

PASport

# Quad Temperature Sensor

PS-2143



<b>Sensor Specifications:</b>	
<b>Quad Temperature Sensor:</b> Range: -35°C to 135°C Accuracy: $\pm 0.5^\circ\text{C}$ Resolution: 0.0025°C Repeatability: 0.01°C Unit options: °C, °F, K	
<b>Probe Specifications:</b>	
<b>Fast Response Temperature (PS-2135)</b> Range: -10°C to +70°C Accuracy: $\pm 0.5^\circ\text{C}$ Resolution: 0.0025°C Construction: A 10K thermistor is housed in a water proof PVC tip. The thermistor is connected to a 3.5 mm stereo connector with a 4-foot PVC insulated wire.	<b>Stainless Steel Temperature (PS-2153):</b> Range: -35 to 135°C Accuracy: $\pm 0.5^\circ\text{C}$ Resolution: 0.0025°C Construction: A 10K thermistor is housed in a stainless steel tube.

## Quad Temperature Quick Start

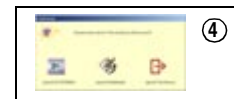
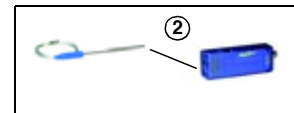
The PS-2143 Quad Temperature Sensor can be used to take four simultaneous temperature probe measurements. The sensor comes with two Stainless Steel Probes (PS-2153) and a Fast Response Probe (PS-2135).

### Additional Equipment Needed

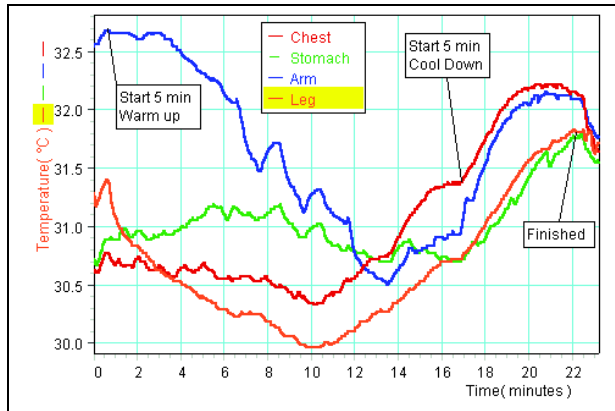
- PASPORT™ interface (USB Link, PowerLink, Xplorer, etc.) with USB-compatible computer or a PS-2000 Xplorer
- EZscreen or DataStudio® software (version 1.9.0 or later)

### Equipment Setup

- ① Connect the PASPORT interface to a USB port on your computer or to a USB hub.
- ② On the Quad Temperature Sensor, insert one or more temperature probes into the temperature port.
- ③ Connect the Quad Temperature Sensor to the PASPORT interface. (If using an Xplorer in the classroom, connect the Xplorer cable to your computer.)
- ④ The software launches when it detects a PASPORT sensor. Launch DataStudio.



## Sample Data: Temperature Differences Among Various Parts of the Body During Exercise



## Activity: Temperature Differences Among Various Parts of the Body

**Equipment required:** PS-2143 Quad Temp. Sensor, PASPORT interface, DataStudio (1.9.0 or later), Four Fast Response Temperature Probes, adhesive patches/tape

1. Plug the PS-2143 Quad Temp. Sensor into a PASPORT interface.
2. Connect the PASPORT interface to a USB-compatible computer.
3. Launch DataStudio.
4. Plug a Fast Response Temperature Probe into each of the ports on the Quad Temp. Sensor box.
5. (Optional): Calibrate each of the probes using the calibration procedure on card 2B.
6. Place a probe in each of the following locations: a) chest b) abdomen c) upper arm and d) leg. (**Note:** To hold the probes in place, put an adhesive patch or piece of medical tape over each probe.)
7. In DataStudio, open a Graph display. From the Data list, drag the icons for the temperature measurements to the graph.
8. Click the **Start** button to begin collecting data.
9. Ask the student to exercise vigorously for about 10 minutes, and watch the data while exercising. Stop and rest for about 10 minutes.
10. To end data collection, click the **Stop** button.
11. Compare the body temperature at each of the four locations during exercise. At which location was the body temperature a) the lowest and b) the highest? At which point was the change in temperature the greatest? Explain your answers. Do more muscular parts of the body generate more or less heat than those parts with more fat tissue?
12. (Optional): With disposable thermometers, have each student take his/her body temperature. During exercise, which is higher, the core body temperature or the skin temperature? Explain your answers.
13. (Optional): Using skin calipers, take a skinfold measurement for the chest, abdomen, arm, and leg. Is there a relationship between the temperature increase and the skinfold measurement?

DataStudio/DS Lite Tasks:	Procedure:
<b>Record the temperature:</b>	On the main toolbar, click the <b>Start</b> button.
<b>Change the sample rate:</b>	In the Setup window, use the <b>Plus</b> and <b>Minus</b> buttons to change the rate. To set a new time unit, click on the down arrow next to Hz and select a new unit.
<b>Change measurement units:</b>	In the Setup window, click on the down arrow next to the appropriate temperature probe number and select a new unit.
<b>Scale to fit the data:</b>	Click the <b>Scale-to-Fit</b> button on the Graph toolbar to automatically scale the data.
<b>View data statistics:</b>	On the Graph toolbar, click the <b>Statistics</b> button.

## Calibrating the Temperature Probe

Calibration of the Fast Response Temperature Probe (PS-2135) or Stainless Steel Temperature Probe (PS-2153) is not required. The accuracy of the PASCO temperature probes is better than 0.5°C across the entire range of the probe. However, if you wish to calibrate, the probe may be calibrated using the following procedure.

**Equipment required:** DataStudio software (ver.1.9.0 or later), PS-2143 Quad Temperature Sensor, temperature probes, ice water, boiling water

1. Plug the PS-2143 Sensor into a PASPORT interface connected to a USB-compatible computer.
2. Plug a temperature probe into the sensor box using any of the four 3.5 mm ports on the sensor box.
3. Click the **Setup** button in the DataStudio toolbar. The Setup window will open.
4. Click on the Temperature **Calibrate** button next to the appropriate probe number in the Setup window. The Calibrate window will open.
5. Place the temperature probe in an ice water bath.
6. Ensure the value in the dialogue box for **Point 1** is 0. This value may be changed to the temperature of the controlled temperature bath if it is different than 0°C.
7. Click the **Set** button adjacent to the Point 1 dialogue box.
8. Place the temperature probe in boiling water.
9. Ensure the value in the dialogue box for **Point 2** is 100. This value may be changed to the temperature of a controlled temperature bath if it is different than 100°C.
10. When the displayed current value stops changing, click the **Set** button adjacent to the Point 2 dialogue box.
11. To save the calibration values, click the **OK** button. The calibration is complete.

## Collecting Data with the Quad Temperature Sensor

1. Plug one or more temperature probes into one or more of the external ports.
2. Connect a PASPORT interface to a USB port on your computer or to an Xplorer.
3. Connect the Quad-Temp Sensor to a PASPORT interface.
4. In DataStudio or Xplorer, click the **Start** button to begin collecting data. To end data collection, click the **Stop** button.

## Changing Measurements in DataStudio

**Note:** To activate recording for a specific probe, click to place an "X" in the box next to the probe that matches the probe's port number. To stop the sensor from recording temperature for a specific probe, disconnect the probe or click in the appropriate box to remove the "X."

## Sensor Usage Tips



**CAUTION:** To avoid damaging the sensor box, do not place the Quad Temperature box in water, liquids, chemicals, ovens, or fire at any time.



**CAUTION:** Do not use the sensor beyond the recommended temperature specification range on card 1A.

**Tip:** DataStudio 1.9.0 will automatically detect when a temperature probe is first connected. The temperature measurement can be manually added in the Setup window.

**Tip:** If using the Quad Temperature to take freezer measurements, put the probe in the freezer, but keep the box outside of the freezer.

## Suggested Applications

- Studying thermal heat flow (in either one or two dimensions)
- Comparing body core vs. limb temperatures
- Comparison of temperatures among various chemical reactions
- Exploring solar radiation
- Studying the properties of insulation

## PASCO Equipment Used with the Quad Temperature Sensor

### Temperature Probes:\*

- PS-2135 Fast Response Temperature Probe (3-pack)
- PS-2131 Skin/Surface Temperature Probe
- PS-2153 Stainless Steel Temperature Probe

### Energy Transfer Products

- ET-8499 Energy Transfer - Calorimeter
- ET-8770 Energy Transfer - Friction
- ET- 8593 Energy Transfer - Solar
- ET-8782 Energy Transfer - Thermoelectric
- ET-8779 Thermal Hammer

### Thermodynamics Products:

- TD-8572 Heat Engine/Gas Law Apparatus
- TD-8592 Small Piston Heat Engine
- TD-8596 Ideal Gas Law Syringe
- TD-8595 Absolute Zero Apparatus
- TD-8497 Solar Constant Set

\*The Quad Temp. Sensor was designed for use with PASCO temperature probes that have a 3.5 mm stereo plug.