PASPort

Turbidity Sensor
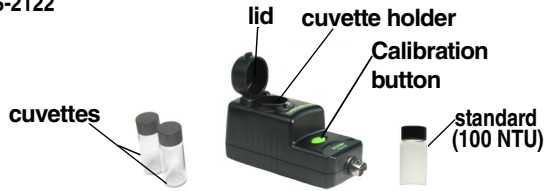
PS-2122

cuvettes

lid   cuvette holder
Calibration
button

standard
(100 NTU)

Equipment required:

- USB Link with USB-compatible computer or PS-2000 Xplorer

- EZscreen, DataStudio®, or DataStudio Lite software (ver. 1.7 or later)

Turbidity Quick Start

The PS-2122 Turbidity Sensor measures the turbidity level ("cloudiness") of water in nephelometric turbidity units (NTU). The Turbidity Sensor is designed only for educational purposes; it is not intended for environmental compliance testing.

Equipment Setup

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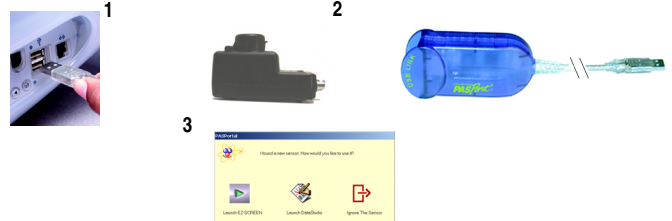

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Sample Preparation

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 ensure an equal distribution of particulate matter. *Do not shake the cuvette or allow air bubbles to form!*
3. Handle the cuvette by the cap; avoid touching the glass with your fingers! Wipe the outside glass lens clean with a non-abrasive cleaning tissue and/or silicone oil*.

Note: For an accurate measurement, take the reading immediately after sample preparation, before the particulate matter settles out of solution.

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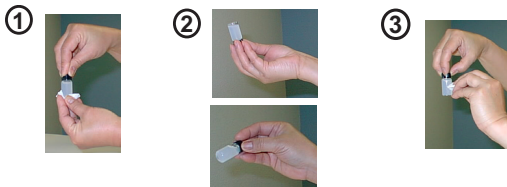
Orienting the Cuvette (Optional)

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 solution into the cuvette holder. (**Note:** For an accurate reading, you must have an equal distribution of particles in solution. Follow all instructions under "Sample Preparation.")
2. Put a piece of black cloth over your hand and the sensor (so that no light seeps through). Click the **Start** (▶ Start) button in DataStudio.
3. With your covered hand, rotate the cuvette while observing the reading in DataStudio. At the lowest turbidity reading, click the **Stop** (■ 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!)

* To order silicone oil from PASCO, use part no. PS-2510.

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Calibrating the Turbidity Sensor

Calibration of the Turbidity Sensor is required the first time the sensor is used. Calibration is also necessary when you are measuring solutions with varying temperatures (more than 1 °C difference between solutions), or when using different cuvettes. You can calibrate the Turbidity Sensor when it is connected to a PASPORT interface (USB Link, PowerLink, Xplorer, etc.). All calibrations are stored in flash memory inside the sensor. When you unplug the sensor and reconnect it, the sensor retains the last calibration stored in memory.

Calibrating with Turbidity Standards

Turbidity standards (solutions of known turbidity) enable you to calibrate the Turbidity Sensor to a known turbidity value. Most turbidity standards are mixed with a molecule called formazin. A 100 NTU formazin turbidity standard is provided with the sensor. To order a replacement standard, use part no. PS-2511.

Calibration Procedure

Note: When calibrating, do not collect data or click the **Start** (► Start) button in DataStudio. The PS-2122 Turbidity Sensor cannot communicate during this time and you will receive an error message.

The Turbidity sensor requires a **two-point** calibration. To perform calibration, you will need distilled water and a known turbidity standard (100 NTU).

1. Insert a cuvette filled with distilled water into the cuvette holder.
2. Close the lid tightly, so that light cannot enter the casing.
3. Press the green **Calibration** button. Release the button. The light should turn on.
4. When the button light blinks, replace the cuvette with the 100 NTU cuvette, close the lid, and press and release the button.
5. When calibration is complete, the button light will turn off.
6. To verify, click the **Start** (► Start) button in DataStudio. The turbidity reading should approximate 100 NTU (±1 NTU).

Tip: For accurate readings, fill the cuvette *to the lid* with at least 6 ml of sample and always close the lid tightly before measurements. Do not use the Turbidity Sensor around bright lights.

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Turbidity Activity

This activity can be completed outdoors without being connected to a computer. For example, using Xplorer(s), students can measure the turbidity of various water samples in the field, then download data from the Xplorer(s) when they return to the classroom (or record the values for each turbidity reading on paper).

Equipment required: PS-2122 Turbidity Sensor, USB Link connected to a USB-compatible computer (or Xplorer), DataStudio or DataStudio Lite, 1-3 cuvettes, distilled water, 6 ml of tap water, 6 ml each of water samples (tap water and/or natural sources).

Note: If only one cuvette is available, you will need to rinse the cuvette with distilled water between samples. For best results, follow the guidelines in the "Orienting the Cuvette" and "Sample Preparation" sections on card 1B.

1. Collect samples from sources you want to test—for example, fish tank, drinking fountain, pool, slow-moving vs. fast-moving water, pond vs. stream, rainwater samples, etc. For each water sample to be tested, fill a cuvette with at least 6 ml of water.
2. Connect the Turbidity Sensor to a USB Link and choose "Launch DataStudio" (or connect the Turbidity Sensor to an Xplorer).
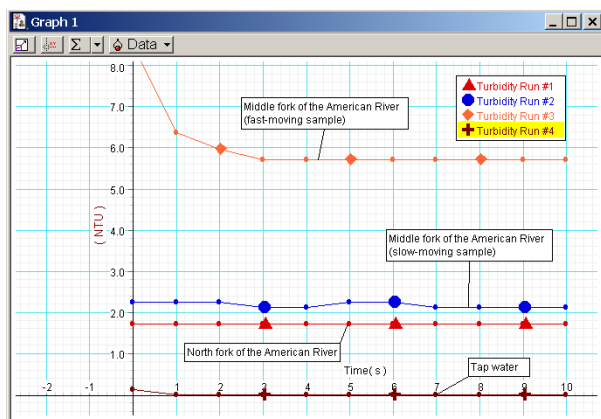
3. Fill a cuvette with distilled water (0 NTU). Screw the cap on securely.
4. Insert the cuvette containing distilled water (6 ml) into the cuvette holder and close the lid of the sensor.
5. Click the **Start** (► Start) button to begin collecting data and the **Stop** (■ Stop) button to end data collection.
6. Fill a second cuvette with 6 ml of tap water. Gently rock the cuvette back and forth to ensure an equal distribution of particulate matter that may be present. (See "Sample Preparation" on card 1B for details.)
7. Open the Turbidity Sensor lid, remove the first cuvette, and replace it with the cuvette containing tap water. Repeat step 5 above to collect data for the sample.
8. Follow the steps outlined above to test other samples. Compare the turbidity readings for each of the samples. Discuss factors that may contribute to turbid water (sediment, silt, bacterial growth, etc.)

Other Experiment Ideas
- Measuring the turbidity of water before and after using a water filtration system
- Monitoring the turbidity of a solution after chemical treatment
- Analyzing the turbidity of water containing various types of bacteria

Activity Example: Sample Results

Viewing Results in DataStudio

Turbidity Levels Sampled from Various Sources of Water

DataStudio/DS Lite	Procedure
Open a Graph display:	In the Displays list, double click on a Graph display.
View a turbidity run:	From the Data list, drag the Turbidity run icon to an open display.
Open the Experiment Setup window:	On the main tool bar, click the **Setup** button.
Change the sample rate:	Click the **Maximize** button and scroll to the Turbidity options box. Click on the **Plus** and **Minus** buttons to change the rate.
View data statistics:	In the open display, click on the **Statistics** button and select a parameter.

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Using the Turbidity Sensor with Xplorer

1. Turn on the Xplorer.
2. Plug the Turbidity Sensor into the Xplorer. (Note: If you wish to perform calibration, use the procedure described on card 2A.)
3. To collect data, click the **Start/Stop** ▶ button. The LED light flashes when Xplorer is storing data. (To stop, click the Start/Stop button again.)
4. 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.
5. At the DataStudio prompt, click **Retrieve Now**. DataStudio automatically displays the turbidity reading (NTU) for the sample.

Using the Turbidity Sensor with the PASPORT EZscreen

1. Plug the Turbidity Sensor 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 toggle between separate runs of data, click the **Toggle** button.

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

Turbidity Sensor Specifications

Specifications:

Sensor Range:	0 to 400 NTU
Accuracy:	0 to 20 NTU: ± 0.2 NTU 20 to 100 NTU: ± 0.5 NTU 100 to 400 NTU: ± 1 NTU
Resolution:	0.1 NTU
Default sample rate:	1 sample/sec
Maximum sample rate:	5 samples/sec
Temp. range*:	5 to 40 ^{0}C (recommended)

1 NTU = 1 nephelometric turbidity unit

*The temperature range applies to both the temperature of the solution in the cuvette and the ambient temperature. If the ambient temperature range varies more than 10 ºC, recalibrate the sensor before taking measurements.

Please Read - Important Sensor Usage Tips!

- For an accurate reading, there must be an equal distribution of particles in solution. Follow all suggestions under "Sample Preparation" on card 1B. Then immediately insert the sample into the Turbidity Sensor before particles settle out of solution. For very turbid samples, the initial turbidity measurement will fluctuate as settling begins. Wait for the reading to stabilize before recording the measurement.
- To minimize error, avoid taking readings around bright lights. The lid must be closed securely to avoid error from light entry.
- Avoid or dilute dark-colored samples. Increased error may occur with samples that have a dark color.
- Always fill the cuvettes to the lid, with at least 6 ml of sample. Underfilling may introduce error or give false readings.
- Before taking a turbidity reading, remove "floaters" or large, visible particles of sediment from samples, as these may introduce error in the readings. (Use a suction pipette or sieve to extract the visible floaters.)

Particle Size and Turbidity

The Turbidity Sensor was designed for relative measurements of turbidity solutions with a particle size range between 0-200 microns. Because turbidity is a time-dependent dynamic phenomenon, factors such as particle density, particle size, temperature, and pressure may cause reading variation, especially in repeatability studies. For particle sizes above 200 microns, we recommend extracting the large particles and/or measuring for longer sampling periods.

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