PHYSICS

TECHNOLOGY SOLUTIONS FOR PHYSICS

- LAB ACTIVITIES & CURRICULUM
- DATA COLLECTION SOFTWARE
- APPARATUS & EQUIPMENT
- WIRELESS SENSORS

Position

Velocity

SMART FAN ACCESSORY

PASCO
wireless smart cart

PASCO
wireless smart

SINCE 1964 **PASCO**®

Table of Contents

Physics Sensor Technology & Lab Equipment

Turn abstract physics concepts into tangible observations with world class solutions from PASCO
Our high-quality sensors, software, and labs empower students to think like real-life scientists as they form hypotheses, collect data, and perform analyses to make sense of the world around them. Plus, our sensors are compatible with most devices, enabling students to collect and display experimental data using a computer, laptop, Chromebook, tablet, or Bluetooth-enabled smartphone.

- Stream live sensor data to virtually any device.
- Contextualize measurements with a variety of graphical displays.
- Perform long-term studies by logging data to a sensor's on-board memory.
- Easily integrate new sensors or software with free webinar trainings, how-to videos, and technical support.
- Explore dozens of ready-made experiments for general, Honors, AP®, and IB® Physics courses, all available for free from the PASCO Experiment Library.
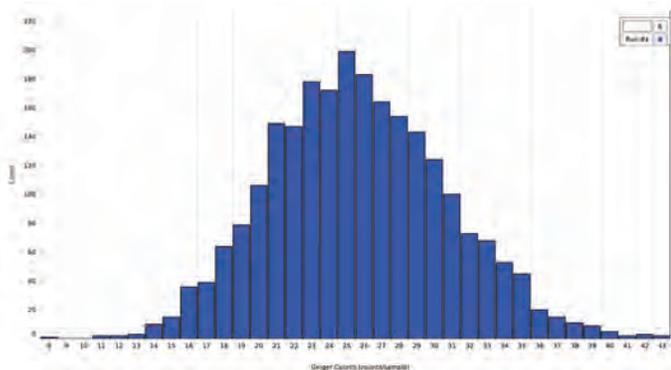
Deepen student understandings of core concepts, while developing key 21st-century skills with live, interactive data that streams to virtually any device.

Our growing line now includes over 30 Wireless Sensors!

800.772.8700 (inside US)   +1 916.786.3800 (outside US)

SPARK LXi2 Datalogger

PS-3600B

The SPARK LXi2 Datalogger is a Bluetooth, handheld datalogger that enables students to connect wired and Wireless sensors, collect data, generate graphs, and analyze results. It is durable, splash-proof, and works seamlessly with PASCO sensors. The SPARK LXi2 can simultaneously accommodate up to five wireless sensors, includes two ports for PASPORT sensors, as well as two ports for the included Fast Response Temperature Probe and Voltage Probe. It can be used with PASCO Wireless sensors, PASPORT sensors and an AirLink, the SPARKlink® Air, and the 550 Universal Interface.

Built for Student Use:

• Portable

• Rugged, shock-absorbing case

• 8" Color Capacitive Touchscreen (1280 x 800 pixels)

• 2 GHz Quad Core Processor, 2.0 GB RAM, 32 GB Memory

• Voltage and temperature sensor ports with included probes

The SPARK LXi2 features two PASPORT ports as well as ports for the included temperature and voltage probes.

Scan to learn more about the SPARK LXi2

SPARK LXi2 Datalogger.......................................PS-3600B

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550 Universal Interface

The 550 Universal Interface is fast, powerful, and incredibly affordable. The cost-effective 550 offers half the ports and many of the same features as our 850 Universal Interface, including both Bluetooth and USB connectivity. The 550 Universal Interface includes two PASPORT sensor ports, two digital sensor ports, two analog sensor ports, and a built-in signal generator.

The 550's two digital inputs are compatible with all ScienceWorkshop digital sensors, as well as timing devices, and photogates. The two analog ports connect with our analog ScienceWorkshop sensors and can support a 2.0 MHz max sampling rate and 1.22 mV resolution for voltage sensing.

The 550's built-in signal generator powers motors, speakers, circuits, and many other devices. With PASCO Capstone software and the 550, you can control various DC and AC waveforms, without requiring any other technology. The 550 provides 8 V at 400 mA, selectable voltage limits, built-in voltage and current measurements, and DC offset. Capstone software turns the 550 into a live oscilloscope that can display simultaneous traces.

Beyond having USB connectivity, the 550 can also send data wirelessly to any Bluetooth enabled computer, iPad, or Android tablet using PASCO Capstone or SPARKvue software.

Features:

• USB and Bluetooth connectivity

• 3.2 W power amplifier

• 2.0 MHz max sampling rate

• 100 kHz signal generator with built-in Voltage and Current sensors

• Compatible with PASPORT, ScienceWorkshop, and Wireless Sensors

• 2 high-speed analog inputs

• 2 digital inputs for photogates and other timing sensors

• 2 PASPORT sensor inputs

• Can be used simultaneously with other PASPORT interfaces

• Uses PASCO Capstone Software or SPARKvue Software

The 550 Universal Interface allows you to connect Science Workshop (analog), PASPORT (USB), and Wireless (Bluetooth®) sensors. It also includes a power amplifier and signal generator (not shown).

550 Universal Interface......................................UI-5001
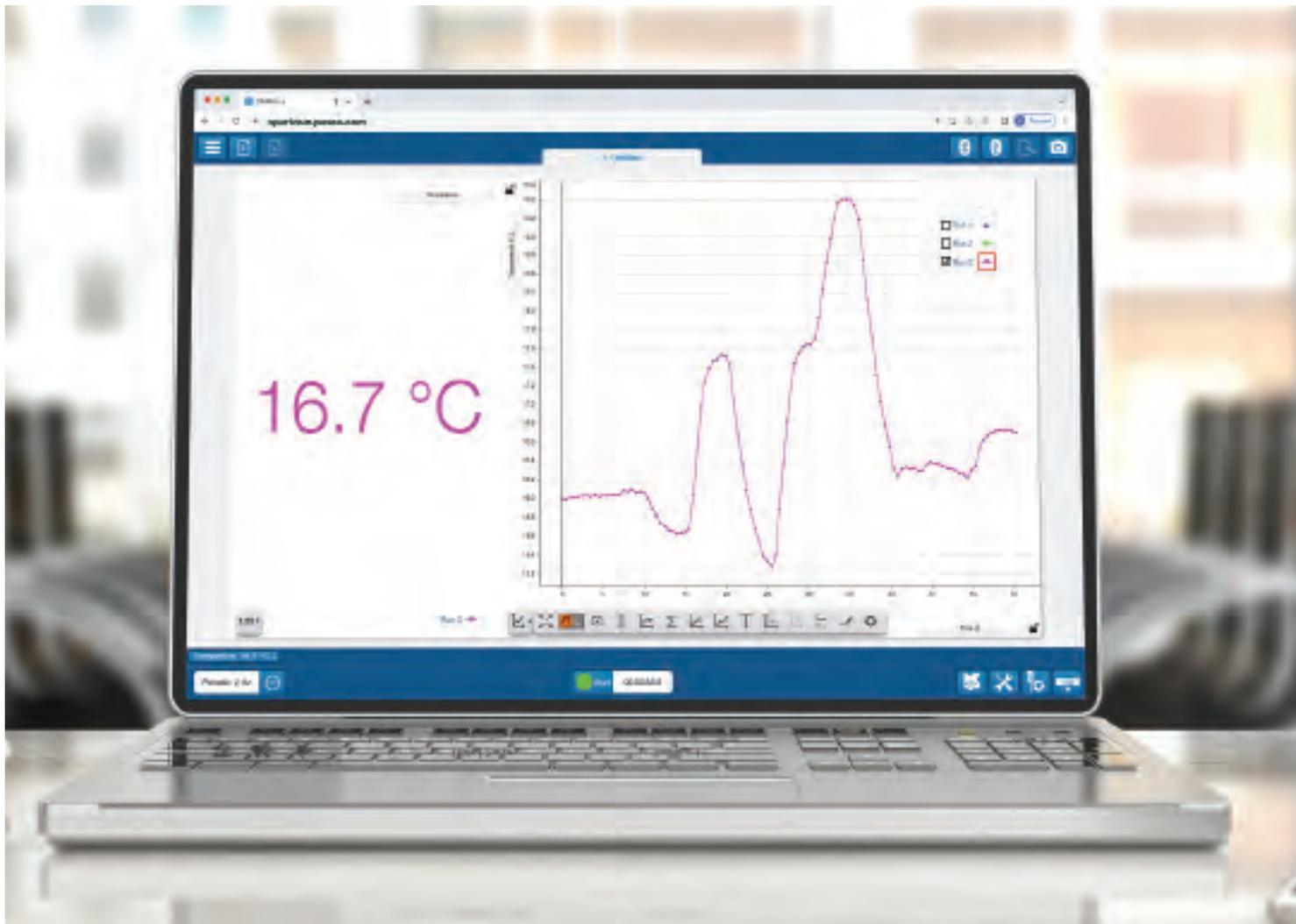
SPARKvue

This FREE award-winning data collection and analysis software works on any platform!

Windows • **Mac OS** • **iOS** • **chrome** • **ANDROID**

SPARKvue's intuitive design has made it an award-winning tool for collecting and analyzing experimental data. The user-friendly platform optimizes data collection and provides tools for in-depth analysis within a compact, yet powerful workspace.

SPARKvue features Blockly coding, allowing students to use block-based code for sense and control of PASCO devices, including any of our sensors.
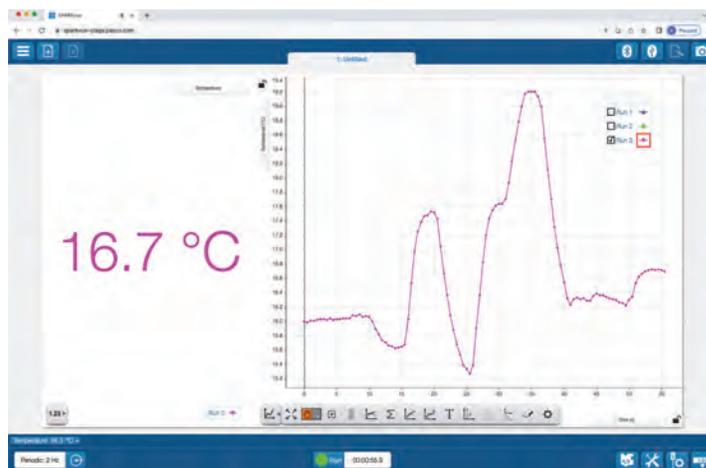
Student Data Collection...**MADE EASY!**

Student-Entered Data & Graphing
MADE EASY!

Choose manual data collection to record live values with the click of a button.

Make a mistake? No problem! Simply select a data point to replace it.

Student-Entered Data
Enter Data!
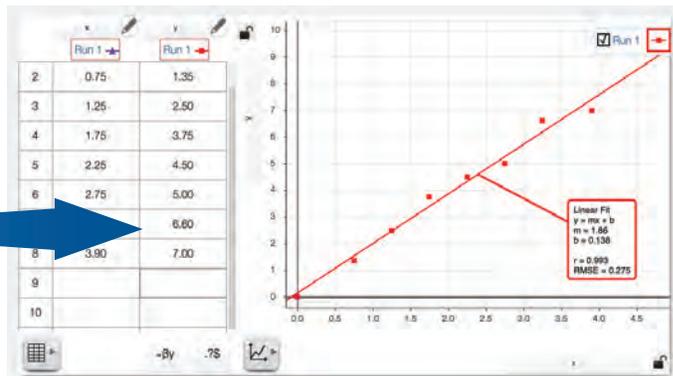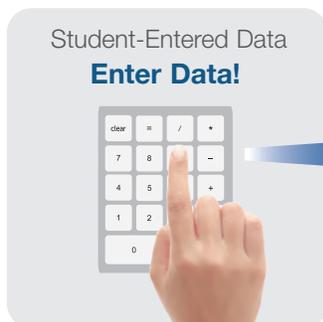
**Graph & Analyze Student-Entered Data**

Collecting & Graphing *Sensor* Data
MADE EASY!

Automate sensor data collection to monitor measurements in real-time.

Save time with pre-made experiment files or easily build your own displays. You and your students will be up and running in minutes.

Student Sensor Data
Connect & Collect!
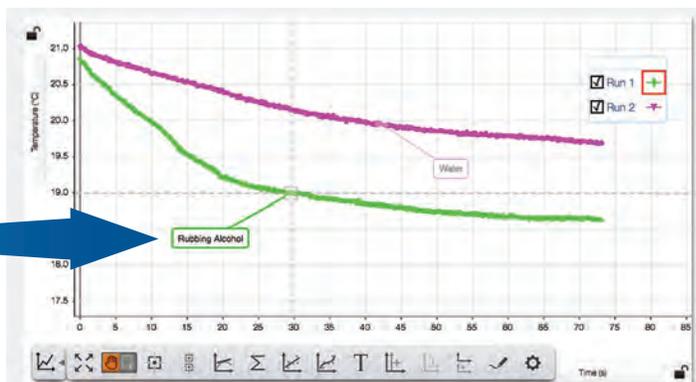
Rapid, Real-Time Data Collection & Analysis

Digits Display   Bar Graph Display   Meter Display   GIS Map Display

Free award winning data collection and analysis software now runs in your browser!

We're excited to announce SPARKvue is now available **FREE** of charge on all your devices as a browser-based application. This new version of our software as a Progressive Web Application (PWA) means you have free access to all the features of SPARKvue from Google Chrome and Microsoft Edge browsers. That's right: No download fees, subscription fees, or update fees, even for Windows® and Mac®. Plus, the app is always updated to the latest version automatically, so you never have to worry about it.

Go to sparkvue.pasco.com to access the PWA. SPARKvue is also available as a **FREE** app for Chromebook™, iPad®, Android™ tablets, and Apple® and Android™ smartphones.

∴ SPARKvue® Launch now as a Web App **PWA** + App Store | Available in the Chrome Web Store | ANDROID APP ON Google play

Looking for additional options? See pasco.com/sparkvue for more details.

Physics Lab Station: Mechanics Starter

The Physics Lab Station: Mechanics Starter bundle is a lab-ready solution for performing several key experiments in mechanics. It includes a sensor-loaded Smart Cart, a durable PAStrack, and a variety of accessories that support student studies of core topics such as velocity, conservation of energy, and Newton's second law.

Real-Time Sensor Measurements Students can use the Smart Cart's built-in sensors to make real-time measurements of position, velocity, acceleration, force, and rotation, displaying them as the lab unfolds for more meaningful learning. They can also collect and compare data from multiple trials, easily apply lines of fit, and perform statistical analysis using PASCO software.

Ready-Made Mechanics Labs This kit is complemented by a collection of ready-made experiments that can be downloaded for free from the Experiment Library. Each lab comes ready-to-use with editable student handouts, teacher answer keys, and helpful teaching tips.

Perform These Experiments:

- Average Speed and Velocity
- Graphing Motion
- Speed and Velocity Graphs
- Conservation of Energy
- Work and Kinetic Energy
- Newton's Second Law
- Coefficients of Friction
- Momentum and Impulse
- Periodic Motion: Mass and Spring

Mechanics Starter Equipment List

Equipment	Part #	Qty.
Smart Cart (red)	ME-1240	1
Smart Cart Rod Stand Adapter	ME-1244	1
Cart Mass (set of 2)	ME-6757A	2
PAStrack	ME-6960	1
Aluminum Meter Stick		1
Dynamics Track End Stop (2 pack)	ME-8971	1
Small "A" Base	ME-8976	1
Stainless Steel Rod, 60 cm Threaded	ME-8977	1
Mass & Hanger Set	ME-8979	1
IDS Spring Set	ME-8999	1
Super Pulley Kit	ME-9433	1
Angle Indicator	ME-9495A	1
Multi-Clamp	ME-9507	1
Friction Block	ME-9807	1
Track Rod Clamp	ME-9836	1
Bumper Accessory Set	ME-9884	1

Physics Lab Station: Mechanics Starter...............ME-5300

Physics Lab Station: Mechanics Extension

The Physics Lab Station: Mechanics Extension bundle expands your physics toolbox, allowing students to explore topics such as statics, rotation, projectile motion, and periodic motion. It includes an additional Smart Cart for studying collisions, a Mini Launcher for firing projectiles, and a Wireless Smart Gate for timing events accurately. A variety of accessories are also included.

Real-Time Sensor Measurements Students can use the Wireless Smart Gate and patented Smart Cart to monitor key measurements in real time, displaying them as the lab unfolds for more meaningful learning. Use the Smart Cart's built-in sensors to measure motion on or off the track, or time events with precision using the dual-beam Wireless Smart Gate. Students can also collect and compare data from multiple trials, easily apply lines of fit, and perform statistical analysis using PASCO software.

Ready-Made Mechanics Labs This kit is complemented by a collection of ready-made experiments that can be downloaded for free from the Experiment Library. Each lab comes ready-to-use with editable student handouts, teacher answer keys, and helpful teaching tips.

Perform These Experiments:

- Conservation of Momentum
- Momentum and Explosions
- Simple Pendulum
- Atwood's Machine
- Two Dimensional Motion: Projectiles
- Exploring Torque
- Exploring a Rotating System
- Momentum and Impulse
- Exploring Physical Pendulums

Mechanics Extension Equipment List

Equipment	Part #	Qty.
Smart Cart (Blue)	ME-1241	1
Photogate Mounting Bracket	ME-6821A	1
Mini Launcher	ME-6825B	1
Pivot	ME-7034	1
Meter Stick Torque Mass Hanger Set	ME-7035	1
Photogate Pendulum Set	ME-8752	1
Pendulum Clamp	ME-9506	1
Photogate Wireless Smart Gate	PS-3225	1

Physics Lab Station: Mechanics Extension ME-5301
Required:
 Physics Lab Station: Mechanics Starter....................ME-5300

Physics Lab Station: Fluids

The Physics Lab Station: Fluids bundle enables students to perform several essential experiments in fluids. It includes a Wireless Pressure Sensor for making measurements of pressure in liquids and gases. A Density Set and Overflow Can are included for measuring buoyant forces in fluids.

Real-Time Sensor Measurements Students can use the Wireless Pressure Sensor to make real-time measurements of pressure in liquids or gases, displaying them as the lab unfolds for more meaningful learning. They can also collect and compare data from multiple trials, easily apply statistics, and export their data using PASCO software.

Ready-Made Fluids Labs This kit is complemented by a collection of ready-made experiments that can be downloaded for free from the Experiment Library. Each lab comes ready-to-use with editable student handouts, teacher answer keys, and helpful teaching tips.

Perform These Experiments:
• Boyle's Law
• Hydrostatic Pressure
• Buoyant Force

Fluids Equipment List

Equipment	Part #	Qty.
Wireless Pressure Sensor	PS-3203	1
Density Set	ME-8569A	1
Overflow Can	SE-8568A	1

Physics Lab Station: Fluids....................................ME-2040
Required:
Physics Lab Station: Mechanics Starter................ME-5300

Physics Lab Station: Electricity and Magnetism

This lab-ready equipment set supports experiments in electricity and magnetism across all levels of physics. It includes Wireless Voltage, Current, and Magnetic Field Sensors, an Essential Physics Modular Circuits Kit, and an Electronic Components Kit.

Textbook Circuits for the Real World The Essential Physics Modular Circuits Kit brings 2D circuitry to the real world, allowing students to study and measure circuits using components that look like textbook models. Each square piece displays both the physical component (resistor, capacitor, etc.) and the schematic to help bridge the gap between circuit diagrams and functioning circuits.

Real-Time Measurements Students can use the Wireless Voltage and Current Sensors to make measurements anywhere in their circuit. Voltage and current readings are displayed in real time, allowing students to quickly compare and contrast different circuit configurations. They can also use PASCO software to collect and compare data, apply lines of fit, and perform statistical analysis.

Ready-Made Electricity & Magnetism Labs This kit is complemented by a collection of ready-made experiments that can be downloaded for free from the Experiment Library. Each lab comes ready-to-use with editable student handouts, teacher answer keys, and helpful teaching tips.

Perform These Experiments:

• Ohm's Law
• DC Circuits
• Capacitors and RC Circuits
• Magnetic Field of a Permanent Magnet
• Electromagnetic Induction
• Magnetic Field in a Coil
• Planck's Constant
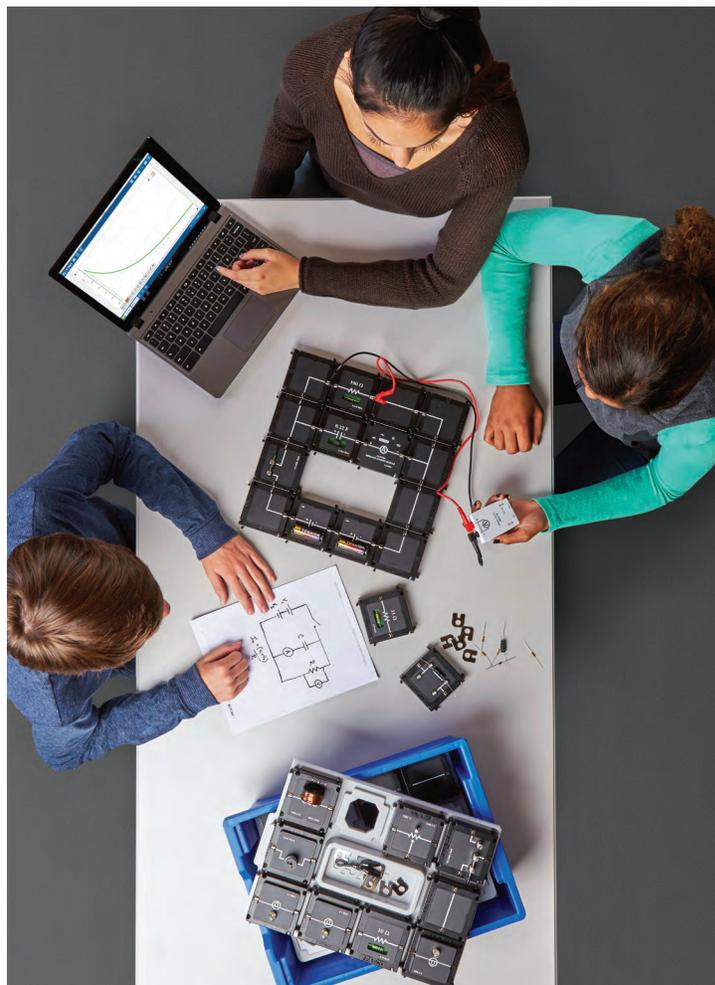
Electricity & Magnetism Equipment List

Equipment	Part #	Qty.
Essential Physics Modular Circuits Kit	EM-3536	1
Wireless Current Sensor Module*	EM-3534	1
Wireless Voltage Sensor*	PS-3211	1
Wireless Magnetic Field Sensor	PS-3221	1
Electronic Components Kit	EM-8818	1

* Included with EM-3536

Physics Lab Station: Electricity and Magnetism.........EM-3557

Physics Lab Station: Optics

The Physics Lab Station: Optics bundle is a lab-ready solution for performing a wide range of optics experiments – from introductory investigations of lenses to advanced experiments in Snell's Law. It includes a Basic Optics Ray Table, a Light Source, Concave and Convex Mirrors, and various lenses and accessories. The included equipment mounts easily to a PASCO Dynamics Track or a 1.2m Optics Track (sold separately) for hassle-free alignment.

Ready-Made Optics Labs This kit is complemented by a collection of ready-made experiments that can be downloaded for free from the Experiment Library. Each lab comes ready-to-use with editable student handouts, teacher answer keys, and helpful teaching tips.

Perform These Experiments:

- Spherical Mirror Reflection
- Snell's Law
- Focal Length of a Converging Lens
- Virtual Images
- Telescope and Microscope
- Shadows

Optics Equipment List

Equipment	Part #	Qty.
Concave/Convex Mirror	OS-8457	1
Basic Optics Viewing Screen	OS-8460	1
Basic Optics Ray Table	OS-8465	1
Basic Optics Light Source	OS-8470	1
Dynamics Track Optics Carriages (Set of 4)	OS-8472A	1
Basic Optics Geometric Lens Set	OS-8456	1
Accessory Lens Set	OS-8519	1

Physics Lab Station: Optics OS-8910
Required:
Physics Lab Station: Mechanics Starter................ME-5300
Or:
Optics Track, 1.2. m OS-8508

Physics Lab Station: Waves and Sound

The Physics Lab Station: Waves & Sound bundle is a lab-ready solution for performing a variety of experiments in waves and sound. It includes a 2-in-1 Wireless Sound Sensor, a complete Tuning Fork Technical Set, a high-quality Resonance Air Column, and a Double-Length Slinky.

Real-Time Sensor Measurements The Wireless Sound Sensor gives students unparalleled insight into the physics of sound and waves. Students can use the sensor to measure the frequency of a sound wave, and then visualize the waveform using PASCO software. Students can use the Double-Length Slinky to create a waveform with a partner, then use PASCO software to easily measure sound waves for further analysis.

Ready-Made Sound and Wave Labs This kit is complemented by a collection of ready-made experiments that can be downloaded for free from the Experiment Library. Each lab comes ready-to-use with editable student handouts, teacher answer keys, and helpful teaching tips.

Perform These Experiments:

- Resonance and Standing Waves
- Properties of Sound Waves
- Measuring the Speed of Sound
- Decoding DTMF Tones
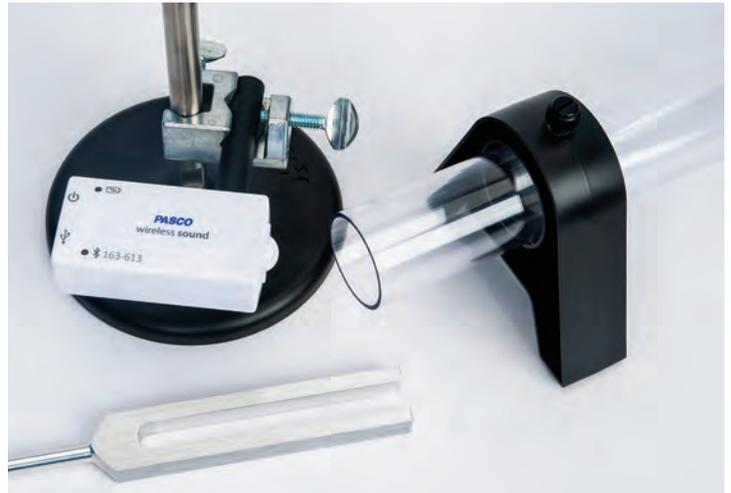
Waves and Sound Equipment List

Equipment	Part #	Qty.
Wireless Sound Sensor	PS-3227	1
Tuning Fork Technical Set	SE-7728	1
Resonance Air Column	WA-9606	1
Double-Length Slinky	SE-8760	1

Physics Lab Station: Waves and Sound WA-9515

Comprehensive Physics Solution – Essential Physics

PASCO's Essential Physics is the only curriculum solution that includes a Student Textbook, Student e-Book, Teacher e-Resources, Student Lab Manual, and Equipment Kits, all at a very affordable price. This 3-D STEM program includes a full year of instruction for both General and Honors Physics classes. Use our complete solution or integrate Essential Physics into your existing curriculum.

Student Textbook & Lab Investigations

- 27 chapters cover a full year of instruction for High School General and Honors Physics programs
- One main idea per page
- Quality illustrations
- Section and Chapter reviews
- 82 complete investigations
- 8 Engineering Design Projects

Student e-Book

- Browser-based version of the textbook
- Same layout with convenient 24/7 online access
- Embedded videos and animations bring content to life
- Interactive equations and simulations enrich key concepts
- Formative and summative assessment questions

Teacher e-Resources for Lab Manual

- SPARKvue software
- Editable documents
- PowerPoint presentations
- Answer keys
- Video lab assistance

Essential Physics is multi-platform and works on iOS, Android™, Chrome™, Windows®, and Mac®. What's more, it includes 24/7 online access, as well as correlations to NGSS and your state standards.

Teacher e-Resources for Textbook

- Infinite Test Bank
- Teacher User Guide
- Teacher e-Book (1-year or multi-year license)

Teacher e-Resources for Textbook

- Infinite Test Bank
- Teacher User Guide
- Teacher e-Book (1-year or multi-year license)
- Alignment details for NGSS and state standards

PASCO Academy Physics Resources

- Available through your PASCO Educator account
- 25 engaging video labs with detailed instruction and data collection
- 25 datasets for student analysis and discussion
- 25 editable lab handouts with teacher answer keys
- Digital access to more than 80 labs for General and Honors Physics

Essential Physics correlates with NGSS and is constructed around the three dimensions:

- Science and Engineering Practices
- Crosscutting Concepts
- Disciplinary Core Ideas

Textbook + e-Book + Equipment

Essential Physics Student Textbook
EP-6323

This rigorous yet accessible textbook includes core Physics topics that cover a complete year of instruction for both High School General and Honors Physics classes. The lessons follow the 5E model and include tools for ELL students, as well as tools for students with different learning styles. And the curriculum aligns to NGSS and your state standards for both regular and advanced coursework. The accessible textbook includes one main idea per page, quality illustrations, 89 complete investigations, eight Design Projects, and Section and Chapter Reviews. The 27 chapters cover these topics:

- Science of Physics
- Physical Quantities and Measurement
- Position and Velocity
- Acceleration
- Forces and Newton's Laws
- Motion in Two and Three Dimensions
- Circular Motion
- Static Equilibrium and Torque
- Work and Energy
- Conservation of Energy
- Momentum and Collisions
- Machines

- Angular Momentum
- Harmonic Motion
- Sound Waves
- Electricity and Circuits
- Electric and Magnetic Fields
- Electromagnetism
- Light and Reflection
- Refraction and Lenses
- Electromagnetic Radiation
- Properties of Matter
- Heat Transfer
- Thermodynamics
- Quantum Physics and the Atom
- Nuclear Physics

Essential Physics Student e-Book

The Student e-Book is an electronic version of the full textbook with interactive elements. Throughout the electronic text, content and theory are supported with optional audio reading, as well as interactive elements, such as digital equations, videos, animations, and simulations. Students also have the option of expanding the content using the 'more' button to go deeper into concepts.

Essential Physics Labs & PASCO Equipment Bundles
Use PASCO's Physics Lab Stations to perform the following hands-on investigations from *Essential Physics.*

ME-5300 Physics Lab Station: Mechanics Starter
- **1A:** Graphs of motion
- **3B:** Motion graphs
- **4A:** Acceleration
- **4B:** A model for accelerated motion
- **5A:** Newton's second law
- **5B:** Hooke's law
- **5C:** Static and kinetic friction
- **6C:** Acceleration on an inclined plane
- **9A:** Work and the force versus distance graph
- **10A:** Inclined plane and the conservation of energy
- **10B:** Work and energy
- **10C:** Springs and the conservation of energy
- **10D:** Work done by friction
- **11C:** Elastic collisions
- **12C:** Ramps and inclined planes

ME-5301 Physics Lab Station: Mechanics Extension
- **6B:** Projectile motion
- **11A:** Conservation of momentum
- **11B:** Inelastic collisions
- **14A:** Oscillators
- **14C:** Resonance

EM-3557 Physics Lab Station: Electricity and Magnetism
- **17A:** Electricity and circuits
- **17B:** Voltage and batteries
- **17C:** Resistors and Ohm's law
- **17D:** Series and parallel circuits
- **17E:** Electrical power
- **17F:** Compound circuits
- **18A:** Magnetic force between magnets

OS-8910 Physics Lab Station: Optics
- **20A:** Magnification of mirrors and lenses
- **20B:** Reflection in a plane mirror
- **20C:** Image formation for curved mirrors
- **21A:** Refraction of light
- **21B:** Creating real and virtual images with lenses
- **21C:** Image formation for a convex lens
- **21D:** Build a microscope and a telescope

WA-9515 Physics Lab Station: Waves and Sound
- **15A:** Waves
- **15C:** Interference
- **16D:** Resonance and Sound

Additionally, the following labs can be performed with the Simple Machines Kit (EP-3577):
- **8A:** Static equilibrium
- **12A:** Levers
- **12B:** Pulleys

Smart Cart (Red/Blue)

Patent Number 10,481,173

ME-1240/1241

The patented Smart Cart is the ultimate tool for studying kinematics, dynamics, Newton's Laws, and more. It is based on a durable ABS body with nearly frictionless wheels, just like our high quality PAScars. Now, we've added built-in sensors that measure force, position, velocity, and acceleration. The versatile Smart Cart can collect measurements on or off a track and transmit the data wirelessly over Bluetooth. In essence, it is a wireless dynamics cart that combines all the necessary sensors, without requiring any additional hardware.

Smart Carts are ideal for studying mechanics topics, such as kinematics and dynamics. The built-in load cells enable two Smart Carts to visually demonstrate Newton's Third Law with ease. Additionally, built-in sensors for force and acceleration enable students to investigate Newton's Second Law in minutes. Smart Carts truly are a physics lab on wheels, and now you can own the most advanced physics cart ever created, all without the restrictions of cables.

Features:

- Built-in ±100 N force sensor
- 3-axis accelerometer
- Bluetooth® connectivity
- Rechargeable battery
- Motion encoder measures position and velocity on or off the track

- Magnetic bumper for force sensor
- 3-position plunger
- Mass tray
- Velcro® tabs
- Force sensor hook and rubber bumper

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 Cart (Red)	ME-1240
Smart Cart (Blue)	ME-1241
Smart Cart Charging Garage	ME-1243

Smart Cart Demonstration Kits

ME-1272 (RED)/ME-1273 (BLUE)

The Red & Blue Smart Cart Demonstration Kits come with a Smart Cart and all the accessories you need to perform amazing physics demonstrations in kinematics and dynamics.

Includes:

- Smart Cart (red or blue)
- Smart Fan Accessory
- Two 250-g Cart Masses
- Smart Cart Rod Stand Adapter

- Ballistic Cart Accessory
- Smart Cart Vector Display
- Sail
- Gratnells Case
- Demonstration Manual

Red Smart Cart Demonstration Kit	ME-1272
Blue Smart Cart Demonstration Kit	ME-1273

Smart Ballistic Cart Accessory

ME-1245

The Smart Ballistic Cart Accessory mounts to any PASCO dynamics cart for a classic demonstration on the independence of X and Y motion. A projectile fired from the accessory while a cart is in motion will be caught farther down the track. When connected to a PASCO Smart Cart, the Smart Ballistic Accessory can launch the projectile based on measurements made by the Smart Cart in either SPARKvue or PASCO Capstone software.

Features:

• Push button timer delays the launch of the projectile until after the cart is pushed
• Release mechanism does not affect cart motion or ball flight path
• The barrel has X and Y adjustments, so perfect vertical projections can be produced every time.
• Connects to the Smart Cart for measurement-based launching conditions

Smart Ballistic Cart Accessory ME-1245

Smart Cart Vector Display

ME-1246

The Smart Cart Vector Display adds visual vectors to your Smart Cart for force, acceleration, or velocity. Connect it to the Smart Cart's accessory port to visualize vectors in real time! The arrows light up proportional to the sensor reading and indicate both magnitude and positive or negative direction.

Features:

• Choose from force, acceleration, or velocity vectors, and watch them in real time.
• Students can visualize constant acceleration as a cart rolls up and then down an incline.
• Great for the student lab station or a physics lecture demonstration!
• Selectable ranges

Smart Cart Vector Display ME-1246

Smart Fan Accessory   Patent Number 10,482,789

ME-1242

What makes this fan so smart? If you use this fan on a regular cart, you can turn it on and select one of three speeds by pushing the button on the side. But plugging it into a Smart Cart gives this Smart Fan Accessory added capabilities:

• **Hands-off Operation:** Turn the Smart Fan on and off wirelessly from your computing device.
• **Adjust the Thrust:** Move the slider in the software and watch the fan respond.
• **Reverse the Spin of the Fan:** Input a negative thrust to make the fan blow in the opposite direction.
• **Set Start and Stop Conditions:** Choose to start the fan when a measurement (such as position) reaches a certain value. Make the fan stop after a certain time, so the cart coasts during part of the experiment.
• **Sense and Control:** Program the Smart Fan thrust to respond to a calculation based on sensor measurements.

Smart Fan Accessory ME-1242

Smart Cart Motor

ME-1247

The Smart Cart Motor is a motor-driven wheel that attaches to the Smart Cart to make it go at a constant velocity, forwards or backwards. Connect the Motor to either SPARKvue or PASCO Capstone to control it remotely and adjust the power on a scale of -100 to +100%.

Smart Cart Motor ME-1247

For more information and specifications on these products, go to pasco.com/physics

*PASCO*bot
SENSE & CONTROL KIT

When nestled inside the PASCObot, the //control.Node serves as a brain, providing both power to the bot and memory storage for students' code.

Build your bot in minutes with simple components and connector pieces that bring power to its wheels.
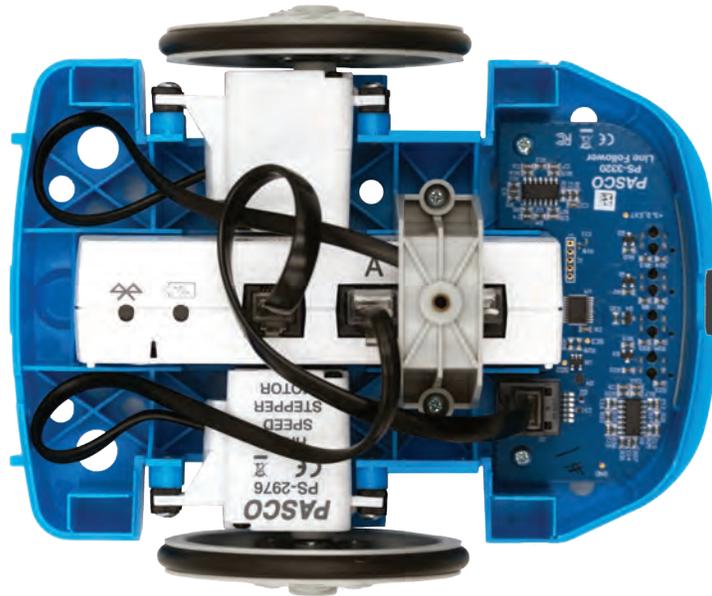
Navigate custom paths, obstacles, and more with code blocks that drive the bot forwards, backwards, or around corners and curves.
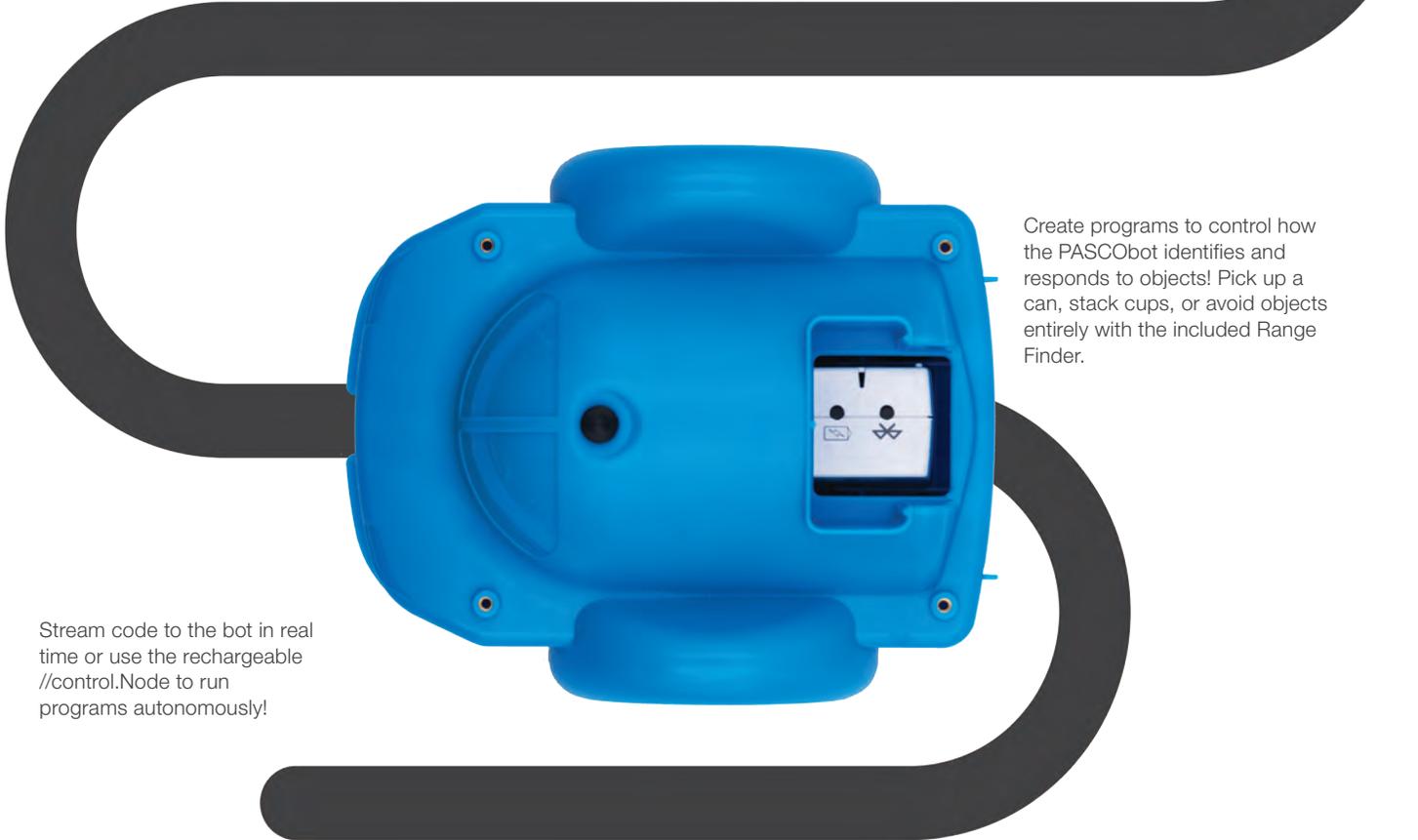
Create programs to control how the PASCObot identifies and responds to objects! Pick up a can, stack cups, or avoid objects entirely with the included Range Finder.

Stream code to the bot in real time or use the rechargeable //control.Node to run programs autonomously!

800.772.8700 (inside US)   +1 916.786.3800 (outside US)

Designed for ages 11+, the PASCObot Sense & Control Kit includes everything students need to explore STEM through coding and robotics. Whether they're new programmers or hobby hackers, the PASCObot makes it easy to support students of all levels with a variety of scaffolded and open-ended activities.

This complete kit includes a PASCObot and //control.Node, as well as all the accessories needed to program how the bot interacts with its environment. From simple movements and spins to object avoidance to complex obstacle courses, there's no limit to what students can create with PASCObot.
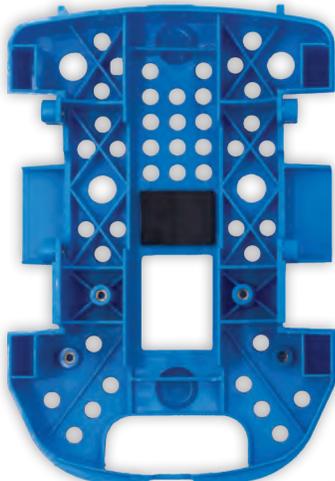
The PASCObot's motion is controlled by two Stepper Motors, which connect to the bot's Wheels. Compatible with other STEM Sense products, the Stepper Motors can be controlled individually to move the bot forwards, backwards, and around corners and curves.

The Line Follower Module enables the PASCObot to detect and respond to custom line paths that students create using the included tape.
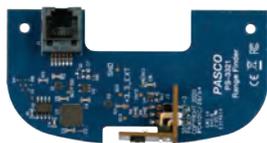
The Range Finder Module gives the PASCObot sight, allowing it to locate, avoid, and respond to objects based on code.

Wireless and rechargeable, the //control.Node has two ports for stepper motors, two ports for servo motors, and one port for digital sensors.

Design custom obstacle courses using the included cups and tape. Then create code to navigate the bot through the course!

The PASCObot Gripper Accessory opens a new world of opportunity by enabling students to program the bot to move, pick up, or even stack a variety of objects. When used with the included Range Finder Module, the PASCObot Gripper Accessory allows students to control how the bot identifies and interacts with objects.
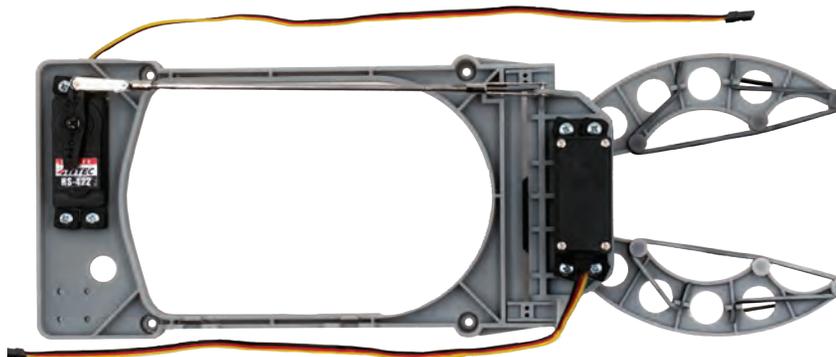
PASCObot Sense & Control Kit.............................ST-7840

The PASCObot Sense & Control Kit includes the PASCObot (body, wheels, stepper motors and //control.Node) – plus all of the modules and accessories shown above. See below and right for individual ordering.

PASCObot Line Follower Module PS-3320

PASCObot Range Finder Module...........................PS-3321

PASCObot Gripper Accessory PS-3325

PASCObot Servo Motor SE-2975

Black and White Tape (2 rolls) SE-2953

Small Plastic Cup Set (5 colors)...........................SE-2952
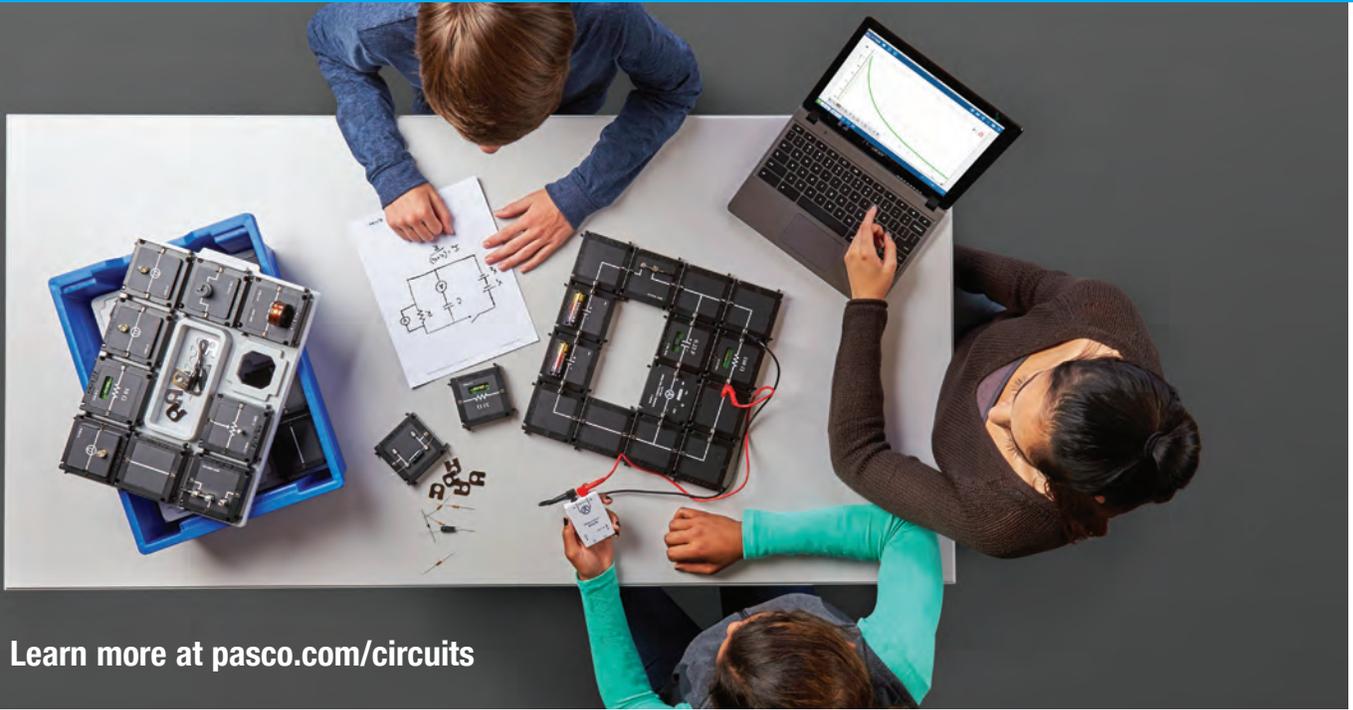
Learn more at pasco.com/circuits

Basic Modular Circuits Kit

EM-3535

These circuit modules are designed specifically for introductory circuit investigations. For students who have never wired a circuit, this modular system makes it easy for them to see their circuit physically laid-out exactly as it appears in their circuit diagram.

Each module connects mechanically to another by sliding the tabs into each other. It works on any tabletop. No special surface is required. To electrically connect two modules, students insert a jumper clip, which emphasizes that an electrical connection has been made. The large size of the modules (8 cm x 8 cm) enables every student around a table to see and understand the completed circuit.

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.

The Basic Modular Circuits Kit is a lower cost, introductory set with fewer components than the Essential Physics Modular Circuits Kit. The Wireless Voltage Sensor and Wireless Current Module are not included.

Basic Modular Circuits Kit....................................EM-3535

Essential Physics Modular Circuits Kit

EM-3536

The Essential Physics Modular Circuits Kit includes more modules, such as the Wireless Current Sensor Module and Wireless Voltage Sensor. The Essential Physics Modular Circuits Kit will also support applications like RC and RLC circuit analysis, electric motors, Kirchhoff's Laws, and much more!
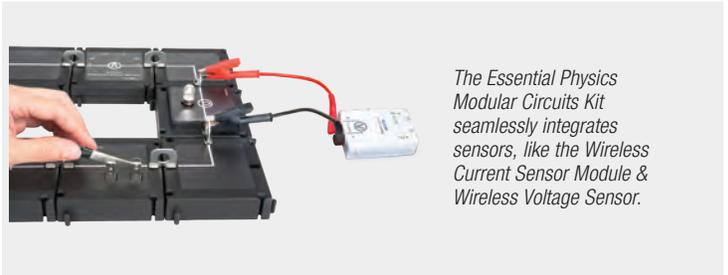
The Essential Physics Modular Circuits Kit seamlessly integrates sensors, like the Wireless Current Sensor Module & Wireless Voltage Sensor.

Essential Physics Modular Circuits Kit..................EM-3536
Modular Circuits Expansion Kit.............................EM-3540

800.772.8700 (inside US)   +1 916.786.3800 (outside US)

Wireless 1 & 2-Axis Force Platforms

PS-3229 & PS-3230

The Wireless Force Platforms build on the success of our PASPORT Force Platforms, offering users the same reliable performance with enhanced durability and a convenient, wireless connection.

The new design features a sturdy, glass-filled nylon platform and four supporting force beams that measure the forces acting normal to the platform's surface. The Wireless 2-Axis Force Platform also includes a fifth beam for measuring forces parallel to the platform. Along the bottom of each platform are four adjustable feet that make leveling quick and easy, while also ensuring stability between the force beams and the surface below. Students can measure the force applied to each beam independently or the overall resultant force acting on the surface of the platform (up to ±5,200 N). With their new wireless designs, the Wireless Force Platforms are easier to use than ever, providing both spacial flexibility and custom sample rates for high speed sampling over Bluetooth Low Energy (up to 10 kHz).

Features:

- Improved ruggedized design with increased maximum force range
- Mechanical force over-limit protection
- Wide top surface for jumping and standing
- Burst sampling option for high speed wireless data collection

Specifications:

1-Axis Product Range: -1320 N to 5280 N (resultant)

2-Axis Product Range: -1320 N to 5280 N (resultant); ±1300 N parallel force

Surface Dimensions: 35 cm x 35 cm

Maximum Sample Rate: 10 kHz

Resolution: 0.2 N

1-Axis Force Over-Limit Protection: -500 N to 2000 N per beam

2-Axis Force Over-Limit Protection: -500 N to 2000 N per vertical beam; ±2000 N parallel beam

The 2-Axis platform measures both the normal and parallel forces acting on the platform simultaneously. Determine the static weight of a structure or person, measure forces associated with the impacts of falling objects, and determine the dynamic vertical and parallel forces that arise when moving or jumping.

Handle Set, Force Platform.................................PS-2548	
Wireless 2-Axis Force Platform PS-3230	
Wireless Force Platform PS-3229	

Wireless Sensors

Wireless Motion Sensor

The Wireless Motion Sensor connects via Bluetooth or USB to your device and uses ultrasound to measure the position, velocity, and acceleration of objects. With fast and reliable ultrasound detection, the Wireless Motion Sensor is ideal for student studies of kinematics, dynamics, and motion graphs.

Applications:

- Pair it with free MatchGraph software to teach motion graphing
- Explore speed and velocity
- Clips directly to PASCO Dynamics Tracks

Wireless Motion Sensor PS-3219

Wireless Smart Gate

Accurately measure speed and velocity with the Wireless Smart Gate's dual photogate beams. It also has a built-in laser switch for measuring objects that are too large to fit through the gate's opening.

Features:

- 180° pivoting head
- Accepts additional photogate head
- Log data directly on the sensor
- Auxiliary port for Time-of-Flight Accessory

Photogate Wireless Smart Gate... PS-3225

Wireless 3-Axis Magnetic Field Sensor

This 3-Axis Magnetic Field Sensor can sense the Earth's magnetic field and fields from coils and bar magnets. There are two ranges: ±50 gauss and ±1300 gauss. This sensor is primarily for static fields.
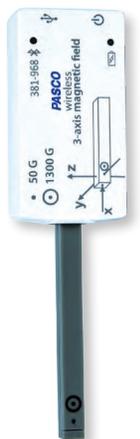
Applications:

- Determine magnetic field strength
- Electromagnetic induction
- Magnetic field in a current-carrying coil

Wireless Magnetic Field Sensor PS-3221

Wireless Force Acceleration Sensor

Capable of simultaneously measuring force, acceleration, and rotational velocity, this sensor is ideal for experiments involving rotating platforms, moving carts, spring oscillations, collisions, and impulse. Students can use the finger-holes for handheld applications, or mount it onto a cart or rod.

Features:

- ±50 N
- 3-axis accelerometer
- 3-axis gyroscope
- Built-in rod clamp
- Onboard datalogging

Wireless Force Acceleration Sensor....................................... PS-3202

Wireless Rotary Motion Sensor

The Wireless Rotary Motion Sensor measures angle, angular velocity, and angular acceleration, as well as their linear equivalents.

Applications:

- Rotational kinetic energy
- Static equilibrium of a rigid body
- Rotational inertia

Wireless Rotary Motion Sensor PS-3220

Wireless 3-Axis Acceleration/ Altimeter Sensor

The Wireless 3-Axis Acceleration/Altimeter can remotely log acceleration in three dimensions and altitude, making it ideal for recording roller coaster rides.

Features:

- Measures acceleration, altitude, and angular velocity
- Adjustable strap for stability
- Ranges of ±16 g, ±100 g, ±200 g, and ±400 g

Wireless Acceleration/Altimeter.. PS-3223

800.772.8700 (inside US)   +1 916.786.3800 (outside US)

Wireless Voltage Sensor

The Wireless Voltage Sensor is ideal for exploring the fundamental concepts of electricity, voltage, and basic circuits.

Applications:

• Measure the voltage across components in a simple circuit

• Measure the induced voltage in a wire coil as a magnet passes through

• Kirchhoff's Voltage Law

• Ohm's Law

• RC and LRC circuit analysis

• Faraday's Law of Induction

Wireless Voltage Sensor.. PS-3211

Wireless Light and Color Sensor

The Wireless Light and Color Sensor features two separate apertures: One measures ambient light from the side of the box, and the other measures percent color of directional light at the end of the box.

Features:

• Wirelessly connects to computers, Chromebooks, tablets, and smartphones

• On-board memory enables the sensor to function as an independent datalogger

• Variable sampling rate for short, precise experiments or lengthy, multi-day data collection

• Bluetooth® connectivity and long-lasting coin cell battery

Wireless Light and Color Sensor...........................PS-3248

Wireless Pressure Sensor

The Wireless Pressure Sensor allows students to easily collect accurate gas pressure data for a wide range of applications.

Applications:

• Study Boyle's Law and Charles' Law

• Hydrostatic pressure

• Determine absolute zero

• Ideal Gas Law

Wireless Pressure Sensor PS-3203

Wireless Current Sensor

The Wireless Current Sensor's wide current range enables introductory and advanced explorations of the fundamental concepts of electricity and basic circuits.

Features:

• Ranges of ±1.0 A and ±0.1 A

• Resolution of 0.2 mA at ±1 A range and 0.02m A at ±0.1 A range

• Bluetooth® sampling rate of 1.0 kHz

• High-speed sampling via USB

• Remote logging

• Variable sampling rate

Wireless Current Sensor PS-3212

Wireless Sound Sensor

The Wireless Sound Sensor contains Sound Level and Sound Wave functions that measure both the true sound level (intensity) and the relative changes in sound pressure level as sound waves incident on the sensor.

Applications:

• Measure sound level and frequency

• Measure the speed of sound in air

• Study sound waves

• Investigate resonance and standing waves

Wireless Sound Sensor PS-3227

Wireless Temperature Sensor

The Wireless Temperature Sensor measures small but significant temperature changes produced by chemical reactions, convection currents, and even skin temperatures.

Features:

• Onboard memory for datalogging

• Records and displays live temperature data

• Water-resistant

• Includes Bluetooth® connectivity and long-lasting coin cell battery

Wireless Temperature Sensor... PS-3201
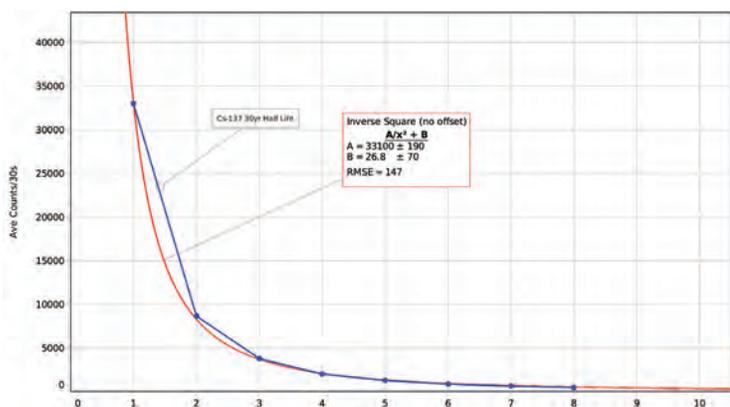
Measure counts/interval from a radioactive source at various distances to explore the inverse square law.
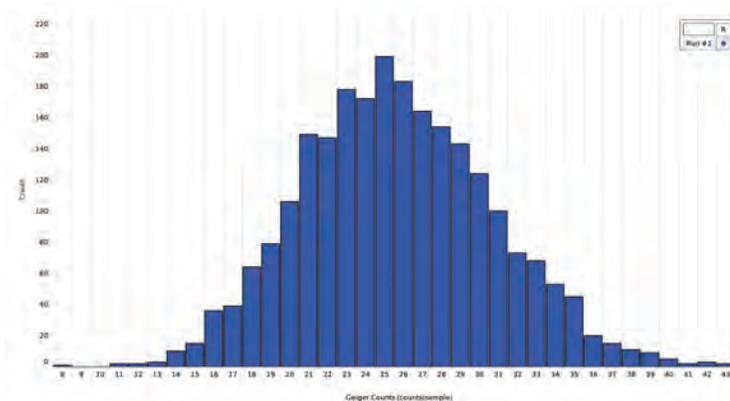
Demonstrate the statistical (gaussian or poisson) nature of counts/interval measured from a radioactive source with a long half-life.

Wireless Geiger Counter

The PASCO Wireless Geiger Counter counts beta, gamma and alpha radiation particles as they enter the Geiger–Müller detector tube inside the counter. Designed for easy mounting, the Geiger Counter provides superior position control in inverse square law labs, as well as an audible beep to indicate the detection of ionizing radiation. The front plastic snout fits conveniently inside the NU-3344 Sample Holder stand (available separately), which stabilizes the front of the counter's detector tube exactly 1 cm from the first slot in the holder.

Includes:

- Wireless Geiger Counter
- **Micro USB Cable:** PS-3584
- Threaded handle for mounting the sensor to a ring stand

Wireless Geiger Counter shown here with optional PASCO Sample Holder Accessory.

Wireless Geiger Counter	PS-3238
Geiger Counter Sample Holder	NU-3344