								
Acceleration				●				
Archimedes' Principle*			●					
Conservation of Matter								●
Introduction to Force*			●					
Newton's First Law				●				
Newton's Second Law*			●	●				
Newton's Third Law*			●					
Position Match Graph				●				
Speed & Velocity				●				
Geosphere								
Air Pollution & Acid Rain					●			
Insolation & the Seasons						●		
Radiation Energy Transfer						●		
Specific Heat of Sand vs. Water						●		
Water, the Universal Solvent*		●						
Lab Skills								
Density*								●
Percent Oxygen in Air	●							
Significant Figures*								●
Varying Reaction Rates						●		
Structure & Properties of Matter								
Electrolyte vs. Non-Electrolyte Solutions*		●						
pH of Household Chemicals					●			
Properties of Ionic & Covalent Compounds*		●						
Thermodynamics								
Boyle's Law	●							
Phase Change						●		
Temperature vs. Heat						●		

*Requires Standard Sensor Bundle

Looking for more teacher resources?

Our collection of Physical Science Teacher Resources is electronic and downloadable. It includes lab prep, teacher tips, assessment, editable student handouts, answer key, and more. And the student version is FREE!

Physical Science through Inquiry Teacher Resources

PS-2843B

The electronic content includes lab preparation information, teacher tips, assessment, an editable Word® version of student handouts, answer key, and much more.

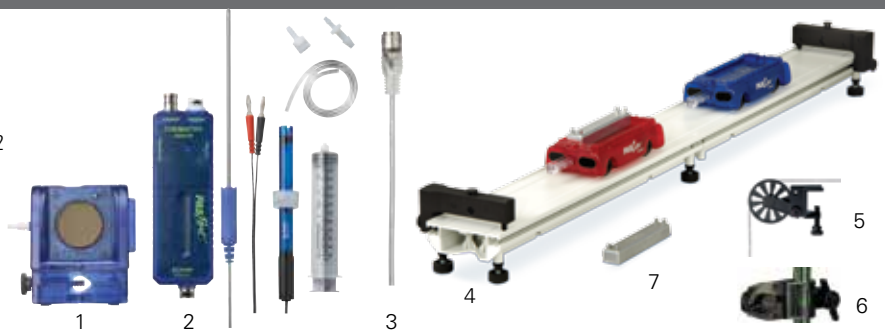
Physical Science Sensor Bundles

Physical Science Starter Sensor Bundle

PS-2845

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. 250 g Stackable Masses (2) ME-6757A

This bundle gives you the sensors you need to perform 22 labs on the opposite page.



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

PS-2846

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-8569A
10. Mass & Hanger Set ME-8979
11. Significant Figures Set – Single ME-9850
12. Overflow Can SE-8568
13. 250 g Stackable Masses (2) ME-6757A

This bundle gives you the sensors you need to perform the 31 labs on the opposite page.

Wireless Force Acceleration Sensor

PS-3202

Capable of measuring force, acceleration, and rotation, this sensor is ideal for experiments involving rotating platforms, moving carts, spring oscillations, collisions, and impulse.

Includes 1 eye bolt, 1 thumb screw, 1 bumper, a lithium-ion battery, and a USB connector. Wireless sensors connect directly to most classroom devices. See below for details.

AirLink

PS-3200

Includes one PASPORT sensor port, USB and Bluetooth connectivity, and USB cable.

Most computing devices will connect directly to PASCO Bluetooth® 4.0 wireless products. Please go to pasco.com/compatibility to determine your direct-connect compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

USB Bluetooth® 4.0 Adapter
PS-3500

10-port USB Charging Station
PS-3501

PASCO's Solutions for Physics

PASCO now has a complete Physics curriculum: Essential Physics! All our Physics solutions combine inquiry-based, hands-on activities with the latest educational technology tools to keep students engaged and increase science literacy. Topics covered include mechanics, electricity and magnetism, optics, thermodynamics, waves, and more.

Physics Index

MORE PHYSICS FROM PASCO

See our 2018 Physics & Engineering Catalog for an extensive offering of physics teaching equipment and apparatus. Request your catalog today online at:
pasco.com/catalog

877.373.0300 (inside US) 916.462.8383 (outside US)

Four essentials for Physics you can't do without!

Smart Cart

ME-1240 (Red)

ME-1241 (Blue)

(page 88)

It is the ultimate tool for your physics lab with built-in sensors that measure force, position, velocity, and acceleration. The Smart Cart can make these measurements on or off a dynamics track and transmit the data wirelessly over Bluetooth®.

Smart Fan Accessory

NEW

ME-1242 *(page 92)*

Plug it into a Smart Cart. When the Fan Accessory it is connected to a Smart Cart, it allows for an unprecedented level of control, functionality and programmability. Also works in manual mode with all PASCO carts.

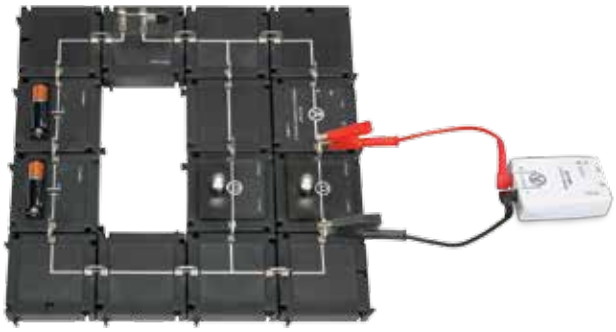
Basic Modular Circuits Kit

EM- 3535 *(page 108)*

Essential Physics Modular Circuits Kit

EM-3536

These circuit modules are designed specifically for introductory circuits classes. For students who have never wired a circuit, this modular system makes it easy for them to visualize current flow because it ends up looking like a circuit diagram.



Wireless Current Module

EM-3534 *(page 108)*

The Wireless Current Sensor Module is designed for use with PASCO Modular Circuit sets (at left). The module can be placed anywhere in a circuit and provide current measurements at that point. Use it to measure currents of up to 1 A, then transmit the collected data wirelessly to your computers, Chromebooks, tablets, or smart phones.

Most computing devices connect directly to PASCO Bluetooth® 4.0 wireless products. Go to pasco.com/compatibility to determine your direct-connect compatibility. PASCO offers the PS-3500 USB Bluetooth® Adapter for computing devices that do not support direct-connect.

USB Bluetooth® 4.0 Adapter
PS-3500

10-port USB Charging Station
PS-3501

Essential Physics Curriculum

This complete physics solution includes Textbook, e-Book, Digital Teacher Edition, and Equipment!

Essential Physics 3rd Edition is a comprehensive, full-color textbook paired with PASCO equipment and the only e-Book for physics on the market. The program includes over 100 interactive tools that increase student engagement and understanding. *Essential Physics* is focused on practical applications that connect students to the physics of nature as well as technology.

About the program:

- Rigorous yet accessible design
- Interactive simulations and equations
- Lessons follow the 5E design
- Strong mathematics scaffolding
- Formative and summative assessment tools
- Differentiation for advanced, below-level, and ELL students
- Works seamlessly with your LMS and Google Classroom
- Includes 24/7 online/offline access. No Internet required!

Essential Physics is multiplatform: iOS, Android™, Chrome™, Windows®, PC, and Mac®!

A textbook and e-Book for all your students

What sets *Essential Physics* apart is the complete and interactive e-Book. Animations, videos, and interactive equations and simulations bring concepts to life for students in ways that text and static images cannot. Combined with digital resources for teachers, formative and summative assessment, and equipment for lab investigations, *Essential Physics* forms a seamless learning system for mastering physics.

Interactive tools include:

31 videos

84 embedded interactive equations

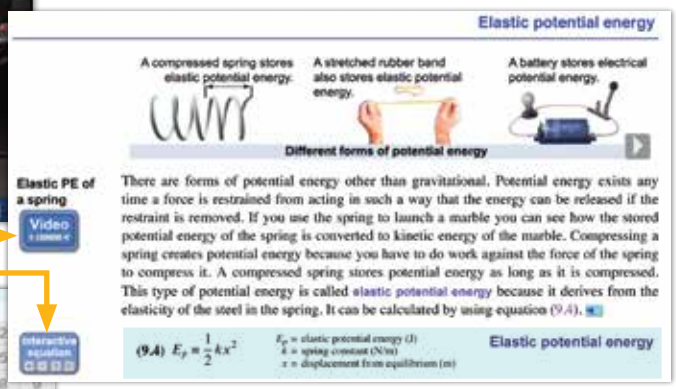
71 interactive simulations

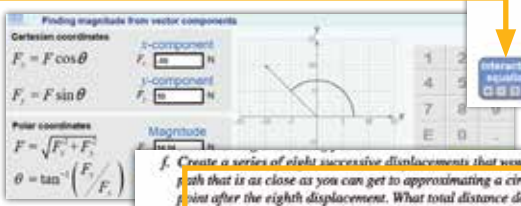
Full audio read

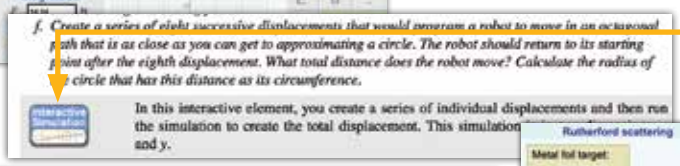
31 embedded animations

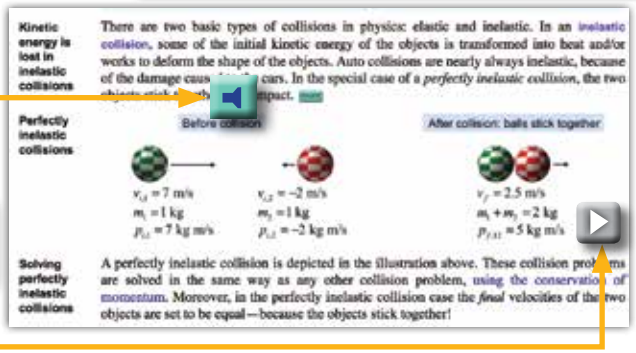
Summative assessment: The Infinite Test Bank

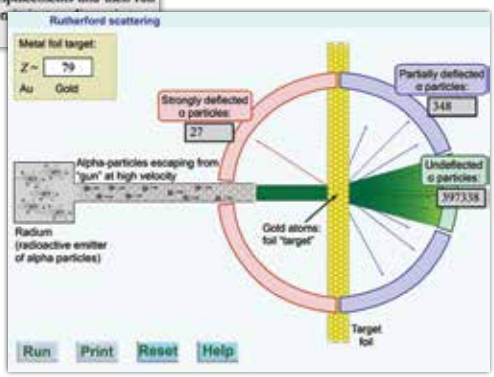
Formative assessment

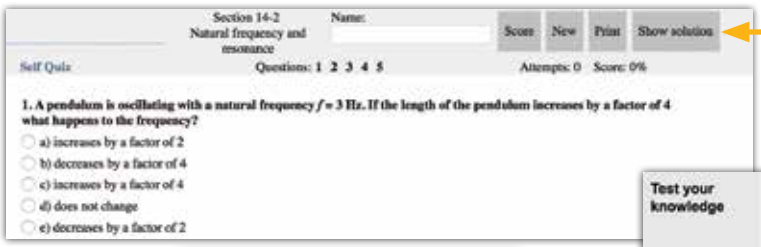


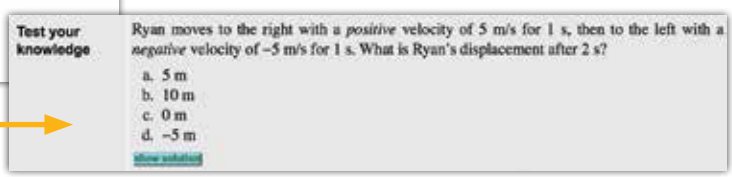












Essential Physics meets 100% of your state standards and supports STEM and NGSS!

The Digital Teacher Edition includes lesson plans, slide presentations, student work, and answer keys, all at point-of-use.

Lesson resources:
- Lesson plan: DOC/PDF
- Slide presentation: PPTX/ PDF/Notes (PDF)
- Student work: DOC/PDF
- Answers: DOC/PDF

Friction is not a specific force in the same way that gravity is a force between two masses. Instead, friction is a "catch-all" term that collectively refers to forces that may be caused by motion and that act to reduce motion. Friction transforms the energy of motion into thermal energy or the wearing away of moving surfaces. *Kinetic friction* describes the friction between sliding surfaces and *rolling friction* describes friction in wheels. *Static friction* describes the tendency of objects to stick to each other and not move until a minimum force is applied to "break things loose."

Some causes of friction

Friction Everything that moves in the macroscopic world feels friction. We model the effect of friction as a force that is opposite in direction from actual motion, or the motion that *might* occur if there were no friction. Sliding, moving through air or water, or rolling are some forms of motion that generate friction that we can model this way.

Air friction	Rolling friction	Sliding friction	Viscous friction
comes from air being pushed aside or flowing around surfaces such as the body of a car or the wing of an aircraft.	comes from rolling contact between two surfaces, such as a wheel and the road.	comes from sliding contact between two surfaces, such as the bottom of skis and a snow-	comes from liquids being displaced or forced to flow around or through objects such as pipes or boats.

Where friction On a microscopic level friction comes matter. Slippery liquids such as oil

Lesson summary:

The lesson resources correspond to the content on these next six pages. The lesson presents the concept of friction as a force. Static, kinetic, and rolling friction are developed through the coefficient of friction model. Viscous friction is also mentioned.

Present key content:

The general model of friction is a force that is a coefficient times the normal force.

Equations

LESSON PLAN *Essential Physics* CHAPTER 5

Friction

Content There are many forms of friction. This lesson introduces the force laws for static friction, kinetic friction, and rolling friction. Students learn the meaning of and typical range of values for the coefficients of friction. In the investigation, students determine the coefficients of static and kinetic friction between two surfaces.

Learning objectives The student will be able to:
1) calculate friction forces from equation models for static, kinetic, and rolling friction; and
2) solve one-dimensional force problems including friction.

Materials/ technology resources
1) Slide presentation: "Friction.ppt"
2) Investigation: track with feet, friction block, thread, balance, Smart Cart with hook, 250-g cart masses (2)
3) SPARKvue file: "05C_Friction.spklab"
4) Student work: "FrictionAssignment.pdf"

Lesson resources:
Lesson plan: DOC/PDF
- Slide presentation: PPTX/ PDF/Notes (PDF)
- Student work: DOC/PDF
- Answers: DOC/PDF

Air friction	Rolling friction	Sliding friction	Viscous friction
comes from air being pushed aside or flowing around surfaces such as the body of a car or the wing of an aircraft.	comes from rolling contact between two surfaces, such as a wheel and the road.	comes from sliding contact between two surfaces, such as the bottom of skis and a snow-covered hill.	comes from liquids being displaced or forced to flow around or through objects such as pipes or boats.

Lesson resources:
- Lesson plan: DOC/PDF
Slide presentation: PPTX/ PDF/Notes (PDF)
- Student work: DOC/PDF
- Answers: DOC/PDF

Lesson resources:
- Lesson plan: DOC/PDF
- Slide presentation: PPTX/ PDF/Notes (PDF)
Student work: DOC/PDF
- Answers: DOC/PDF

NAME

Investigation 5C: Static

Essential question: What determines

Friction is everywhere and can be either helpful or wasteful depending on the situation. In this investigation you will test models of friction against actual measurements to get a sense of how accurate these friction models are.

Coefficient of static friction and kinetic fric

1. Open the experiment file 05C_Friction on Bluetooth.
2. Set up the equipment like the picture. touching the hook.

Table: Coefficient of static friction and kinetic friction

Trial	Max Force (N)	Average Force While Sliding (N)	Mass of Block (kg)	Static Friction Coefficient μ_s	Kinetic Friction Coefficient μ_k
1	11.0	5.08	1.125	0.46	0.21
2	6.25	2.76	0.625	0.45	0.29
3	3.75	1.55	0.375	0.42	0.27

Average value for μ_s: 0.44 Average value for μ_k: 0.26

Lesson resources:
- Lesson plan: DOC/PDF
- Slide presentation: PPTX/ PDF/Notes (PDF)
- Student work: DOC/PDF
Answers: DOC/PDF

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- *e-Book with 24/7 online/offline access*

Essential Physics 3rd Edition Student e-Book only

EP-6323-EBK

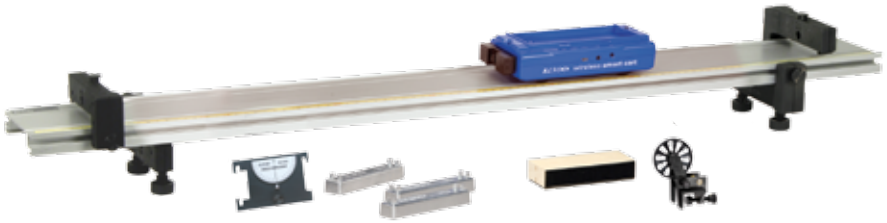
Includes e-Book with 24/7 online/offline access

Equipment Kits

Basic Equipment Kit *17 labs are designed to use this equipment set.*

EP-3571

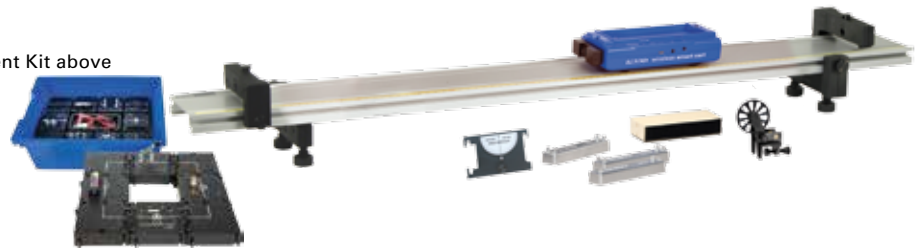
Includes 1 of each of the following:
- Smart Cart (Blue), ME-1241
- Friction Block, ME-9807
- PAScar Cart Mass (set of 2), ME-6757A
- Angle Indicator, ME-9495A
- Track End Stop (set of 2), ME-8971
- Super Pulley with Clamp, ME-9448B
- Gratnells Tray
- 1.2m Dynamics Track, ME-9493
- Track Feet (set of 2), ME-8972
- Weights



Standard Equipment Kit *25 labs are designed to use this equipment set.*

EP-3567

Includes everything in the Basic Equipment Kit above + 1 of each of the following:
- Modular Circuits
- Wireless Current Module
- Wireless Voltage Sensor



Comprehensive Equipment Kit *41 labs are designed to use this equipment set.*

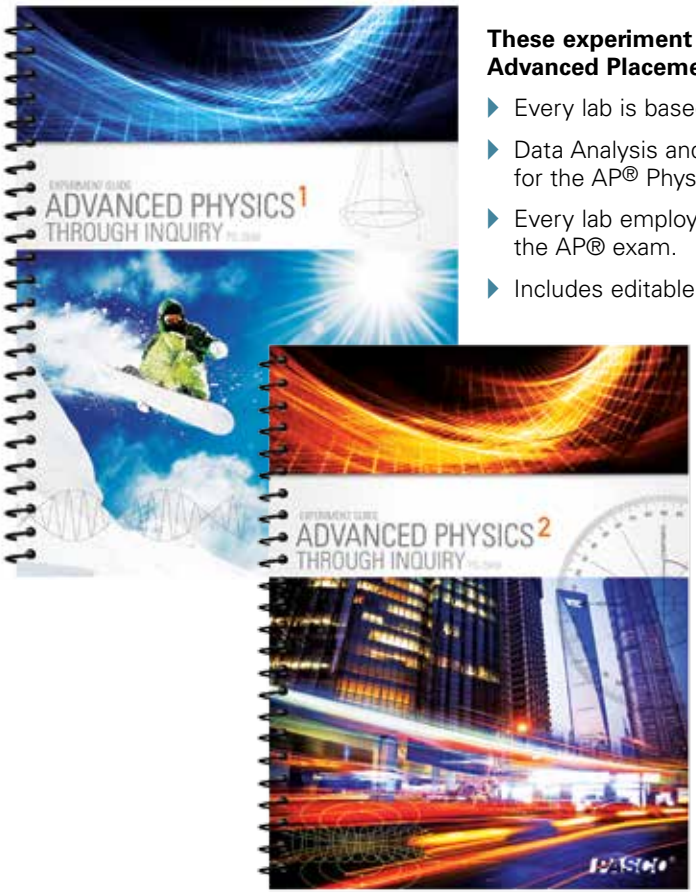
EP-6490

Includes everything in the Standard Equipment Kit above + 1 of each of the following:
- Forces & Machines Engineering Kit
- Oscillations, Waves & Sound Kit
- Light Source
- Optics Components
- Tripod Stands & Crossrail
- Forces Accessories
- Mini Launcher

For complete pricing information go to pasco.com/essentialphysics

Advanced Physics through Inquiry 1 & 2 Experiment Guides

*Advanced-level labs for AP® Physics 1 and 2**



These experiment guides cover the new standards for College Board Advanced Placement Physics 1 and 2.

- Every lab is based on the College Board Learning Objectives.
- Data Analysis and Assessment Questions are designed to prepare students for the AP® Physics 1 and 2 exams.
- Every lab employs the same strategies found in free response questions on the AP® exam.
- Includes editable student handouts.

Prepare your students for inquiry investigations. You decide which level of inquiry is appropriate for each lab.

Each lab is presented three ways:

- Structured
- Guided Inquiry
- Student Designed

Each lab includes teacher resources

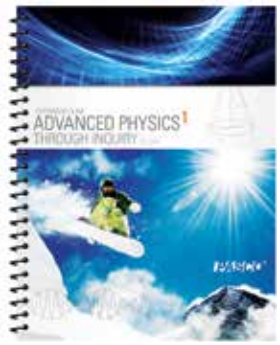
- Pre-lab discussion and questions
- Procedural overview
- Teacher tips
- Sample data
- Assessment and synthesis questions
- Extended inquiry suggestions

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

Both experiment guides include video support!

How-to videos are on the PASCO web site, on YouTube, and included on a DVD to copy to your computers.

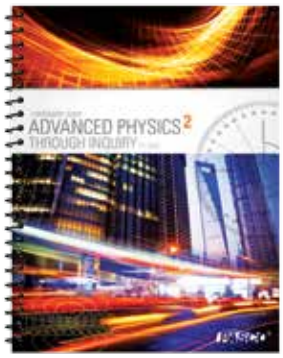
Try It!



Advanced Physics through Inquiry 1 Experiment Guide

PS-2848

ADV PHYSICS 1 EXPERIMENTS	SENSORS: Motion	SENSORS: High Resolution Force	SENSORS: Smart Gate	SENSORS: Rotary Motion	SENSORS: Voltage/Current	ALIGNMENT: IB Standards*	ALIGNMENT: AP Standards**
1. Graphical Analysis: Motion	●					2.1	3.A.1
2. Newton's Second Law	●	●				2.2	3.B.1, 3.B.2
3. Atwood's Machine			●			2.2	3.B.1
4. Coefficients of Friction	●	●				2.2	3.C.4
5. Two Dimensional Motion: Projectiles			●			1.3, 2.1	3.E.1
6. Conservation of Mechanical Energy			●			2.3	5.B.4
7. Work and Kinetic Energy			●			2.3	4.C.2
8. Conservation of Momentum	●					2.4	5.D.2
9. Momentum and Impulse	●	●				2.4	3.D.2
10. Rotational Dynamics				●		B.1	3.F.2, 3.A.1
11. Rotational Statics						B.1	3.F.1
12. Periodic Motion: Mass and Spring		●				4.1, 9.1	3.B.3
13. Simple Pendulum			●			4.1, 9.1	3.B.3
14. Resonance and Standing Waves						B.4	6.3.D, 6.3.4
15. DC Circuits					●	5.1-5.3	1.B.1, 5.B.9, 5.C.3



Advanced Physics through Inquiry 2 Experiment Guide

PS-2849

ADV PHYSICS 2 EXPERIMENTS	SENSORS: Barometer/ Low Pressure	SENSORS: High Resolution Force	SENSORS: PASCO Optics Equipment	SENSORS: Digital Multimeter	SENSORS: 2-Axis Magnetic Field Sensor	SENSORS: Voltage/Current	SENSORS: Rotary Motion	ALIGNMENT: IB Standards*	ALIGNMENT: AP Standards**
1. Hydrostatic Pressure	●							B.3	3.C.4, 5.B.10
2. Buoyant Force		●						B.3	3.C.4, 5.B.10
3. Fluid Dynamics	●							B.3	5.B.10
4. Boyle's Law	●							3.2	5.B.2, 7.A.3
5. Spherical Mirror Reflection			●					C.1	6.E.4
6. Snell's Law			●					4.4	6.E.3
7. Focal Length of a Converging Lens			●					C.1	6.E.5
8. Interference and Diffraction			●					4.4, 9.2, 9.3	6.C.3
9. Electric Field Mapping				●				5.1, 10.1	2.E.2
10. Magnetic Fields					●			5.4	2.D.3, 2.D.4
11. Magnetic Field Strength					●			5.4	2.D.2
12. Electromagnetic Induction						●	●	11.1	4.E.2
13. Capacitor Fundamentals				●				11.3	4.E.4
14. Series and Parallel Capacitors						●		11.3	4.E.5, 5.B.9
15. RC Circuits						●		11.3	4.E.5
16. Planck's Constant						●		12.1	6.F.3, 6.F.4

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

Advanced Physics through Inquiry 1 Experiment Guide

PS-2848

Includes a printed manual and an electronic version. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Electronic version contains a PDF of the full teacher edition, an editable MS Word version of every student handout, and configuration lab files for PASCO Capstone and SPARKvue.

Advanced Physics I Starter Bundle

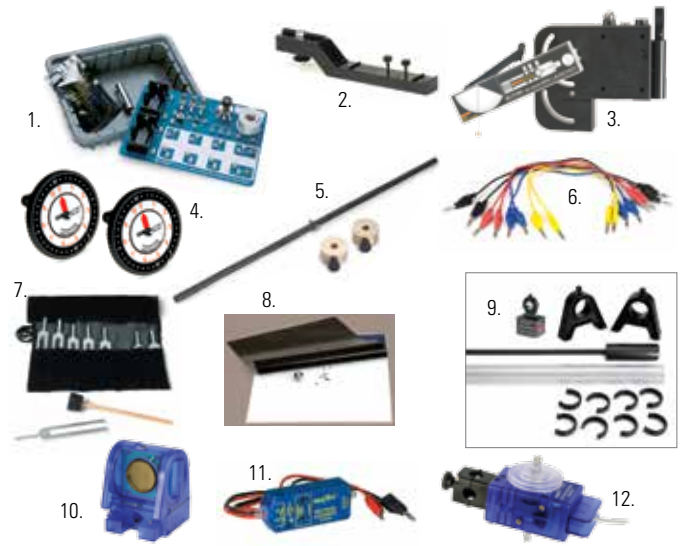
PS-2815A

1. PAScar (Set of 2) ME-6950
2. Discover Friction Accessory ME-8574
3. Photogate Pendulum Set ME-8752
4. Dynamics Track End Stop (2 pack) ME-8971
5. PAStrack ME-6960
6. Force Bracket ME-6622
7. Mass and Hanger Set ME-8979
8. Super Pulley Kit ME-9433
9. Angle Indicator ME-9495A
10. Cart Picket Fences (2 Pack) – IDS ME-9804
11. Photogate Brackets (2 Pack) – IDS ME-9806
12. Pivot Clamp – IDS ME-9836
13. Demonstration Spring Set ME-9866
14. Pendulum Clamp ME-9506
15. 250 g Stackable Masses (Qty. 3)
16. Compact Cart Mass (Qty. 2) ME-6755
17. PASPORT Motion Sensor PS-2103A
18. Smart Gate PS-2180
19. PASPORT High Resolution Force Sensor PS-2189

Advanced Physics I Expansion Bundle

PS-2833

1. AC/DC Electronics Lab Kit EM-8656
2. Photogate Mounting Bracket ME-6821A
3. Mini Projectile Launcher ME-6825B
4. Tension Protractor (Qty. 2) ME-6855
5. Pendulum Accessory ME-8969
6. 4-mm Banana Plug Patch Cord Set SE-7123
7. Tuning Fork Set SE-7342
8. Carbon Paper (100 Sheets) SE-8693
9. Resonance Air Column WA-9606
10. PASPORT Motion Sensor PS-2103A
11. PASPORT Voltage Current sensor PS-2115
12. PASPORT Rotary Motion Sensor PS-2120A



Advanced Physics through Inquiry 2 Experiment Guide

PS-2849

Includes a printed manual and an electronic version. Manual contains detailed teacher version complete with guided inquiry lab activities, suggested answers, and much more. Electronic version contains a PDF of the full teacher edition, an editable MS Word version of every student handout, and configuration lab files for PASCO Capstone and SPARKvue.

Advanced Physics 2 Starter Bundle

PS-2863

1. PAStrack ME-6960
2. Concave Mirror Accessory, Half-Screen Accessory OS-8457
3. Basic Optics Viewing Screen OS-8460
4. Basic Optics Ray Table OS-8465
5. Converging lenses with known focal length OS-8466A
6. Basic Optics Light Source OS-8470
7. Optics Carriages (3 pack) OS-8472
8. Adjustable Lens Holder OS-8474
9. Barometer/Low Pressure Sensor PS-2113A
10. High Resolution Force Sensor PS-2189
11. PASPORT Sensor Extension Cable PS-2500
12. String SE-8050
13. Overflow Can SE-8568
14. Laser Pointer SE-8805

Not Pictured:
Double Slit Diffraction Plate
Plastic cylinder
Metal cylinder
Syringe, 60-mL

Advanced Physics 2 Expansion Bundle

PS-2868

1. Induction Wand EM-8099
2. Variable Gap Magnet EM-8618
3. Alnico Bar Magnets (2 pack) EM-8620
4. AC/DC Electronics Laboratory EM-8656
5. Field Mapper Kit PK-9023
6. 2-Axis Magnetic Field PS-2162
7. Voltage-Current Sensor PS-2115
8. Rotary Motion Sensor PS-2120A
9. Digital Multimeter (with Capacitance) SB-9631B
10. Magnaprobe SE-7390
11. Stainless Steel Calipers SE-8710
12. 4-mm Banana Plug Patch Cord (5-pack) SE-9750
13. 4-mm Banana Plug Patch Cord Alligator Clip (10-pack) SE-9756

Not Pictured:
LED, Blue (450–500 nm)
LED, Green (501–565 nm)
LED, Yellow/Amber (566–620 nm)
LED, Red (621–750 nm)
LED, Infrared (751 nm–1 mm)
Capacitor, 100 µF
Magnet Wire

MatchGraph!™ FREE App

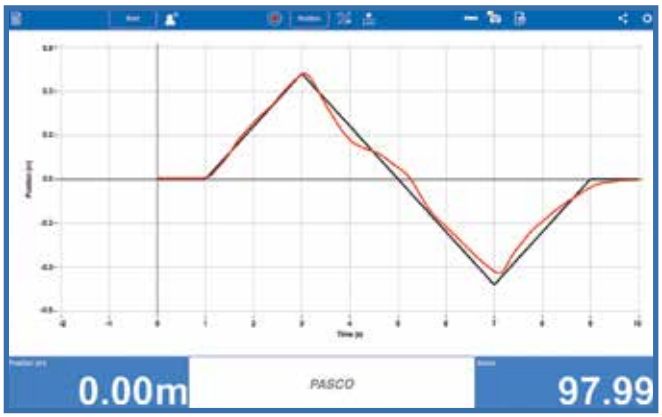
for Windows®, Mac®, and iPad®

Now works with Smart Carts!

This software helps students interpret position and velocity.

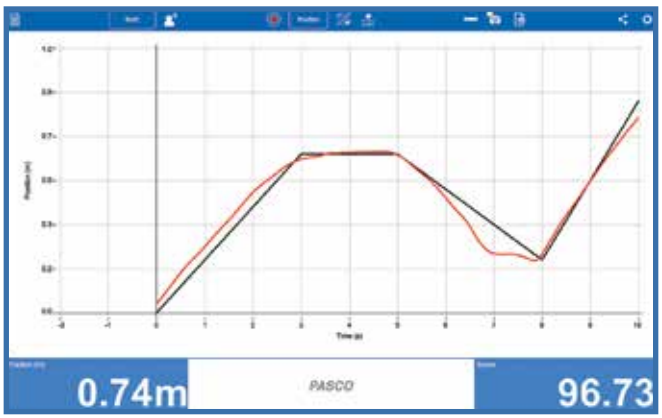
With PASCO's state-of-the-art graphing app, you can engage your students with an experience that is centered on motion. Students gain a deeper understanding of how to interpret graphs by watching the motion of their Smart Carts graphed in real time. Choose between both position and velocity curves. Discuss with your students how the velocity graphs relate to their corresponding Position vs. Time graphs.

MatchGraph!™



MatchGraph features:

- **Students choose from position and velocity profiles** as they learn to relate motion to the graphs they make.
- **Students use their journals to capture images of matches**, which can be used in their lab reports.
- **Students can export their data** into SPARKvue® or PASCO Capstone™ for even more analysis.



MatchGraph Kit

UI-5822A

Includes MatchGraph software, a Motion Sensor, and the AirLink.

Shown in use with:

Smart Cart

(on page 88; sold separately)

ME-1240 (Red)

ME-1241 (Blue)

Wireless Light Sensor

This wireless sensor is a great tool for explorations in Earth, Life, and Physical sciences. With its ambient light detector for illuminance and UV, and its directional detector for colors, your students can explore the electromagnetic spectrum, model planetary motion, and relate photosynthesis to light color and intensity.

Features

All these measurements in one!

- Illuminance (lux)
- UVA, UVB, and UV Index
- RGB color detection
- Battery life >1 year
- Remote logging

Using wireless sensors to collect eclipse data

On August 21, 2017, a total solar eclipse occurred and was visible, in some degree, over much of the continental United States (see map). As the moon in its new phase passed directly in front of the sun, the moon cast a shadow on Earth. Using PASCO wireless sensors, many students across the United States viewed the total eclipse and measured the change in light level and temperature as the moon passed in front of the sun!

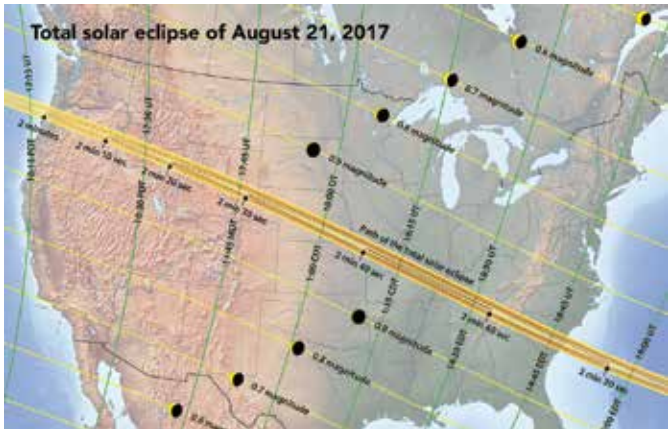


Image courtesy of GreatAmericanEclipse.com

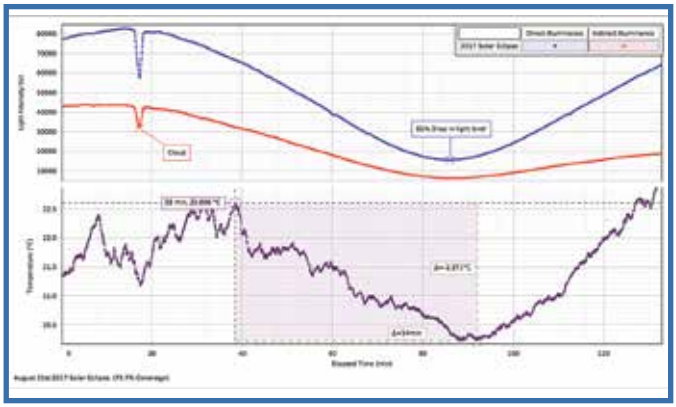
Wireless Light Sensor

PS-3213

Includes 1 coin cell battery.

Also available:

Wireless Temperature Sensor PS-3201

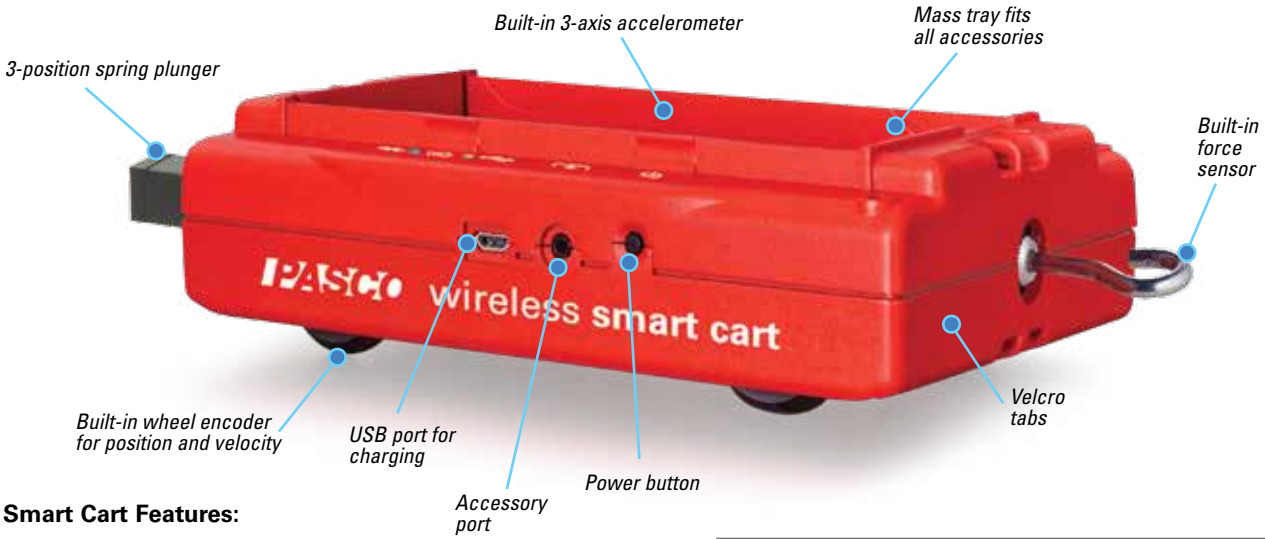


This eclipse data was collected at PASCO in Roseville, CA, on August 21, 2017.

Wireless Smart Cart

The most innovative tool for the high school physics lab since the photogate

It is the ultimate tool for your physics lab with built-in sensors that measure force, position, velocity, and acceleration. The Smart Cart can make these measurements on or off a dynamics track and transmit the data wirelessly over Bluetooth®.



Smart Cart Features:

- Built-in ±100N force sensor
- 3-axis accelerometer
- Built-in wheel encoder
- Bluetooth connectivity
- Magnetic bumper for force sensor
- 3-position plunger
- Mass tray
- Velcro® tabs
- Rechargeable battery
- Force sensor hook and rubber bumper
- Available in red and blue

Smart Cart

ME-1240 (Red)
ME-1241 (Blue)

Smart Fan Accessory

NEW

Plug it into a Smart Cart. When the Fan Accessory it is connected to a Smart Cart, it allows for an unprecedented level of control, functionality and programmability. Also works in manual mode with all PASCO carts.

Smart Fan Accessory

ME-1242

Use PASCO Capstone software to wirelessly control the Smart Fan.

Wireless Smart Cart Charging Garage

Charge up to five Smart Carts at once. Provides storage for the carts and accessory bumpers. Includes power adapter.

Smart Cart Charging Garage

ME-1243

Smart Carts not included.

Other PASCO Carts

Aluminum Plunger Cart

ME-9430

Aluminum Collision Cart

ME-9454

Motorized Cart

ME-9781

PAScars

ME-6933 (Red)

ME-6934 (Blue)

Super Fan Cart

ME-6977

Smart Fan Accessory

NEW

ME-1242

(Cart sold separately.)

How to choose the Dynamics System that's best for you

Select the type of track you want.

Metal or plastic tracks?

Metal Track Advantages

- Available in 1.2 m or 2.2 m lengths
- Straight and rigid
- Can do induced magnetic drag because it's conductive
- Feet can be placed at any position
- High-contrast scale

Plastic Track Advantages

- Can add tracks to make as long as you want
- Lightweight
- Can add curved track to do hills
- Built-in feet
- Storage: 1-meter track disassembles into two 50-cm parts
- Less expensive

Select the type of carts you want.

Metal, plastic, or Smart Carts?

Metal Cart Advantages

- Red and blue for distinguishing in collisions
- More inertia
- Sturdy body
- User-replaceable wheels

Plastic Cart Advantages

- Red and blue for distinguishing in collisions
- Least expensive
- Two string tie positions
- Plunger has a long throw.

Smart Cart Advantages

- Red and blue for distinguishing in collisions
- Completely instrumented with all the sensors you need for dynamics
- Two string tie positions
- Bluetooth 4.0 wireless: No interface required

Which system is best for you?

Basic System *Just Carts and Track*

Example shown:
ME-5705

OR

Standard System *Basic System + Accessory Pack*

Example shown:
ME-5715

Basic System includes

- Track
- 2 Carts
- 2 Feet
- 2 Endstops
- Rod Clamp
- 2 Mass Bars (4 with metal carts)

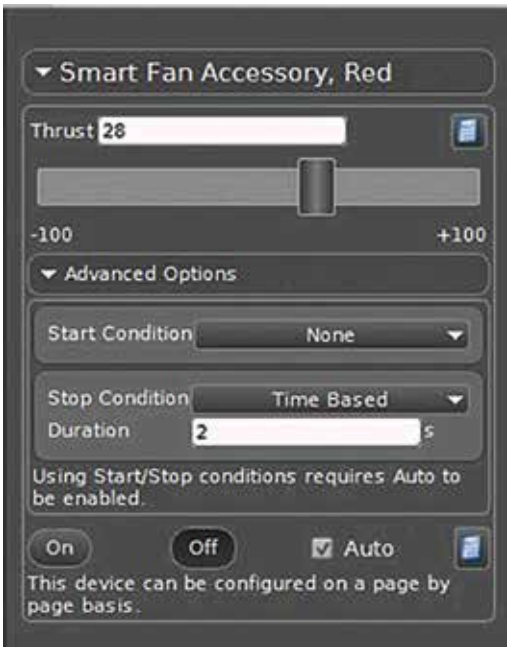
	Plastic Track 1 m	Metal Track 1.2 m	Metal Track 2.2 m
Plastic Carts	ME-5701	ME-5702	ME-5703
Metal Carts	ME-5704	ME-5705	ME-5706
Smart Carts	ME-5707	ME-5708	ME-5709

Standard System includes

- Track
- 2 Carts
- 2 Feet
- 2 Endstops
- Rod Clamp
- 2 Mass Bars (4 with metal carts)
- Spring Set
- Clamp-on Super Pulley
- Friction Block
- Angle Indicator

	Plastic Track 1 m	Metal Track 1.2 m	Metal Track 2.2 m
Plastic Carts	ME-5711	ME-5712	ME-5713
Metal Carts	ME-5714	ME-5715	ME-5716
Smart Carts	ME-5717	ME-5718	ME-5719

NEW Smart Fan Accessory



Use PASCO Capstone software to wirelessly control the Smart Fan.

Use it with your existing PASCO carts.

The Smart Fan can be used in manual push-button mode (3 speeds) with any PASCO cart.

Plug it into a Smart Cart.

When the Fan Accessory it is connected to a Smart Cart, it provides an unprecedented level of control, functionality, and programmability. Turn it on and off wirelessly, control stop and start conditions, and even program the thrust to respond to calculations from sensor measurements.

3D print your own rotating base for the Smart Fan Accessory at ***pasco.com/diy***

Smart Fan Accessory

ME-1242

Includes one Smart Fan Cable for connecting to Smart Cart (19 cm) and four AA batteries.

Also available:

Battery Charger SE-3568

AA Rechargeable Batteries (4) SE-3569

Ballistic Cart Accessory

- Works every time
- Non-contact release
- Adjustable barrel

PASCO's Ballistic Cart Accessory helps beginning physics students grasp the independence of vertical and horizontal motion.

How It Works

Mounted on a dynamics cart, the Ballistic Cart Accessory launches a ball vertically, continues down the track, and then catches the ball as it falls—every time. At slow or fast speeds, the results are the same. Offers an exciting introductory demonstration to projectile motion.

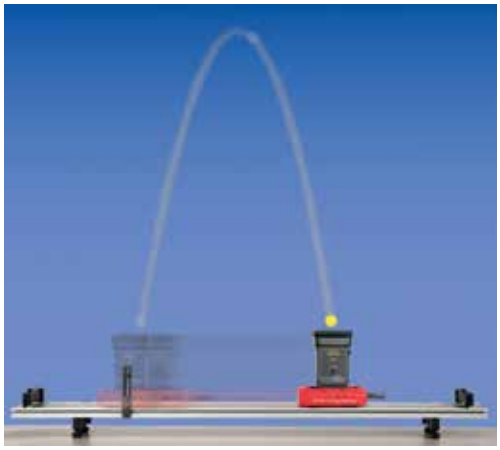
Features:

Photogate Ball Release: PASCO's optical release does not affect cart motion or ball flight path, no matter what the speed of the cart.

Alignable Barrel: The barrel has X and Y adjustments so perfect vertical projections can be produced every time, even on non-level surfaces.

Constant Velocity: Mounts on the low-friction PASCO Dynamics Cart so horizontal velocity remains constant.

Strong Compression Spring: Fires a colored nylon ball 0.5 meters or higher—impressive for demonstration purposes.



Ballistic Cart Accessory attaches to a dynamics cart and projects a ball as it travels along a track.

Ballistic Cart Accessory

ME-9486

Includes
Ballistic Launcher, Trigger Bracket, Plastic Balls (2), and 9V Battery

Required:
Dynamics System

Recommended:
Variable Speed
Motorized Cart ME-9781

PAStrack Accessories

Use these for Conservation of Energy

The Curved PAStrack gives your students the ability to create an ideal hill for conservation of energy experiments. The new Smart Cart can measure its own speed as it accelerates down the hill. Using the mass of the Smart Cart, the initial Potential Energy and final Kinetic Energy can be calculated.

With the Curved PAStrack and a Smart Cart, students can investigate conservation of energy.

Curved PAStrack

ME-6841

1. Concave-up Curved Piece
2. Concave-down Curved Piece
3. PAStrack Connector Clips (2)

PAStrack

ME-6960

Includes two piece track, connector clip (2), leveling feet (6)

Wireless Force Acceleration Sensor

The Wireless Force Acceleration Sensor allows for live data collection in a moving frame of reference. Mount the sensor to a rotating platform or a moving cart to measure forces and accelerations of the constantly changing dynamic system. The wireless design offers improved measurements without a cable affecting the experiment outcome.

Features:

- Bluetooth® and USB connectivity
- Logging
- +/- 50N
- 6-axis accelerometer
- Finger-holes
- Built-in rod clamp

Wireless Force Acceleration Sensor

PS-3202

Includes 1 eye bolt, 1 thumb screw, 1 bumper, a lithium-ion battery, and a USB connector.

Rotating Platform

ME-8951

Wireless Centripetal Force Accessory

ME-8094

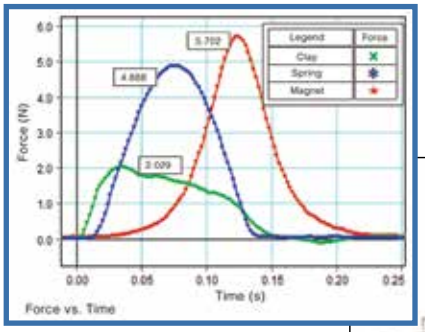
Includes low friction sliding mass holder and mounting post for force sensor.

Force Bracket

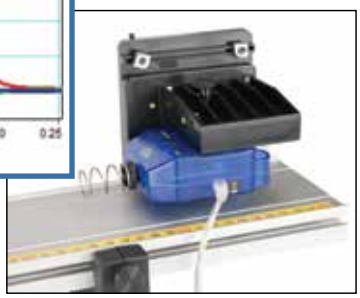
The Force Bracket with bumpers mounts the PASCO Force Sensor directly to a dynamics track. It includes 5 collision attachments for the Force Sensor and conveniently stores each attachment on the bracket itself.

Using any of these attachments, the bracket serves as an excellent support or target for collision studies using the Force Sensor.

Wireless Force Acceleration Sensor (PS-3202) in cart collisions with fixed spring bumper on Force Bracket



Force vs. time data for a clay, spring, and magnet



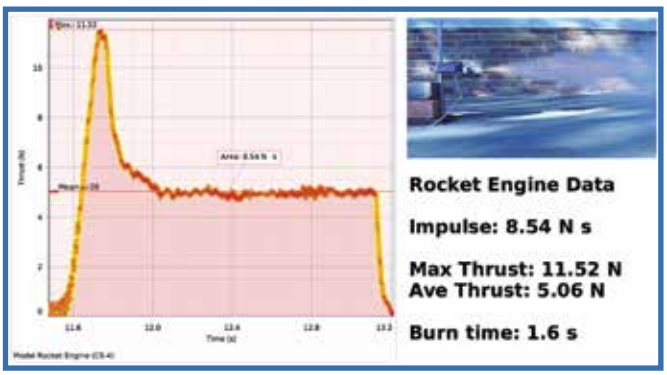
Force Bracket

ME-6622

Includes spring bumpers (2) (different spring constants), magnetic bumper (1), rubber bumper (1), clay cup for inelastic collisions (1) (clay included), #0 Phillips head screwdriver (to attach to force sensor)

Rocket Engine Test Bracket

With the Rocket Engine Test Bracket 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. Accommodates rocket engine sizes A, B, C and D.



Rocket Engine Test Bracket

ME-6617

For outdoor use only. A force sensor must always be securely mounted when a rocket engine is fired.

Test Bracket

Recommended:

Large Rod Base ME-8735
45 cm Stainless Steel Rod ME-8736

Projectile Launchers

NEW **FEATURES**

Multiple Launcher Angles

- Level with table
- Horizontal
- Vertical
- Positive angles (0 - 90˚)
- Negative angles (-45 - 0˚)

Mini Projectile Launcher

ME-6825B

Includes launcher base, projectile balls, loading rod, safety glasses, 2-D collision accessory and manual.

SPECIFICATIONS

Range: 0.5 m, 1 m, 2 m

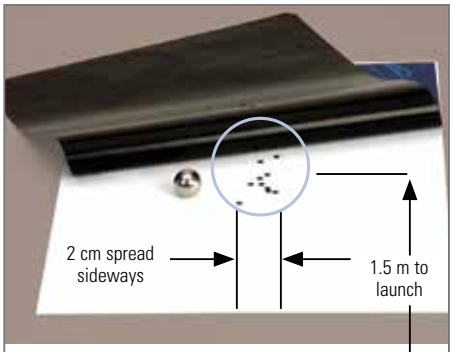
Projectile Launcher

ME-6800

Includes launcher base, projectile balls, loading rod, safety glasses, 2-D collision accessory and manual.

SPECIFICATIONS

Range: 1.2 m, 3 m, 5 m



Students get accurate and repeatable results with the Mini Projectile Launcher.

Projectile Launcher Smart Gate System

ME-6798

Includes Mini Projectile Launcher: ME-6825B
Photogate Mounting Bracket: ME-6821A
Smart Gate: PS-2180
Aluminum Table Clamp: ME-8995
45-cm Stainless Steel Rod: ME-8736

Photogate Mounting Bracket

ME-6821A

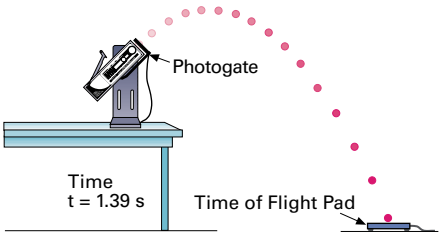
Time-of-Flight Accessory

ME-6810A

Connects to Smart Gate

Time of Flight Accessory

Get precise measurement for the time a projectile is in the air. When the ball is launched, timing starts as the ball passes through a photogate. Timing stops when the projectile hits the Time-of-Flight Accessory.



Discover Centripetal Force Kit

Learn about centripetal force in a simple, direct way.

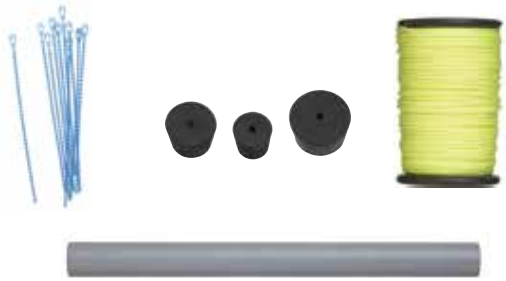
Dramatic, effective and fun – the Discover Centripetal Force Kit is all things that good science education is all about. This low-cost kit allows students to directly investigate how the factors of mass, radius and radial velocity affect the amount of centripetal force needed to keep an object moving in a circle.

As the rubber stopper is swung about in a horizontal circle, students time the revolutions to find the speed. From that speed, the weight needed to balance the rotation, and the radius, the relationships of all the variables can be determined.

Discover Centripetal Force Kit

ME-9837A

Includes equipment for two lab stations, rubber stoppers (3 sizes), plastic ties, yellow string, and hollow tube.



PASCO Stopwatch

ME-1234

- Durable
- Simple to Use
- No Alarm
- Uses One AA Battery (included)
- Memory: Stores Up to Nine Event Times

Also available:

Stopwatch (10-pack) ME-1235

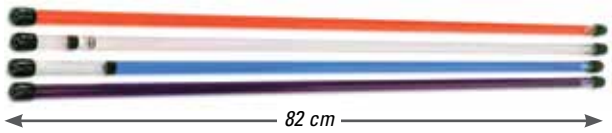
Constant Velocity Tubes (4)

Teach the concept of slope with these Constant Velocity Tubes, which effectively introduce the relationship between graphs and motion. Students can use a meterstick and stopwatch to plot the position of a bubble as a function of time, as it moves up the tube. The slope and vertical intercept from the graph yield the equation of motion.

Constant Velocity Tubes (4)

SE-9072

Includes both a bubble and a metal ball.



Required:

Meter Stick (6 pack) SE-8827
PASCO Stopwatch ME-1234

Tension Protractor

One Device Measures Both Tension and Angle

A torsion 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. Vector analysis will become easy for your students when using the Tension Protractor. The torsion spring scale is carefully calibrated at the factory and can be zeroed by the user with a thumb screw on the back.

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°

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

Equal-Length Spring Set

The five color-coded equal-length springs in this set have different spring constants: *25 N/m, 30 N/m, 35 N/m, 40 N/m, 50 N/m (± 5%)*

These springs appear to be the same except for their colors. When equal masses are hung from each spring, they reach a different equilibrium displacement due to their differing spring constants. These steel springs are 30 cm (unstretched) with an approximate diameter of 1.4 cm.

Equal-Length Spring Set

ME-8970

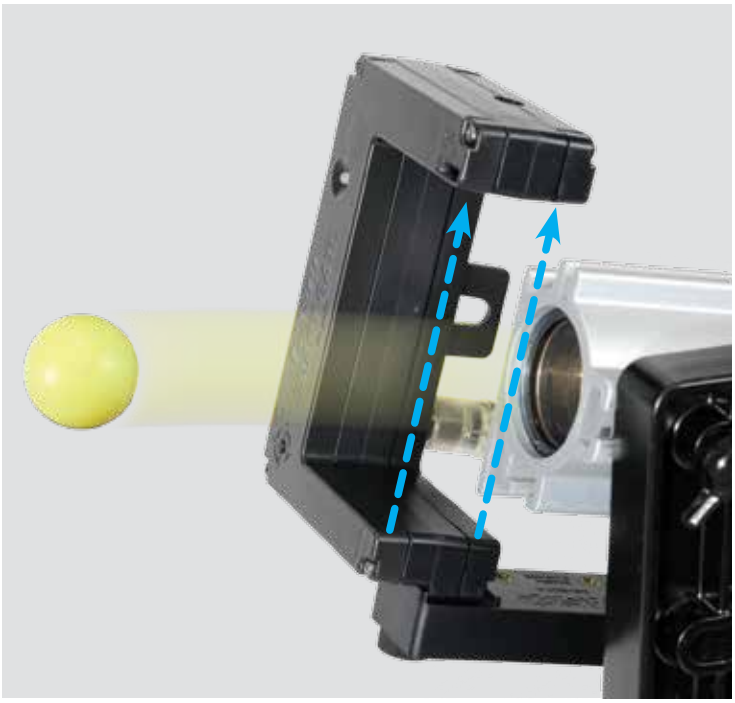
Springs are supplied with a white storage box with cardboard separators to keep the springs from touching each other.

Includes
White storage box
Five (color-coded) springs
30 cm long

Recommended:
Pendulum Clamp ME-9506
Hooked Mass Set SE-8759

Smart Gate

The new Smart Gate is four Photogates in one! It has dual Photogate beams spaced at 1.5 cm to accurately measure speed. Built-in laser switch (when used with a laser pointer) allows you to time larger objects. Other features include a Photogate tape slot, and an auxiliary port to daisy-chain an additional Photogate or the Time-of-Flight Accessory.



Features:

- Connects directly to any PASPORT interface
- Dual detectors for accurate measurement of speed
- Daisy-chain to Photogate (ME-9498A) or Time of Flight (ME-6810)
- Photogate tape slot
- Laser switch timer
- Compatible with Super Pulley
- Compatible with all existing PASCO Photogate accessories

Smart Gate

PS-2180

Includes Smart Gate, PASPORT cable, and rod.

Smart Gate Pulley System

PS-3702

The Super Pulley attaches directly to the Smart Gate, providing a simple, low-friction system to measure position, velocity and acceleration.

Smart Gate System

PS-3701

Includes Smart Gate: PS-2180
Photogate Head: ME-9498A

Super Pulley

The PASCO Super Pulley produces excellent results, nearly frictionless, and durable

The PASCO Super Pulley is the standard in physics labs. Its low-friction design produces excellent results. The precision spacing of the 10 spokes makes it ideal for photogate monitoring with PASCO's computer interfaces and photogate systems.

Features:

- **Low Friction:** Dual precision ball-bearings (not cone bearings) keep friction to a bare minimum, support heavier loads, and minimize wear.
- **Lightweight:** The sheave is only 5.5 grams, so pulley inertia is negligible in most applications.
- **Precision Dimensions:** The 10 spokes are accurately spaced, and the inside and outside diameters are machined to precise dimensions. This means accurate results and graphs.

Super Pulley

ME-9450A

Super Pulley with Mounting Rod

ME-9499

This Super Pulley mounted on a rigid plastic mounting rod (12.7 mm diameter, 14 cm long) fits most standard laboratory clamps.

Mounting Rods (10 pack)

ME-9483

These rigid plastic pulley handles (14 cm long, 1.27 mm diameter) screw into a Super Pulley.

Super Pulley with Clamp

Upgrade your force table and inclined plane experiments. The Super Pulley with its integral clamp makes setup and alignment easy. The pulley height is fully adjustable, so you can skim the top of a force table for parallax-free readings. Yet you can keep the force parallel to the track on an inclined plane, as shown in the photo below. Fits tables up to 2.0 cm (13/16 in.) thick.

Super Pulley with Clamp

ME-9448B

Atwood's Machine

Two Super Pulleys mounted on a 6.4 cm long rod produce a classic, low-friction introduction to Newton's Second Law. The instruction sheet fully describes both the experiment and the theory.

Atwood's Machine

SA-9241

Includes two pulleys and connecting rod

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.

Rotational Inertia Wands

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 Wands

ME-9847

Includes one red wand and one blue wand

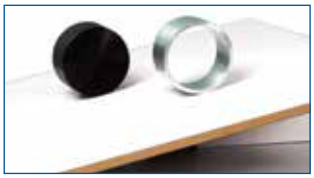
Specifications:

Length: 1 m

Ratio of blue rotational inertia to red: Approx. 6

Rotational Inertia Set

Release two different sized objects simultaneously.



How It Works

Compare rotational inertias of objects with different shapes and sizes. Students learn that the speed of an object rolling down the ramp is not affected by its mass or radius. The shape or distribution of the mass determines the outcome. The sphere will reach the bottom first, followed by the disk. The ring will be last.

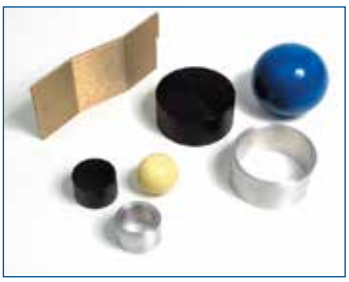
Rotational Inertia Set

ME-9774

Includes
10 cm outer diameter set
- *Solid Sphere (810 g)*
- *Ring (Aluminum, 230 g)*
- *Disk (Plastic, 370 g)*

5 cm outer diameter set
- *Solid Sphere (110 g)*
- *Ring (Aluminum, 90 g)*
- *Disk (Plastic, 70 g)*

Release Mechanism



Spherical Mass Set

Hollow Steel Ball

This set includes four balls with a diameter of 25 mm each, but featuring various masses and rotational inertias.

Typical Applications

- Race the hollow steel ball and solid aluminum ball down an incline. They have about the same mass, but the solid aluminum ball has a much larger acceleration down the ramp.
- Fire the yellow plastic, solid steel, and hollow steel balls from a PASCO Short- or Long-Range Projectile Launcher.

Spherical Mass Set

ME-8968

Includes
Solid Yellow Nylon Ball (10 grams)
Solid Steel Ball (66 grams)
Hollow Steel Ball (21 grams)
Solid Aluminum Ball (24 grams)
(release mechanism not included)

Bicycle Gyroscope

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.

This 2.8 kg (6 lb.) Bicycle Gyroscope has a solid 12.7 mm (½") steel shaft with cushioned hand-grips.

Precision ball-bearings result in extremely low-friction for both the Bicycle Gyroscope and the Rotating Chair.

Attach cord to hole in handle to demonstrate precession.

Use the included pull-cord with handle to spin up the wheel.

Features:

- Solid 1/2" Steel Shaft
- Cushioned Hand-Grips
- Precision Ball-Bearings for Low Friction
- Non-marking Rubber Tire

Bicycle Gyroscope

ME-6837

Includes bicycle gyroscope, two cords with handles.

Shown in use with:
Rotating Chair ME-6856

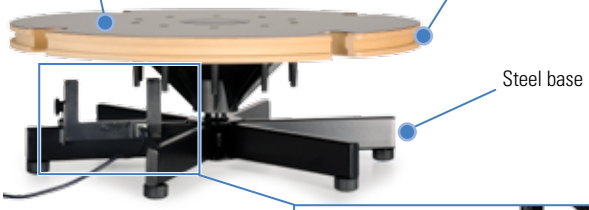
Rotating Chair

Rugged design and incredibly low friction make this far superior to any office chair.

Sturdy 45 cm diameter rotating platform can be used with or without included chair.

Wrap rope around groove to apply torque.

Steel base



Use a photogate (not included) with built-in spokes to measure the rotational speed and acceleration.

Rotating Chair

ME-6856

Includes chair and rotating platform with leveling feet

Shown in use with:
Photogate Head ME-9498A

Bicycle Gyroscope Mass Set

Adding all four of the masses adds 1.6 kg to the wheel's (approximate) 2.8 kg mass and increases its rotational inertia by over 60%.

Mass securely clamps to the wheel rim using included screws.

Bicycle Gyroscope Mass Set

ME-6972

Includes four 400 g masses and screws.

Required:
Bicycle Gyroscope ME-6837

String Vibrator and Sine Wave Generator

PASCO's String Vibrator creates high amplitude standing waves with crisp, clean nodes. You can drive it with the Sine Wave Generator to get a series of frequencies at which the string resonates. The modular strobe illuminates the entire string and slows the motion of the string.

String Vibrator

WA-9857A

Includes string vibrator unit and wave cord (3m).

Recommended:
Sine Wave Generator WA-9867

Sine Wave Generator

WA-9867

Includes power supply

Bright Modular LED Strobe

Although the waves in the string appear to be standing still, you can see that they are actually moving by strobing the string at a slightly different frequency from the driving frequency of the string. The PASCO LED Strobe has up to four individual LED lamps all driven by the same strobe controller. With this configuration, the whole string can be lit by distributing the LED lamps along the length of the string.

Once you have a strobe, you will want to use it on many other things besides vibrating strings: vibrating tuning forks, water dripping out of a faucet, falling balls, etc.

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

LED Strobe

ME-6978

Includes control box and one modular LED strobe.

Also available:
Additional LED Strobe Module ME-6982

Resonance Air Column

- Very loud resonance
- Tough polycarbonate tube
- Use with speaker or tuning fork

The Resonance Air Column (WA-9606) emits a very loud sound when the plunger is moved to a node position. It works as well as a water column but without the mess. The plunger handle is made of flexible acetyl so it will not break.

This column has a polycarbonate tube, so it will not break or chip. It includes eight plastic snap-on rings that can be slid along the tube to mark the nodes. A meter stick is used to read the positions of the rings.

The Resonance Air Column can be used as a closed tube or an open one. In the closed mode, tuning forks or speakers are suitable for sound sources. In the open mode, a speaker with a signal generator is required to vary the frequency until the tube sounds a resonance.

Specifications:

Material: Polycarbonate
Length: 4.0 ft (1.2 m)
Diameter: 1.5" O.D. (3.8 cm)
Wall thickness: 1/16" (1.6 mm)
Plunger Length: 4.2 ft (1.3 m)
Plunger Handle: Acetyl

Resonance Air Column

Resonance Air Column (with speaker) WA-9594
Resonance Air Column (without speaker) WA-9606

WA-9594 includes a Resonance Air Column (WA-9606) and Mini Speaker (WA-9605). WA-9606 includes a tube and plunger, eight node markers, and two detachable stands.

Required for WA-9606:
Mini Speaker WA-9605

Shown:
ME-9594

Sine Wave Generator

The Sine Wave Generator is an effective tool for generating waves with speakers or wave drivers. It enables users to change both the frequency (0-800 Hz) and amplitude of the sine wave output. Both fine and coarse frequency controls are included and the digital display features a 0.1 Hz resolution. In addition, the generator can "learn" the fundamental frequency for a particular configuration. Students can observe the quantum nature of standing wave patterns as the Sine Wave Generator jumps from one resonant frequency to the next.

Sine Wave Generator

WA-9867

Includes power supply

Single Section Wave Motion Demonstrator

A-frame design collapses for easy storage.

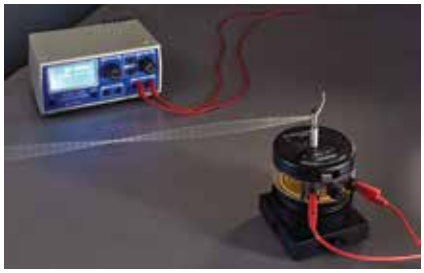
Single Section Wave Motion Demonstrator

SE-9601

Includes
Section 1 (46 cm long rods)
Length of section: 92 cm
Clamp for rigid termination
Dash pot for liquid damping

Mechanical Wave Driver

- Drive any wave experiment at specified frequencies
- Variable amplitude
- Tough and versatile



Features

Frequency Response: From 0.1 to 1000 Hz with an amplitude of approximately 5 mm up to about 50 Hz.

Mounts Vertically or Horizontally: Designed to sit upright on a table, on its side, or mounted on a 12.7 mm (1/2 inch) rod.

Driving Signal Required: Requires a function generator with a minimum of ±8 V@0.5 A. An accurate measurement of frequency is necessary for quantitative resonance experiments.

Mechanical Wave Driver

SF-9324

8 Ω Impedance

Required:
Banana Plug Patch Cord SE-9751
and one of the following function generators:
Sine Wave Generator WA-9867
Function Generator PI-8127
850 Universal Interface UI-5000
Equivalent function generator providing up to 1 A to an 8 Ω impedance.
Shown in use with:
2 Meter Patch Cord Set SE-9415A

Chladni Plates Kit

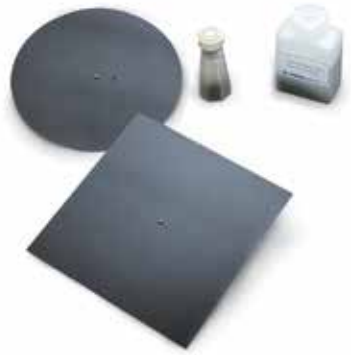
In the early nineteenth century, Ernst Chladni added another dimension to wave experiments by sprinkling sand on a thin plate and using a violin bow to induce vibrations. The sand collected along the nodal lines of the wave patterns painted clear and beautiful pictures of the various modes of vibration.

The Chladni Plates Kit and a Wave Driver allow continuous vibrations to be produced at measurable frequencies. Students can determine the resonant frequencies of the plates and examine the modes of vibration at any frequency.

The Chladni Plates Kit includes a 24 cm x 24 cm square plate, round plate, 0.8 kg of extra-fine sand, and a sand shaker. The round plate can be vibrated about its center or about an offset point to investigate both symmetric and asymmetric modes of vibration.

Chladni Plates Kit

WA-9607



Snakey

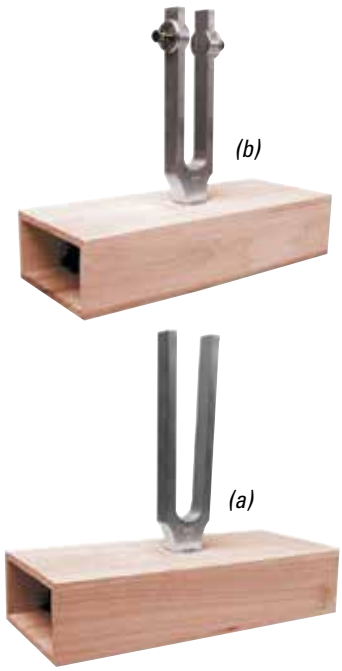
Easily create clear standing wave patterns.

This extra-long metal spring is ideal to study mechanical waves. The Snakey has an unstretched length of 2 meters. Pull the convenient end loops more than 10 meters apart to demonstrate transverse, longitudinal, and standing waves.

Snakey

SE-7331

Sympathetic Resonance Box Set



Resonance boxes are great instruments for amplifying sound from a tuning fork. These boxes are constructed from hardwood and feature an A4 tuning fork mounted directly to the box.

The set contains a hardwood resonance box with a 256 Hz A4 tuning fork (a) and a hardwood resonance box with an adjustable tuning fork (b)

Sympathetic Resonance Box Set

SE-7345

Doppler Rocket

- Experience the frequency shift of sound waves
- Easily generate high velocity motion
- Rugged construction

Flying Horizontally — A set of two ropes can be passed through the center of the unit. This allows students to use the included handles to propel the Doppler Rocket across the room at high velocities. The unit is guided by the ropes. Students hear the change in pitch as the Doppler Rocket flies past them.

The Doppler Rocket combines the elements of a toy with an audio Doppler shift to create an educational experience students won't forget. The Doppler Rocket emits a true, sinusoidal sound waveform at a constant frequency of approximately 620 Hz. The circuit and speaker are housed in skinned foam that protects the unit during normal impacts. The circuit is powered by a 9 V battery. As the Doppler Rocket passes the students, they hear a noticeable shift in frequency. Velocities of 10 m/s can be easily achieved, resulting in a 20 Hz shift in frequency.

Doppler Rocket

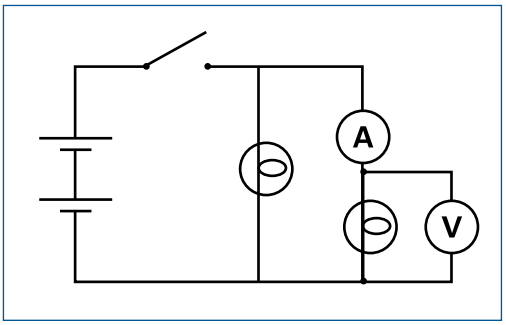
WA-9826

Includes Doppler Rocket, rope (30 meters), handles (4), handle cushions (4), and battery (9 Volt).

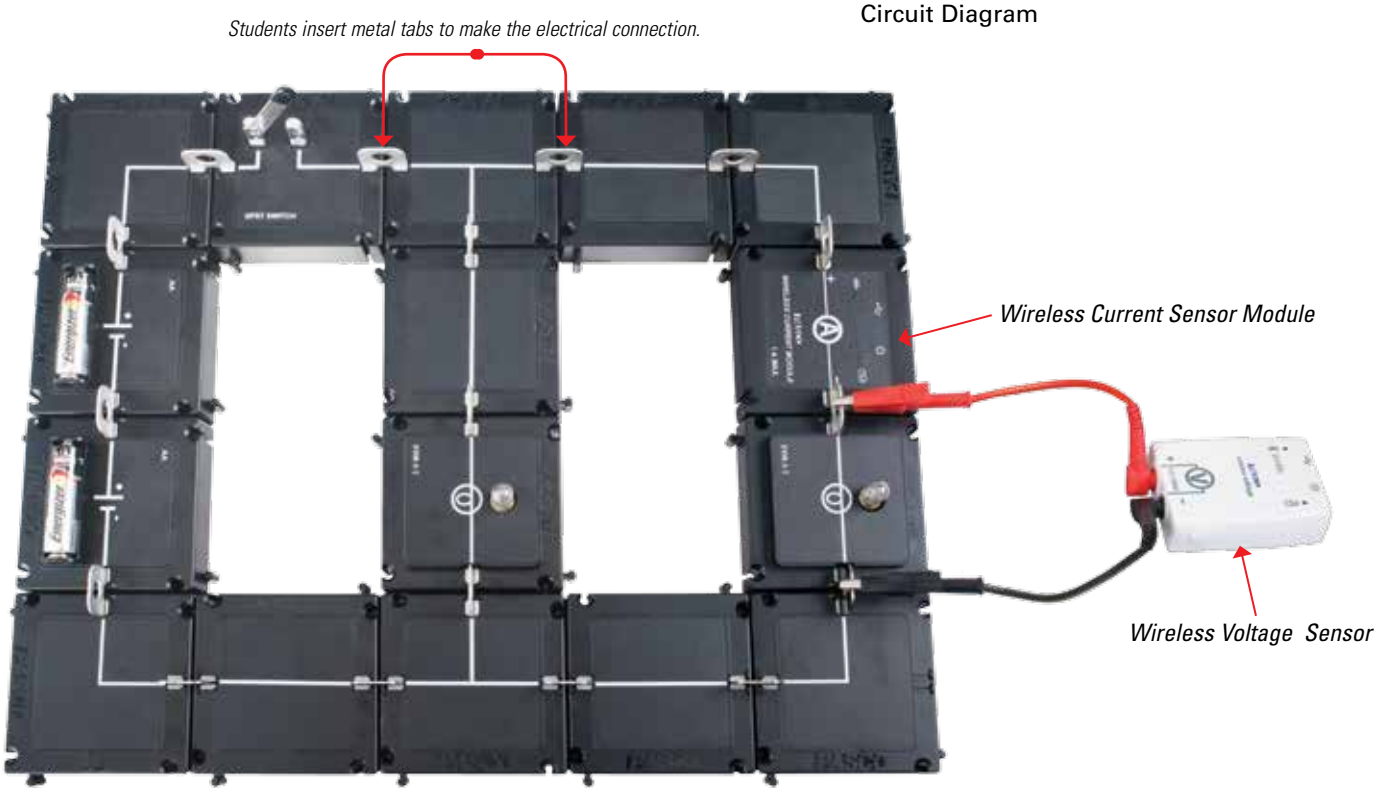
PASCO Modular Circuits

- Puts learning first
- Eliminates confusing wires
- Easy-to-connect modules

These circuit modules are designed specifically for introductory circuits labs. For students who have never wired a circuit, this modular system makes it easy for them to see the layout because it ends up looking like a circuit diagram.



Circuit Diagram



Wireless Current Sensor Module makes it obvious that current goes through the component.

- Wireless Current Sensor Module EM-3534
- Wireless Voltage Sensor PS-3211

Since the Wireless Current Sensor is a module, it naturally fits in series with the circuit components.

The Wireless Current Sensor Module doesn't have extra wires going to an interface, so students see clearly where the current goes.

Two Modular Circuits Kits Are Available

The Basic Modular Circuits Kit includes the modules required to investigate basic circuits. It does not include sensors and activities can be performed either with the use of a multimeter or by adding sensors. The *Essential Physics* Modular Circuits Kit includes more modules, allowing for a greater variety of activities and includes the Wireless Voltage Sensor and the Wireless Current Sensor Module.

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Each module connects mechanically to another by sliding the tabs into each other.

To make them visible, many of the components are mounted on top of the module or in a well for protection.

Modular Circuit Kits

***Essential Physics* Modular Circuits Kit** EM-3536

Basic Modular Circuits Kit EM-3535

Each kit comes in a Gratnell® case with trays that organize the modules. Also includes 2 AA batteries.

Required:

PASCO Capstone Software See page 123
or SPARKvue Software See page 122

Also available separately:

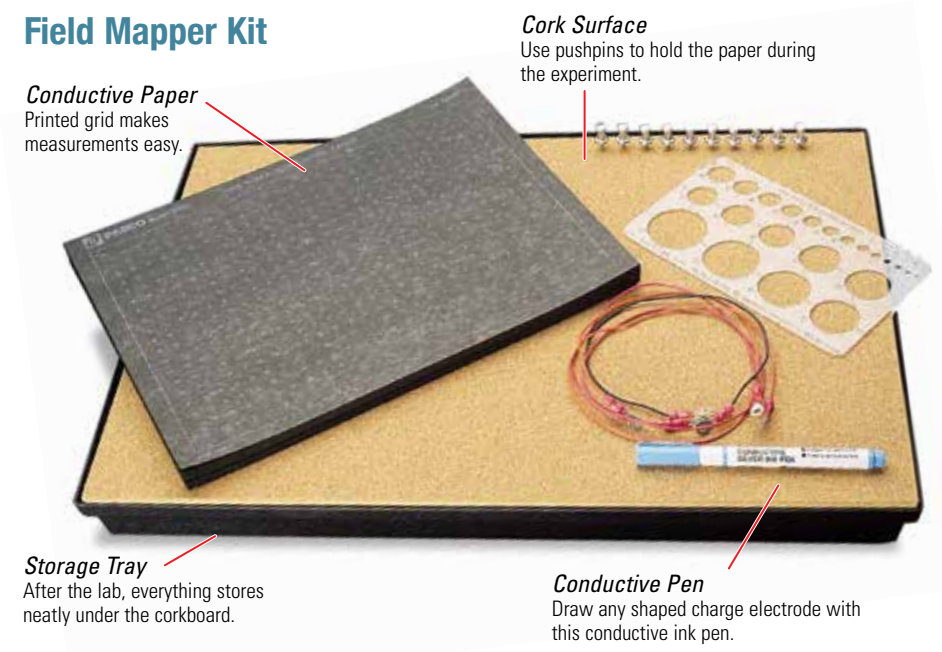
Battery Charger SE-3568
AA Rechargeable Batteries (4) SE-3569

Included in each kit

Module	Basic EM-3535	Essential EM-3536
Corner Wire Module	4	4
Straight Wire Module	4	5
Tee Module	2	2
Spring Module	1	1
Switch Module, SPDT	1	1
Switch Module, SPST	1	1
Resistor Module	2	3
Capacitor Module	1	1
Light Bulb Module	2	3
Potentiometer Module	0	1
Motor Module	0	1
LED Module	0	1
1000 Turn Coil Module	0	1
Battery Holder Module	2	2
Battery, AA	2	2
Jumper Clips	30	45
Diode	1	1
330 ohm Resistor	1	2
1000 ohm Resistor	1	2
100 microfarad Capacitor	1	1
330 microfarad Capacitor	1	1
Magnets (0.45" x 0.25")	0	8
Plotting Compass	0	1
Alligator Clip Jumper Wire	0	1
EM-3534 Current Sensor Module	0	1
PS-3211 Wireless Voltage Sensor	0	1
Gratnells® Storage Tray	1	1

Download free activities for Modular Circuits at pasco.com/circuits

Field Mapper Kit



How It Works

With this kit students can map both the potentials and the electric fields around any conceivable system of two-dimensional charged conductors.

The procedure is simple:

1. **Draw Any Electrode:** Draw the electrode with the special conductive silver ink pen. It is easy to use, dries quickly, and there is no mess.
2. **Plot the Equipotentials:** Connect a battery or power supply across the electrodes, then use a voltmeter to locate the equipotential lines.
3. **Plot the Electric Field:** Tape voltmeter probes together, then hold one probe on the paper and rotate the other probe around it like a compass. The maximum voltage reading indicates the direction of the electric field.

Includes

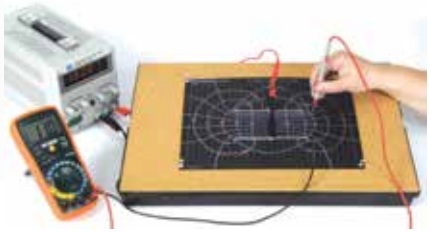
Conductive paper with cm grid:
23 x 30 cm (50 sheets)
10 pushpins; three wires
Conductive ink pen and circular template
Plastic tray with corkboard top: 32 x 48 cm
Instruction manual with 10 experiments

Typical Experiments

1. Dipoles of Like Charges
2. Dipoles of Opposite Charges
3. Parallel Plate Capacitor
4. Point Source and Guard Ring (cylindrical capacitor)
5. Floating Electrode

Plus five more experiments.

To see the experiments, type the product number into the search box at www.pasco.com and download the manual.



Field Mapper Kit

PK-9023

Required:

Basic Digital Multimeter *(or any voltmeter with at least a 10 MΩ input impedance)*	SE-9786A
Power Supply *(or another low voltage DC power supply or battery)*	SE-8587

Replacement supplies

Conductive Ink Pen *(limited shelf life of six months; not refillable)*	PK-9031B
Conductive Paper with grid *(50 sheets, 23 x 30 cm)*	PK-9025B
Conductive Paper (no grid) *(100 sheets, 30 x 43 cm)*	PK-9026

Special Conductive Ink Pen

The PASCO Conductive Silver Ink Pen makes it easy to study field patterns. Draw over 60 meters of patterns with a single pen. Pen shelf life is six months. Not refillable.

Conductive Ink Pen

PK-9031B

Pen shelf life is six months. Not refillable.

Classic Electrostatics Materials Kit

Providing the classic introduction to electrostatics, this kit allows students to rub any of the three rods with rubbing cloths to produce a positive or negative charge. Place the rods on the insulated pivot stands to investigate electrostatic forces.

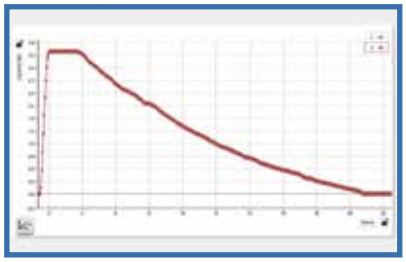
Classic Electrostatics Materials Kit

SF-9068

Includes Three rods (acrylic, glass, PVC), Two insulated pivot stands, and Three rubbing cloths (wool, silk, fur)

Wireless Current Sensor

This sensor's wide current range allows for introductory and advanced explorations of the fundamental concepts of electricity and basic circuits.



Features

- **Two Ranges:** ±1A, ±0.1A
- **Resolution:** 0.2mA (±1A range); 0.02mA (±0.1A range)
- **Bluetooth® sampling rate of 1 kHz**
- **Higher speed sampling via USB**
- **Includes remote logging**

Wireless Current Sensor

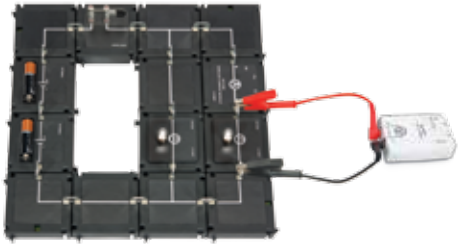
PS-3212

Includes rechargeable battery and banana-clip cables.

Wireless Voltage Sensor

Explore energy and energy transformations with this sensor. Use it to:

- Measure the voltage of student-constructed batteries and see how chemical energy can turn into electrical energy.
- Look at renewable energy by connecting to a wind turbine.
- Track the flow of energy by creating simple circuits.



Features

- **Two Ranges:** ±15 V, ±5 V
- **Resolution:** 7mV (±15V range); 2mV (±5V range)
- **Bluetooth® sampling rate of 1 kHz**
- **Higher speed sampling via USB**
- **Includes remote logging**

Wireless Voltage Sensor

PS-3211

Includes rechargeable battery, USB cable, 1 red and 1 black shrouded, banana-to-alligator-clip test leads

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.

Coils

Coil (200 Turn) SF-8609
Coil (400 Turn) SF-8610
Coil (800 Turn) SF-8611
Coil (1600 Turn) SF-8612
Coil (3200 Turn) SF-8613

Ring Launcher with Accessories

- Electromagnetic induction
- Shoots aluminum ring 2 meters high
- Improved design with thermal shutoff

This Ring Launcher has been optimized to maximize safety by enclosing all wiring inside the case. A thermal shutoff switch protects the coil by preventing overheating.

Includes a coil with a bulb that lights by induction when the coil is placed over the launcher core. Also includes five rings: one split aluminum ring that will not launch, one copper ring, one shorter aluminum ring, and two regular length aluminum rings.

A classic demonstration

In this demo, an aluminum ring is propelled straight up by the Lorentz force that arises from the interaction between the alternating magnetic field of the coil and the current induced in the ring.

For great demo ideas using the PASCO Ring Launcher, check out James Lincoln's AAPT video. James explains how the ring launcher works and walks you through all the classic demonstrations.

https://www.youtube.com/watch?v=G0sTOcyhcFM

Ring Launcher design ideas contributed by Carl Schneider & John Ertel from the U.S. Naval Academy.

Lighting a bulb connected to a coil by induction; coil and bulb are included in Ring Launcher Accessories.

Ring Launcher with Accessories

EM-8817

120 Vac Only

Includes launcher, coil with light bulb, split aluminum ring, aluminum ring (2), short aluminum ring, copper ring

Replacement:

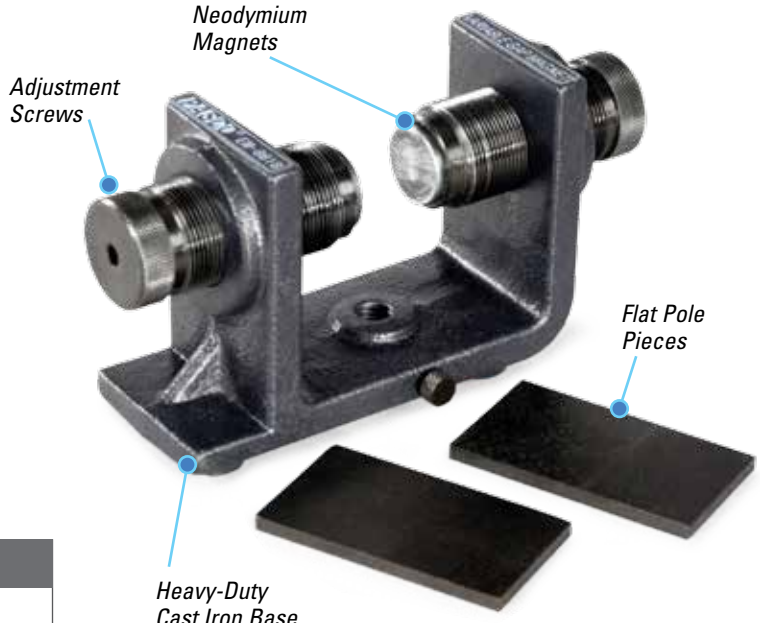
Ring Launcher Accessories EM-8662

Variable Gap Magnet

- Lower cost
- Larger magnets (1 inch diameter)
- Greater field (1 Tesla maximum)
- Great for induction experiments

The Variable Gap Magnet is rugged and durable while providing excellent results as a demonstration tool. The two one inch (2.54 cm) diameter neodymium magnets are mounted on a heavy-duty cast iron base that has a threaded hole for mounting on a support rod to provide even more versatility.

The gap may be varied from 0.5 cm to 8.9 cm using the adjustment screws. Two flat pole pieces are also included to provide a uniform magnetic field when needed.



May be used in four freestanding positions or mounted on a threaded rod.

Variable Gap Magnet

EM-8618

Includes Variable Gap Magnet with Pole Pieces

Magnetic Force Accessory

- **Demonstrate Magnetic Damping**
  Swing the solid aluminum paddle through the gap and it stops dead, the motion damped due to eddy currents. Now try the slotted paddles. One swings freely while the other is immediately damped.

- **Demonstrate Force on a Current-Carrying Wire**
  Pass a current through the wire swing (power supply not included) to investigate the right-hand rule for magnetic forces.

Magnetic Force Accessory

EM-8642A

Includes three aluminum paddles (solid, slotted, closed slotted)
Glass rod
Aluminum rod
Wire swing
Special mounting rod

Heat Engine/Gas Law Apparatus

An affordable, general-purpose apparatus for quantitative experiments involving the Ideal Gas Law and for investigations of a working heat engine.

Features a nearly friction-free piston/cylinder system. The 32.5 mm diameter graphite piston fits snugly into a precision-ground Pyrex® cylinder so that the system produces almost friction-free motion of 10 cm and minimal leakage.

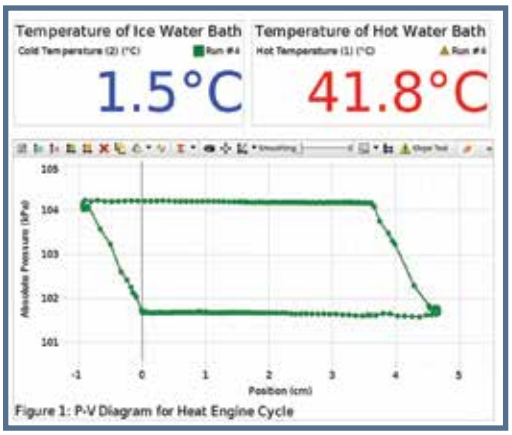
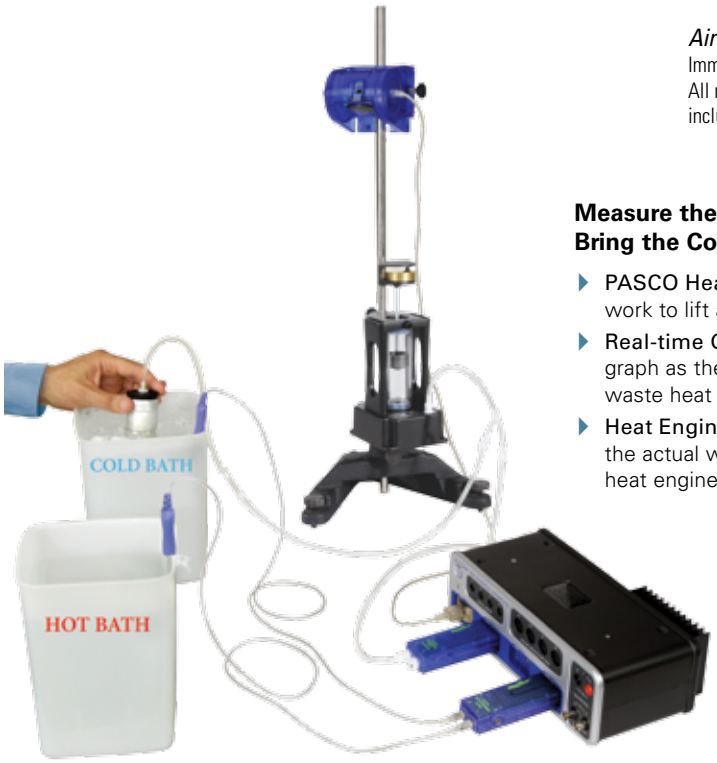


Figure 1: P-V Diagram for Heat Engine Cycle



Measure the Actual Efficiency of a Real Heat Engine, and Bring the Concept of P-V Diagrams to Life

- **PASCO Heat Engine:** Extracts heat from a large hot-water reservoir and does work to lift a weight.
- **Real-time Graph:** The heat engine cycle is traced on a Pressure vs. Volume graph as the engine goes through each part of its cycle, closing the cycle as waste heat is exhausted to the ice-water reservoir.
- **Heat Engine Efficiency:** Students compare the area inside the P-V cycle to the actual work done lifting the weight, and see how the efficiency of this heat engine compares to the theoretical maximum.

Heat Engine/Gas Law Apparatus

TD-8572A

Includes Heat Engine, air chamber, rubber stoppers (one and two hole), tubing with quick-connect fittings, shut-off valve and one-way valve.

Shown in use with:
850 Universal Interface UI-5000
Dual Pressure Sensor PS-2181
Motion Sensor PS-2103A
3 Liter Plastic Container Set (2) ME-7559
Small "A" Base ME-8976
60 cm Threaded Rod ME-8977

Compression Igniter

Students will be amazed to see the paper catch on fire without a match.

Put a small piece of tissue paper into the cylinder and quickly push down on the piston. In a quick compression there is no time for heat to be exchanged between the air inside and its surroundings, causing the temperature to rise well above the combustion temperature of paper.

Features:

- Adiabatic Compression Ignites Paper!
- Works Every Time
- Durable and Cleanable

This Compression Igniter has been specially designed to be cleanable. The bottom screws off to clean out the soot and to load the paper. The large piston handle decreases the pressure on your hand and makes it easier to hit the piston quickly.

The glass tube is surrounded by plastic for safety. In the event that the glass tube breaks, the glass tube can be replaced.

Compression Igniter

TD-8577

Includes the compression igniter, spare glass tube with "O" rings, cleaning wire and, complete instructions with theory.

Recommended:
Replacement Tubes (2) TD-8498A

Student Bell Jar

This bell jar provides a vacuum chamber for students to perform many experiments including:

- Watching a balloon expand or warm water boil as air is pumped from the chamber.
- Observing that a suction cup no longer sticks when the jar is evacuated.

Student Bell Jar

SE-9790

Includes: 8 cm x 6 cm dia. clear plastic bell jar with base; plastic vial, balloons, and suction cup; and 60-cc syringe and valves for evacuating the jar.

Dynamics Track Optics Kit

- Turns your dynamics track into an optical bench
- Use with 1.2 or 2.2 m Dynamics Tracks and PAStrack
- Expandable with Basic Optics System components

The PASCO Dynamics Track Optics Kit includes specially designed slides (carriages) that snap on the dynamics track. PASCO Basic Optics components attach directly to the carriage for positioning anywhere on the track.

Choose from a wide range of optics components to expand your system.

See, test and understand how lenses work using the Dynamics Track Optics Kit.

Dynamics Track Optics Kit

OS-8471A

Includes Basic Optics Light Source (Point, Object, Rays, Primary Colors), two adjustable lens/mirror holders, Geometric Lens Set (+100mm, +200mm and -150mm focal length), Viewing Screen, three Optics Carriages.

Requires any PASCO Track.

Basic Optics Light Source

The Basic Optics Light Source is an excellent source for a variety of optics experiments. A single 10-watt quartz-halogen bulb provides bright, easy-to-see illumination without a lot of heat. By turning the box to a different side, it becomes a:

1. **Crossed Arrow Object with Metric Scale.** Ideal for showing images, focal point, and magnification.
2. **Bright Point Source.** The very small filament of the halogen bulb provides an excellent point source for experimenting with shadows or the Inverse Square Law.
3. **Three Primary Colors Source.** The red, green, and blue filters provide three rays of light that are easily combined with a lens for color mixing.
4. **One,Three, or Five Ray Source.** Rotate the knob on front of the light source to vary the number of rays produced.

Basic Optics Light Source

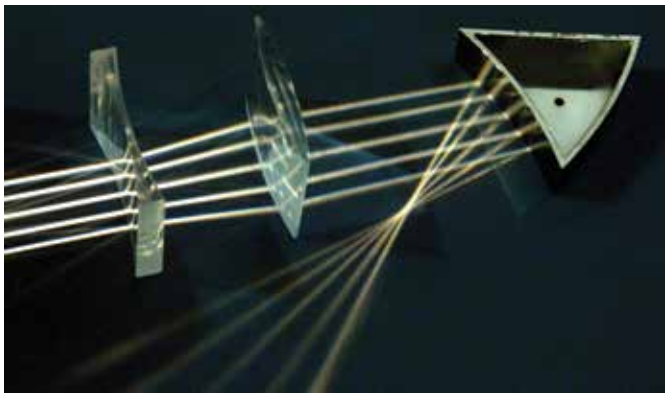
OS-8470

Use free-standing or easily clip directly to Basic Optics Track.

Ray Optics Kit

The Ray Optics Kit is a basic set of optics components for ray and color experiments. To use any of the components, place them on a flat tabletop in the path of rays from your ray box (not included). Place a white sheet of paper on the table to facilitate ray tracing and make the rays more visible.

To study a lens made of air and surrounded by water, use the storage box as a water tank. Remove the foam insert but leave the white plastic sheet under the box to serve as a reflective surface. Put the hollow lens in the box with a small weight on top to keep it from floating. Fill the box with water just below the top of the hallow lens. Use an eye dropper or pipette to empty and fill sections of the lens.

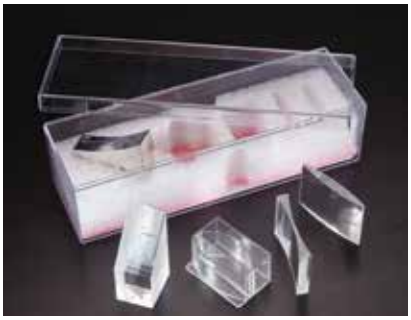


Components from the Ray Optics Kit showing Refraction and Reflection.

Ray Optics Kit

OS-8516A

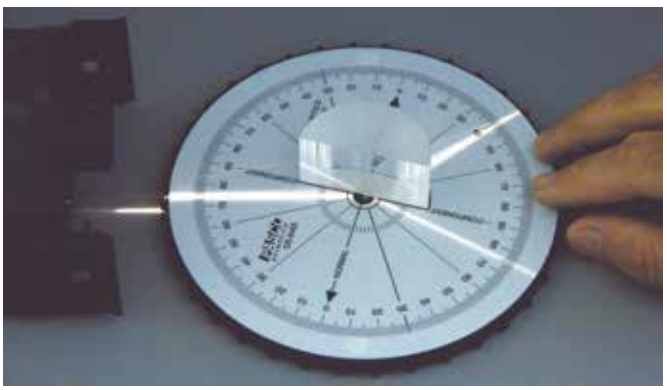
Includes
Double convex lens
Double concave lens
Rhomboid
Triangular mirror accessory with concave, convex and plane reflective surfaces
Hollow lens to fill with a liquid or use as an air lens.



Ray Table

- Angle of Reflection
- Snell's Law
- Total Internal Reflection

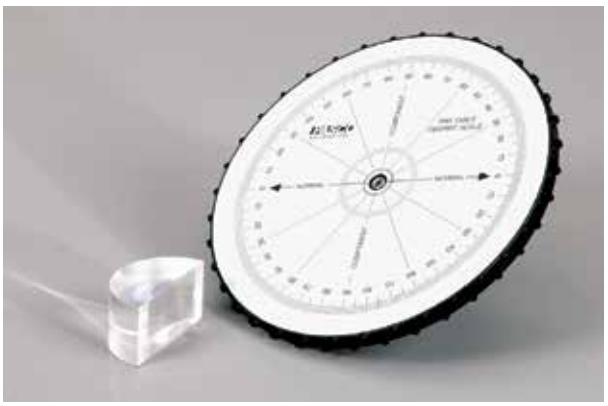
The Ray Table provides an excellent viewing surface for ray optics. It can be rotated about its axis to quickly change the incident angle of the ray. The resulting angles of reflection and refraction are easily measured directly off the polar grid printed on the table. The (included) acrylic cylindrical D lens simplifies the experiment by having the rays bend at only one surface. Investigate Snell's Law for both cases of rays either entering or leaving the acrylic.



Ray Table

OS-8465

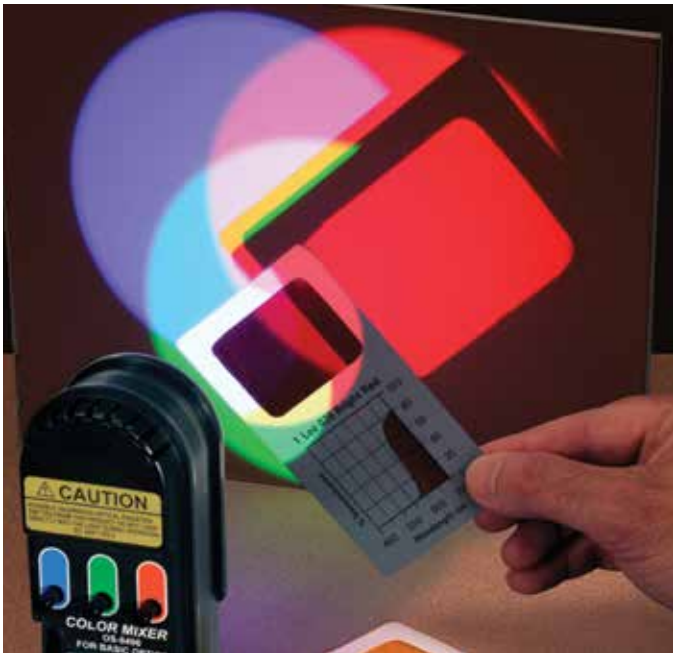
Includes Table and D-shaped Lens



Color Mixer

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.

- Demonstrates additive color mixing.
- Clips to PASCO Optics Bench (OS-8508) or Dynamics Track Optics Carriages (OS-8472).



The red filter's spectral chart shows it transmits only red light. Students observe as the blue and green circles disappear and the overlapping areas of magenta, yellow, and white become red.

Color Mixer

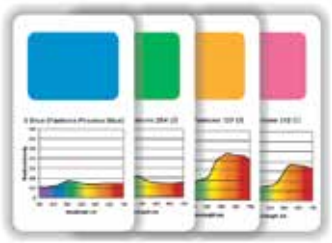
OS-8496

Includes: a tri-color light source, a power supply, and individual adjustments for the intensity of the super bright red, green, and blue LEDs.

Color Mixer Accessory Kit

OS-8495

Includes: 7 Filter Cards, 11 Printed Color Cards, and a Manual with 9 Lab Activities



Polarizer Demonstrator

Here are two large polarizing sheets for easy visibility in classroom demonstrations. With these sheets you can show how the intensity of transmitted light varies with the angle between the two sheets, or investigate stress patterns by viewing plastic objects (not included) between crossed polarizers.

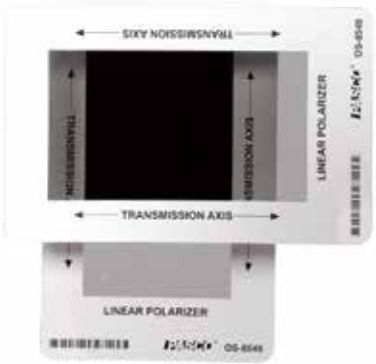
Polarizer Demonstrator

OS-9477A

Includes two round polarizer discs with stands.

Linear Polarizer

These rectangular polarizers are mounted in cardboard frames. The polarizing film dimensions are 3.5″ x 6″.



Linear Polarizer

OS-8549 (2-pack)

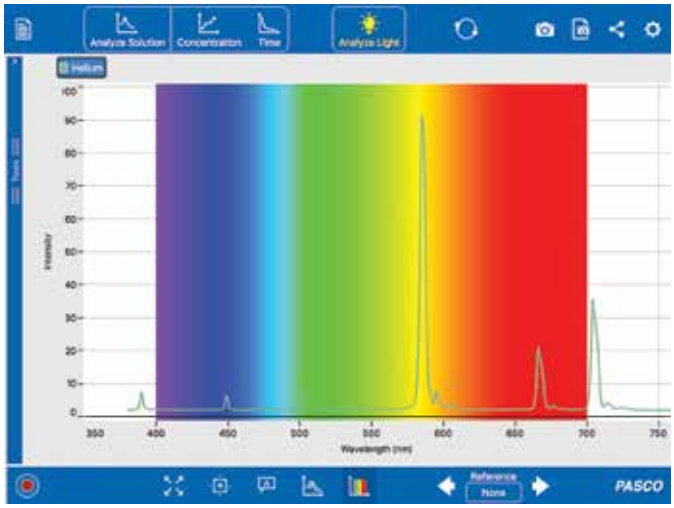
Includes two rectangular polarizer sheets

Award-Winning Wireless Spectrometry for Your iPad®, Android™ Tablets, Computers, and Chromebook™ *

Measure intensity, absorbance, transmittance, and fluorescence

The Bluetooth® and USB connectivity enable use with your iPad, tablets, and computers, which makes this a powerful and intuitive tool for your spectrometry needs.

*Our list of compatible Chromebooks is rapidly expanding.



Emission spectrum of helium

PASCO Spectrometer Specifications:

- Bluetooth and USB connectivity
- 2–3 nm FWHM resolution
- 380–950 nm range
- 2 fluorescence excitation wavelengths at 405 nm and 500 nm
- LED-boosted tungsten light source

The PASCO Spectrometer comes with **PASCO's FREE Spectrometry software.**

- Windows® and Mac® versions included with purchase.
- FREE for iOS, Chromebook, and Android tablets.
- Designed specifically for introductory spectrometry experiments.

Wireless Spectrometer

PS-2600

Includes PASCO Spectrometer and 10 cuvettes

Also available:

Optional Fiber Optic Cable
PS-2601

Cuvettes & Caps
SE-8739

Cuvette Rack
SE-8777

Interface Comparison

Compare the features and capabilities and see which interface works best in your lab.

	 AirLink PS-3200	 SPARKlink Air PS-2011	 550 Universal Interface UI-5001
PASPORT Ports	1	2	2
Analog Inputs	0	0	2 (±10 V, optional gain voltage 10x, 100x)
Digital Inputs	0	0	2
Connects via USB	Yes	Yes	Yes
Connects via Bluetooth	Yes	Yes	Yes
Rechargeable battery for cordless operation	Yes	Yes	No (AC adapter only)
Works with PASCO Capstone Software	Yes	Yes	Yes
Works with SPARKvue Software	Yes	Yes	Yes
Accepts PASPORT Sensors	Yes	Yes	Yes
Accepts ScienceWorkshop Sensors	No*	No*	Yes
Maximum Sampling Rate	Sensor dependent <1000 Hz	Sensor dependent <1000 Hz	Up to 2 MHz on one channel
Signal Generator	N/A	N/A	±8 V, at 400 mA, DC to 100 kHz
Included Items	USB Cable	AC adapter, USB cable, fast response temperature probe,voltage probe	USB cable, Power supply
Expansion Port	No	No	No

* The AirLink and SPARKlink Air can accept most ScienceWorkshop sensors with the proper adapter although they won't have the same high maximum sample rates. One exception is the Sound Sensor (CI-6504), which is not recommended for use with an adapter.

AirLink

PS-3200

Includes one PASPORT sensor port, USB and Bluetooth connectivity, and USB cable.

SPARKlink Air

PS-2011

Includes 2 PASPORT sensor ports, as well as voltage and temperature ports, USB and Bluetooth connectivity, USB cable, and voltage probe and fast response temperature probe.

The PASCO 550 Universal Interface…

This powerful wireless sensor interface for Physics works with SPARKvue and Capstone.

This is the interface with the measurement capability for any physics experiment your physics lab needs. It features:

- 2 MHz sampling rate
- 2 high-speed analog inputs
- 2 digital inputs for photogates and other timing sensors
- 2 PASCO PASPORT sensor inputs
- Signal generator with built-in Voltage and Current sensors.
- Use with other PASPORT interfaces
- Connect to computers via USB
- Bluetooth® connectivity

With the 550, your Physics lab is equipped with high-speed data collection, signal generation and power supply, oscilloscope and FFT displays, timers, and more.

550 Universal Interface Specifications:

2 high-speed analog inputs

Measurement Range: ±10 V differential input
Input Impedance: 1 MΩ
Input Protection: ±250 V continuous
Selectable Voltage Gain: X1, X10, X100
Resolution: 14-bit, 0.12 mV

2 Digital Inputs

Digital sensors such as Photogates and Time-of-Flight plug directly into the 550 Interface.

- Compatible with all ScienceWorkshop digital sensors
- Sensor Connect Detection
- 0-5 V TTL
- Bi-directional

2 PASPORT Inputs

Compatible with PASCO's complete line of more than 80 PASPORT sensors.

- Sample rates depend on sensors

Signal Generator

Waveforms: sine, triangle, square wave, positive and negative ramps, DC

Frequency Range: 0.001 Hz to 100 kHz; 1 mHz resolution
Amplitude Range: ±8 V; **Resolution:** 1.33 mV, 12-bit DAC.
Max Output Current: 400 mA at 8 V, over-current detection
Selectable Voltage Limit
Selectable DC Offset
Frequency Sweep Function
Measure Output Current, Voltage

550 Universal Interface

UI-5001

Requires:

PASCO Capstone Software
See ***pasco.com***
OR
SPARKvue Software
See ***pasco.com***

SPARKvue®

Try our award-winning SPARKvue software for FREE!

Get Started Today

The full and complete version of SPARKvue is now available as a FREE app for iPad® and Android™ tablets, Chromebook™, as well as free apps for iPhone and Android phones.

Download on the App Store | ANDROID APP ON Google play | available in the chrome web store

We also offer free 60-day trials for PC and Mac®* at **pasco.com**

Smart Phones

Android phone | iPhone

Tablets

Android tablet | iPad

Laptops/Desktops/2-in-1s

Windows tablet | Chromebook | PC | Mac

SPARKvue (single user license)

PS-2401

sparkvue

SPARKvue (site license)

PS-2400

sparkvue

SPARKvue App

Download:

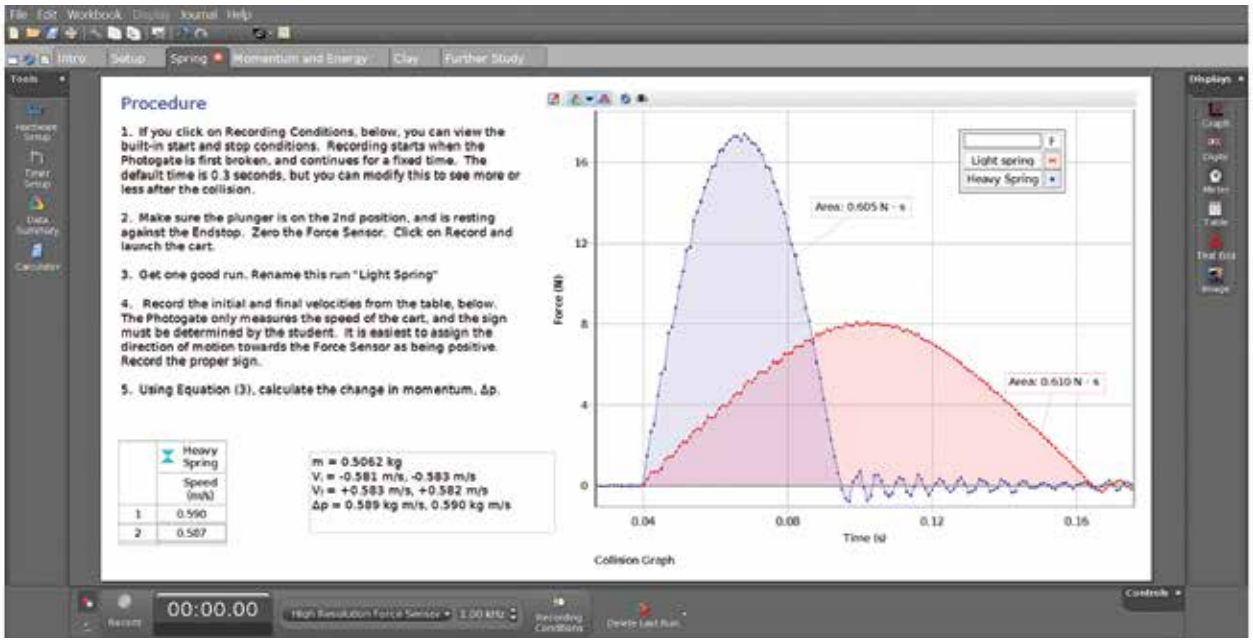
Download on the App Store | available in the chrome web store

ANDROID APP ON Google play

PASCO capstone™ Software

Designed specifically to collect, display, and analyze data in physics and engineering labs

- Site license includes student home use
- For MAC® and Windows™



Sensors

PASCO Capstone Basic Features

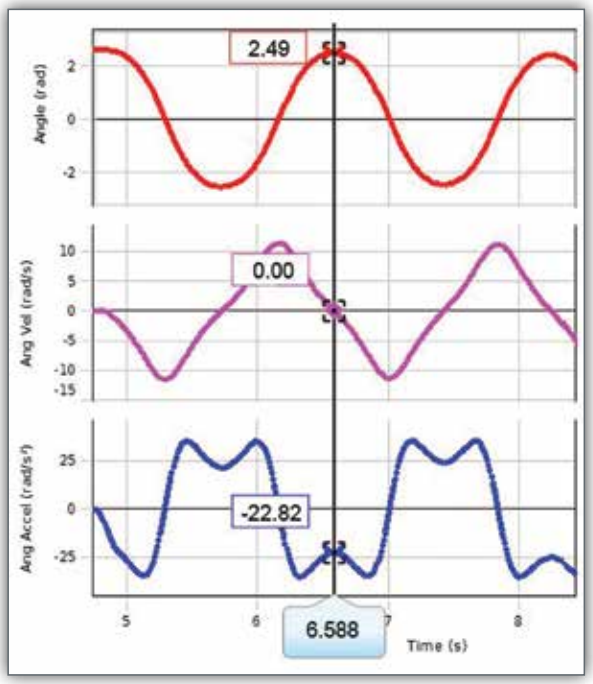
- Auto-ID sensors are recognized when they are plugged in (or identified through Bluetooth®)
- Works with PASPORT, ScienceWorkshop, and new Wireless sensors
- In-app pairing of wireless sensors makes it easy to pick wireless sensors by proximity
- Pre-configured photogate timers

Workbook Format

- Basic displays include graph, table, digits, meter, oscilloscope, text box, picture.
- Make multiple pages with instructions and embedded live graphs.
- Collect data and display it in real time.
- Play back data in real time or slow or high speed.
- Enter data manually – Easy setup in a table
- Lay out displays with smart guidelines.
- Create a Journal by taking snapshots of pages or displays.
- Copy and paste displays into documents.
- Made a mistake? Just hit the Undo button.

Graphs

- Draw predictions on graphs before taking data.
- Multiple y-axes and/or multiple plot areas
- Perform Quick-Calcs on the graph axis to linearize data.
- Curve-fits report the uncertainties in the parameters.
- Multi-coordinate tool gives y-values wherever it intersects data.



Multi-Coordinate Tool

This tool finds the values of all the measurements all at once. It's great for showing how the position, velocity, and acceleration are related in oscillations.

PASCO Capstone Software
Single User License UI-5401 Site License UI-5400

ErgoBot

An extraordinary STEM learning solution

- Displays position and velocity in real time
- Connects graphs to equations of motion
- Free-wheel or motor drive
- Arduino® compatible
- Communicates wirelessly with any computer or mobile device using Bluetooth®.

Teach Physics

- Measurement
- Position and displacement
- Speed, velocity, and acceleration
- Position vs. time graphs
- Velocity vs. time graphs
- Vectors
- Newton's laws
- Motion on an inclined plane

Teach Engineering

- Introductory robotics
- Programming
- Design with real constraints
- Problem solving
- Optimizing a solution
- Performance testing
- Accuracy and precision

STEM

Programming and Robotics with the ErgoBot

This unique module offers 23 lessons and projects covering introductory and intermediate programming, robotics, sensors, code development, variables, loops, logic structures, autonomous operation, design, engineering, optimization, and performance testing.

- 23 lessons and projects
- 7 interactive simulations
- Interactive IDE
- 23 slide presentations
- 23 student assignments

The ErgoBot

The ErgoBoard

Teacher Resources

- Everything works right out of the box – nothing to solder or assemble.
- Designed for the classroom – use the same ErgoBot every period, all day.
- Projects 1-8 require no installed software. Students write easy code that gets the ErgoBot moving in less than 20 minutes.
- All three sensors are included and need only a few jumpers to connect.
- Build up to C-level programming language using logic and sensors.
- The teacher's guide includes 23 projects with lessons, slides, and a wealth of instructional material.
- The Arduino-compatible ErgoBoard is available separately to upgrade your existing ErgoBot.

Hardware and software work together to make the easiest most engaging programming course ever created.

- No assembly required
- 23 projects start from novice level
- Works with Windows® and Mac® OS X
- Wireless Bluetooth® communication
- Practical for every classroom

ErgoBot

EP-6471

ErgoBoard with Sensors

EP-6472

ErgoBot with ErgoBoard Robotics

EP-6473

Includes ErgoBot, ErgoBoard and sensors

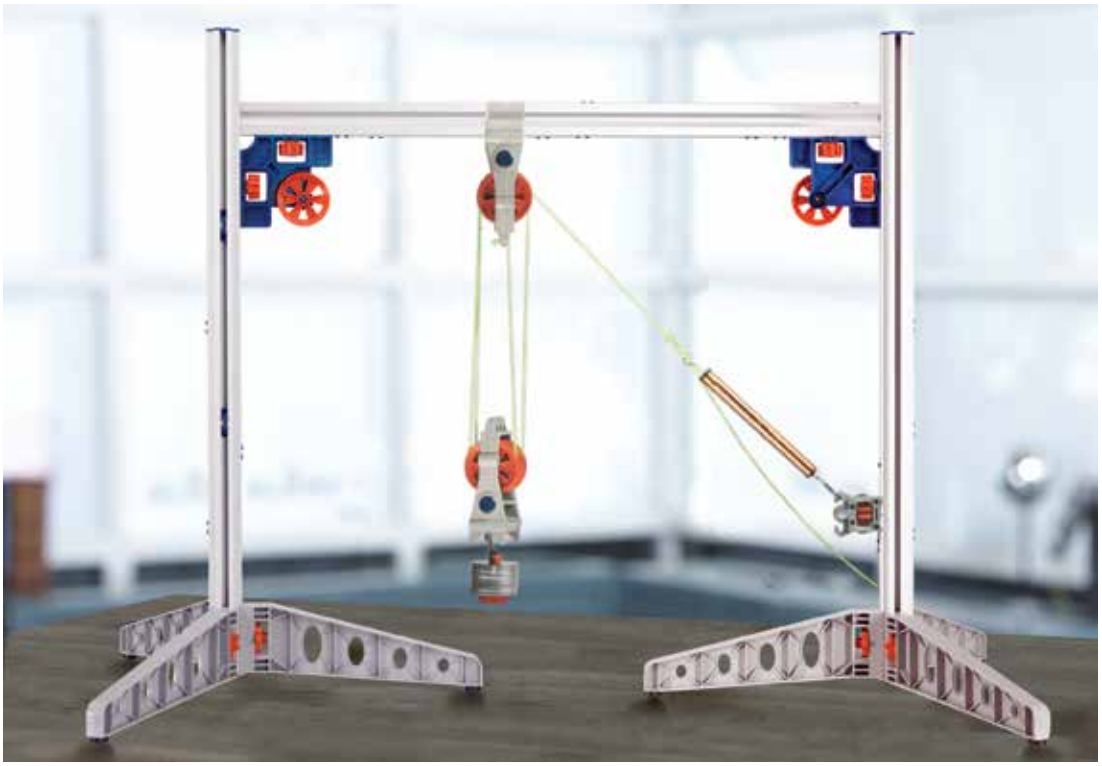
ErgoBot Programming and Robotics Teacher Resources

EP-6485

STEM Modules

Forces and Machines

Our Forces and Machines Kit engages students in a wide range of physics, physical science, and engineering concepts. Two triple-pulley blocks make it easy to build machines with mechanical advantage up to 6:1. Build all three classes of levers with our pair of 20-cm levers, or combine gears, levers, and pulleys together to show how rotating machines work.

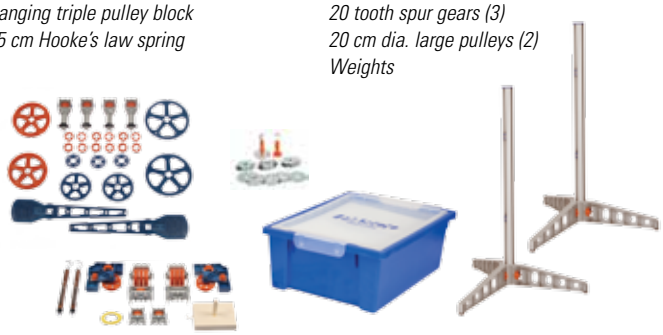


Forces and Machines Engineering Kit

EP-3577

Kit includes:

Extruded rail
10 N metal spring scales (2)
Tripod stand (2)
Universal spring hanger
Right-angle connector with pulley (2)
Fixed triple pulley block
Hanging triple pulley block
25 cm Hooke's law spring
Friction block
Quick-attach gear hubs (4)
Gear spacers (8)
20 cm levers (2)
60 tooth spur gears (2)
40 tooth spur gears (2)
20 tooth spur gears (3)
20 cm dia. large pulleys (2)
Weights



- 11 lessons and projects
- 9 interactive equations
- 11 slide presentations
- 11 lesson plans
- 11 student assignments
- Requires Forces and Machines Engineering Kit

Forces and Machines Teacher Resources

EP-6483

Light, Color, and Optics

Introduce your students to the science and technology of light including reflection, refraction, color, intensity, lenses, mirrors, real and virtual images, human vision, digital imaging, and the quantum theory of light.

- 12 lessons
- 5 interactive simulations
- 8 interactive equations
- 12 slide presentations
- 12 lesson plans
- 12 student assignments

Requires Light and Optics Kit

Light and Optics Kit

The Optics Kit is a complete laboratory for learning about light, color, and optical technology. Three 50 mm optics mounts slide easily and then lock down with thumbscrews. The light source makes a perfect illuminated "object" for optics experiments, and the fixed spacing of the colored LEDs makes it easy to observe and measure image properties such as magnification, inversion, and brightness.

Light, Color, and Optics Teacher Resources

EP-6481

Light, Color and Optics Kit

EP-3558

Kit includes:

50 mm optics mounts (3)
Rechargeable light source
AC adapter/charger
Refraction tank
Triangular prism
Phosphorescent plastic
50 mm convex lens - 10 cm f.l.
50 mm convex lens - 20 cm f.l.
50 mm convex lens - 50 cm f.l.
50 mm concave lens - 20 cm f.l.
50 mm convex mirror - 20 cm f.l.
50 mm concave mirror - 50 cm f.l.
50 mm screen
50 mm diffraction grating
Eyeglasses

Oscillations, Waves, and Sound

Teach the science and technology of waves and sound. Lessons cover harmonic motion, waves, sound, period, frequency, wavelength, resonance, Doppler effect, interference, frequency spectrum, multi-frequency sound, digital sound, human perception, and music.

- 13 lessons
- 5 interactive simulations
- 8 interactive equations
- 13 slide presentations
- 13 lesson plans
- 13 student assignments

Requires Waves and Sound Kit

Waves and Sound Kit

The Waves and Sound Kit gives you fundamental tools you need to teach harmonic motion, waves, and sound. Our "slinky" and "snaky" springs are high-quality metal (not plastic), and four chrome-plated steel tuning forks are great for making the connection between science and music.

Oscillations, Waves, and Sound Teacher Resources

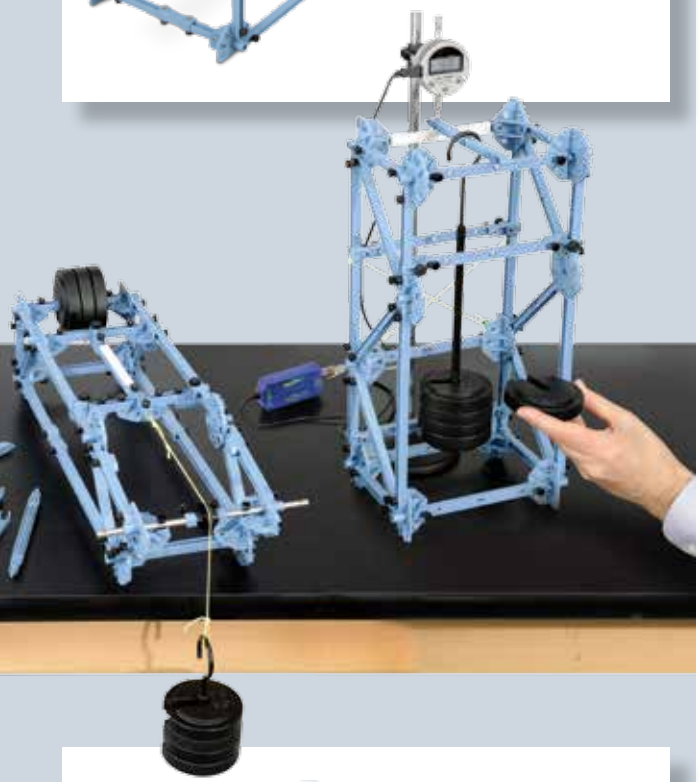
EP-6480

Waves and Sound Kit

EP-3578

Kit includes:

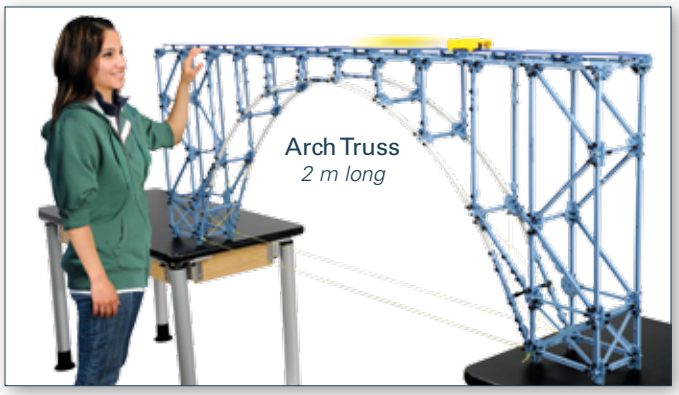
Steel transverse wave "snaky" spring (1.8 m)
Extra-large steel longitudinal wave "slinky" spring
25 cm extension spring
Pendulum/spring hanger
Resonance lever
1" diameter aluminum pendulum ball
Resonance tube
Tuning fork 256 Hz
Tuning fork 320 Hz
Tuning fork 284 Hz
Tuning fork 512 Hz

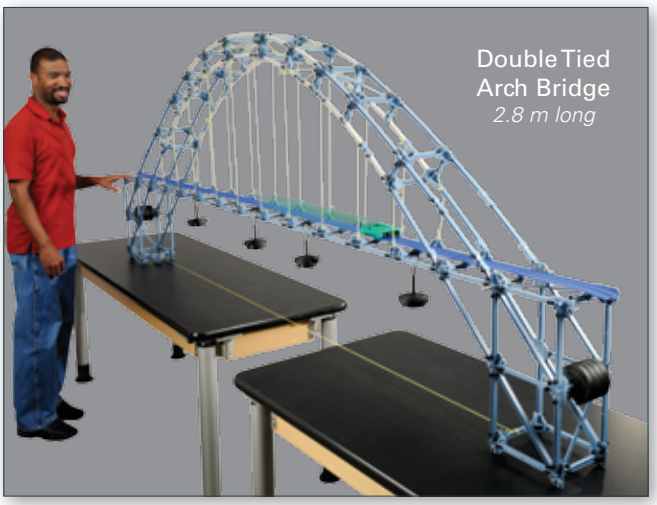


PASCO's Engineering Solutions

In the following Engineering section, you will find instructional resources and classroom applications.

Engineering Index





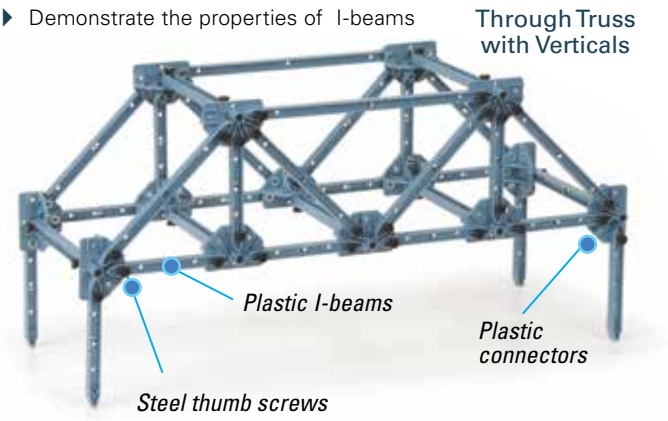
MORE ENGINEERING FROM PASCO

See our latest Physics & Engineering Catalog for an extensive offering of physics teaching equipment and apparatus. Request your catalog today online at:

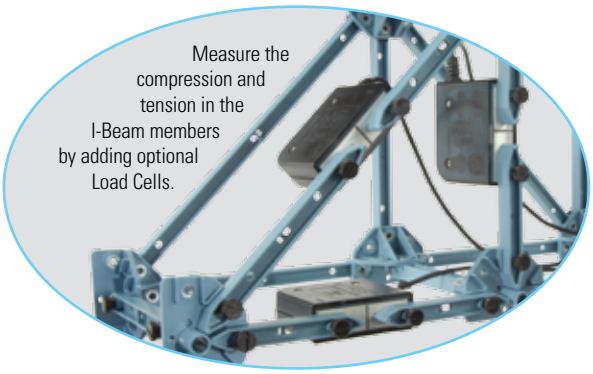
pasco.com/catalog

Truss Set

- Teach the basics of trusses
- Demonstrate the properties of I-beams



Use the Truss Set to build a variety of structures to investigate the principles of trusses. The ABS plastic I-Beams fasten securely together using the provided connectors and thumb screws. Load cells can be inserted anywhere into the design by replacing one beam at a time. Students can load the truss by hanging weights.



Construction is easy: I-Beams fit into the connectors and are secured with thumb screws. Thumb screws are also slotted so a screwdriver can be used.

Truss Set

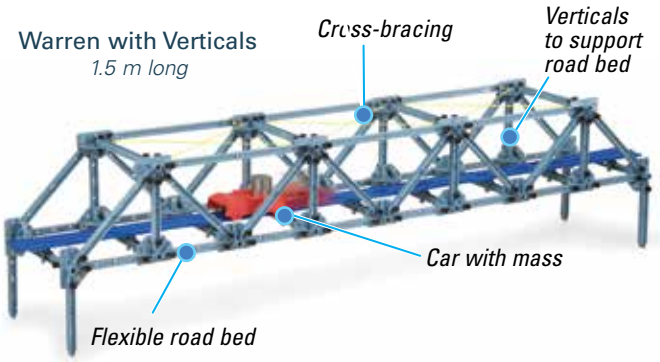
ME-6990

Includes one package each of Truss Set Members and Truss Set Screws

Recommended:
Load Cell Amplifier/6-port PS-2198

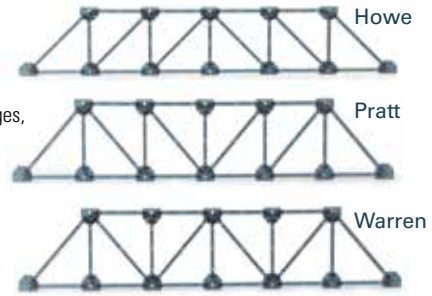
Bridge Set

- Study the principles of bridge construction
- Road bed and car add realism to bridges
- Add load cells to see dynamic loading as car traverses bridge

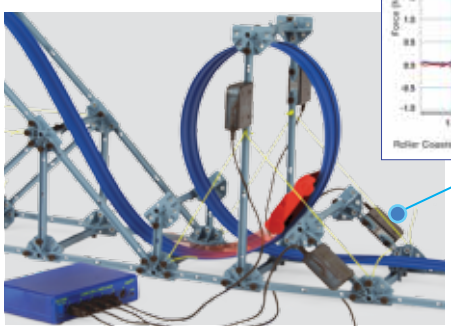


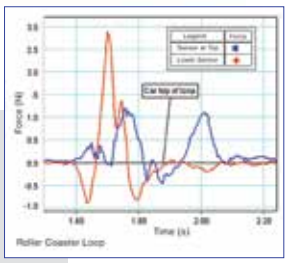
Special cord locks allow tensioning of cord (cables) for cross-bracing. A flexible plastic road bed clips to the cross-beams and, using load cells, the tension and compression of each element can be displayed in real time.

Students can build several types of fundamental bridges, including Howe, Pratt, and Warren bridges.



Design your own roller coaster!





Add Load Cells to measure the forces needed to support the track as the car goes up and over the loop.

Bridge Set

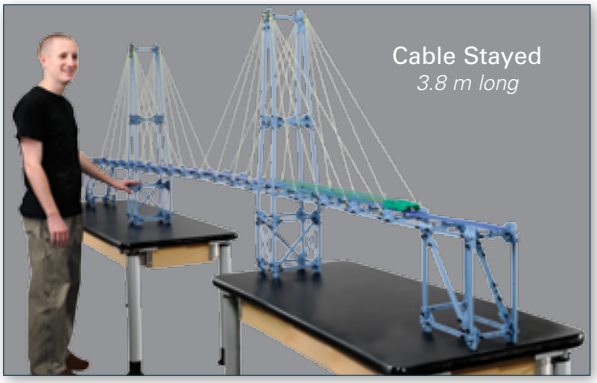
ME-6991

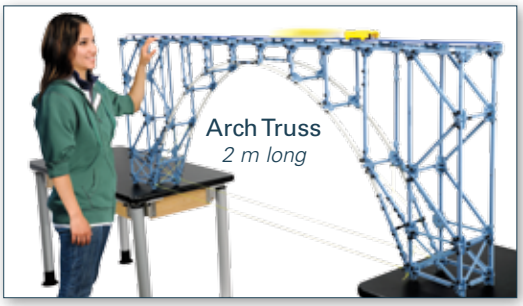
Includes two packages each of Truss Set Members and Truss Set Screws. One package each of Roadbed Spares and Cord Lock Spares

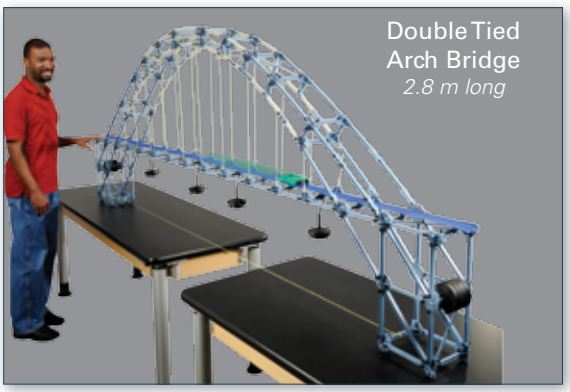
Recommended:
Load Cell & Amplifier Set PS-2199
(includes Load Cell Amplifier and four Load Cells)

Large Structures Set

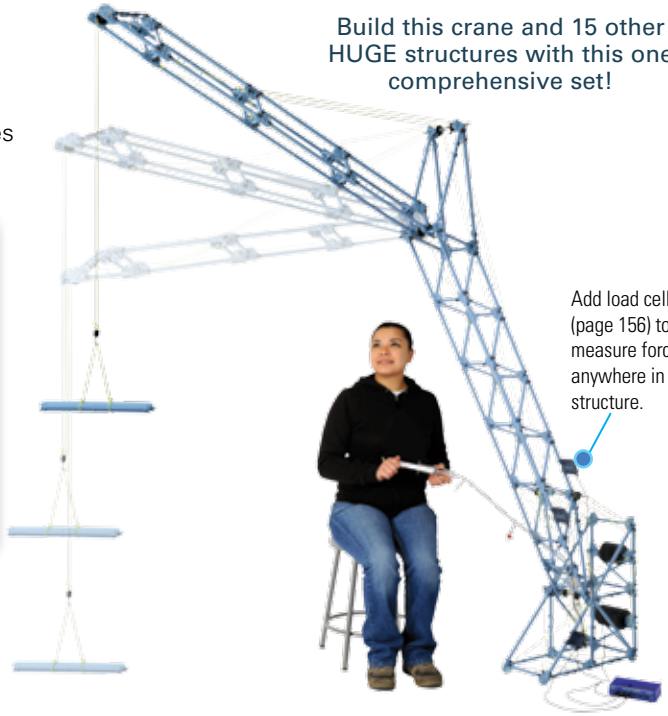
The Large Structures Set includes all the components contained in the Advanced Structures Set (ME-6992B) plus additional parts to build even bigger structures. It also includes the Mini Cars with plastic track to build roller coasters and to add realistic roadbeds to your bridges.



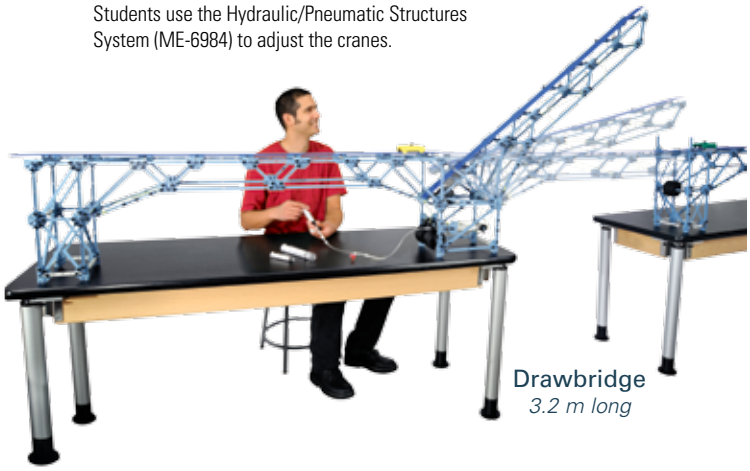




Build this crane and 15 other HUGE structures with this one comprehensive set!



Students use the Hydraulic/Pneumatic Structures System (ME-6984) to adjust the cranes.



Large Structures Set

ME-7003

Includes six packages of Truss Set Screws, three packages of Truss Set Members, two packages of Connector Spares, one package each of #6 I-Beam Spares, Flexible I-Beams, Cord Lock Spares, Axle Spares, Round Connector Spares, Angle Connector Spares, Flat Beams, Structures Rod Clamps, Mini Car Track Spares, Force Platform Structures Bracket, and one each Green Car, Yellow Car, 9.1 m Track, and Starter Bracket

Shown in use with:

Load Cell & Amplifier Set PS-2199
Hydraulic/Pneumatic Structures ME-6984
Slotted Mass Set ME-7589

Advanced Structures Set

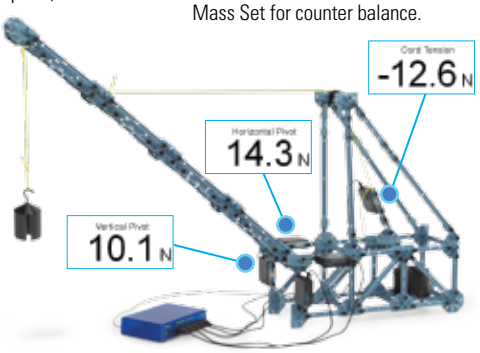
The Advanced Structures Set includes more components to build a larger variety of structures. Axles and pulleys allow construction of cranes, cars, and even a working catapult!

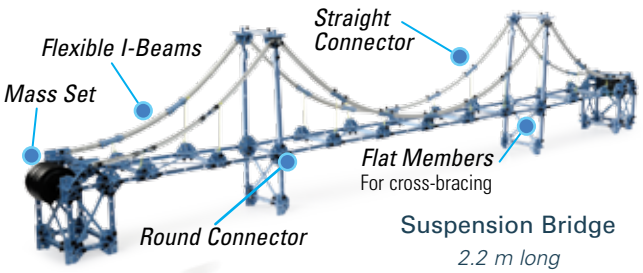
- Build larger bridges
- Build cranes, catapults, cars

Support structure uses 1/2 kg masses from the Large Slotted Mass Set for counter balance.

Forces on a Boom

Vary all parameters including length and angle of the boom. Directly measure the horizontal and vertical forces exerted by the pivot (axle) on the boom and the tension in the supporting cord.



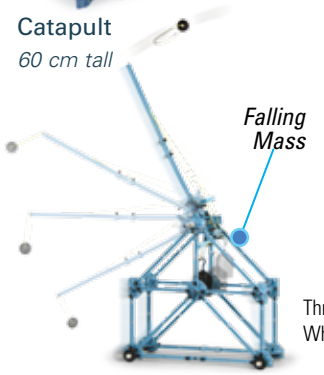


Suspension Bridge

2.2 m long

Catapult

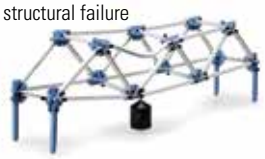
60 cm tall



Throws a projectile over 10 meters! Wheels allow catapult to move.

Flexible I-Beams

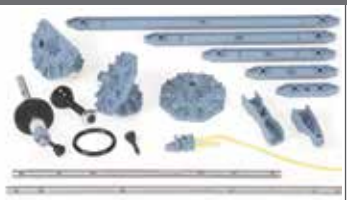
Dramatically demonstrate structural failure



Advanced Structures Set

ME-6992B

Includes three packages of Truss Set Members. Four packages of Truss Set Screws. One package each of Flexible I-Beams, Cord Lock Spares, Axle Spares, Round Connector Spares, Angle Connector Spares, Flat Beams, Structures Rod Clamps, and Force Platform Structures Bracket



Shown in use with:

Load Cell & Amplifier Set PS-2199
(includes four Load Cells)

Hooked Mass Set SE-8759
Large Slotted Mass Set ME-7566

Materials Testing Machine

Here is the most affordable way to teach material testing. This integrated system measures both force and position. Investigate material properties including Young's modulus, tensile strength, yield strength, ductility, and modulus of resilience. Data is displayed real-time in graphs or digit displays using PASCO Capstone™ software.

Download PASCO Capstone Trial Version at **pasco.com/capstone**

Materials Testing Machine

ME-8236

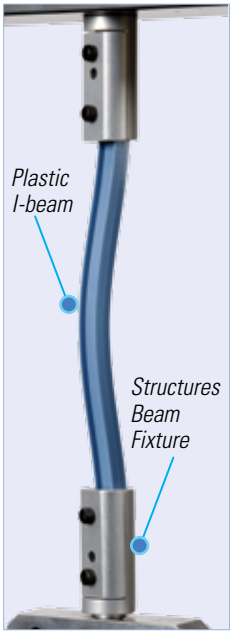
Includes: Machine, compliance calibration rod, and safety shields (requires PASCO Capstone software and a PASCO interface)

Required:

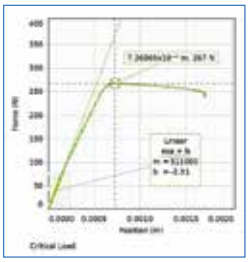
PASCO Capstone Software
Single User License UI-5401

Structures Beam Fixture

Test your structures components. Use the Structures Beam Fixture and include Structures I-beams in investigations about tension, compression, and buckling. This adapter is an accessory to the Materials Testing Machine (above).



Find the critical load that causes the beam to buckle.



Structures Beam Fixture

ME-8242

For more information go to: **pasco.com/micro/MTS**

Sensor Index

PASCO's 5-Year Warranty

To withstand the rigors of student use, PASCO products are made of the highest quality materials. They are designed and manufactured by our team of education researchers and engineers in Roseville, California. And we back up our products with a 5-year warranty, so you can be completely confident about buying PASCO solutions.

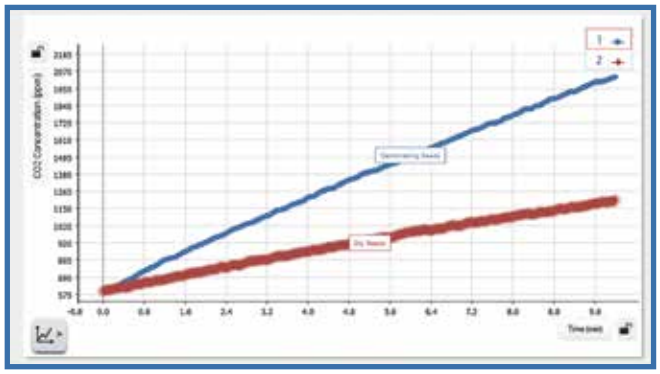

wireless pH
054-294
wireless conductivity
763-672
wireless temperature
984-521
wireless temperature
983-964
pH

Wireless CO_2 Sensor

PS-3208

Includes 250-ml sampling bottle and USB charging cable.

Use this wireless sensor to measure the concentration of CO_2 gas in a closed system or open environment. Study core topics (including photosynthesis, respiration, and carbon cycling) with this versatile probe. CO_2 data can be logged directly on the device for long-term life science and environmental science studies.



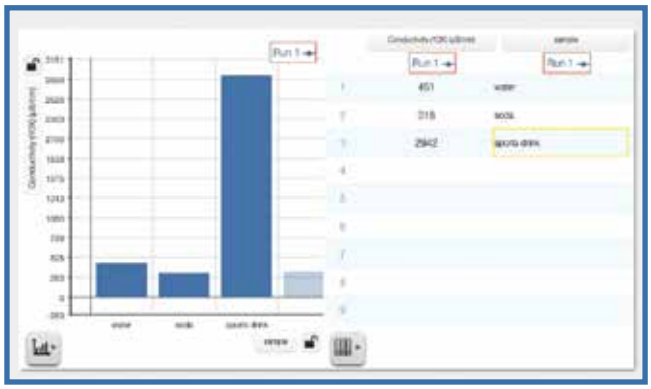
Directly compare separate controlled environments.

Wireless Conductivity Sensor

PS-3210

Includes 1 coin cell battery.

Use the Wireless Conductivity Sensor to measure the electrical conductivity of a water solution. With this wireless sensor you can investigate the properties of solutions, as well as model and measure water quality.



Measure the conductivity of water and water-based solutions.

Features

- Measure both conductivity and total dissolved solids
- Automatic temperature compensation
- Dust- and sand-proof and water-resistant (1 meter for 30 minutes)
- Battery life >1 year
- Remote logging

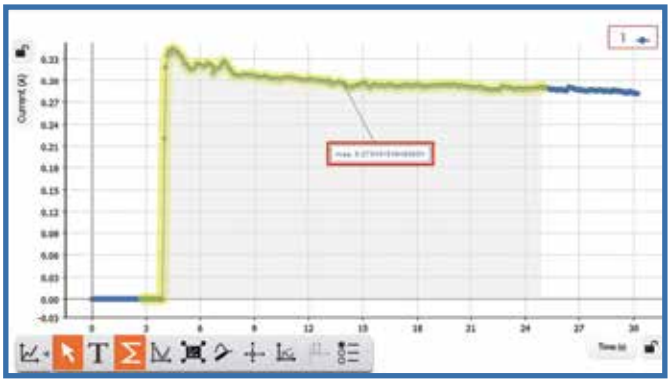
See our new Wireless Colorimeter and Turbidity Sensor on page 143.

Wireless Current Sensor

PS-3212

Includes rechargeable battery and banana-clip cables.

This sensor's wide current range allows for introductory and advanced explorations of the fundamental concepts of electricity and basic circuits.



Features

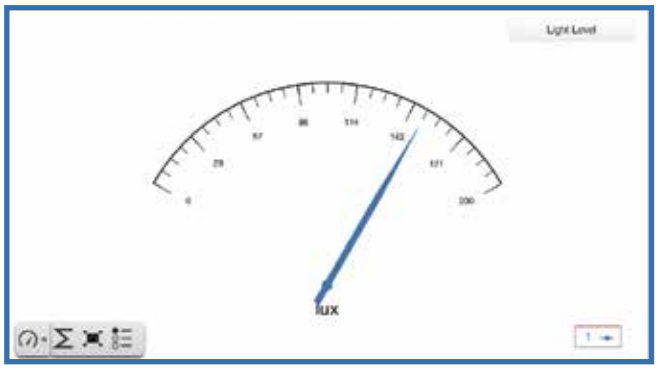
- Range ±1A
- Bluetooth® sampling rate of 1 kHz
- High-speed sampling via USB; 100 kHz burst mode
- Includes remote logging on your device

Wireless Light Sensor

PS-3213

Includes 1 coin cell battery.

This wireless sensor is a great tool for explorations in Earth, Life, and Physical sciences. With its ambient light detector for illuminance and UV, and its directional detector for colors, your students can explore the electromagnetic spectrum, model planetary motion, and relate photosynthesis to light color and intensity.



Features

All these measurements in one!

- Illuminance (lux), PAR, and irradiance
- UVA, UVB, and UV Index
- RGB color detection
- Battery life >1 year
- Includes remote logging on your device

Wireless Force Acceleration Sensor

PS-3202

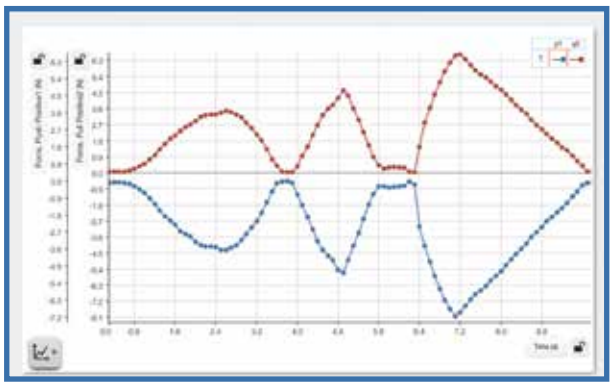
Includes 1 eye bolt, 1 thumb screw, 1 bumper, a lithium-ion battery, and a USB connector.

Capable of measuring force, acceleration, and rotation, this sensor is ideal for experiments involving rotating platforms, moving carts, spring oscillations, collisions, and impulse. The wireless design offers improved measurements without a cable affecting experiment outcome. Finger-holes support handheld applications, or mount it onto a cart or rod.

The Teaching Advantage

- Simultaneously measures force and acceleration. Measures acceleration in x, y, and z axes and resultant acceleration. Built-in gyroscope measures rotation.
- Features convenient Bluetooth® wireless connectivity and long-lasting rechargeable battery.
- Probe can be quickly zeroed through software for accurate taring.
- Logs force and acceleration data directly onto the sensor for long-term experiments.

When students are the force, Newton's Third Law is no longer a leap of faith.



Directly compare action and reaction of forces.

Smart Cart

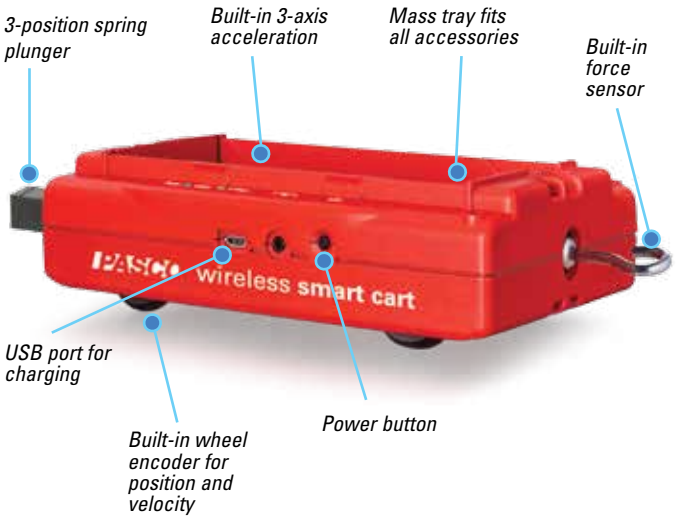
ME-1240 (Red)
ME-1241 (Blue)

The most innovative tool for the high school physics lab since the photogate

It is the ultimate tool for your physics lab with built-in sensors that measure force, position, velocity, and acceleration. The Smart Cart can make these measurements on or off a dynamics track and transmit the data wirelessly over Bluetooth®.

Features:

- Built-in ±100N force sensor
- 3-axis accelerometer
- Built-in wheel encoder
- Bluetooth connectivity
- Magnetic bumper for force sensor
- 3-position plunger
- Mass tray
- Velcro® tabs
- Rechargeable battery
- Force sensor hook and rubber bumper
- Available in red and blue



Wireless pH Sensor

PS-3204

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

This sensor measures the pH of a solution as discrete measurements or as a continuous reading. Use the probe to study water quality, test household solutions, or perform high-resolution acid-base titrations.

The Teaching Advantage

- High resolution with low noise allows even subtle pH changes to be observed.
- Factory calibration lets students get right to data collection, with optional user calibration supported.
- Uses durable, accurate gel-filled Ag-Ag Cl electrode.
- Features convenient Bluetooth® wireless connectivity and long-lasting coin cell battery.
- Logs pH data directly onto the sensor for long-term experiments.

The versatile Wireless pH Sensor works as well in the field as in the lab.

Easily measure and compare the pH of common acids and bases.

Wireless Pressure Sensor

PS-3203

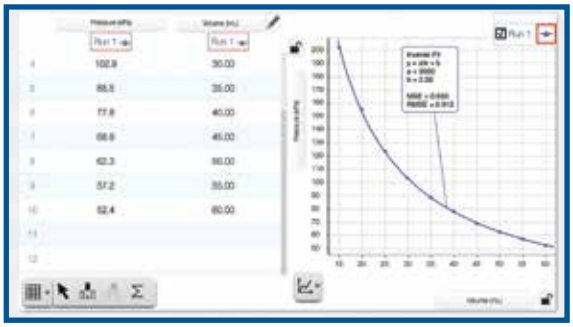
Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barbed luer locks, 1 female barbed luer lock, 1 60cc syringe, a lithium-ion battery, and a USB connector.

With the new Wireless Pressure Sensor you can make accurate and consistent measurements of gas pressure, regardless of ambient conditions, and explore gas laws and how chemical reactions affect gas pressure.

The Teaching Advantage

- Measures pressure relative to an internal sealed reference vacuum, which allows the collection of reliable data even when the pressure within the system drops below ambient pressure.
- Supports common units (kPa, atm, psi, mmHg, or N/m2) for many applications.
- Features Bluetooth® wireless connectivity and long-lasting rechargeable battery.

A test tube, piece of steel wool, and a Wireless Pressure Sensor are all you need to have your students calculate the amount of oxygen in the air.



With the included syringe, your students can easily quantify the relationship between pressure and volume.

Wireless Temperature Sensor

PS-3201

Includes 1 coin cell battery.

Welcome to the modern thermometer. Students can access instant temperature readings but also continuously monitor, log, and plot temperature data in SPARKvue on nearly any connected device. When class-time ends but the experiment continues, students can set the sensor to log data autonomously for days or weeks and then download the data for analysis.

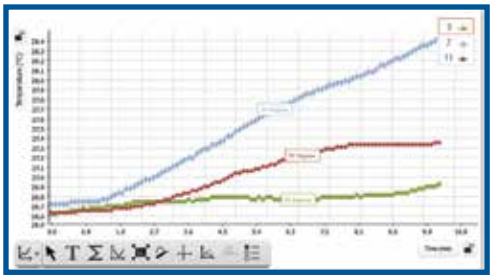
The Teaching Advantage

- Simplicity: just pair and go, no cables and adapters to manage
- Variable sampling rate for capturing small fast changes or experiments that run for hours, days, or weeks
- Features convenient Bluetooth® wireless connectivity and long-lasting coin cell battery
- Logs temperature data directly onto the sensor for long-term experiments.

Specifications

Range: -40°C to 125°C
Resolution: 0.05°C
Accuracy: 0.5°C
Battery: Coin cell (>500,000 samples)
Logging: Yes
Bluetooth: BT 4.0

The versatile Wireless Temperature Sensor works well, both in the lab and out of doors.



Easily compare the temperature in different environments.

Wireless Voltage Sensor

PS-3211

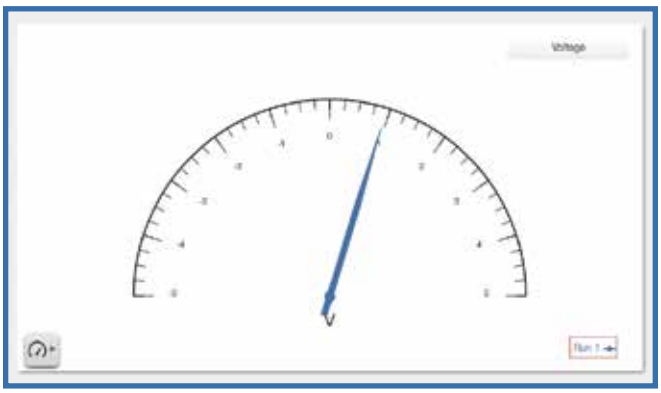
Includes 1 red and 1 black shrouded, banana-to-alligator-clip test leads.

Explore energy and energy transformations with this sensor. Use it to:

- Measure the voltage of student-constructed batteries and see how chemical energy can turn into electrical energy.
- Look at renewable energy by connecting to a wind turbine.
- Track the flow of energy by creating simple circuits.

Features

- Range ±15 V
- Bluetooth® sampling rate of 1 kHz
- High-speed sampling via USB; 100 kHz burst mode
- Includes remote logging on your device.

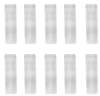


See our new Wireless Weather Sensor with GPS on page 151.

Wireless Spectrometer

PS-2600

Includes Spectrometer and 10 cuvettes.



Also available:

Optional Fiber Optic Cable PS-2601

Cuvettes & Caps SE-8739

Cuvette Rack SE-8777

Award-Winning Wireless Spectrometry for iOS®, Android™, Computers, and Chrome*

Measure intensity, absorbance, transmittance, and fluorescence.

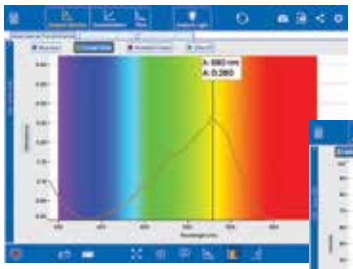
Now PASCO offers Bluetooth® spectrometry for your iPad and Android tablets! This new spectrometer from PASCO is specifically designed for introductory spectrometry experiments. The Bluetooth and USB connectivity enable use with your computers and tablets, making this a powerful and intuitive tool for your spectrometry needs. With this one apparatus you can measure intensity, absorbance, transmittance, and fluorescence.

You can perform these labs with the Wireless Spectrometer:

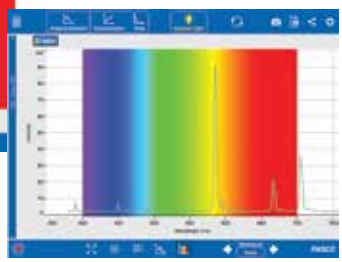
- Emission Spectra of Light
- Absorbance Spectra
- Beer's Law
- Kinetics
- Fluorescence

Specifications

- Bluetooth and USB connectivity
- 2–3 nm FWHM resolution
- 380–950 nm range
- 2 fluorescence excitation wavelengths at 405 nm and 500 nm
- LED-boosted tungsten light source



Full visible spectrum analysis of solutions



Create Beer's Law plots to relate absorbance and concentration.

The Wireless Spectrometer is compatible with **PASCO's spectrometry software.**

- PC and Mac versions included with purchase.
- FREE for iOS, Android, and Chrome* tablets.
- Designed specifically for introductory spectrometry experiments.

**Go to pasco.com and see our ever-expanding list of compatible Chromebooks.*

Polarimeter

PS-2235

Includes 1 Sample Cell

Also available:

Polarimetry Sample Cell Replacement PS-2234

PASCO Polarimeter for your Chromebook™, iPad®, Tablets, and Computers

Measure the optical rotation of chiral compounds.

PASCO's new Polarimeter has both Bluetooth® and USB connectivity, so it works on your iPad®, Chromebook™, tablets, and computers. It is ideal for introductory Organic and Biochemistry experiments with chiral compounds.

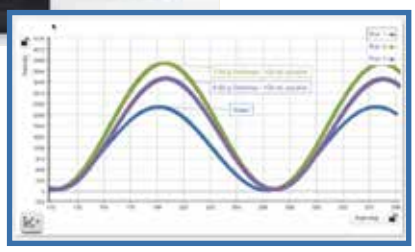
In this new device, plane polarized light is passed through a sample, which contains a chiral compound, to an analyzer and a detector. The degree of optical rotation of the plane polarized light is based on the type and amount of sample present.

Determine the concentration of a sugar solution based on the optical rotation of plane polarized light.

Specifications

- Bluetooth® and USB connectivity
- 589 nm LED light source
- Accuracy = ± 0.09° optical rotation
- SPARKvue- and Capstone-compatible
- Industry-standard, horizontal polarimeter sample cell (100 mm)

Determine the concentration of a sugar solution based on the optical rotation of plane polarized light.



Optical rotation of sucrose

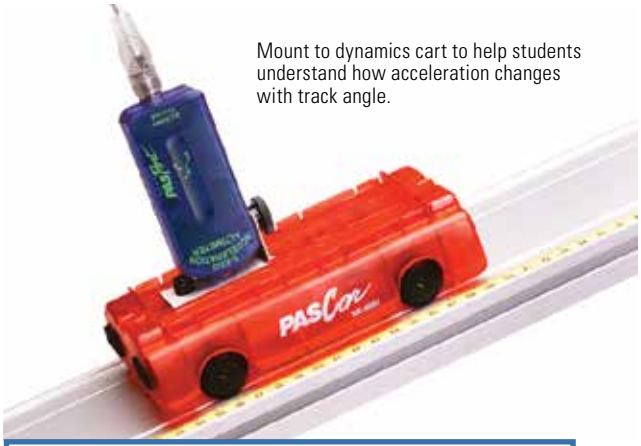
3-Axis Acceleration/Altimeter

PS-2136A

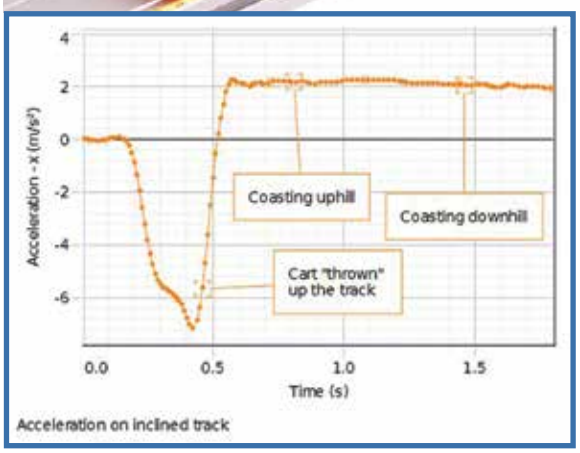
Includes cart mounting bracket, thumb screws, and Sensor Extension Cable.

Simultaneously measure changes in altitude and acceleration.

- Measures X, Y, and Z components of acceleration
- Automatically calculates magnitude of the resultant
- Choose units of m/s2 or g's
- Can measure altitude changes as small as 10 cm
- Measure 16 g with .002 g resolution accelerations
- Sample acceleration measurements up to 500 Hz
- Sample acceleration and altitude up to 100 Hz
- Altitude max sample rate 20 Hz



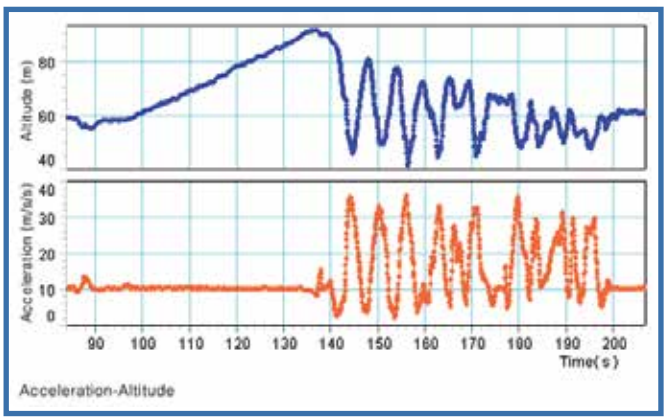
Mount to dynamics cart to help students understand how acceleration changes with track angle.



The cart acceleration parallel to the track is measured as the cart is "thrown" up the incline and allowed to coast up and back down the track.

The Teaching Advantage

- Easily mounted to PASCO carts for studying Newton's Laws
- 3-axis icon on the sensor indicates the location of the accelerometer



Acceleration and altitude data from a roller coaster.

PASCO's 5-Year Warranty

To withstand the rigors of student use, PASCO products are made of the highest quality materials. They are designed and manufactured by our team of education researchers and engineers in Roseville, California. And we back up our products with a 5-year warranty, so you can be completely confident about buying PASCO solutions.

Visual Accelerometer

PS-2128

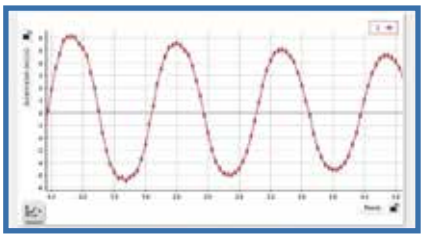
Includes plastic screws for attaching to a PASCO cart, Sensor Extension Cable, and 3 AA batteries.

What can be hard to explain can be easy to show with the Visual Accelerometer. Introduce linear acceleration, centripetal acceleration and forces, and learn about simple harmonic motion. Measure the acceleration while riding an elevator.

The Teaching Advantage

- Three selectable ranges, so both gentle and sudden accelerations can be analyzed.
- Auto-scale setting 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.
- Students can clearly see direction of acceleration in relation to the cart's motion.

Mounts directly to PASCO dynamics carts.



Clear data combined with the built-in visual cues to reinforce student understanding.

See and measure the lateral acceleration involved in simple harmonic motion.

Wireless Solutions

for iOS, Android™, Chrome™, Mac® and PC devices

Have devices for your science program and just need to connect sensors?

No problem. We have the simple answer. It's the same solution, whatever device you use. Select our AirLink or SPARKlink Air and connect any PASPORT sensor to your existing tablets. Then download SPARKvue for iOS and Android devices.

AirLink PS-3200

The new AirLink connects any PASPORT sensor directly to your devices via Bluetooth®. Now, when you use this AirLink, you can perform experiments that were difficult or impossible before and transmit the data directly to your mobile devices. And using the AirLink will simplify your lab setup by removing the clutter of cables.

SPARKlink® Air PS-2011

Two sensor ports for connecting sensors to your computer and mobile devices via USB or Bluetooth® make the SPARKlink Air ideal for schools with computers, tablets, or a mixture of both.

SPARKvue®

Download on the App Store

ANDROID APP ON Google play

Download SPARKvue for free! It brings real-time sensor data collection, visualization and analysis for inquiry-based science to your iPad, Chromebook, or Android tablet.

See page 5 for more information.

Blood Pressure Sensor

PS-2207

All models include a sensor and an arm cuff with inflation bulb.

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.

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

Breath Rate Sensor

PS-2187

Includes Masks (10) and Clips (10).

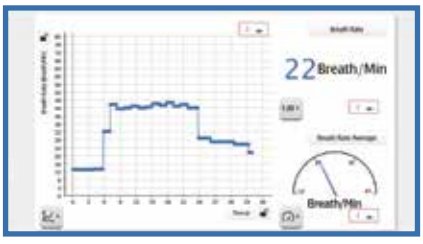
Also available:
Replacement Masks (10 Pack) PS-2567
Replacement Clips (10 Pack) PS-2568

Measuring breath rate is as easy as breathing. Study physical fitness by measuring breath 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.



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

Charge Sensor

PS-2132

Includes 0.9 m shield cable with alligator clips.

Measure the amount and the polarity of electric charge present. Demonstrate and measure charging by induction, use 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

Immediately see the polarity and the quantity of charge present on an object.

Wireless CO_2 Sensor

PS-3208

Includes 250-ml sampling bottle and USB charging cable.

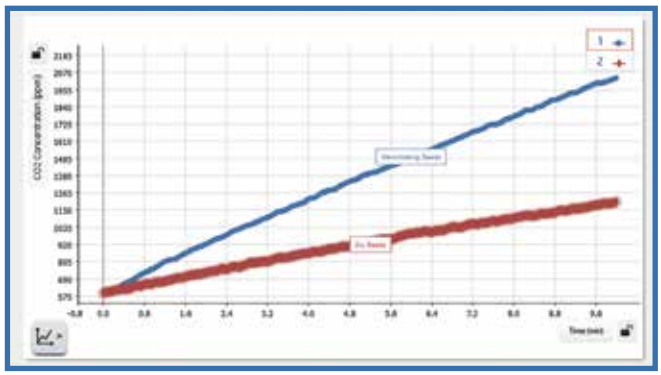
Also available:

Dissolved CO_2 Waterproof Sleeve PS-3545

Use this wireless sensor to measure the concentration of CO_2 gas in a closed system or open environment. Study core topics (including photosynthesis, respiration, and carbon cycling) with this versatile probe. CO_2 data can be logged directly on the device for long-term life science and environmental science studies.

Features

- Includes remote logging on your device.



Directly compare separate controlled environments.

Wireless Colorimeter and Turbidity

NEW

PS-3215

Includes 10 cuvettes, 1 turbidity calibration standard (100 NTU), 2 cuvette racks and USB charging cable.

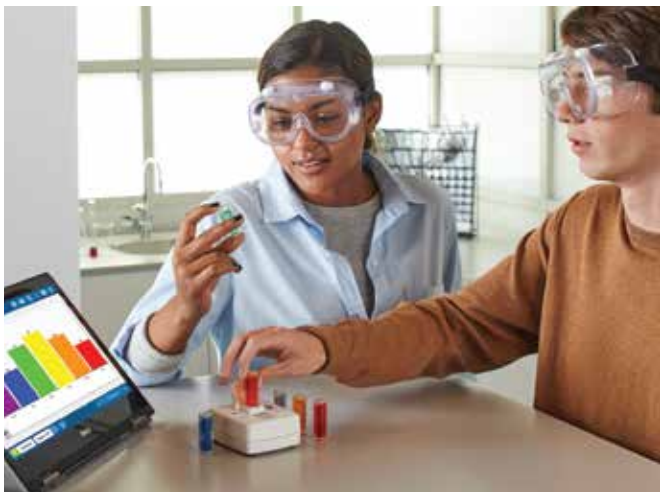
Also available:

Spectrometer/Colorimeter Cuvettes SE-8739

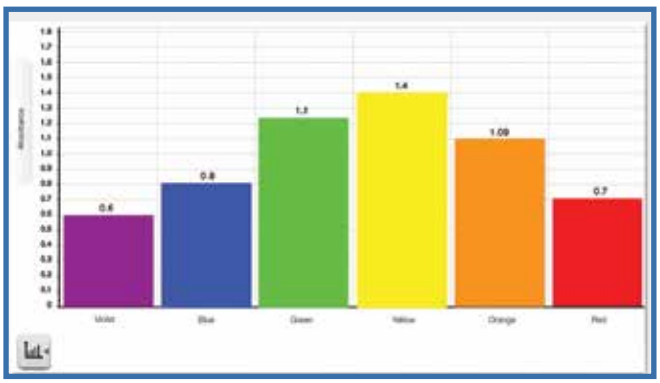
Determine the concentration of a solution with ease. Study absorbance vs. concentration to explore Beer's Law, and measure chemical rates of reaction.

The Teaching Advantage

- Simultaneous data collection in six 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.



Set up in seconds and collect individual measurements with ease.



Determine the relationship between absorbance and concentration.

Wireless Conductivity Sensor

PS-3210

Includes 1 coin cell battery.

Use the Wireless Conductivity Sensor to measure the electrical conductivity of a water solution. With this wireless sensor you can investigate the properties of solutions, as well as model and measure water quality.

Features

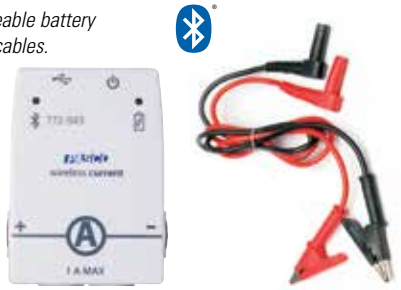
- Measure both conductivity and total dissolved solids
- Automatic temperature compensation
- Dust- and sand-proof and water-resistant (1 meter for 30 minutes)
- Battery life >1 year
- Remote logging

Measure the conductivity of water and water-based solutions.

Wireless Current Sensor

PS-3212

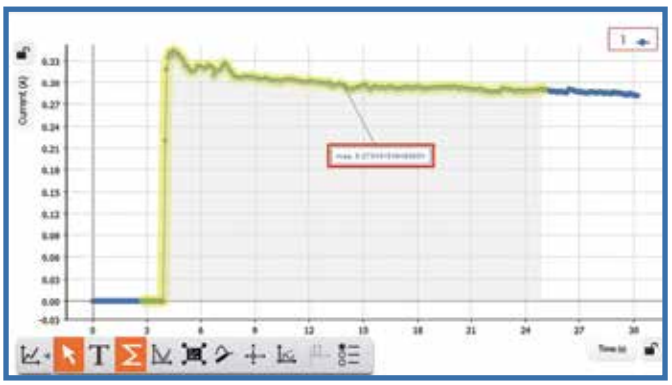
Includes rechargeable battery and banana-clip cables.



This sensor's wide current range allows for introductory and advanced explorations of the fundamental concepts of electricity and basic circuits.

Features

- Range ±1A
- Bluetooth® sampling rate of 1 kHz
- High-speed sampling via USB; 100 kHz burst mode
- Includes remote logging on your device



Optical Dissolved Oxygen Sensor

PS-2196

Also available:

Optical Dissolved Oxygen Sensor Metal Guard

The stainless steel metal guard protects the probe tip from damage and weighs down the probe for making measurements at depth.

PS-2588

Optical Dissolved Oxygen Sensor Cap

This replacement sensor cap has a 12-month warranty.

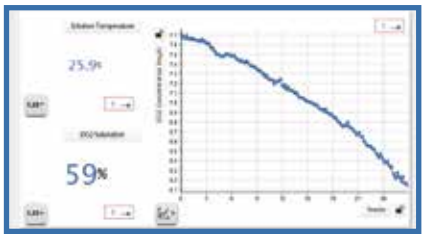
PS-2587

PASCO's Optical Dissolved Oxygen Sensor makes it easier than ever before to measure dissolved oxygen in the field or in a lab environment. The luminescent technology has several advantages over a galvanic dissolved oxygen sensor, including:

- There is no warm-up time.
- No calibration is required
- It is low maintenance (no filling solution and electrode polishing)
- There is a built-in temperature and pressure compensation

Specifications

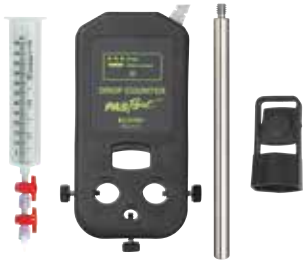
Cable Length: 3 m
Response Time: 90% in 25 sec
Operating Temperature: 0–50°C
Operating Pressure: 375–825 mmHg
Range: 0–20 mg/L or 0–300% saturation
Accuracy: ±0.6 mg/L or ±3.0% out of box
±0.1 mg/L or ±1.0%, whichever is greater after calibration
Above 200% ± 10%



High-Accuracy Drop Counter

PS-2117

Includes Drop Dispenser and Micro Stir Bar plus a stainless steel sensor rod for easy attachment to a ring stand.



Also available:

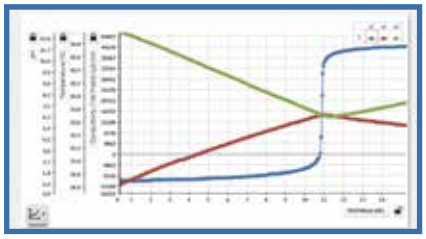
Drop Dispenser PS-6935

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

- IR filter assures accurate counts because room lighting cannot affect results
- Sensor unit can suspend up to three other probes in solution, simplifying many experiments
- Wider drop window (18x13mm) means better drop detection and easier alignment with burettes

Integrated probe-management makes titration setup a snap.



Perform simultaneous pH, conductivity, and temperature titrations using the Wireless pH Sensor and the Drop Counter.

Heater-Stirrer

NEW

PS-3401

Includes support rod.

This compact heater-stirrer is an essential for any lab! The white ceramic top is ideal for heating and for seeing color changes when mixing solutions. It has been designed to withstand spills. Its safety features include warning labels and indicator LEDs. The included rod makes it easy to support sensors.

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.

The Teaching Advantage

- Magnet is completely sealed to prevent damage from chemicals
- Allows study of solutions in micro-quantities

EKG Sensor

PS-2111

Includes 100 self-adhesive electrode patches.

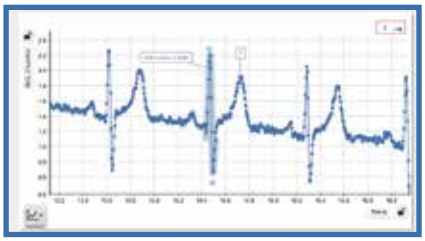
Also available:
EKG Sensor Electrode Patches (100-pack; one-year shelf life) CI-6620

Take the mystery out of that old medical show staple by letting students measure and record the electrical signals produced by the heart. Students can use it to measure their own 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 setup and quick data collection make 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.

Ethanol Sensor

PS-2194

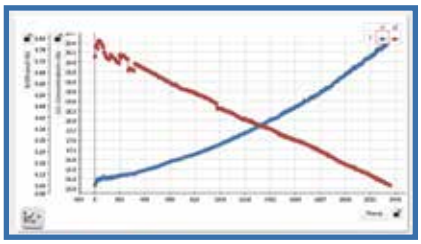
Includes probe and PTFE tape.

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.

EXPLORE BLOOD PRESSURE

Round out your exploration of the circulatory system with our Blood Pressure Sensor.

For more information, see pages 24 and 142.

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 field use.

Collect data safely from the shore with the telescoping handle.

The built-in temperature sensor is located next to the impeller to better correlate temperature and flow rate data.

Force Platform

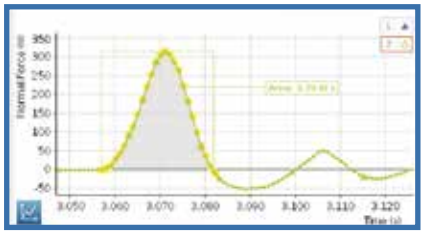
PS-2141

Measure large forces applied over a wide 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 Third 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

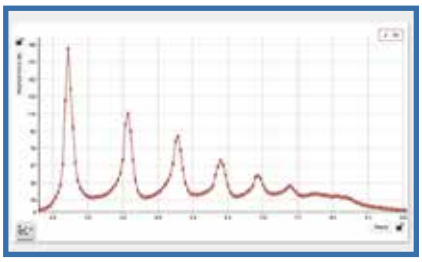
PS-2142

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 platform 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.

Wireless Force Acceleration Sensor

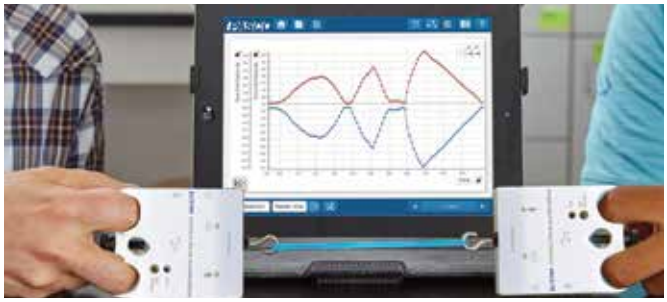
PS-3202

Includes 1 eye bolt, 1 thumb screw, 1 bumper, a lithium-ion battery, and a USB connector.

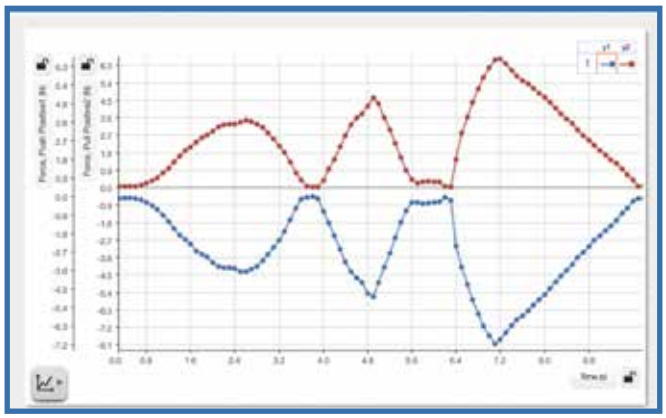
Capable of measuring force, acceleration, and rotation, this sensor is ideal for experiments involving rotating platforms, moving carts, spring oscillations, collisions, and impulse. The wireless design offers improved measurements without a cable affecting experiment outcome. Finger-holes support handheld applications, or mount it onto a cart or rod.

The Teaching Advantage

- Simultaneously measures force and acceleration. Measures acceleration in x, y, and z axes and resultant acceleration. Built-in gyroscope measures rotation.
- Features convenient Bluetooth® wireless connectivity and long-lasting rechargeable battery.
- Probe can be quickly zeroed through software for accurate taring.
- Logs force and acceleration data directly onto the sensor for long-term experiments.



When students are the force, Newton's Third Law is no longer a leap of faith.



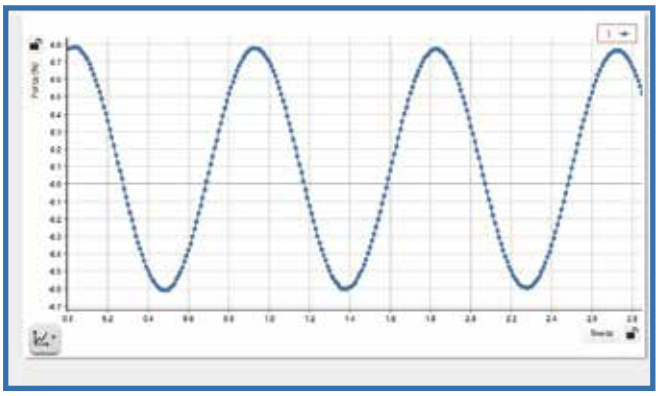
Directly compare action and reaction of forces.

High Resolution Force Sensor

PS-2189

This force sensor allows the student to measure smaller changes in force, such as forces exerted by an oscillating mass, the force of a swinging pendulum, or use it as a pan balance for long-term experiments with evaporating liquids.

Study simple harmonic motion.

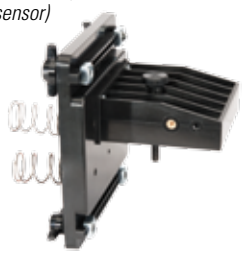


High resolution means even the smallest oscillations in force are captured with high fidelity.

Force Bracket

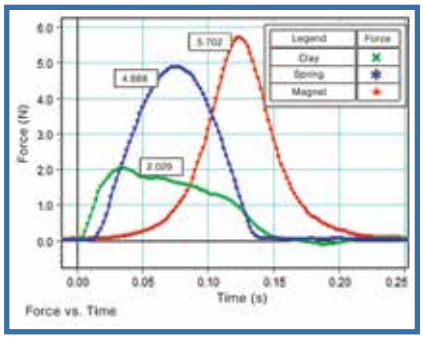
ME-6622

Includes spring bumpers (2) (different spring constants), magnetic bumper (1), rubber bumper (1), clay cup for inelastic collisions (1) (clay included), #0 Phillips head screwdriver (to attach to force sensor)



The Force Bracket with bumpers mounts the PASCO Force Sensor directly to a dynamics track. It includes 5 collision attachments for the Force Sensor and conveniently stores each attachment on the bracket itself.

Using any of these attachments, the bracket serves as an excellent support or target for collision studies using the Force Sensor.



Force vs. time data for a clay, spring and magnet.

Force Sensor Balance Stand

CI-6460

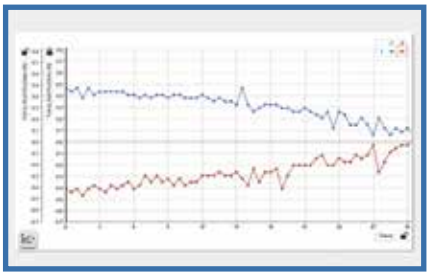
Includes Force Sensor stand and balance pan. Force Sensor sold separately.

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.

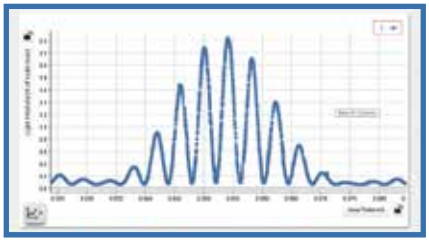
For outdoor use only!

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 V 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.

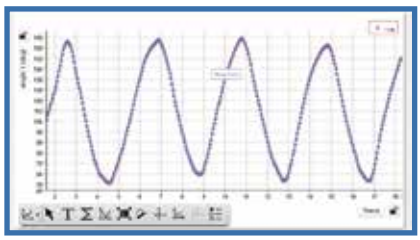
Measure two joints simultaneously. Just add an additional probe:
Goniometer Probe PS-2138
Includes probe and Velcro® connection kit.

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 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

Wireless Weather Sensor with GPS

NEW

PS-3209

Includes USB charging cable

The Wireless Weather Sensor is an all-in-one instrument for monitoring environmental conditions. By incorporating several sensing elements into a single unit, the sensor provides up to **17 different measurements!** Use the sensor in logging mode with the Weather Vane Accessory for long-term monitoring, or use it as a hand-held instrument to study microclimates and record ambient conditions relevant to many biological and environmental phenomena.

Specifications:

Battery: Rechargeable
Water-resistance: IP-64 splash-proof
(Please see pasco.com for detailed specifications.)

Equip your Wireless Weather Sensor for extended environmental monitoring with the Weather Vane Accessory. Once deployed the sensor will freely rotate to capture wind speed and direction, whether you are monitoring data in real time or using the sensor in logging mode to capture hours (or days!) of data for later analysis.

Weather Vane Accessory

NEW

PS-3553

Includes tripod, tripod adapter, and weather vane.

General Science Sensor

PS-2168

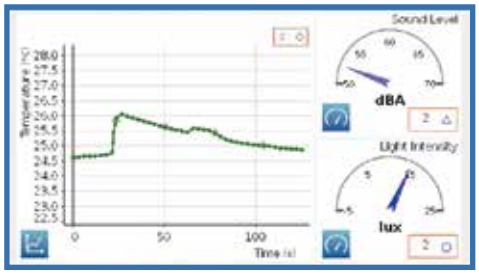
Includes built-in Light and Sound Sensors, Stainless Steel Temperature Probe and Voltage Probe.

Simultaneously measure temperature, light, sound level, and voltage — all with this 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 three selectable ranges for low, indoor, and outdoor measurements.



Collect and view different measurements at the same time.

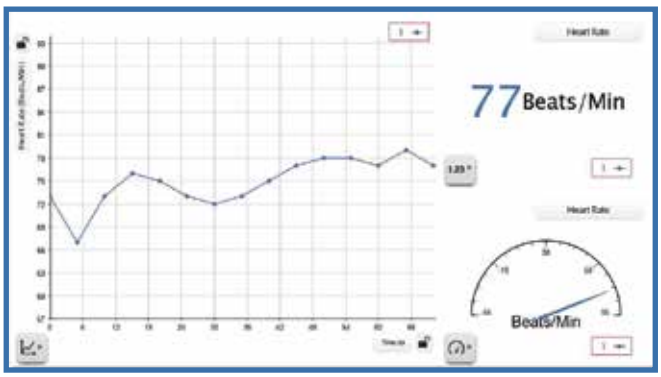
Wireless Hand-Grip Heart Rate Sensor

NEW

PS-3206

Includes hand-grips and Bluetooth® Heart Rate Module with one coin-cell battery.

Using the new wireless Hand-Grip Heart Rate Sensor, it's easier than ever before to conduct physiology labs on the cardiovascular system or homeostasis. Use this sensor for a quick and easy way to acquire wireless measurement for either continuous monitoring or initial vs. final data points.



Compare your heartbeat during a variety of activities.

Wireless Exercise Heart Rate Sensor

NEW

PS-3207

Includes Bluetooth® Heart Rate Module with one coin-cell battery and chest strap (M-XXL).

The Wireless Exercise Heart Rate Sensor has a chest strap and will transmit data wirelessly up to 10 m away!

A single data set shows heart rate before, during, and after exertion.

Wireless pH Sensor

PS-3204

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

This sensor measures the pH of a solution as discrete measurements or as a continuous reading. Use the probe to study water quality, test household solutions, or perform high-resolution acid-base titrations.

The Teaching Advantage

- High resolution with low noise allows even subtle pH changes to be observed.
- Factory calibration lets students get right to data collection, with optional user calibration supported.
- Uses durable, accurate gel-filled Ag-Ag Cl electrode.
- Features convenient Bluetooth® wireless connectivity and long-lasting coin cell battery.
- Logs pH data directly onto the sensor for long-term experiments.

The versatile Wireless pH Sensor works as well in the field as in the lab.

Easily measure and compare the pH of common acids and bases.

Ion Selective Electrodes

Ammonium
PS-3516

Carbon Dioxide
PS-3517

Calcium
PS-3518

Chloride
PS-3519

Potassium
PS-3520

Nitrate
PS-3521

Each Ion Selective Electrode (ISE) includes a 2m cable.

Requires one of these:
Wireless pH Sensor PS-3204
Or
a PASPORT pH Amplifier

Also available:
Electrode Support PS-3505

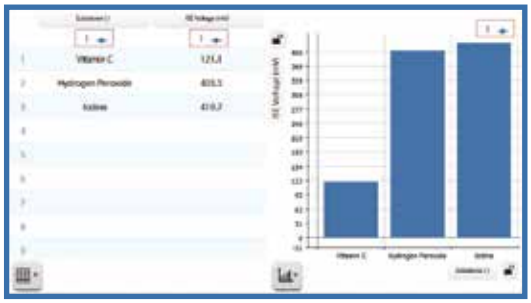
Oxidation Reduction Potential Probe

PS-3515

Requires one of these:
Wireless pH Sensor PS-3204
Or
a PASPORT pH Amplifier

Also available:
Electrode Support PS-3505

Use this probe to monitor solutions during oxidation-reduction titrations, perform water quality studies, and study the effects of water chlorination. This probe is not a standalone sensor. It connects to and requires an amplifier.



Quickly determine the overall tendency of a solution to gain or lose electrons.

Wireless Light Sensor

PS-3213

Includes 1 coin cell battery.

This wireless sensor is a great tool for explorations in Earth, Life, and Physical sciences. With its ambient light detector for illuminance and UV, and its directional detector for colors, your students can explore the electromagnectic spectrum, model planetary motion, and relate photosynthesis to light color and intensity.

Features

All these measurements in one!

- Illuminance (lux)
- UVA, UVB, and UV Index
- RGB color detection
- Battery life >1 year

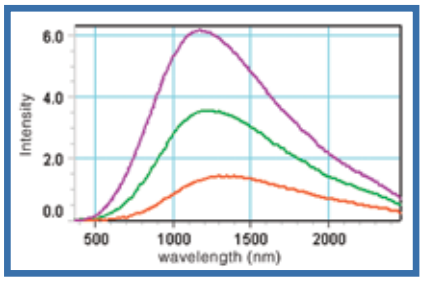
Broad Spectrum Light Sensor

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



Classic textbook diagram of the intensity versus wavelength blackbody curves.

Temperature/Sound Level/ Light Sensor

PS-2140

Includes Ambient Temperature, Light, and Sound Level Sensors.

Here are 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 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 shows how the sensor reads your world.

High Sensitivity Light Sensor

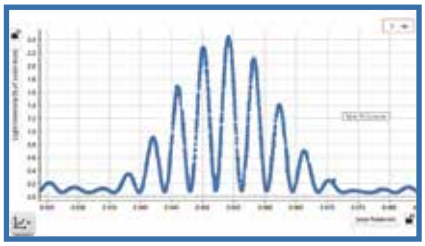
PS-2176

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

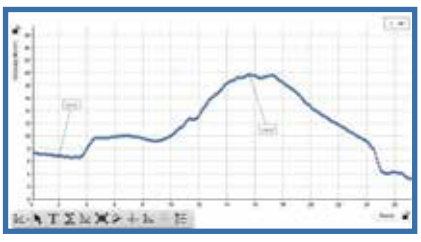
PS-2148

You can't see it, but 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.

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)

These 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.

Measure the stress and strain experienced by a structure in-line with the load cell amplifier.

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

100N Load Cell

PS-2200

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

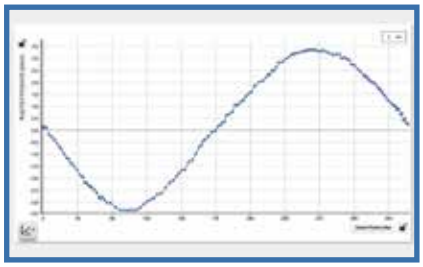
- Single-range sensitivity: ±1000 gauss
- Align sensor with magnetic field along length of probe until highest field strength displays

Measure the magnetic field generated by a current passing through a coil.

Simultaneously measure radial and axial field strengths. Map magnitude and direction from a bar magnet 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.

2-Axis Magnetic Field Sensor

PS-2162

Includes Sensor Extension Cable.

Recommended:
Zero Gauss Chamber EM-8652

Zero Gauss Chamber

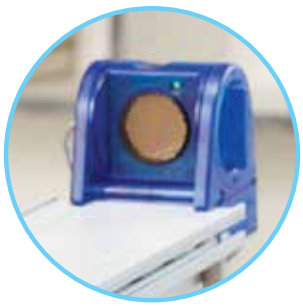
EM-8652

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.

Looking for the Magnetic Stirrer (SE-7700)? See page 145.

Motion Sensor

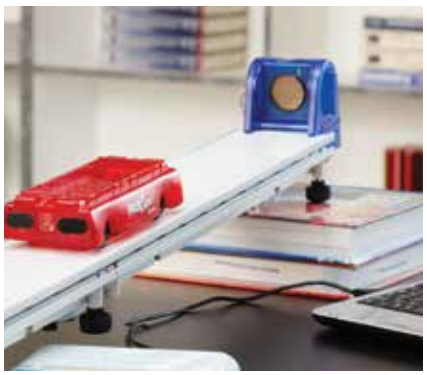
PS-2103A



Locked onto the end of our dynamics track

Standing flat on a table top

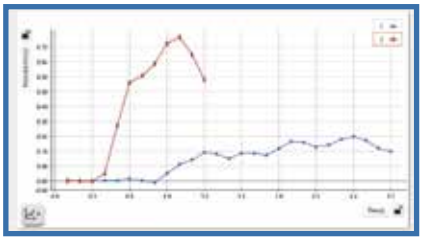
Mounted on a rod stand



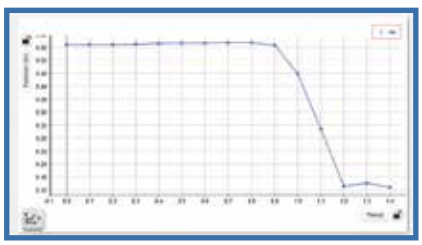
Integration of sensor and equipment makes changing the angle of incline a breeze.

Motion Sensor Guard

SE-7256



Comparing the acceleration of a cart down a track at different angles takes no time at all.



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

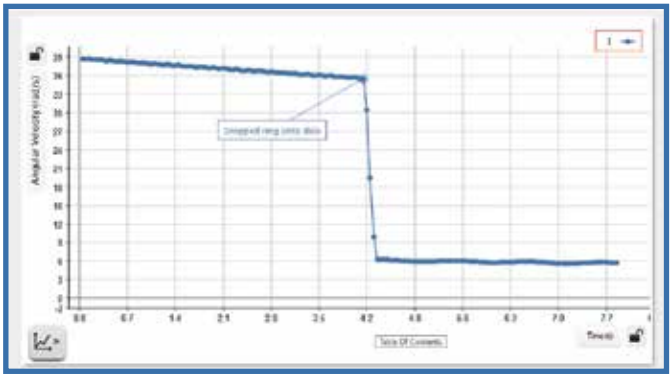
- Sensor's 0.09 degree resolution (about 4,000 points per revolution) allows highly precise angular measurements
- Sensor measures reliably up to 30 revolutions per second (which translates to a maximum linear speed of about 4.5 m/s)
- Attached rod clamp allows sensor to be mounted in almost any orientation

Rotary Motion Sensor

PS-2120A

Recommended:

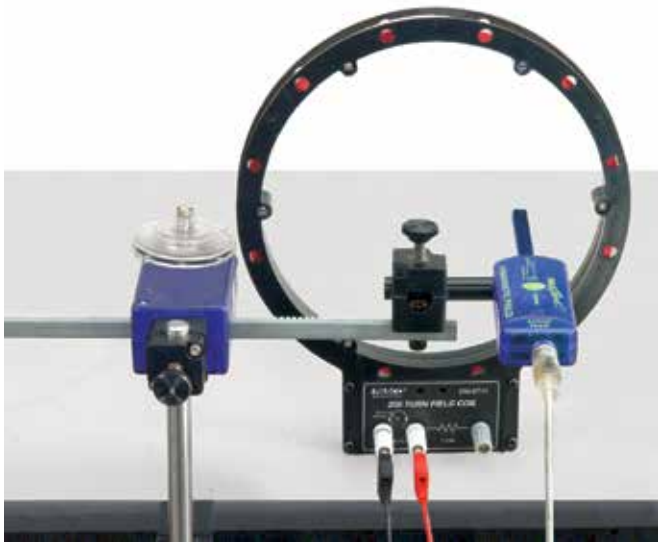
Linear Motion Accessory CI-6688A
Mini Rotational Accessory CI-6691
See applications below.



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.

Flat pH Probe

PS-3514

Connects to and requires a pH Sensor. Includes soaker bottle.

This pH probe gives you the freedom to measure what you want, where you want. Study pH levels in different kinds of foods, investigate the pH of common skin and hair care products, and easily collect pH data when doing soil analysis.

Whether your flat surface is a Petri dish or a slice of cheese, find the pH with a minimum of fuss.

The Flat pH Probe (above) requires one of the following:

Wireless pH Sensor PS-3204
Or
PASPORT pH Amplifier

Oxygen Gas Sensor

PS-2126A

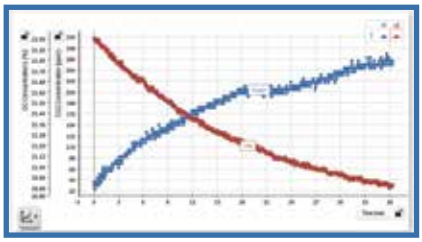
Includes integrated rubber stopper and 250 ml sampling bottle with cap.

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 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.



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

Wireless pH Sensor

PS-3204

Includes 1 coin cell battery and a direct-connect pH probe with storage bottle.

This sensor measures the pH of a solution as discrete measurements or as a continuous reading. Use the probe to study water quality, test household solutions, or perform high-resolution acid-base titrations.

The Teaching Advantage

- High resolution with low noise allows even subtle pH changes to be observed.
- Factory calibration lets students get right to data collection, with optional user calibration supported.
- Uses durable, accurate gel-filled Ag-Ag Cl electrode.
- Features convenient Bluetooth® wireless connectivity and long-lasting coin cell battery.
- Logs pH data directly onto the sensor for long-term experiments.

The versatile Wireless pH Sensor works as well in the field as in the lab.

Easily measure and compare the pH of common acids and bases.

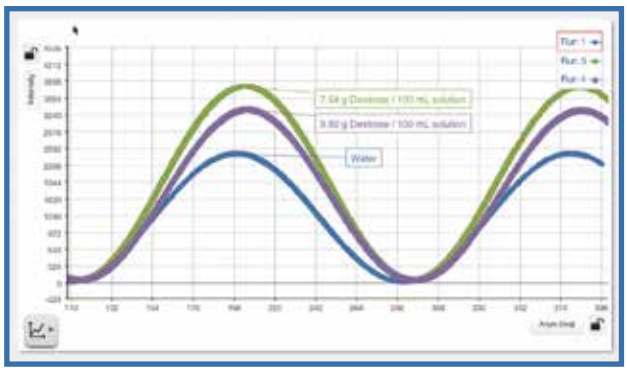
Polarimeter

PS-2235

Includes 1 Sample Cell

Also available:
Polarimetry Sample Cell Replacement
PS-2234

Determine the concentration of a sugar solution based on the optical rotation of plane polarized light.



Optical rotation of sucrose

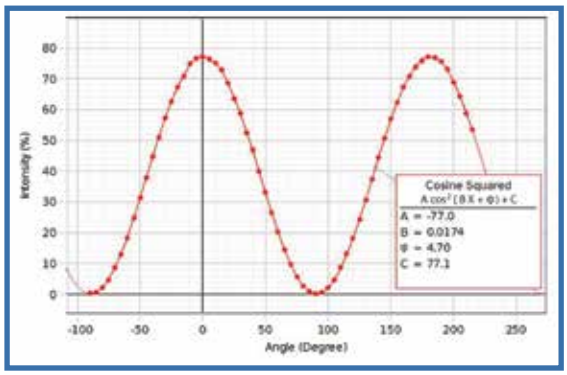
Polarizer Demonstrator

OS-9477A

Includes two round polarizer discs with stands.

Also available:
Polarizer Demonstrator Accessory OS-8172
Linear Polarizer (2-pack) OS-8549

Introduce the concept of polarization with this colorful and meaningful demonstration.



As the polarizer is rotated, the intensity of the light varies as the square of the cosine of the angle between the two polarizers.

Smart Gate

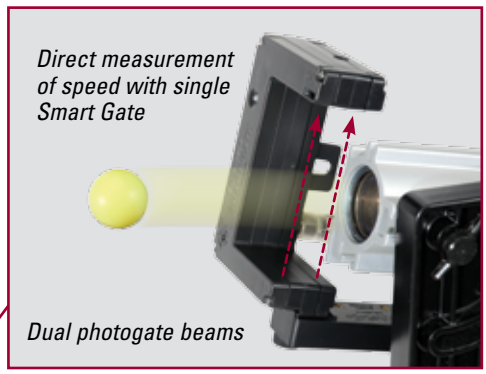
Four photogates in one!

- Dual Photogate beams
- Laser switch
- Photogate Tape Slot
- Daisy chain auxiliary Photogate or Time-of-Flight

The Smart Gate has dual Photogate beams spaced at 1.5 cm to accurately measure speed. Built-in laser switch (when used with any laser) allows you to time objects too large to fit through the standard Photogate. Other features include a slot for Photogate Tape, and an auxiliary port for an additional Photogate or the Time of Flight Accessory.

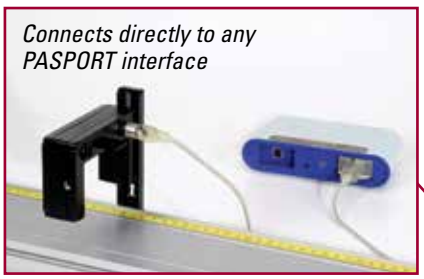
Slot for photogate tape

Auxiliary port for Time-of-Flight



Direct measurement of speed with single Smart Gate

Dual photogate beams



Connects directly to any PASPORT interface

Laser switch

Shine any laser onto the built-in receiver to time large objects

Smart Gate

PS-2180

Includes
Smart Gate
Cord

Recommended:
High Resolution Photogate Tape ME-6666

Smart Gate System

PS-3701

Needs only one PASPORT connection. Photogate daisy-chains to Smart Gate.

Includes Smart Gate: PS-2180
Photogate Head: ME-9498A

Smart Gate Pulley System

PS-3702

The Super Pulley attaches directly to the Smart Gate, providing a simple, low-friction system to measure position, velocity and acceleration. Additionally, with the pulley removed, the photogate can be used to perform standard photogate experiments.

Includes Smart Gate (1) PS-2180, Super Pulley (1) ME-9450A
Super Pulley Rod (1) ME-8736

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
- Connects to Smart Gate

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.

Time-of-Flight Accessory

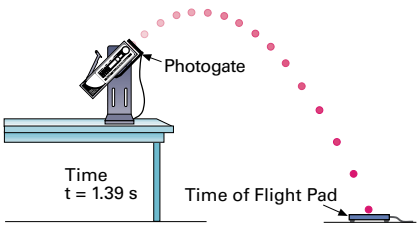
ME-6810A

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
- Connects to Smart Gate



Timing begins when the photogate beam is broken and ends when the projectile hits the pad and the signal is sent to the interface.

Photogate Tape, High Resolution

ME-6666

Includes
High Resolution
Photogate Tape (30m).

Required:
Smart Gate PS-2180

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.

Cart Picket Fences

ME-9804
(Set of 2)

Wireless Pressure Sensor

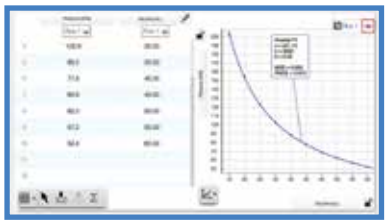
PS-3203

Includes 2 feet of polyurethane plastic tubing, 1 tube connector, 2 male barbed luer locks, 1 female barbed luer lock, 1 60cc syringe, a lithium-ion battery, and a USB connector.

With the new Wireless Pressure Sensor you can 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, you can study the Ideal Empirical Gas Laws.

The Teaching Advantage

- Measures pressure relative to an internal sealed reference vacuum, which allows the collection of reliable data even when the pressure within the system drops below ambient pressure.
- Supports common units (kPa, atm, psi, mmHg, or N/m2) for many applications.
- Features Bluetooth® wireless connectivity and long-lasting rechargeable battery.



With the included syringe, your students can easily quantify the relationship between pressure and volume.

A test tube, piece of steel wool, and a Wireless Pressure Sensor are all you need to have your students calculate the amount of oxygen in the air.

Dual Pressure Sensor

PS-2181

Includes 60cc syringe, tubing and quick-release connectors.

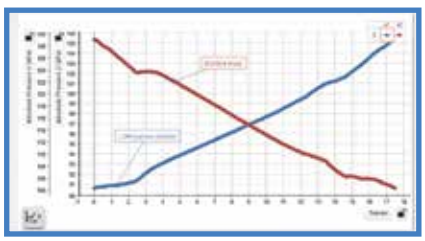
Also available:
Quad Pressure Sensor PS-2164

This sensor measures the 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.



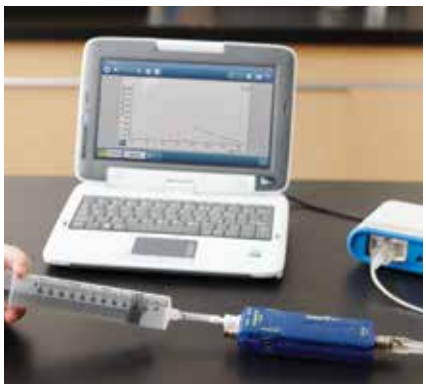
Simultaneously measure the pressure on both sides of the membrane.

Absolute Pressure/ Temperature Sensor

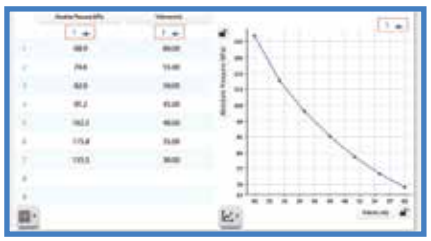
PS-2146

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. This sensor can be used to estimate absolute zero in common ˚C and ˚F scales.



Ideal for studying gas laws such as Boyle's Law.



Plot pressure versus volume to better understand their relationship.

Alpha Beta Gamma Radiation Sensor

PS-2166

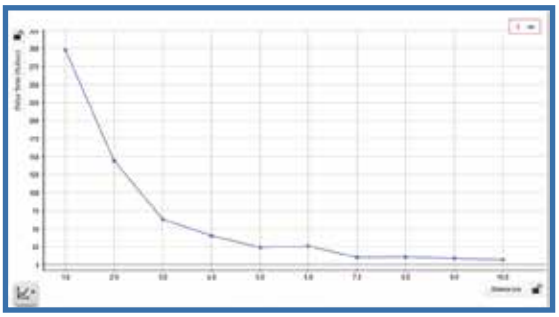
Includes Digital Adapter

Measure alpha, beta, and gamma radiation levels. Discover the relationship between radiation intensity and distance from the source. Use the 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).

***Note:** Purchased Sources are "Non-Cancellable" and "Non-Returnable".*
See Radioactive Source Disclaimer below.

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.

***Note:** Purchased Sources are "Non-Cancellable" and "Non-Returnable".*
See Radioactive Source Disclaimer below.

PASCO Radioactive Source Disclaimer –

Before purchasing PASCO radioactive sources:
Local, national, and international regulations may restrict the purchase, storage, transport, use or disposal of radioactive sources. Please consult your local regulations to ensure your compliance before you purchase radioactive sources.

PASCO advertised sources are direct shipped to customers from Spectrum Techniques (http://spectrumtechniques.com). Please review their "Terms and Conditions" page before purchasing. Once shipped, purchased sources are "Non-Cancellable" and "Non-Returnable". Radioactive sources cannot be returned under any circumstances including "End of Life" disposal.

Other/Misc: PASCO generally advertised sources are USNRC License Exempt (US only). International exempt sources (per the International Atomic Energy Agency) are available for international customers or by request.

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.

Salinity Sensor

PS-2195

The Salinity Sensor measures 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

Compare fresh and brackish samples quickly and easily.

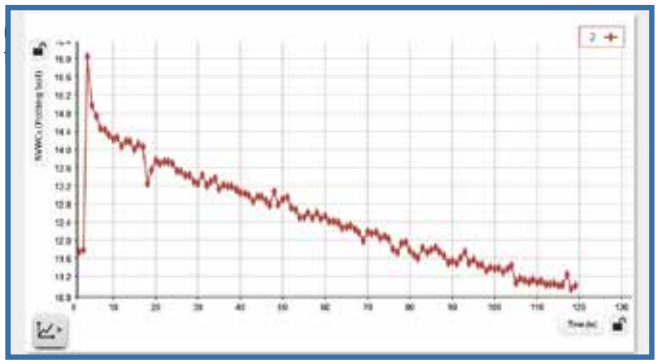
Soil Moisture Sensor

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



Soil moisture data over time shows evaporation.

Sound Level Sensor

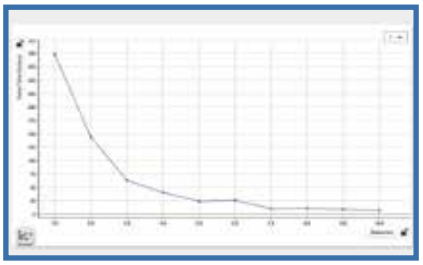
PS-2109

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.

Award-Winning Wireless Spectrometry for iPad®, Android™ Tablets, Chromebooks* and Computers

Measure intensity, absorbance, transmittance, and fluorescence.

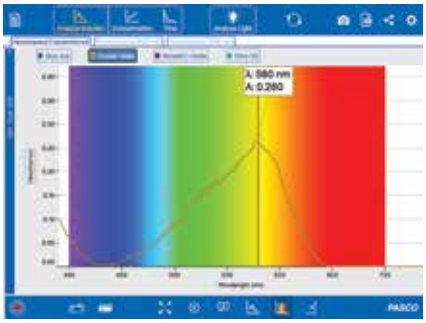
Now PASCO offers Bluetooth® spectrometry for your iPad and Android tablets! This new spectrometer from PASCO is specifically designed for introductory spectrometry experiments. The Bluetooth and USB connectivity enable use with your computers and tablets, making this a powerful and intuitive tool for your spectrometry needs. With this one apparatus you can measure intensity, absorbance, transmittance, and fluorescence.

You can perform these labs with the Wireless Spectrometer:

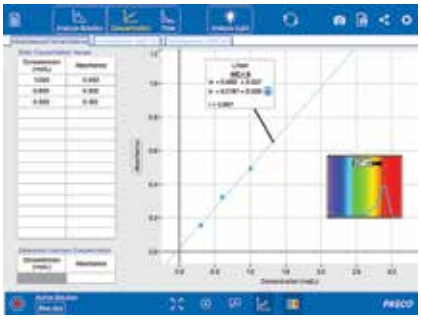
- Emission Spectra of Light
- Absorbance Spectra
- Beer's Law
- Kinetics
- Fluorescence

Wireless Spectrometer Specifications:

- Bluetooth and USB connectivity
- 2–3 nm FWHM resolution
- 380–950 nm range
- 2 fluorescence excitation wavelengths at 405 nm and 500 nm
- LED-boosted tungsten light source



Full visible spectrum analysis of solutions with a large digits display helps set the wavelength and see the absorbance.



Create Beer's Law plots to relate absorbance and concentration.

Wireless Spectrometer

PS-2600

Includes Wireless Spectrometer, 10 cuvettes, and Spectrometry software.

Also available:

Optional Fiber Optic Cable

PS-2601

The Wireless Spectrometer is compatible with **PASCO's new spectrometry software.**

- PC and Mac versions included with purchase.
- FREE for iOS and Android tablets.
- Designed specifically for introductory spectrometry experiments.

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//CODiE// 2015 SIIA CODiE FINALIST

bett AWARDS 2016 FINALIST

Spirometer

PS-2152

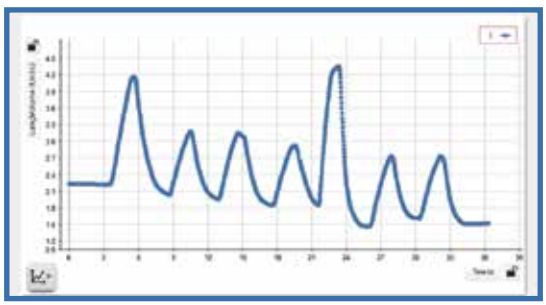
Also available:

Replacement Mouth Pieces (10)
PS-2522

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.

Wireless Temperature Sensor

PS-3201

Includes 1 coin cell battery.

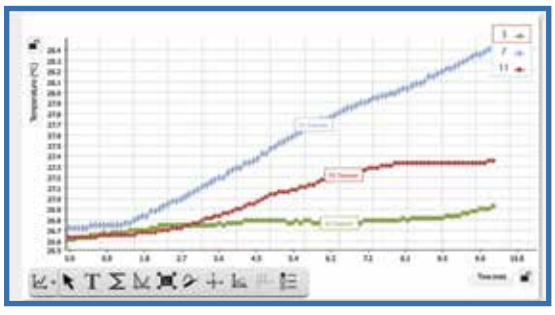
winner! 2016 AWARDS OF EXCELLENCE TECH & LEARNING

Students can access instant temperature readings and continuously monitor, log, and plot temperature data in SPARKvue on nearly any connected device. When class-time ends students can set the sensor to log data autonomously for days or weeks and then download the data for analysis.

The Teaching Advantage

- Simplicity: just pair and go
- Variable sampling rate
- Logs temperature data directly onto the sensor for long-term experiments.

The versatile Wireless Temperature Sensor works well, both in the lab and out of doors.



Easily compare the temperature in different environments.

Non-Contact Temperature Sensor

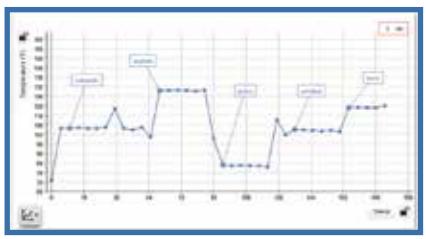
PS-2197

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 can create a temperature profile of a surface or building with the Non-Contact Temperature Sensor.



Temperature profile provides a great foundation for discussion of insulation, energy conservation, and more.

Skin/Surface Temperature Probe

PS-2131

Requires one of the following:

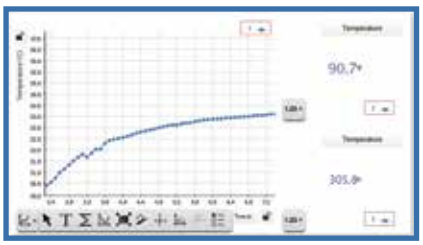
Temperature Sensor
PS-2125
Temperature/Sound Level/Light
PS-2140

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 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.

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.

Stainless Steel Temperature Probe

PS-2153

Requires one of the following:

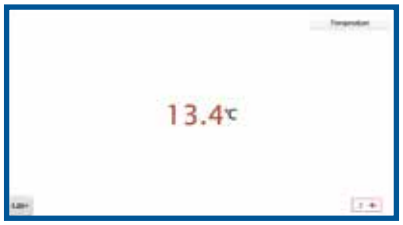
Temperature Sensor
PS-2125
Temperature/Sound Level/Light
PS-2140

Investigate melting and 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 temperature in the water or in the ground.



Compare temperature at the soil surface to temperature below the surface

Fast Response Temperature Probes

PS-2135 (3-pack)

Includes 10 adhesive patches.

Requires one of the following:

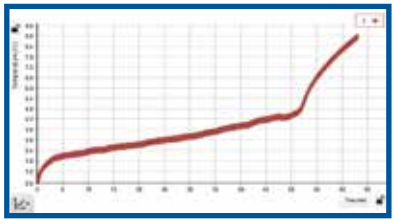
Temperature Sensor
PS-2125
Temperature/Sound Level/Light
PS-2140

Use with a Temperature Sensor to measure temperature in sensitive and fast-changing conditions, or 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).

Thermocline Sensor

PS-2151

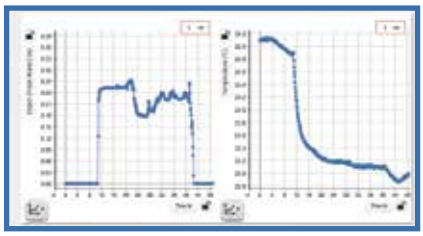
Includes Thermocline Sensor head.

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 freshwater vs. saltwater 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 m 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.

These sensors still available at pasco.com

- **Temperature (PS-2125)**
- **Quad Temperature (PS-2143)**
- **Type K Temperature (PS-2134)**
- **Voltage/Current (PS-2115)**

Wireless Colorimeter and Turbidity

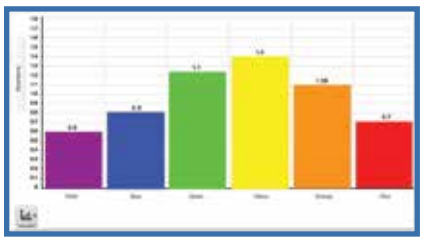
NEW

PS-3215

Includes 9 cuvettes, 1 turbidity standard calibration (100 NTU), 2 cuvette racks and USB charging cable.

The Wireless Colorimeter can measure absorbance and transmittance at six different wavelengths. Each wavelength represents a region of the ROYGBV color wheel. Measure the colors of a solution to introduce the principles of spectroscopy, relate absorbance to concentration, and study reaction rates. The colorimeter also functions as a turbidimeter for water quality analysis by measuring the scattering effect of suspended particles.

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.

Wireless Voltage Sensor

Explore energy and energy transformations with this Wireless Voltage Sensor. Use the sensor to:

- Measure the voltage of student constructed batteries and see how chemical energy can turn into electrical energy.
- Look at renewable energy by connecting to a wind turbine
- Track the flow of energy by creating simple circuits.

Use the Voltage Sensor to see how tilt angle is related to solar cell effectiveness.

Wireless Voltage Sensor

PS-3211

ezSample™ Snap Vial Kits

Ammonia EZ-2334
Chlorine EZ-2339A
Iron EZ-2331
Nitrate EZ-2333B
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.

The sample instantly flows into tube, mixing with the reagent.

Place the vial in your Water Quality Colorimeter and read the results.

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.

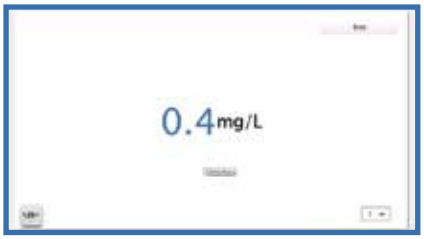
In this titration for Alkalinity, color initially changes to pink.

On final color change, turn titrator over and measure concentration using the built-in scale. That's it!

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

ezSample™ Field Titrator Kits

Alkalinity EZ-2340
Carbon Dioxide EZ-2341
Total Hardness EZ-2338

Required:
Water Quality Colorimeter PS-2179

Wireless Weather Sensor with GPS

NEW

PS-3209

Includes USB charging cable

Weather Vane Accessory

NEW

PS-3553

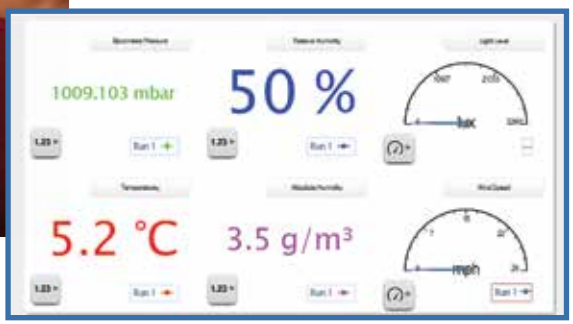
Includes tripod, tripod adapter, and weather vane.

The Wireless Weather Sensor is an all-in-one instrument for monitoring environmental conditions. By incorporating several sensing elements into a single unit, the sensor provides up to **17 different measurements!** Use the sensor in logging mode with the Weather Vane Accessory for long-term monitoring, or use it as a hand-held instrument to study microclimates and record ambient conditions relevant to many biological and environmental phenomena.

Specifications:

Battery: Rechargeable
Water-resistance: IP-64 splash-proof
(Please see pasco.com for detailed specifications.)

Use the Wireless Weather Sensor with GPS to find your position and your local weather conditions.



The Wireless Weather Sensor can take 17 different measurements simultaneously.

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

Sensor Extension Cable

PS-2500

2 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 length.

Replacement Items

Advanced Water Quality
Optical Dissolved Oxygen Sensor Cap PS-2587

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

Optical Dissolved Oxygen
Metal Guard PS-2588
Sensor Cap PS-2587

EKG
Electrode Patches (100 pack) CI-6620

Exercise Heart Rate
Transmitter and Belt PS-2512A

Field Mapper Kit
Conductive paper
w/grid PK-9025B
no grid PK-9026

High Accuracy Drop Counter
Drop Dispenser PS-6935

Oxygen Gas
Oxygen Gas Probe PS-6524

pH
pH Electrode PS-2573

Photogate Tape
High Resolution Tape (30m) ME-6666

Polarimeter
Sample Cell Replacement PS-2234

Spirometer
Mouth Pieces (10 pack) PS-2522

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

Voltage
Voltage Probe PS-2165

EcoZone™ System

ME-6668

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

EcoChamber

ME-6667

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

Photosynthesis

PS-2521B

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

Metabolism Chamber

ME-6936

Includes 250 mL sampling bottle with cap.

Also available:
Metabolism Chamber 4 pack
SE-6938

Aquatic Productivity Bottles

ME-6937

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

To measure dissolved oxygen, the following is required:

Optical Dissolved Oxygen Sensor
PS-2196

Heater-Stirrer

NEW

PS-3401

Includes support rod.

The Heater-Stirrer is the new lab essential!

This compact heater-stirrer has a white ceramic top that is ideal for heating and for seeing color changes when mixing solutions. It has been designed to withstand spills. Its safety features include warning labels and indicator LEDs. And the included rod makes it easy to support sensors.

When used as a heater:

This compact new Heater-Stirrer can boil water in minutes. The ceramic top provides an even heating surface and the indicator LEDs let you know when the top is hot.

When used as a stirrer:

This new apparatus is great for mixing solutions. The white top makes color changes during titrations easy to see.

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 USB port on a computer (Mac or Windows) with SPARKvue version 1.3 or later.

ken-a-vision® Digital Monocular Comprehensive Scope

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 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 SKX Balances

SE-8823A (220 g)
SE-8756B (420 g)
SE-8757B (2200 g)
SE-8758B (8200 g)

Also available:

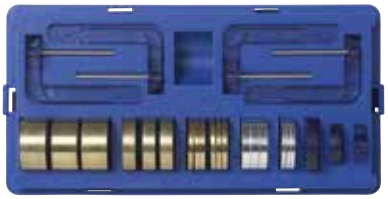
Ohaus Bluetooth Device Adapter SE-8822

Ohaus USB Device Adapter SE-8821

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%)

Mass and Hanger Set (200g)

ME-9337

Includes (ME-9350) cast aluminum mass hanger (200 gram), (ME-9351) set of four 200 gram brass masses. Diameter of masses: 5 cm; height of hanger: 16 cm; steel pin: 8 cm height, 3.6 mm diameter

Also available:

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.

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.

Right Angle Clamp

SE-9444

This standard right angle clamp fits rods up to 18 mm (11/16 inch) in diameter.

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.

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.

Table Clamp

ME-8995

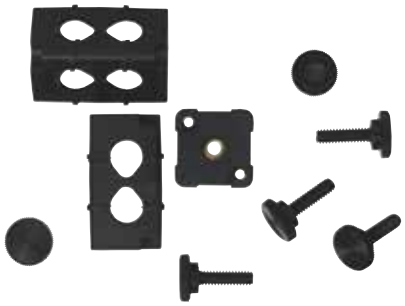
These rugged clamps are perfect for attaching a variety of objects to a table. Available in 8 cm and 10 cm sizes.

Also available:

Large "C" Clamp (6 pack) SE-7285

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.

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.

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

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.

⚠ WARNING
CHOKING HAZARD
Small parts. Not for children under 3 years.

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 Rod

Large Base and Support Rod

ME-9355

Large Base and Support Rod includes built-in leveling screws and a 45 cm threaded aluminum rod.

Educators Trust PASCO Professional Development...




PASCO's Professional Development provides teachers with the training, guidance, and innovative solutions they need to lead sensor-based science lessons. Our trainers are curriculum experts who model how to confidently guide students through inquiry-based science lessons.

PASCO training sessions are relevant for teachers at all grade levels. Trainings include classroom-ready activities aligned to STEM-based standards and national and state correlations for:

- *Elementary and Middle School sciences*
- *High school and higher education Biology, Chemistry, Earth Science, Environmental Science, Physical Science, and Physics*
- *Advanced, AP®, and IB® courses in Biology, Chemistry, Environmental Science, and Physics**

PASCO PD is fully customizable and tailored to your scope and sequence, so you get affordable training that fits your curriculum.

Our PD includes ongoing teacher support and a free follow-up webinar. PASCO PD isn't just a one-time workshop. Our trainers provide their ongoing support and expertise, whenever and wherever you need it.

"When educators learn, students learn more."

Hayes Mizell, in "Why Professional Development Matters."
Written for Learning Forward.
http://www.learningforward.org/docs/pdf/why_pd_matters_web.pdf

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What a PASCO Professional Development plan provides for you, your school, and your district...

1 Student-centered, classroom-ready lab activities for all the sciences

Our labs range from structured-inquiry to open-inquiry. They can be used on multiple platforms including iPad®, Android™ tablets, Chromebook™, and Mac®.

With them, teachers can:

- Integrate technology into the classroom, while showing students better ways to collect data.
- Engage students and make data meaningful for them while they *do* science.

2 Customizable delivery options and training formats that fit your needs

We custom-design the training to suit your individual requirements. Training programs include:

- Training onsite at your school
- Support in the classroom while you teach
- Webinar-based training
- Train-the-trainer
- Summer institutes

3 Skills development

PASCO's PD approach is to help you create a solid foundation for STEM success, as students develop these fundamental skills underlying science content standards:

- Critical thinking skills
- Procedural expertise
- Proficiency in design and construction of lab experiments
- Analytical skills
- Inquiry-based learning leading to science literacy

4 Skills necessary to implement your Science Standards

PASCO's trainers will show you how to use probeware to effectively engage students in scientific and engineering practices, while addressing disciplinary core ideas and crosscutting concepts.

— A —

— B —

— C —

— D —

— E —

— F —

— G —

— H —

— I —

— J-K —

— L —

— M —

— N —

— O —

— P —

— Q-R —

— S —

– T –

– U –

– V –

– W –

— X-Y-Z —

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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

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Business Hours:
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PASCO

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PASCO Mission

Providing educators worldwide with innovative solutions for teaching science

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