BIOLOGY

TECHNOLOGY SOLUTIONS FOR BIOLOGY

- Data Collection Software
- Apparatus & Equipment
- Wireless Sensors
- Lab Activities

SINCE 1964 PASCO®

60 YEARS OF INNOVATION

PASCO is Celebrating 60 Years of Innovation in Science Education

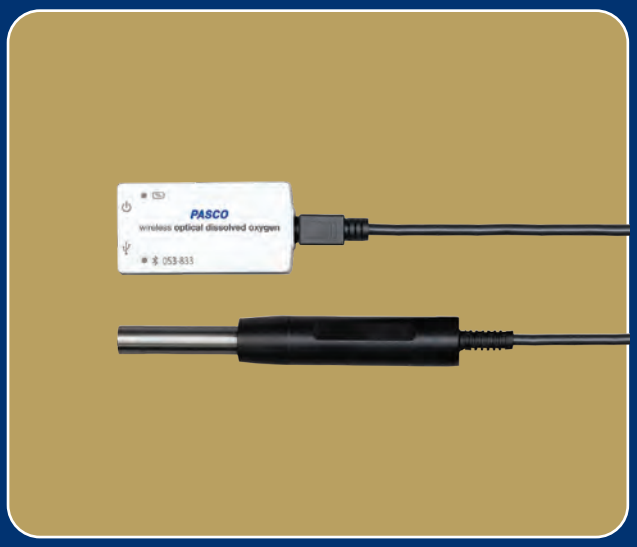
60 years ago, PASCO scientific introduced its first product, the Millikan Oil Drop Experiment, that had its origins as a high school science project. Amazingly, schools ordered this apparatus from a company they had never heard of – displaying a great amount of trust in a new company.

And for the past 60 years, high schools and colleges have continued to place their trust in the apparatus we design, manufacture, sell and support. For that trust over the years, we simply say, ***"Thank You!"*** With your continued support and suggestions, we will strive to maintain that trust into the future.

What have we been doing for the past 60 years? I invite you to peruse our catalog and see the hundreds of products that bear the name PASCO.

PASCO capstone™

SPARKvue™



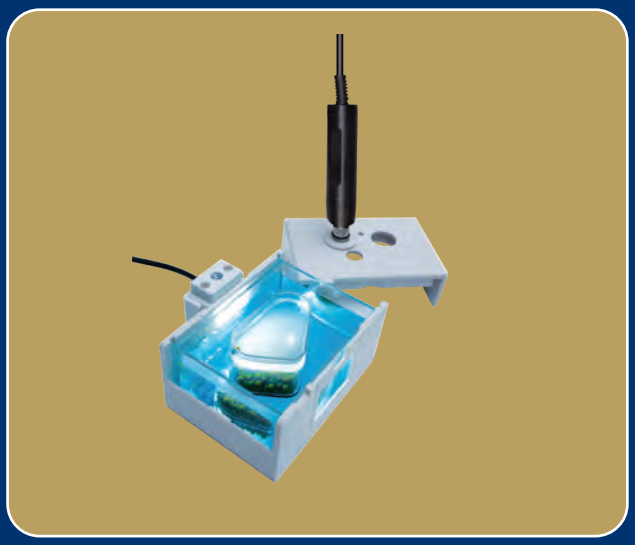
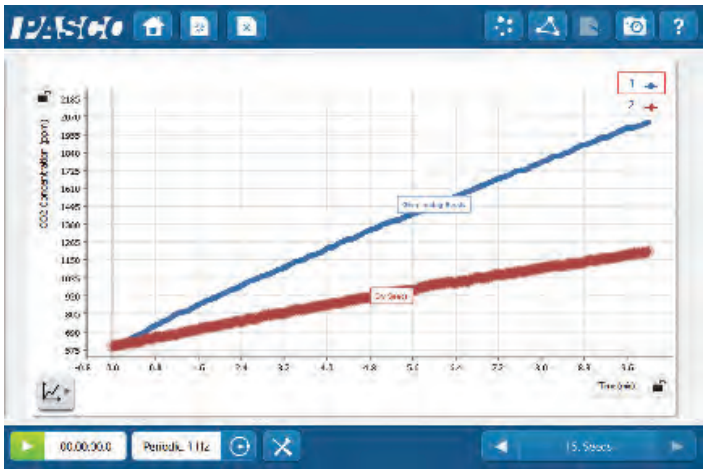


Table of Contents

Biology Sensor Technology & Lab Equipment

Engage your biology students in the thrill of discovery with world class solutions from PASCO. Our high-quality sensors, software, and labs empower students to think like real-life biologists as they form hypotheses, collect data, and perform analyses to make sense of the world around them. Plus, they're 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 onboard 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® Biology courses, all available for free from the PASCO Experiment Library.



Deepen student understandings of core topics, 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)

Biology Lab Stations

Together, the Biology Starter and Extension Lab Stations offer a lab-ready solution for exploring essential topics in biology. Complete with Wireless Sensors, lab manual, and a custom storage case, these convenient stations let students perform a wide variety of investigations. Explore topics such as osmosis, enzyme activity, and membrane permeability. Pair the Biology Starter and Extension Lab Stations with PASCO's Advanced Biology Through Inquiry Teacher Lab Manual to perform more than twenty advanced biology investigations – plus dozens of free labs from the PASCO Experiment Library.

Biology Station Labs

The Biology Starter Lab Station supports 7 of the 10 included investigations.
Add the Extension Lab Station to perform all 10 lab investigations.

Starter Station Labs	Extension Station Labs
Enzyme Action	Plant Respiration & Photosynthesis
Membrane Permeability	Plant Pigments
Osmosis	Cell Size
Respiration of Germinating Seeds	
Acid Rain	
Regulation of Body Heat	
Cellular Respiration in Yeast	

The Biology Starter and Extension Lab Stations include 10 labs and the following Wireless Sensors and materials:

Biology Starter Lab Station

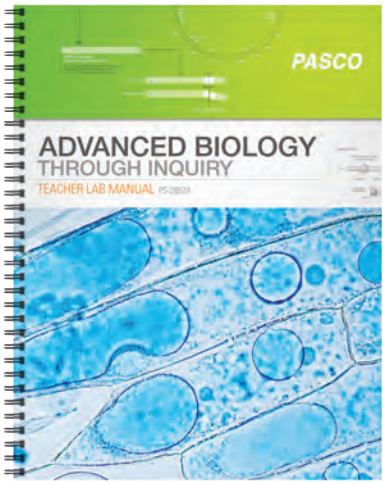
- Temperature
- Pressure
- pH
- CO_2
- Storage Case

Biology Extension Lab Station

- Optical Dissolved Oxygen
- Colorimeter & Turbidity
- Conductivity
- EcoChamber

Lab Stations Support Advanced Biology

Use the Biology Lab Stations with PASCO's Advanced Biology Through Inquiry Lab Manual to support student investigations of advanced biology topics.



Advanced Biology Through Inquiry Teacher Lab Manual
(PS-2852A)

Includes eighteen editable labs with pre- and post-lab questions, step-by-step instructions, software files, and helpful teaching tips.

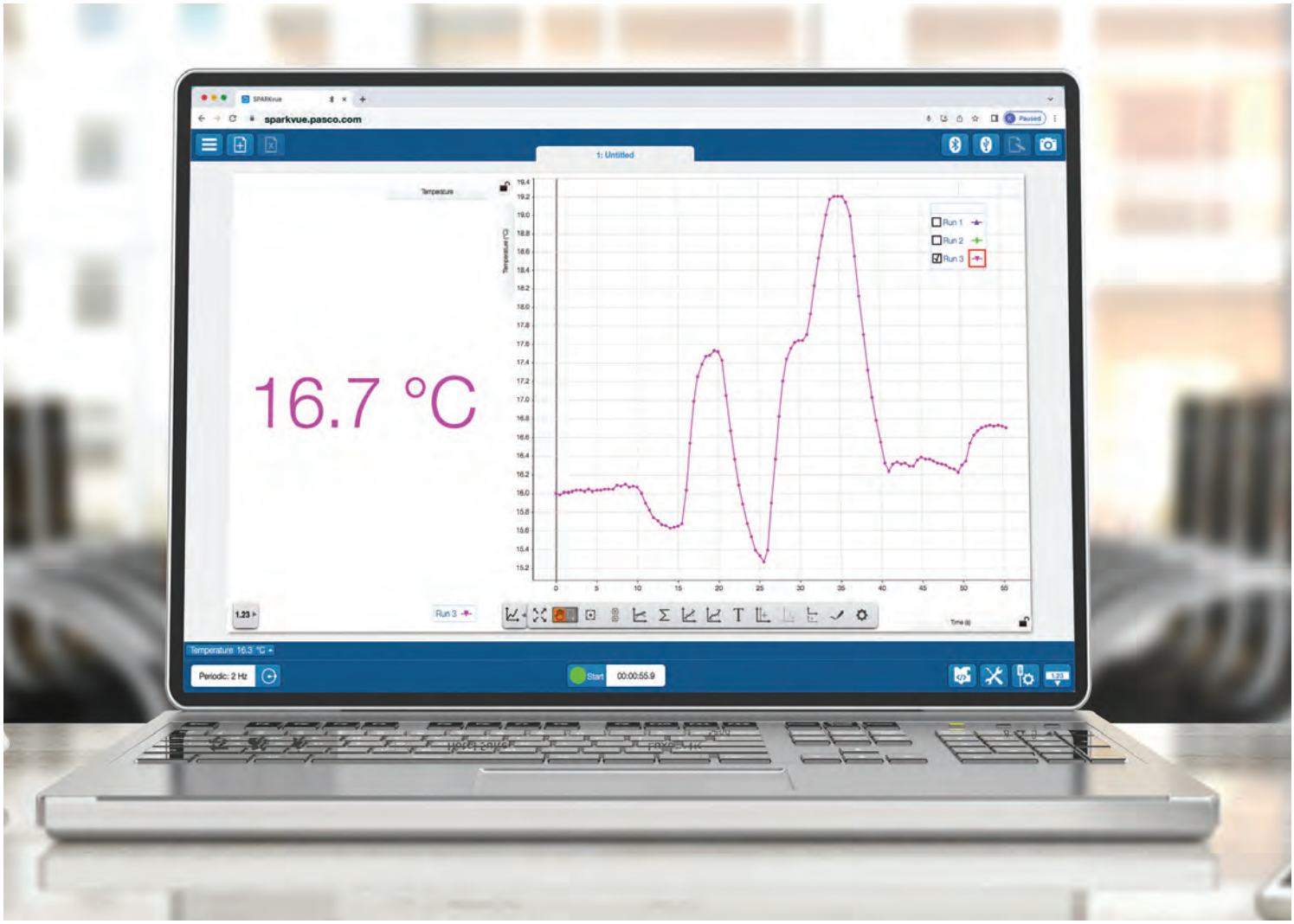
Physiology Extension Bundle

PS-2935D

Add the Physiology Extension Bundle to support student studies of the heart cycle, human respiration, stimulus and response, and more! This bundle includes a Wireless EKG Sensor, a Wireless Spirometer, Spirometer Mouth Pieces, a Wireless Blood Pressure Sensor with Standard Cuff, and a Wireless Hand-Grip Heart Rate Sensor.

Biology Starter Lab Station.....EB-6334
Biology Extension Lab Station.....EB-6335
Essential Biology Teacher Lab Manual.....EB-6331

Advanced Biology Through Inquiry Teacher Guide.....PS-2852A
Wireless Physiology Extension Bundle.....PS-2935D



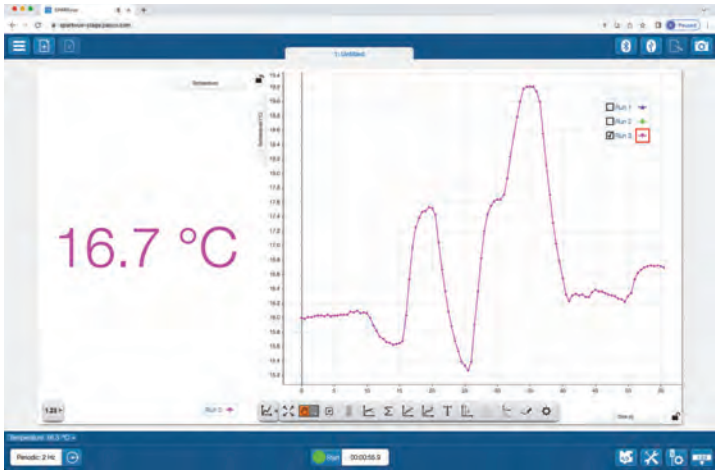
SPARKvue

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.

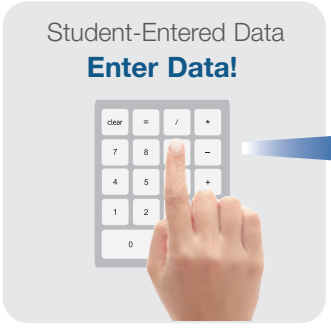


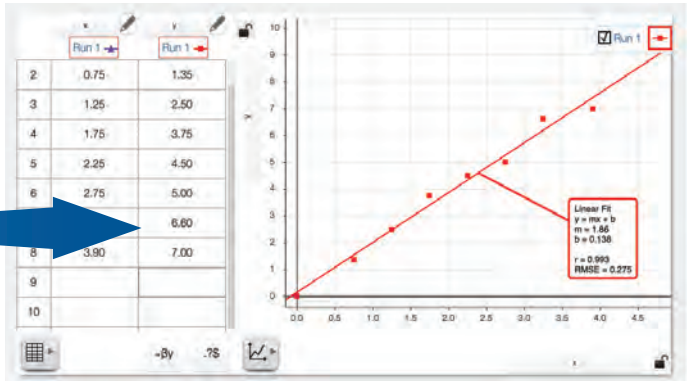
Student Data Collection...**MADE EASY!**

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.



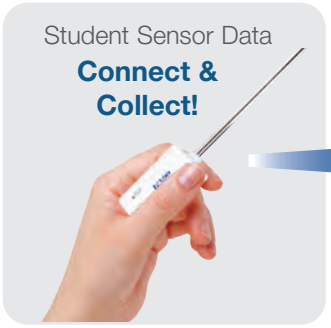


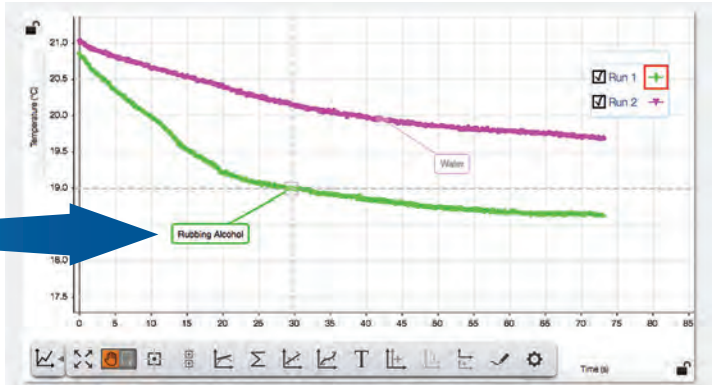
Graph & Analyze Student-Entered Data

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.





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 + Download on the App Store Available in the Chrome Web Store ANDROID APP ON Google play

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

Wireless CO_2 Sensor

Measure changes in carbon dioxide (CO_2) gas levels quickly and easily with the Wireless CO_2 Sensor. This sensor employs live data to make core labs such as photosynthesis, cellular respiration, and metabolism experiments engaging and impactful.

Features:

- Store up to 55,000 logged data points during long-term experiments
- Integrated stopper for use with sample bottle and common glassware

Wireless CO_2 Sensor (Carbon Dioxide).....PS-3208

Wireless Oxygen Gas Sensor

The Wireless Oxygen Gas Sensor measures gaseous O_2 concentrations as well as humidity and air temperature. It is durable, accurate, and easy to use, enabling students to quickly and easily make measurements of photosynthesis, respiration, and oxygen cycling, both in open and closed systems.

Features:

- Bluetooth® and USB connectivity
- 0-100% Oxygen Gas Concentration
- ±1% Oxygen at constant temperature and pressure
- Also reports ambient temperature and humidity
- 2-3 year operating life with replaceable sensing element

Wireless Oxygen Gas Sensor.....PS-3217

Wireless Optical Dissolved Oxygen Sensor

NEW

The Wireless Optical Dissolved Oxygen Sensor is ideal for monitoring DO_2 in the lab or field. In addition to the dissolved oxygen sensor, it also includes probes for measuring atmospheric pressure and water temperature. The optical technology is fast, accurate, and does not require stirring, filling solutions, warm-up, or frequent calibration.

Wireless Optical Dissolved Oxygen Sensor.....PS-3246

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
- Simply pair and go, no cables or adapters to manage
- 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
- Indirect PAR measurements for biological studies

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

Wireless Temperature Sensor

Welcome to the modern thermometer. The Wireless Temperature Sensor transmits live data and allows students to continuously monitor, log, and plot temperature measurements on nearly any device. When lab-time ends but the experiment continues, students can set the sensor to log data autonomously for days, weeks, or months, then download it for analysis later.

This durable, wireless sensor features a stainless steel probe for the most demanding of applications, as well as a battery that lasts over a year*. It can be used in a wide array of experiments and activities because it measures small, but significant temperature changes produced by chemical reactions, convection currents, and even skin temperatures.

Specifications:

Range: -40ºC to 125ºC

Resolution: 0.01ºC

Accuracy: 0.5ºC

Logging: Yes

Connectivity: Bluetooth 4.0

Wireless Temperature Sensor.....PS-3201

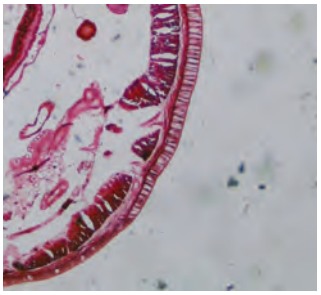
Standard Compound Optical Microscope

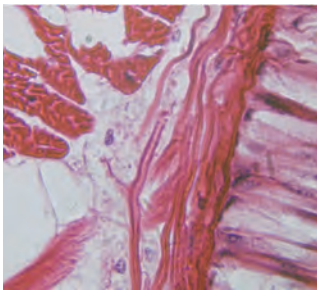
NEW

This standard optical microscope is great for general viewing of cell structures at 40x, 100x, 400x viewing. It gives insights to topics from Biology, Life Science, Anatomy and Physiology, Cellular and Field Biology. High quality optical lenses allow for fine details in high contrast to be studied in appropriate detail for starter to experienced microscope users. Perfect for establishing labs with sets of durable equipment classes can use for years. Compatible with student or professionally prepared slide set like the Microscope Slide Kingdom survey (SE-6214) to give students a solid start to explore cellular features and concepts across all living kingdoms.

Features:

- Observe small specimens like plant, animal, and bacterial cells, translucent objects such as insect larvae, or fine particles like powder
- 10 x eye piece
- 10x eyepiece and 4x, 10x, and 40x (oil) objective lenses provide magnification options of 40x, 100x, and 400x
- Adjustable focus between coarse and fine settings
- Dual light source (upper and lower LED) provides adjustable brightness
- Cord or cordless power options (External AC/DC Adapter or 3xAA Batteries)
- Equipped with a plain stage with clip and single lens condenser with disc diaphragm





Sample imagery above captured with standard eyepiece USB camera. Slides from the *Kingdoms Survey,Prepared Slide Set* (sold separately)

Standard Compound Optical Microscope.....SE-6213

Prepared Slide Set, Kingdoms Survey SE-6214

Wireless Pressure Sensor

The Wireless Pressure Sensor allows students to easily collect accurate gas pressure data for a wide range of applications. Included is a 60-cc syringe, tubing, and connectors that facilitate experiments such as Boyle's Law, measuring pinch-grip strength, and studying enzyme reactions. Within PASCO's software, students can easily select their desired units from a list containing kPa, mmHg, inHg, mbar, psi, atm, and torr.

Applications:

- Investigate pinch-grip strength and muscle fatigue
- Use it as a potometer to measure plant transpiration
- Study enzyme reactions using hydrogen peroxide and catalase

Wireless Pressure Sensor PS-3203

Wireless Conductivity Sensor

The Wireless Conductivity Sensor measures the electrical conductivity of an aqueous solution. It is ideal for investigating the properties of solutions, including total dissolved solids (TDS) for water quality inquiry. Because it is temperature compensated, calibrations are less frequent and can be applied across a range of temperatures. With a range of 0 to 20,000 µS/cm, this sensor can be utilized for chemical, biological, and environmental studies.

Applications:

- Perform water quality studies
- Study the diffusion of ions through membranes
- Determine the ionic content of an aqueous solution

Wireless Conductivity Sensor PS-3210

Wireless EKG Sensor

The Wireless EKG Sensor measures electrical signals produced by contractions of the heart or muscles, and reports them in real-time on virtually any student device. The perfect sensor for fast-paced physiology courses, the EKG Sensor provides students with real-time feedback as they explore the effects of various stimuli on cardiac or muscular activity. Heart Rate data is reported in beats per minute (BPM), while the voltage (mV) detected from cardiac contractions is intuitively displayed in an EKG trace.

Features:

- Standard three-electrode design
- Easy-to-use, disposable stick-on electrodes
- No messy gel required
- Great for stimulus response reflex studies

Wireless EKG Sensor.....PS-3236

Wireless Hand-Grip Heart Rate Sensor

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.

Specifications:

Sensor Range: 0 to 240 beats per minute

Accuracy: ±1 beat per minute

Maximum Sample Rate: Every two seconds

Default Sample Rate: Every five seconds

Approximate mass: 218 g

Wireless Hand-Grip Heart Rate Sensor.....PS-3206

Wireless Spirometer

The Wireless Spirometer Sensor makes it safe and easy for students to collect respiratory measurements, including flow rate, pressure, and lung volume. Ideal for studies in health and human physiology, the Wireless Spirometer Sensor streamlines experiments by providing students with real-time data, interactive graphs, and intuitive analysis tools right on their devices. The disposable mouthpieces are designed for use with a single student and feature exchangeable filters that protect the sensor from particulates for maximum safety. Additional mouthpieces are available in convenient packs of ten.

Features:

- Measures flow rate, pressure, and lung volume
- Bi-directional air flow (inspiration and expiration)
- Displays volume in liters
- Exchangeable filter and disposable, hygienic mouthpieces

Wireless Spirometer.....PS-3234

Wireless Exercise Heart Rate Sensor

The Wireless Exercise Heart Rate Sensor has a chest strap and will transmit data wirelessly up to 10 m away! The electrode belt fits around the ribcage (worn against the skin for best results, but can be worn over a shirt if a drop of saline solution is applied under the electrodes). As students move, their cardiac data transmits wirelessly to their device.

Applications:

- Compare a student's heart rate before, during, and after exercise
- Calculate recovery rate after physical activity
- Determine the effects of mild stimulants (e.g. caffeine)
- Investigate how heart rate changes when a student sits, reclines, stands or moves suddenly

Wireless Exercise Heart Rate Sensor.....PS-3207

Wireless Blood Pressure Sensor with Standard Cuff

PASCO's Wireless Blood Pressure Sensor allows students to quickly and easily measure both systolic and diastolic arterial blood pressure (mmHg) as well as heart rate (pulse in bpm). Comparing the digits display for systolic and diastolic pressure with the display of blood pressure from the real-time graph helps students gain a contextual understanding of the physiology of blood pressure.

Specifications:

Heart Rate Range:
36 to 200 bpm

Heart Rate Accuracy:
±1 bpm

Heart Rate Resolution:
1 bpm

Blood Pressure Range:
0 to 375 mmHg

Blood Pressure Accuracy:
±3 mmHg

Blood Pressure Resolution:
0.05 mmHg

Gauge Pressure Units:
mmHg, N/m^2, kPa, atm, psi

Wireless Blood Pressure Sensor with Standard Cuff.....PS-3218

Wireless Colorimeter and Turbidity Sensor

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. When using the ezSample Snap Vials, the colorimeter also functions as a turbidimeter for hassle-free water quality analysis.

ezSample: Hardness, Alkalinity, NO_3^{-1} | PO_4^{-3} | Fe^{+3} | NH_4^{+} | Cl^{-}

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

Features:

- Stabilized light source for consistent readings
- Measures six different wavelengths simultaneously

Wireless Colorimeter & Turbidity Sensor.....PS-3215

Wireless Spectrometer (Vis)

The award-winning PASCO Wireless Spectrometer is specifically designed for modern teaching labs. It connects to student devices via USB or Bluetooth Low Energy and includes free Spectrometry software with built-in tools for spectral analysis. Scan times are fast, enabling students to collect a full spectrum of data in less than a second. Built-in plots are provided for common applications, including Absorbance vs. Wavelength, Intensity vs. Wavelength, Absorbance vs. Concentration (Beer's law), and Absorbance vs. Time (kinetics).

Measures: Intensity, absorbance, transmittance, and fluorescence

Compatibility: Windows®, Mac®, iPhone® and Android™ smartphones, iPad®, Android™ and Chrome™ tablets; includes software.

Resolution: 2-3 nm FWHM

Range: 390-950 nm

Fluorescence: 405 nm and 500 nm

Wireless Spectrometer (VIS).....PS-2600A

UV-Vis Spectrometer

The SE-3607 is an easy-to-use, wide range UV-Vis spectrometer that delivers fast, accurate and reliable performance for routine analyses in chemistry and biochemistry teaching labs. With USB connectivity and cross-platform Spectrometry Software, the PASCO UV-Vis Spectrometer improves collaboration between lab members, enabling data collected on a computer or laptop to be analyzed on tablets, iPads, and Chromebooks*.

Highlights:

- Spectral scans from 180-1050 nm
- Award-winning Spectrometry software (free)
- Adjustable scan averaging, signal integration time, and smoothing
- Graphs Absorbance vs. Wavelength (full spectrum scans)
- Graphs Absorbance vs. Concentration (Beer's law)
- Graphs Absorbance vs. Time (kinetics)

UV-Vis Spectrometer.....SE-3607

Instrument Comparison

Which solution is right for you?

Our compact analytical instruments are specially designed with teaching labs in mind. Use the chart below to compare their features and determine which solution is right for you and your students.

COLORIMETER & TURBIDITY
PS-3215

PASCO SPECTROMETER
PS-2600A

PASCO UV-Vis SPECTROMETER
SE-3607

Feature	Colorimeter & Turbidity	PASCO Spectrometer	UV-Vis Spectrometer
Light Source	White LED	RGB LED-Boosted Tungsten	Deuterium (UV) Tungsten (Vis)
Optical Resolution	±25 nm	2 nm	1 nm
Wavelength Range	450, 500, 550, 570, 600, 650 nm	390 – 950 nm	180 – 1050 nm
Wavelength Accuracy	NA	≤6 nm	1 nm
Photometric Range (for best accuracy)	0.05 – 1.5	0.1 – 1.8	0.1 – 1.0
Photometric Accuracy	±5%	±5%	±5%
Full Spectrum Scans	No	Yes	Yes
Scan Time	N/A	1 ms – 25 s	1 ms – 25 s
Connects via USB	Yes	Yes	Yes
Connects via Bluetooth	Yes	Yes	No
Rechargeable battery (for cordless operation only)	Yes	Yes	No
Fluorescent Excitation	No	405, 500 nm	No
Works with SPARKvue & Capstone Software	Yes	No	No
Works with PASCO Spectrometry Software	No	Yes	Yes
Data Storage/Onboard Memory	Yes	No	No
Good for Field Use	Yes	Yes	N/A
Turbidimeter	Yes	No	No

Greenhouse Sense & Control Kit

ST-2997

Designed for the exploration of biological and ecological concepts, the Greenhouse Sense & Control Kit includes everything students need to design, build, program, and study their very own greenhouse.

Student Activities

The Greenhouse Sense & Control Kit includes five student activities that can be edited to fit your course needs. Each activity focuses on a key concept in biology or environmental science and includes extensions to engineering and design practices.

Build career awareness with activities that make real-world connections to:

- Agricultural monitoring
- Ecological management
- Plant physiology

Help students develop competency in:

- Coding
- Problem solving
- Data collection and analysis
- Ecological concepts
- Science and Engineering practices

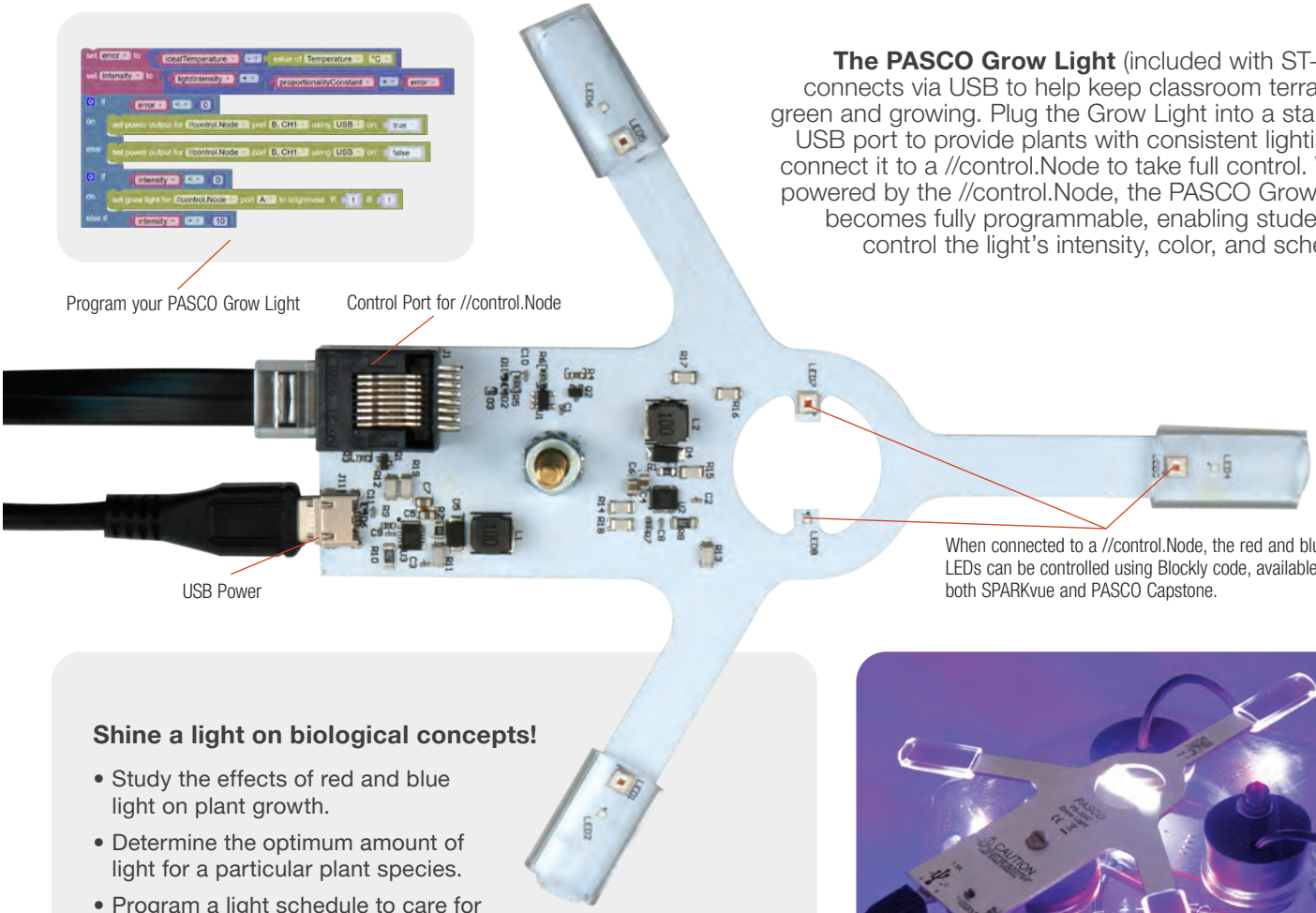
Student Activities

- Program a Sunny Day for Plants
- Coding a Cooling Breeze
- Program Perfectly Timed Rain
- Optimize Water Movement
- Program a Greenhouse Sense and Control System

Blockly

Program your PASCO Grow Light

The PASCO Grow Light (included with ST-2997) connects via USB to help keep classroom terrariums green and growing. Plug the Grow Light into a standard USB port to provide plants with consistent lighting, or connect it to a //control.Node to take full control. When powered by the //control.Node, the PASCO Grow Light becomes fully programmable, enabling students to control the light's intensity, color, and schedule.



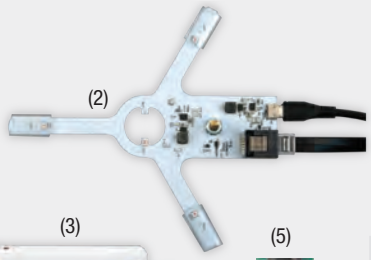
Shine a light on biological concepts!

- Study the effects of red and blue light on plant growth.
- Determine the optimum amount of light for a particular plant species.
- Program a light schedule to care for plants over weekends and breaks.

Greenhouse Sense & Control Kit Equipment

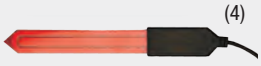
This complete kit includes: an EcoChamber (1), PASCO Grow Light (2), Greenhouse Sensor (3) Soil Moisture Probe (4), Humidity/Light/Temperature Probe (5), Power Output Module (6), Fan (7), Water Pump (8), tubing with drip-watering ends (9), and //control.Node (10).

(1)



(2)

(3)



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(7)

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(8)

(9)

Greenhouse Sense and Control Kit	ST-2997
Greenhouse Sense and Control Kit (without //control.Node)	ST-2998
Available Separately:	
Greenhouse Sensor	PS-3322
PASCO Grow Light	PS-3347

PASCO®
10101 Foothills Blvd. • Roseville, CA 95747-7100
+1 916-786-3800 • pasco.com
Change Service Requested

Photosynthesis Chamber

PASCO's New Photosynthesis Chamber, coupled with the Wireless Optical Dissolved Oxygen Sensor (PS-3246), allows students to monitor most common photosynthesis experiments. Typical experiments require students to infer photosynthetic rate changes by using chloroplasts and dye. Help your students better understand photosynthesis via direct measurement of oxygen while controlling light, temperature or nutrients. Ideal for exploring aquatic plants, algal beads, and even the consumption of oxygen by respiration.

The lid features three convenient ports for sensors; stoppers are included to maintain a closed system. The ports will accommodate Wireless Temperature Sensor (PS-3201), Wireless Conductivity (PS-3210A), Wireless pH Sensor (PS-3204) or other ion selective electrodes for additional measurements. A clear inner chamber allows full sunlight exposure, or set into an outer cover chamber to block out light.

Nine separate LED lights (white, red, green or blue) allow students to test these variables and others such as plant nutrient uptake and elimination.

Photosynthesis Chamber PS-3251

Dual chambers allow sample to set in temperature controlling water bath.