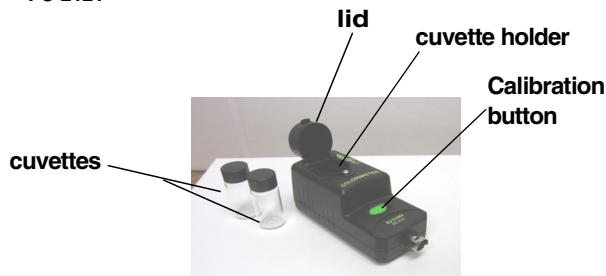


PASport

Colorimeter

PS-2121



Equipment needed:

- USB Link (PS-2100) with USB-compatible computer or Xplorer (PS-2000)
- DataStudio®, DataStudio Lite, or EZscreen software

Colorimeter Quick Start

The PS-2121 Colorimeter measures the transmittance (%) of different colors of light through a solution, and can be used to determine a solution's concentration.

Equipment Setup

1. Connect the USB Link to a USB port on your computer, or to a USB hub. (If using an Xplorer, connect the Xplorer cable to a USB port on your computer.)
2. Connect the sensor to the USB Link or to the Xplorer.
3. The software launches when it detects a PASPORT™ sensor. Select a choice from the PASPORTAL window.



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Colorimeter Specifications

Specifications:


Range:	0 to 100% transmittance
Wavelengths:	Red (660 nm), orange (610 nm), green (565 nm), blue (468 nm)
Accuracy:	± 0.5% transmittance
Resolution:	0.1% transmittance
Default sample rate	1 sample/sec
Maximum sample rate:*	5 samples/sec
Temp. Range:**	5–40°C (recommended)

Colorimeter Usage Tips

- * The recommended sample rate is 1 Hz for color and Beer's law studies. If you plan to do reaction order studies, use a faster sample rate.
- ** The temperature range applies to both the temperature of the solution in the cuvette and the ambient temperature. Using the Colorimeter above or below the recommended range or with condensation may give false readings.

Activity: Transmittance and Absorbance of Colors in Solution

Equipment Required: PS-2121 Colorimeter, DataStudio or DataStudio Lite, USB Link connected to a USB-compatible computer, distilled water, red (or other) food coloring, 2 cuvettes

- Fill one cuvette with distilled water and screw the cap on securely.
- Fill another cuvette with colored solution (i.e. 2 drops of red food coloring and 6 ml of water). Screw on the cap, then gently rock the cuvette back and forth to evenly mix the solution without creating bubbles.
- Insert the cuvette containing distilled water into the cuvette holder and tightly close the lid.
- Plug the Colorimeter into the USB Link, launch DataStudio, and click the **Start** button to begin collecting data. The default graph displays the transmittance readings for each of the four possible wavelength settings. Click the **Stop** button to end data collection.
- Open the Colorimeter lid, remove the first cuvette, and replace it with the cuvette containing the colored solution. Repeat steps 3 and 4 to collect data for the colored solution.
- Examine the graph display from run #2 (the colored solution). Note the transmittance readings at each wavelength setting. How do they differ from transmittance readings for the distilled water?
- To view absorbance data, click on the **Setup** button to open the PASPORT Setup window. Maximize the PASPORT Setup window to view the Colorimeter options.
- Uncheck each of the four transmittance boxes, and click to place an "X" next to each of the four absorbance boxes. (Note the changed "Data" list in the Summary bar to the left.) Close the Setup window.
- To open a new Graph display, double click on the Graph icon  in the Data list. When the dialog box appears, select a data source to display absorbance for a data run and wavelength. Click OK to open Graph 2, which will display Absorbance vs. Time. (Note: If desired, you can use a Digits display instead of a Graph.)
- To compare absorbance values for the distilled water and colored solution, drag the appropriate icons from the Data list to Graph 2. Analyze which colors were absorbed or transmitted for each run and explain your results.

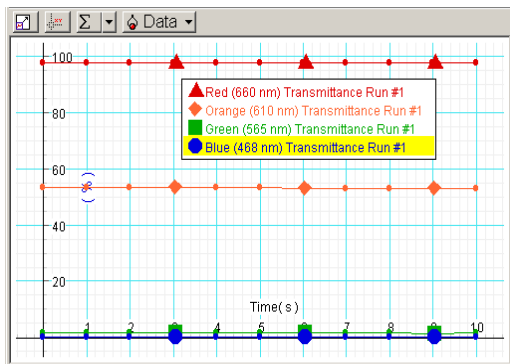


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Activity Example (Continued): Sample Results

Transmittance of Colors through a Red Solution



Note: Only the first data run of all four colors (red, blue, green, orange) will correspond to the graph colors that DataStudio displays. (This applies to either default measurements or the first four chosen in the PASPORT Setup window).

Viewing Results in DataStudio

DataStudio/DS Lite

Procedure

View transmittance or absorbance results:

From the Data list, drag a colored Transmittance or Absorbance icon to a Graph or other display.

Open the Experiment Setup window:

On the main toolbar, click on the **Setup** button to open the Experiment Setup window.

Set up the Colorimeter to read absorbance:

In the upper right corner of the Experiment Setup window, click on the **Maximize** button. Scroll to the Colorimeter box and check the absorbance boxes.

View a linear fit*:

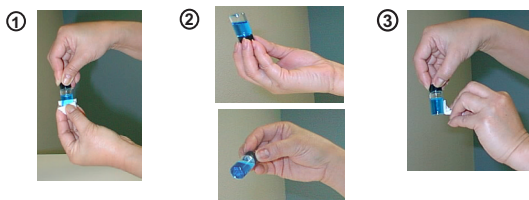
Click on the **Statistics** button. From the Statistics menu, select "Linear Fit."

*To calculate the log or inverse of absorbance, create an equation using the DataStudio Calculator. The linear fit and Calculator features are not available in DataStudio Lite.

Sample Preparation

Before taking measurements, always do the following:

1. Fill the cuvette with at least 6 ml of sample. Screw the cap on securely.
2. Gently rock the cuvette back and forth to distribute the solute molecules equally throughout the solution. *Do not shake the cuvette or allow air bubbles to enter.*
3. Handle the cuvette by the cap and wipe the outside glass lens clean with a non-abrasive cleaning tissue. *Avoid touching the glass with your fingers!*
4. (Optional): Place one of the provided labels on the cap of the cuvette. (See "Orienting the Cuvette" below.)



Orienting the Cuvette (Optional)

To minimize reading variance due to natural differences or imperfections in the glass of the cuvette, do the following for each cuvette you plan to use:

1. Insert the cuvette containing distilled water or other solution into the cuvette holder.
2. Put a piece of black cloth over your hand and the cuvette (so that no light seeps through). Click the **Start** button in DataStudio.
3. With your covered hand, rotate the cuvette while observing the reading in DataStudio. At the highest transmittance reading, click the **Stop** button. Do not rotate the cuvette any further.
4. With the cuvette still in the holder, place one of the provided arrow labels on the cap, with the the arrow pointing toward the screw on the holder. (For subsequent measurements, always align the arrow with the screw on the holder. Do not switch caps between cuvettes!)



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Calibration Procedure

Calibration of the Colorimeter is not always required, but is recommended for better accuracy. You can calibrate the colorimeter when it is connected to either an Xplorer or a USB link. All calibration readings are stored in flash memory inside the PS-2121. When you unplug the sensor and reconnect it, the sensor retains the last calibration reading.

CAUTION: To avoid errors when calibrating, do not use the Colorimeter around bright lights or with turbid solutions. Always close the lid tightly before taking measurements. For accurate readings, fill the cuvette to the lid with sample.

1. To calibrate for 100% transmittance, insert a cuvette filled with distilled water into the cuvette holder and tightly close the lid.
2. Press the green **Calibration** button on the sensor. The light illuminates to indicate calibration is in progress.
3. Wait for the light to turn off and then remove the sample.
4. To check your calibration, reinsert the cuvette, close the lid, and click the **Start** button in DataStudio. All color readings should approximate 100% transmittance.

Note: While in calibration mode, please do not start collecting data. The PS-2121 Colorimeter cannot communicate during this time and an error will occur.

A blinking red light on the Calibration button means either (a): The dark count is too high; stray light is entering the cuvette holder or (b): The sensor measurement is out of range. The light turns off when the reading is within the normal range.

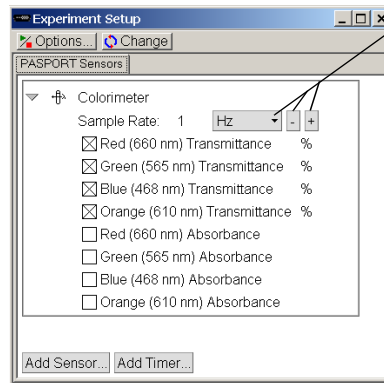
Experiment Suggestions

- Performing reaction rate, enzymatic, and bacterial growth studies
- Monitoring the concentration of substances in water or other solutions

Using the Colorimeter with DataStudio

By default, when you plug a Colorimeter into a USB link and click the **Start** button, DataStudio automatically displays the percent transmittance readings for each of the four colors (red, green, blue, orange) in a Graph display. Any time you need to change the Colorimeter's settings to read a different measurement, you must use the PASPORT Setup window in DataStudio. To open the PASPORT Setup window, click the **Setup** button on the main toolbar. Then click to place an "X" next to the desired measurement. To remove the setting, click on the "X" again.




Example: You want the Colorimeter to read absorbance instead of % transmittance for all four colors. In the boxes next to the colors with the "transmittance" unit, click to remove the "X." Then click to place an "X" in each of the boxes next to the colors with the "Absorbance" unit.



Use the down arrow and the **Plus** and **Minus** buttons to change the sample rate.


Note: Colorimeter options appear in the Setup window when you connect a Colorimeter to a USB link. To view all Colorimeter measurement options, use the **Maximize** button in the Setup window.

Using the Colorimeter with the PASPORT EZscreen

1. Plug the Colorimeter into the PASPORT USB link. When the PASPORTAL window opens, select "Launch EZ-SCREEN."
2. To begin collecting data, click the **Start/Stop**  button.
3. To end data collection, click the **Start/Stop** button.
4. To cycle through the different colors and measurement types, click the **Colorimeter icon**  in the bottom right corner of the screen.
5. To toggle between separate runs of data, click the **Toggle**  button.

Note: To simultaneously view all colors in one graph, you must use either DataStudio or DataStudio Lite.

Using the Colorimeter with Xplorer

1. Turn on the Xplorer.
2. Plug the Colorimeter into the Xplorer. (Note: If you wish to perform calibration, you must have Xplorer connected to your computer. Use the procedure described on the reverse of this card.)
3. To collect data, click the **Start** button . The LED light flashes when Xplorer is storing data. (To stop, click the Start button again.)
4. To cycle through the measurements (transmittance or absorbance) for each color, click the **Plus** button (to move forward) or **Minus** button (to move backward.)
5. To view your data in DataStudio, connect the Xplorer cable to the USB port on your computer and to the USB port on the side of Xplorer.
6. At the DataStudio prompt, click **Retrieve Now**. DataStudio automatically displays the % transmittance readings for the four colors.

Note: To view absorbance readings in DataStudio, you must open the Setup window and change the settings. See "Using the Colorimeter with DataStudio" on this card.