PASPort

Weather Sensor

PS-2154

Sensor Specifications:	
Barometric Pressure: Range: 4.4 to 34 in. Hg Accuracy: ±0.03 in. Hg Resolution: .001 in. Hg	**Relative Altitude:*** Range: 0 to 7000 meters Accuracy: ±5% Resolution: .3048 meters
Absolute Humidity Range: Range: 0 to 50 g/m^3 Accuracy: 10% of reading Resolution: 0.1 g/m^3 or better	**Relative Humidity:** Range: 0 to 100% Accuracy: ±2% Resolution: 1% or better
Dew Point: Range: -50°C to +55°C Accuracy: ±2°C Resolution: 0.1°C or better	**Temperature:** Range: -20°C to +55°C Accuracy: ±0.5°C Resolution: 0.1°C or better

*Altitude in meters = 7000*ln (29.92/Barometric Pressure), where Barometric Pressure is in inches of Hg.

Weather Quick Start

The PS-2154 Weather Sensor measures barometric pressure, relative altitude, absolute and relative humidity, dew point, and temperature.

Additional Equipment Needed

- PASPORT™ interface (USB Link, Xplorer, PowerLink, etc.) with USB-compatible computer or a PS-2000 Xplorer
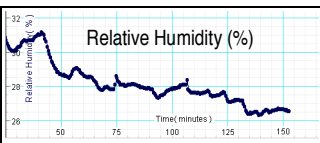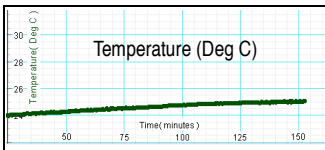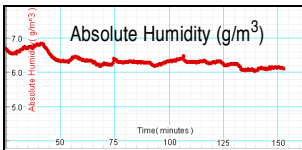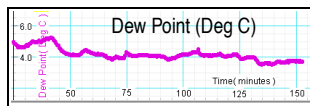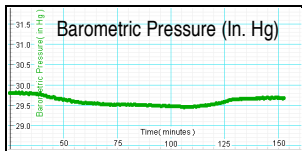- EZscreen or DataStudio® software (version 1.8.5 or later)

Equipment Setup

1. Connect a PASPORT interface to a USB port on your computer or to a USB hub.
2. Connect the Weather Sensor to a PASPORT interface. (If using an Xplorer in the classroom, connect the Xplorer cable to your computer.)
3. The software launches when it detects a PASPORT sensor. Select a point of entry.*

*Note: When you connect the Weather Sensor, two weather workbook activities will display in the PASPORTAL window. To open a workbook, click on the name in the PASPORTAL window.

Short-Term Study of Weather Parameters

Barometric Pressure (In. Hg)

Dew Point (Deg C)

Absolute Humidity (g/m³)

Temperature (Deg C)

Relative Humidity (%)

DataStudio/DS Lite	Procedure:
Change measurement units:	Click the **Setup** button to open the PASPORT Experiment Setup window. Scroll to the Weather Sensor Box. Click on the down arrow next to the parameter you wish to change and select a new unit.
Change the sample rate:	In the PASPORT setup window, scroll to the Weather Sensor Box. Click the down arrow next to Hz to select a time unit. Click the **Plus** or **Minus** button to change the rate.
Scale to fit the data:	On the Graph display tool bar, click the **Scale-to-Fit** button.

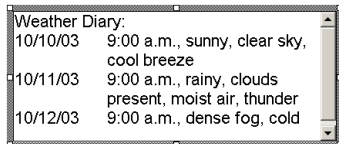## Weather Activities: Short and Long Term Studies

Equipment required: PASPORT Xplorer (PS-2000), PASPORT Weather Sensor (PS-2154), DataStudio or EZscreen software, roll of tape

Experiment: Short-Term Study of Weather Parameters:
1. Plug the Weather Sensor into a PASPORT Xplorer.
2. On the Xplorer, set the sample rate to 1 sample/5 seconds or less.
3. Click the **Start** button to begin recording data while moving with the sensor in different environmental conditions, such as the following: a) up and down a hill b) toward and away from a body of water.
4. Explain how the barometric pressure and altitude change as you climbed up and descended the hill. As you approached the body of water, were the temperature, relative humidity, and dew point affected?

Experiment: Long-Term Study of Weather Parameters:
1. Plug the Weather Sensor into a PASPORT Xplorer.
2. Set Xplorer's sample rate to 1 sample/minute.
3. Place the Weather Sensor (with Xplorer) in an area near your classroom and out of direct sunlight. Mark the location with tape.

Weather Diary:
10/10/03   9:00 a.m., sunny, clear sky, cool breeze
10/11/03   9:00 a.m., rainy, clouds present, moist air, thunder
10/12/03   9:00 a.m., dense fog, cold

4. Click the **Start** button to begin recording data.
5. After 10 minutes of recording, bring the sensor indoors and connect the Xplorer to your computer.
6. Open DataStudio. At the prompt, retrieve your data into DataStudio.
7. In a DataStudio Workbook display, open a text box, and record the date, time, and weather conditions.
8. Repeat steps 1-7 for 2-4 weeks. Each time, place the sensor in the exact location and time of day as before. After 2-4 weeks, note any trends in your journal.

Collecting Data with the Weather Sensor

Note: Calibration of the Weather Sensor is not required, as the sensor is factory calibrated. However, if desired, you can align the sensor measurement's barometric pressure with the standardized pressure from your local weather station. (Do this with DataStudio's experiment calculator.)

1. Connect a PASPORT interface to a USB-compatible computer.
2. Connect the Weather Sensor to a PASPORT interface (i.e. Xplorer, PowerLink, USB Link, etc.)
3. When the PASPORTAL window launches, open DataStudio (or a worbook activity) and click the **Start** button to begin collecting data.

Changing Weather Measurements in DataStudio

By default, all measurements automatically record when you plug the sensor into a PASPORT interface. To reset the recording of a removed measurement, click to place an "X" in the box next to the desired measurement.
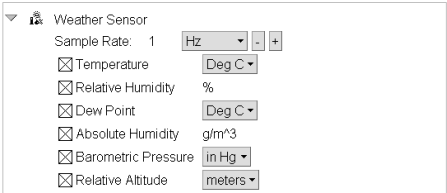
Note: To remove the setting for the recording of a specific measurement, click to remove the "X" in the box next to the parameter you wish to discontinue recording.

Calculate Barometric Pressure from the Change in Altitude

To correct or standardize to average sea level pressure, use the following formula:

$$\text{barometric pressure} = \frac{29.92}{e^{\frac{\text{altitude(meters)}}{7000}}}$$

Example: If your altitude reading is 5280 ft. above sea level, or 1609.34 meters, your average atmospheric pressure will be 23.77 inches of Hg. To standardize the sensor's readings, calculate the offset (29.92 - 23.77 = 6.15 inches) and use the DataStudio experiment calculator to add that value to your sensor readings.

Typical Pressure Changes with Increases in Altitude

Altitude (feet)	Barometric Pressure (In. Hg)	Atmospheric Pressure (kPa)
0	29.92	101.33
500	29.28	99.12
1000	28.65	96.99
1500	28.03	94.89
2000	27.42	92.79
2500	26.83	90.76
3000	26.26	88.72
3500	25.69	87.03
4000	25.14	84.99

Weather Sensor Usage Tips

⚠️ **CAUTION:** Do not place the Weather Sensor in liquids. Placing the Weather Sensor in liquids will permanently damage the sensor. Do not allow the pin connector or other components of the Weather Sensor to become wet at any time.

• For short-term studies (less than one hour), use faster sample rates (1 sample/second or less). The altitude and barometric pressure vary together, so you can discuss the relationship with your students.

• For long-term studies, use slower sample rates (1 sample per 30 seconds or longer). At sample rates of 1 sample/30 seconds or longer, the Xplorer will go into sleep mode. Each time that you turn on the power supply to the Xplorer with the Weather Sensor connected, the Weather Sensor resets the altitude to zero.

• The Relative Altitude on the Weather Sensor resets to zero in the following situations: a) When Xplorer is in sleep mode, b) When the power is turned off and then back on, and c) When the sensor is plugged into the interface.

• If using the Weather Sensor in a freezer, allow about 30 minutes post data collection to allow the sensor to thaw to room temperature.

• Rapid sensor temperature changes may cause condensation on the humidity sensing element and false readings.

Suggested Applications

• Monitoring weather parameters, such as barometric pressure, humidity, and temperature over a long period (monthly, seasonal, etc.)

• Examining the relationship between related parameters, such as barometric pressure and altitude, humidity and dew point, etc.

• Single parameter studies, such as barometric pressure in different locations or altitudes; humidity at various times of the day; temperature changes on a windy day, etc.

Sensor Setup in Wet Conditions

When using the Weather Sensor in wet conditions, such as in rain or snow, place the sensor and Xplorer in a plastic sleeve or a modified 2-liter bottle (**Figure 1**). If using a plastic bottle, cut a hole in the bottom of the bottle. Attach a string to the end of the Xplorer and thread through the hole in the bottle. Suspend the apparatus upside down from a tree, nail, or other stationary post.

Figure 1: Weather Sensor and Xplorer suspended in plastic 2-liter bottle