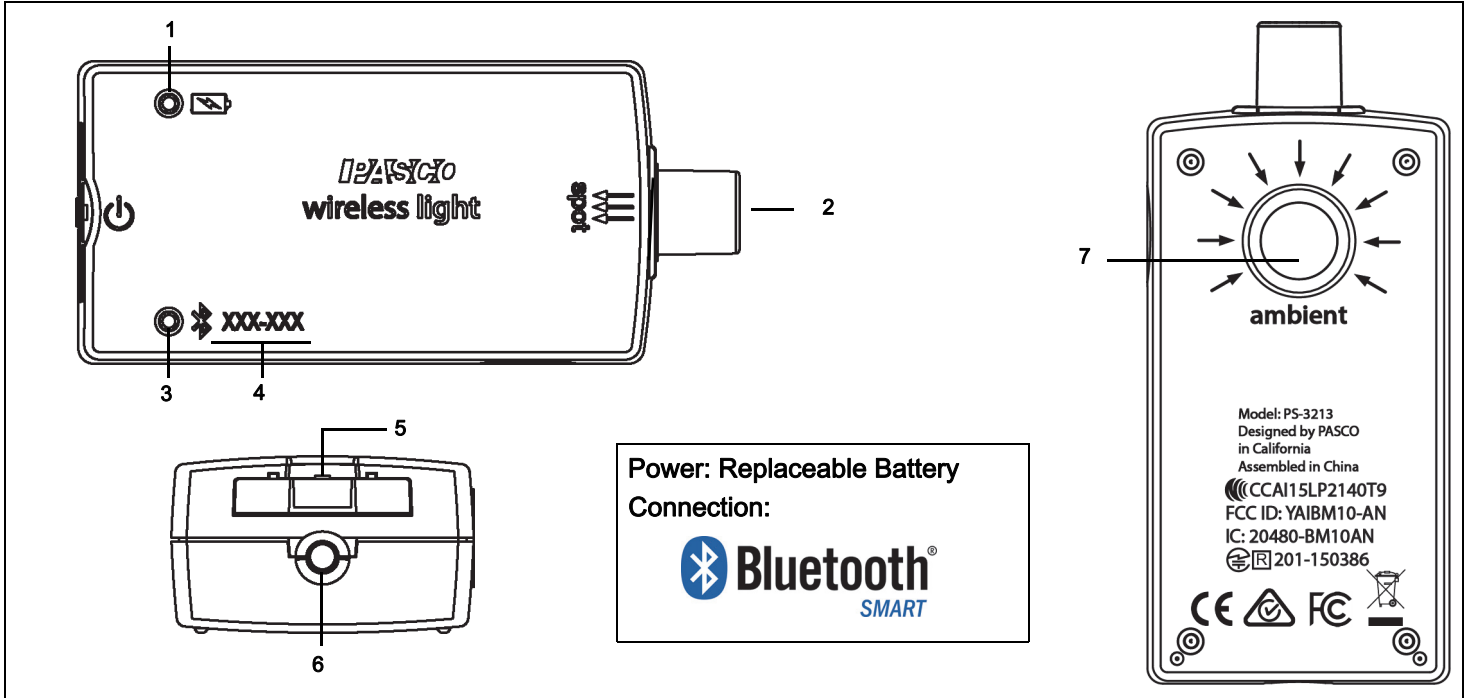


# Wireless Light Sensor

## PS-3213



Power: Replaceable Battery  
Connection:

|   |                      |   |                        |
|---|----------------------|---|------------------------|
| 1 | Battery Status LED   | 5 | Battery Drawer         |
| 2 | Spot Light Aperture  | 6 | ON Button              |
| 3 | Bluetooth Status LED | 7 | Ambient Light Aperture |
| 4 | Device ID Number     |   |                        |

## Hardware

| Included Equipment    | Part Number |
|-----------------------|-------------|
| Wireless Light Sensor | PS-3213     |

## Introduction

The Wireless Light Sensor is a coin cell battery powered wireless sensor that connects to a computer or tablet device through Bluetooth. The sensor measures light through two apertures. The Spot Light Aperture measures red-green-blue (RGB), and white. The Ambient Light Aperture measures illuminance (measured in lux or

lumens per square meter), Photosynthetically Active Radiation (PAR) in sunlight, and solar irradiance (in watts per square meter). The Ambient Light Aperture also measures UVA (ultra-violet A) and UVB (ultra-violet B) allowing ultra-violet index (UVI) to be calculated.

PASCO Data Collection Software will display and analyze the measurements from the sensor. NOTE: The software also supports remote data logging for long term experiments.



The sensor is designed to optimize the battery usage time. Since each sensor has a unique Device ID number, more than one can be connected to a computer or tablet at the same time.

## ON/OFF Information

To turn the sensor on, press and hold the ON button until the status LEDs start blinking. To turn the sensor off, press and momentarily hold the ON button until the status LEDs stop blinking. (See the LED information.)

The sensor puts itself to sleep after several minutes of inactivity if not connected, and after about one hour of inactivity if connected.

## Data Collection Software

| PASCO Capstone  | SPARKvue  |
|---|---|
|  |    |
| <ul style="list-style-type: none"> <li>• Mac OS X</li> <li>• Windows</li> </ul>   | <ul style="list-style-type: none"> <li>• Mac OS X</li> <li>• Windows</li> <li>• iOS</li> <li>• Android</li> <li>• Chromebook</li> </ul> |

See the PASCO Web page at

[www.pasco.com/software](http://www.pasco.com/software)

for help in selecting the right PASCO software and to check the latest versions.

## Software Help

See the SPARKvue Help or PASCO Capstone Help for information about collecting, displaying, and analyzing data.

- In SPARKvue, select the HELP button in any screen including the Home Screen.
- In PASCO Capstone, select PASCO Capstone Help from the Help menu, or press F1.

## Bluetooth<sup>®</sup> Compatibility

Check the PASCO Web page at

[www.pasco.com/compatibility](http://www.pasco.com/compatibility)

for the latest information. See Appendix A for more information about Bluetooth compatibility, the PS-3500 USB Bluetooth Adapter, and older Mac OS X models.

## LED Information

The Bluetooth and the Battery Status LEDs operate as follows depending on the type of connection:

**For a wireless Bluetooth connection:**

| Bluetooth LED | Status        |
|---------------|---------------|
| Red blink     | Ready to pair |
| Green blink   | Connected     |
| Yellow blink  | Logging*      |

| Battery LED | Status    |
|-------------|-----------|
| Red blink   | Low power |

\***Logging:** PASCO wireless sensors can either stream live data to a compatible device for “real-time” viewing or log data (save it to the sensor’s memory). After logging, the data can be uploaded to the computing device for display and analysis at a later time. Logging capability supports long-term or remote data collection while not connected to a device.

Check the PASCO Web page at:

[www.pasco.com/software](http://www.pasco.com/software)

for the latest software version.

## Set Up the Software

### SPARKvue

#### Connecting the Wireless Sensor to a Tablet or a Computer via Bluetooth

- For SPARKvue, select the Bluetooth icon to open the Wireless Devices list. In the Wireless Devices list, the sensors are ordered by proximity to the device.
- Select the correct address that matches the XXX-XXX number found on the sensor.
- Select Done. A list of measurements appears under the sensor in the Home Screen.

#### Collect Data

- In the SPARKvue Home Screen, select a measurement from the list under the sensor’s name. A graph of the measurement versus time opens.

- In SPARKvue, select the Start button to begin collecting data.

## PASCO Capstone

### Connecting the Wireless Sensor to a Tablet or a Computer via Bluetooth

- For PASCO Capstone, select Hardware Setup in the Tools palette. The sensors in the list are ordered by proximity to the wireless device.
- Select the sensor with the address that matches the XXX-XXX Device ID number on the sensor.

### Collect Data

- In PASCO Capstone, select a display in the main window or from the Display palette. In the display, use the <Select Measurement> menu to pick a measurement to be shown.
- Select Record to begin collecting data.

## Troubleshooting the Wireless Light Sensor

- If the Wireless Light Sensor loses Bluetooth connection and will not reconnect, try cycling the ON button. Press and briefly hold the button until the status LEDs blink in sequence, and then release the button. Start the sensor in the usual way.
- If the sensor stops communicating with the computer software or tablet application, try restarting the software or application.
- If the problem remains, press and hold the ON button for 10 seconds and then release. Start the sensor in the usual way.
- Turn Bluetooth off and then turn it back on. Retry.

## About the Battery

### Battery Usage

Battery life is very important to making the sensor simple and always ready to use, so all of the PASCO wireless products are designed for long battery life. For example, the sensor turns itself off after a few minutes of inactivity to conserve battery life.

The Wireless Light Sensor includes a 3 V coin cell battery (CR2032). We expect more than one year of battery life, but the actual amount depends on factors such as the data collection sampling rate.

## Sensor Storage

If the sensor will be stored for many months, we recommend that you remove the battery to avoid damaging the sensor in case of a battery leak.

## Maximizing Battery Life

One of the factors that affects battery life is the storage temperature. Therefore, avoid storing the sensor in very cold or very hot environments.

## Battery Removal and Replacement

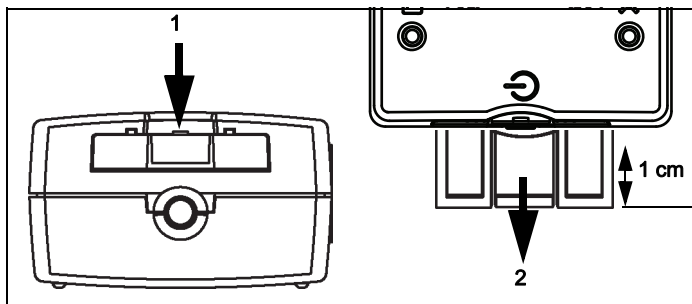
If the sensor's battery status LED blinks red, the battery may need to be replaced. Replacing the small, disk-shaped battery involves opening the Battery Drawer on the back of the sensor, removing the old battery, installing a new battery of the same type, and closing the Battery Drawer. The procedure uses a small, thin blade screwdriver or a finger nail and a CR2032 three volt battery.

- Coin-cell Battery Replacement Pack (10 pack) - PS-3504

NOTE: This battery is commonly available in electronic and commercial stores.

### Open the Battery Drawer

Hold the sensor top-side up. Use a thin blade screwdriver or a finger nail to push down slightly on the center section of the battery drawer. See 1.



Pull the battery drawer out of the sensor about one centimeter. See 2

Turn the sensor over so the bottom is facing upward. Pull the battery drawer the rest of the way out of the sensor.

Replace the battery with another identical battery.

### Close the Battery Drawer

Align the battery drawer with the slot on the end of the sensor and push the battery drawer all the way into the sensor until you hear a click.

The discharged battery must be recycled or disposed of separately from household waste. (See “Battery Disposal Instructions” under Technical Support.)

### Related Item

- Coin-cell Battery Replacement Pack (10 pack) - PS-3504

### Suggested Experiments

Practically any experiment that uses a Light measurement can be done with the PS-3213 Wireless Light Sensor. See the PASCO Web site at

[www.pasco.com/products/lab-manuals](http://www.pasco.com/products/lab-manuals)

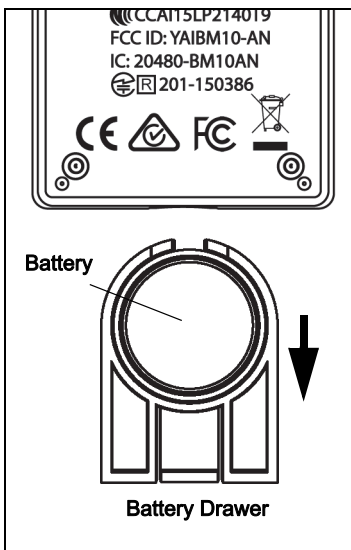
and also select “Training & Resources” at the top of the page for more information about experiments.

Or, enter “Light” into the Search window at

[www.pasco.com](http://www.pasco.com)

### Measurements

The Spot sensor measures relative light levels in red, green, blue, and white. The Ambient sensors measure relative light levels in red, green, blue, white, UVA, and UVB. Note that the software does not report red, green blue, and white from the Aperture.



### Measurements

| Ambient Light Sensor                         |                               |
|--|-------------------------------|
| Measurement                                  | Range of Values               |
| UVA (%)                                      | 0 to 100                      |
| UVB (%)                                      | 0 to 100                      |
| UV Index                                     | 0 to 12 (typical in daylight) |
| Illuminance* (lux)                           | 0 to 131,000                  |
| PAR* ( $\mu\text{mol}/\text{m}^2/\text{s}$ ) | 0 to 2400                     |
| Irradiance* ( $\text{W}/\text{m}^2$ )        | 0 to 1362                     |

\* Based on solar radiance

| Spot Light Sensor |          |
|-------------------|----------|
| Measurement       | Range    |
| White* (%)        | 0 to 100 |
| Red (%)           | 0 to 100 |
| Green (%)         | 0 to 100 |
| Blue (%)          | 0 to 100 |

\*Sum of normalized RGB peaks

See Appendix B for more information about the Measurements.

### Specifications

| Item                          | Information  |
|-------------------------------|--|
| Battery                       | Coin Cell.<br>Expected battery life greater than one year. |
| Connectivity                  | Bluetooth SMART  |
| Max Wireless Range            | 30 m (unobstructed)  |
| Max Sample Rate (Ambient)     | 2 samples/second   |
| Default Sample Rate (Ambient) | 1 sample/sec   |
| Max Sample Rate (Spot)        | 20 samples/second  |
| Default Sample Rate (Spot)    | 5 samples/second   |

**Suggestions**

- SE-6478 Ergopedia Optics System
- SE-6481 Ergopedia Light, Color and Optics Teacher Resources
- EX-5547A Light Intensity vs. Distance Experiment
- Solar Panel Efficiency
- Photosynthetic activity at different light levels or colors
- Transpiration at different light levels
- Modeling day and night
- Modeling seasons
- UV protection of different materials

**Technical Support**

For assistance with any PASCO product, contact PASCO at:

Address: PASCO scientific  
10101 Foothills Blvd.  
Roseville, CA 95747-7100

Phone: +1 916 462 8384 (worldwide)  
8700-772-8700 (U.S.)

Web: [www.pasco.com/support](http://www.pasco.com/support)

Email: [support@pasco.com](mailto:support@pasco.com)

The Reference Guide will be updated periodically. For the latest revision of this Reference Guide, visit the PASCO Web site at

[www.pasco.com/manuals](http://www.pasco.com/manuals)

and enter the product number, PS-3213, in the text window.

**Replacement Parts**

For information about possible replacement parts, contact Technical Support:

- Coin-cell Battery Replacement Pack (10 pack) - PS-3504

**Limited Warranty**

For a description of the product warranty, see the PASCO catalog. For more information visit [www.pasco.com/legal](http://www.pasco.com/legal)

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**FCC Statement**

This Class A digital device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**CE Statement**

This device has been tested and found to comply with the essential requirements and other relevant provisions of the applicable EU Directives.

**Product End of Life Disposal Instructions:**

This electronic product is subject to disposal and recycling regulations that vary by country and region. It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment. To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle/disposal service, or the place where you purchased the product.

The European Union WEEE (Waste Electronic and Electrical Equipment) symbol (to the right) and on the product or its packaging indicates that this product must not be disposed of in a standard waste container.



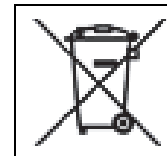
**Battery Disposal Instructions:**

Batteries contain chemicals that, if released, may affect the environment and human health. Batteries should be collected separately for recycling, and recycled at a local hazardous material disposal location adhering to your country and local government regulations. To find out where you can drop off your waste battery for recycling, please contact your local waste disposal service, or the product representative.

The Lithium Polymer (Li-Poly) rechargeable battery used in this product is marked with the International symbols to indicate the need for the separate collection and recycling of batteries



Li-Poly



## Appendix A: Bluetooth<sup>SM</sup> Compatibility

Check the PASCO Web page at

[www.pasco.com/compatibility](http://www.pasco.com/compatibility)

for the latest information on Bluetooth SMART compatibility.


| Platform              | Bluetooth SMART Compatibility                                     |
|-----------------------|---|
| iOS                   | iPad 3 and later<br>iPhone 4S and later<br>iPod touch 5 and later |
| SPARK Element         | All models  |
| Android               | Android 4.3 and later   |
| Chromebook            | Chrome OS (requires PS-3500 Adapter*)                             |
| Mac OS X <sup>1</sup> | Models introduced July 2011 or later                              |
| Windows               | Windows 7 and later (requires PS-3500 Adapter*)                   |

\*The PS-3500 USB Bluetooth Adapter, when connected to a USB port, allows up to three Bluetooth SMART devices, such as this PASCO wireless device, to connect to Windows computers, Chromebooks, and older Macintosh computers.



Note: The PS-3500 USB Bluetooth Adapter is the only adapter we can currently recommend. Many other Bluetooth 4.0 adapters are available but this adapter has a specific design that enables in-app pairing of Bluetooth SMART sensors.

<sup>1</sup>To check the Mac computer's Bluetooth compatibility, do the following:

- Click the  (Apple) Menu.
- Select *About This Mac*
- Click the *More Info...* button.
- Click the *System Report...* button.
- Select *Bluetooth* from the sidebar on the left, underneath *Hardware*.
- Scan down the list of information until you find "LMP Version".
- If your Mac is equipped with Bluetooth SMART, the LMP Version will show **0x6**. (Anything lower than **0x6** means an older version of Bluetooth. Your

device will need the PS-3500 USB Bluetooth Adapter.)

<sup>1</sup>The Mac Mini and MacBook Air were updated with Bluetooth SMART support in 2011. The MacBook Pro was updated in 2012. The Mac Pro that debuted in December 2013 has Bluetooth SMART support.

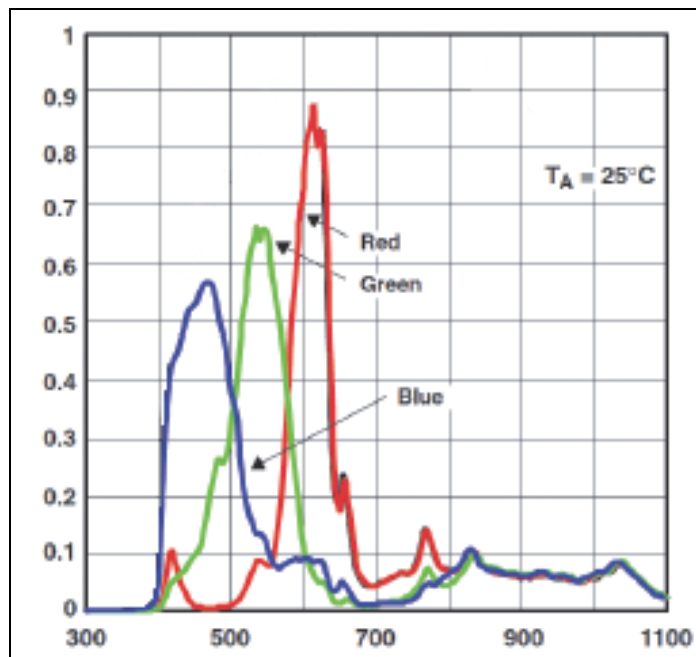
**Exception:** Before you upgrade to El Capitan (Mac OS X 10.11.x), if you have a Macintosh with LMP version "0x4" that requires the PS-3500 USB Bluetooth 4.0 Adapter, please contact PASCO Technical Support for further instructions.

### What is Bluetooth SMART<sup>®</sup>?

Bluetooth SMART (also known as Bluetooth Low Energy or Version 4.0 of the Bluetooth specification) is the latest protocol of the proprietary open wireless technology standard created by telecoms vendor Ericsson in 1994. It is the power- and application-friendly version of Bluetooth that was built for the Internet of Things (IoT).

## Appendix B: Light Sensor Response Curves

The graph shows normalized Relative Responsivity versus Wavelength in nanometers (nm) for Red, Green, and Blue.



The approximate wavelength ranges at half-max are:

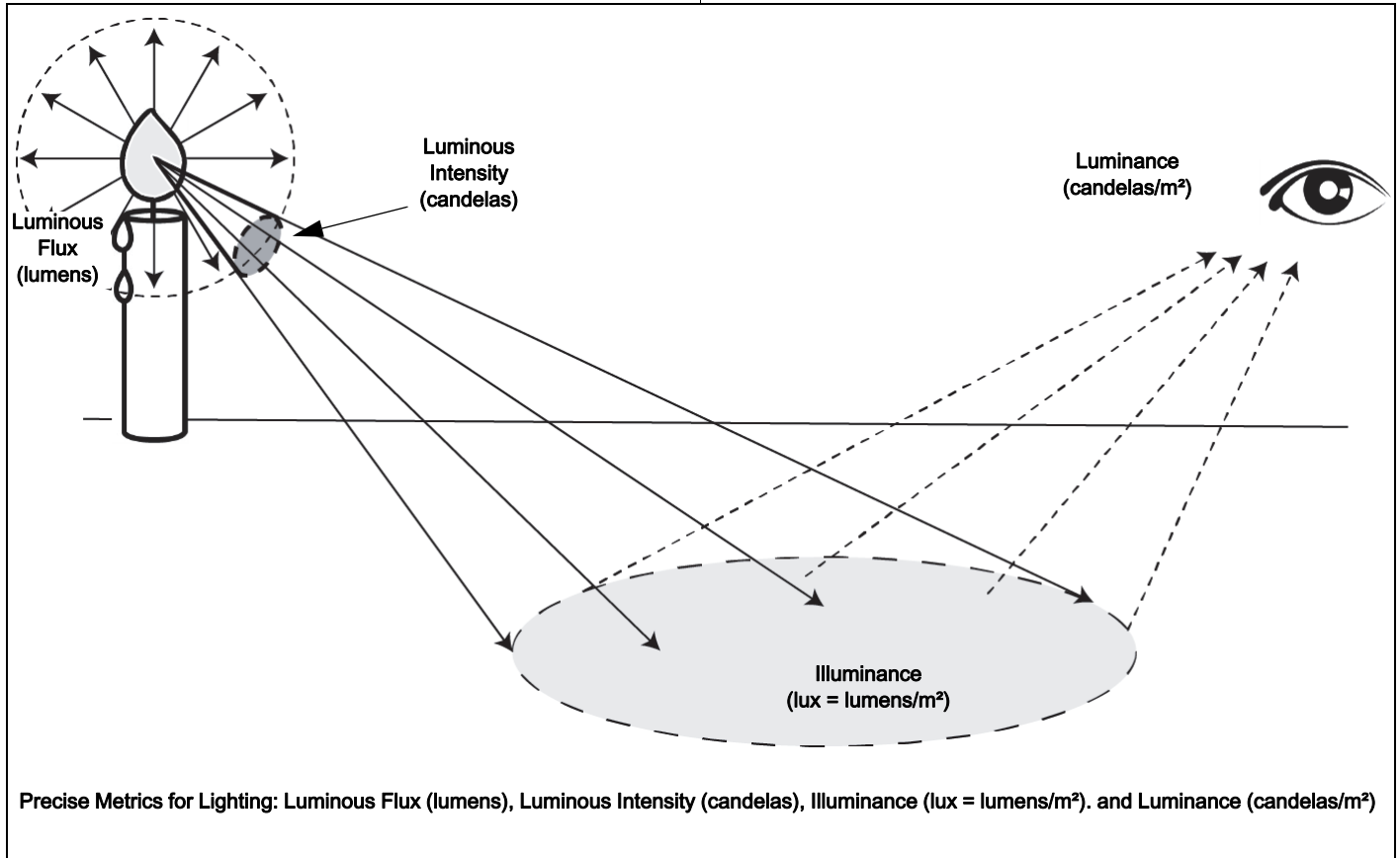
Red - 580 to 650, Green - 510 to 580, Blue - 400 to 510



The following graphic of precise metrics for lighting has images showing Luminous Flux, Luminous Intensity, Illuminance, and Luminance.

**Luminous Flux** is the quantity of the energy of the light emitted per second in all directions. In photometry, **Luminous Intensity** is a measure of the wavelength-weighted power emitted by a light source in a particular direction per unit solid angle, based on the luminosity function, a standardized model of the sensitivity of the human eye. Illuminance is the amount of luminous flux per unit area. The luminosity function (or luminous efficiency function)

describes the average spectral sensitivity of human visual perception of brightness. It is based on subjective judgments of which of a pair of different-colored lights is brighter, to describe relative sensitivity to light of different wavelengths. In photometry, **Illuminance** is the total luminous flux incident on a surface, per unit area. It is a measure of how much the incident light illuminates the surface, wavelength-weighted by the luminosity function to correlate with human brightness perception. **Luminance** is the intensity of light emitted from a surface per unit area in a given direction.



**UVA:** Ultraviolet A is ultraviolet radiation with wavelengths between 315 and 400 nm.

**UVB:** Ultraviolet B is ultraviolet radiation with wavelengths between 290 and 320 nm, comprising less than 1 per cent of the ultraviolet radiation that reaches the earth.

**UV Index:** The UV index is effectively a rough measure of the amount of harmful ultraviolet radiation in the sunlight reaching the Earth's surface at a given location. The index is a scale used to estimate the risk for sunburn in midday sunlight, with a low number meaning less risk than a high number.

**PAR:** (Photosynthetically Active Radiation) This designates the spectral range (wave band) of solar radiation

from 400 to 700 nm that photosynthetic organisms are able to use in the process of photosynthesis. This spectral region corresponds more or less with the range of light visible to the human eye.

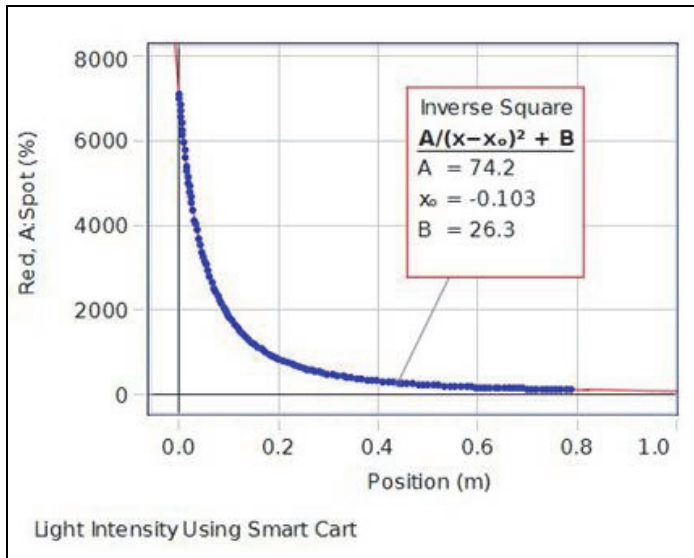
**Illuminance:** This is the total luminous flux incident on a surface, per unit area. It is a measure of how much the incident light illuminates the surface,

**Irradiance:** In radiometry, irradiance is the radiant flux (power) received by a surface per unit area. The SI unit of irradiance is the watt per square meter (W/m²).

**Sample Data**

The graph shows the measurement of light intensity versus distance using the PS-3213 Wireless Light Sensor

mounted on a PASCO Smart Cart (ME-1240), a PASCO Basic Optics Light Source (OS-8470), a PASCO Track, and PASCO data collection software.



The illustration shows the equipment setup.

