Master Materials and Equipment List

Italicized entries indicate items not available from PASCO. The quantity indicated is per student or group. Some activities may require protective gear for each student (for example, safety goggles, gloves, apron, or lab coat).

Teachers can conduct some lab activities with sensors other than those listed here. For assistance with substituting compatible sensors for a lab activity, contact PASCO Teacher Support (800-772-8700 inside the United States or http://www.pasco.com/support).

Act	Title	Materials and Equipment	Part Number	Qty
1	**Scientific Inquiry** This lab is designed to help student familiarize themselves with their data collection system while engaging in scientific investigations.	Data Collection System PASPORT® Temperature Sensor[1] *Cup, 270-mL (9-oz)* *Hot water* *Insulating materials readily available in the laboratory (polystyrene, foil, plastic wrap, cloth, wool, packing peanuts)*	 PS-2135[3] 	1 1 1 500 mL A variety
		CHEMISTRY		
2	**Significant Figures** Use a four scale meter stick to determine the correct number of significant figures to include when reporting a measurement or a calculated value based upon measurements.	PASCO Four Scale Meter Stick, from the PASCO Significant Figures Set – Single *Graduated cylinder, 10-mL,* *Graduated cylinder, 100-mL,* *Beaker, 100-mL,* *Irregular-shaped object* *Regular-shaped object*	ME-9849	1 1 1 1 1 1
3	**Density** Use a density set to determine that density is an intensive property of a substance independent of the shape or size of an object.	PASCO Density Set Balance *Beaker, 150-mL* *Graduated cylinder, 50- or 100-mL* *Metric ruler (or* caliper*)* Overflow can String *Water*	ME-8569 SE-8757A SE-8568 SE-8050 	1 2 or 3 per class 1 1 1 1 30 cm 500 mL
4	**Phase Change** Use a fast response temperature sensor and stainless steel temperature sensor to determine how to add heat to a substance without the temperature of the substance increasing.	Data Collection System PASPORT Stainless Steel Temperature Sensor *Beaker, 150-mL or larger* *Crushed ice to fill the beaker* *Distilled (deionized) water* *Graduated cylinder, 10-mL* Hot plate Rod stand *Rock salt* *Stir rod* *Tablespoon* *Test tube rack* *Test tube, 10-mm × 100-mm* Utility clamp	 PS-2170 SE-8830 ME-9355 SE-9446	1 1 2 1 104 mL 1 1 1 200 g 1 1 1 1 1

Act	Title	Materials and Equipment	Part Number	Qty
5	**Water, the Universal Solvent** Use a conductivity sensor to measure the changes in conductivity of water as substances dissolve in it and to classify substances based on their ability to dissolve in water.	Data Collection System PASPORT Conductivity Sensor Balance *Beaker for waste water* *Beakers, 250-mL* *Distilled water, 400 mL* *Graduated cylinder, 100-mL* *Pencil* *Sample paper* *Solute sample: salt (NaCl)* *Solute samples, 10 g (select two from the following: Epsom salt (MgSO4), alum (KAl(SO4)2, borax (Na2B4O7 or Na2[B4O5(OH)4], sports drink mixes that contain electrolytes, salt substitutes that contain potassium chloride (KCl)* *Stirring rod* *Sugar cube* *Thread, 40 cm* *Wash bottle with distilled water*	 PS-2116A SE-8757A 	1 1 1 per class 1 4 400 mL 1 1 3 ~10 g 2 1 1 40 cm 1
6	**Electrolyte versus Non-Electrolyte Solutions** Use a conductivity sensor to determine which substances in sports drinks (water, sugars, or salts) are electrolytes.	Data Collection System PASPORT Conductivity Sensor *Beaker for collecting rinse water* *Distilled (deionized) water* *Funnel* *Sodium chloride solutions (0.02 M, 0.04 M, 0.06 M, 0.08 M, 0.10 M)* *Sports drink* *Sucrose solutions (0.02 M, 0.04 M, 0.06 M, 0.08 M, 0.10 M)* *Test tube rack* *Test tube, 20-mm × 150-mm* *Wash bottle filled with distilled (deionized) water*	 PS-2116A 	1 1 1 50 mL 1 25 mL of each 25 mL 25 mL of each 1 6 1

Act	Title	Materials and Equipment	Part Number	Qty
7	**Properties of Ionic and Covalent Compounds** Use a conductivity sensor to determine if an unknown substance is an ionic, polar covalent, or non-polar covalent compound based on its physical properties.	Data Collection System PASPORT Conductivity Sensor *Aluminum foil squares, 5-cm × 5-cm* *Distilled (deionized) water* *Graduated cylinder, 10-mL* Hot plate *Masking tape* *Paraffin wax* *Spatula* *Stopper to fit test tubes* *Table salt (sodium chloride)* *Table sugar (sucrose)* *Test tube rack* *Test tube, 15-mm × 100-mm* *Tongs* *Unknown A (use glucose)* *Unknown B (use crayon pieces)* *Unknown C (use potassium chloride)* *Wash bottle and waste container*	 PS-2116A SE-8830 	1 1 6 30 mL 1 1 1 1 g 1 3 1 g 1 g 1 5 1 1 g 1 g 1 g 1
8	**pH of Household Chemicals** Use a pH sensor and common household chemicals to relate pH and hydronium ion (H_3O^+) concentration, classifying solutions as acidic, basic, or neutral.	Data Collection System PASPORT pH Sensor *0.5 M Sodium bicarbonate* *Beaker, 50-mL* *Bleach* Buffer solution pH 4 Buffer solution pH 10 *Coffee* *Graduated cylinder, 10-mL* *Graduated cylinder, 50-mL* *Lemon Juice* *Liquid soap* *Milk* *Soft drink* *Test tube rack* *Test tube, 15-mm × 100-mm* *Wash bottle and waste container* *Water (from the tap)* *White vinegar (~5% acetic acid)* *Window cleaner*	 PS-2170 SC-2321 	1 1 5 mL 2 5 mL 25 mL 25 mL 5 mL 1 1 5 mL 5 mL 5 mL 5 mL 1 10 1 5 mL 5 mL 5 mL

Act	Title	Materials and Equipment	Part Number	Qty
9	**Percent Oxygen in Air** Use an absolute pressure sensor to learn about the components of air and how to determine the percent of oxygen in air.	Data Collection System PASPORT Absolute Pressure Sensor PASPORT Sensor Extension Cable Quick-release connector[2] Tubing connector[2] Tubing, 1- to 2-cm[2] *Beaker, 150-mL* *Glycerin* *One-hole rubber stopper to fit test tubes* *Paper towels* *Steel wool, fine mesh (#000)* *Stir rod* *Test tube, 25-mm × 150-mm* *White vinegar (~5% acetic acid)*	 PS-2170 PS-2500 	1 1 1 1 1 1 1 2 drops 1 As needed 1 g 1 1 50 mL to 60 mL
10	**Evidence of a Chemical Reaction** Use a fast response temperature sensor to distinguish between physical changes and chemical reactions and identify unknown changes as either physical changes or chemical reactions using evidence to support your decision.	Data Collection System PASPORT Fast Response Temperature Sensor *0.05 M Silver nitrate* *0.1 M Sodium chloride* *0.5 M Copper(II) sulfate* *1.0 M Citric acid* *1.0 M Sodium bicarbonate* *1.0 M Sodium hydroxide* Balance *Beaker for collecting rinse water* *Beaker, 250-mL* *Calcium carbonate* *Colored drink powder* *Effervescent tablet* *Graduated cylinder, 100-mL* *Graduated cylinder, 10-mL* Hot plate *Lauric acid* *Spatula* *Stir rod* *Test tube holder* *Test tube rack* *Test tube, 15-mm x 100-mm* *Wash bottle filled with distilled (deionized) water* *Water (from the tap)* *Weighing paper* *White vinegar (~5% acetic acid)*	 PS-2135[3] SE-8757A SE-8830 	1 1 2 mL 2 mL 2 mL 2 mL 2 mL 2 mL 2 or 3 per class 1 2 ~0.2 g ~0.2 g 1 1 1 1 ~0.5 g 1 1 1 1 7 1 255 mL 1 2 mL

Act	Title	Materials and Equipment	Part Number	Qty
11	**Conservation of Matter** Use a balance to test the law of conservation of matter for both physical and chemical changes by finding the mass of the reactants before the chemicals react and the mass of the products after the reaction has occurred.	Balance *0.1 M Sodium sulfate* *0.1 M Strontium chloride* *5% Acetic acid* *Beaker, 250-mL* *Distilled (deionized) water* *Plastic soda bottle (with cap), 500-mL* *Sodium bicarbonate* *Sodium nitrate* *Test tube, 15-mm × 100-mm*	SE-8757A	1 5 mL 5 mL 30 mL 1 10 mL 1 8 g 5 g 2
12	**Varying Reaction Rates** Use a fast response temperature sensor to study how temperature affects chemical reaction rates.	Data Collection System PASPORT Fast Response Temperature Sensor *Alka-Seltzer® tablets* *Clear plastic cups or beakers, 300-mL (10 oz)* *Graduated cylinder, 100-mL* *Room temperature water* *Water, ice-cold* *Water, warm, maintained at a constant temperature*	 PS-2135[3] 	1 1 6 3 1 400 mL 400 mL 400 mL
13	**Endothermic or Exothermic Chemical Reactions** Use a fast response temperature sensor and absolute pressure sensor to obtain evidence of chemical reactions and to determine if the reactions are endothermic or exothermic.	Data Collection System PASPORT Fast Response Temperature Sensor PASPORT Absolute Pressure Sensor Quick-release connector[2] Barbed tubing connector[2] Tubing, 20 to 30 cm[2] Barbed tubing connector[2] *Alka-Seltzer® tablets* *Beaker or clear plastic cup, 250-mL* *Distilled water* *Erlenmeyer flask, 250-mL* *Graduated cylinder, 100-mL* *Instant hot-pack (disposable type)* *Stopper, 1-hole, for Erlenmeyer flask*	 PS-2135[3] PS-2170 	1 1 1 1 1 1 1 2 1 100 mL 1 1 1 1
	PHYSICS			
14	**Position: Match Graph** Use a motion sensor to introduce the concept of representing motion as a change of position in a graphical form.	Data Collection System PASPORT Motion Sensor *Object to hold (textbook, basket ball) (optional)* Rod Stand (optional)	 PS-2103A ME-9355	1 1 1 1
15	**Speed and Velocity** Use a motion sensor to test predictions of how the speed and velocity of a cart will differ.	Data Collection System PASPORT Motion Sensor Dynamics cart[2] Dynamics track[2] Dynamics track end stop[2]	 PS-2103A ME-6962 	1 1 1 1 1

Act	Title	Materials and Equipment	Part Number	Qty
16	**Acceleration** Use a motion sensor to introduce the concept of representing motion as a change of position in a graphical form.	Data Collection System PASPORT Motion Sensor Dynamics cart[2] Dynamics track[2] Dynamics track end stop[2] Dynamics track Rod Clamp Rod stand	 PS-2103A ME-6962 ME-9836 ME-9355	1 1 1 1 1 1 1
17	**Introduction to Force** Use a force sensor to measure and experience contact forces, and some non-contact forces, in relation to gravity.	Data Collection System PASPORT Force Sensor Balance (optional) Masses (at least three different values) *Objects (textbook, ball, carts, et cetera)* Right angle clamp Rod stand Short rod	 PS-2104 SE-8757A ME-8979 SE-9444 ME-9355 ME-8736	1 1 1 per class 3 Several 1 1 1
18	**Archimedes' Principle** Use a force sensor to explore the relationship between the volume of fluid displaced by a submerged object and the buoyant force experienced by that submerged object.	Data Collection System PASPORT Force Sensor Balance *Cup or beaker to catch water from overflow can* *Graduated cylinder, 25-mL (optional)* *Objects to submerge* Overflow can Right angle clamp Rod stand *Ruler* Short rod *Small cup to add water to the overflow-can* String *Water*	 PS-2104 SE-8757A SE-8568 SE-9444 ME-9355 ME-8736 SE-8050 	1 1 1 per class 1 1 2 1 1 1 1 1 25 cm 500 mL
19	**Newton's First Law** Use a motion sensor to determine the influence of force in the motion of an object, and that an object's motion is unchanged in the absence of an external force.	Data Collection System PASPORT Motion Sensor Dynamics cart[2] Dynamics track end stop[2] Dynamics track with feet[2] Mass and hanger set String Super pulley with clamp	 PS-2103A ME-6962 ME-8979 SE-8050 ME-9448A	1 1 1 1 1 1 1 m 1

Act	Title	Materials and Equipment	Part Number	Qty
20	**Newton's Second Law** Use a force sensor and motion sensor to develop an understanding of the relationship between the net force applied to an object, the acceleration of the object, and the object's mass.	Data Collection System PASPORT Force Sensor PASPORT Motion Sensor Balance Dynamics Cart[2] Dynamics Track[2] Dynamics Track End Stop[2] Mass and Hanger Set String Super Pulley with Clamp	 PS-2104 PS-2103A SE-8757A ME-6962 ME-8979 SE-8050 ME-9448A	1 1 1 1 1 1 1 1 per class 1.5 m 1
21	**Newton's Third Law** Use two force sensors to observe the relationship between an action force and the resulting reaction force.	Data Collection System PASPORT Force Sensors Hook and rubber bumpers[2] Large table clamp (optional) *Rubber band* Short rod (optional)	 PS-2104 ME-9472 ME-8736	1 2 2 1 1 1
22	**Boyle's Law** Use an absolute pressure sensor to observe the relationship between volume and pressure of an enclosed gas at constant temperature.	Data Collection System PASPORT Absolute Pressure Sensor Quick release connector[2] Syringe, 60 mL[2] Tubing[2]	 PS-2170	1 1 1 1 1
23	**Temperature versus Heat** Use a temperature sensor to explore the relationship between heat transfer and temperature change in various substances.	Data Collection System PASPORT Temperature Sensor[1] Balance Basic Calorimetry Set Aluminum mass, 200-g[2] Calorimetry cup[2] Copper mass, 200-g[2] *Beaker, 600-mL* Hot plate *Paper clip* String, 15-cm piece *Vegetable oil* *Water*	 PS-2135[3] SE-8757A TD-8557A SE-8830 SE-8050	1 2 1 per class 2 2 2 2 1 2 4 500 g 500 g
24	**Voltage: Fruit Battery/Generator** Use a voltage sensor to explore both the chemical and physical production of a potential difference.	Data Collection System PASPORT Voltage Sensor Alligator clips (one red, one black) Series/Parallel battery holders *Copper* *Zinc* *Batteries, "D" cell* *Variety of fruit*	 PS-2165[4] SE-9756 SE-8799	1 1 2 3 1 piece 1 piece 3 Minimum 1 piece per student group

Act	Title	Materials and Equipment	Part Number	Qty
25	**Faraday's Law of Induction** Use a voltage sensor to explore relationships between the electromotive force generated by passing a magnet through a coil and different parameters of the magnet and coil.	Data Collection System PASPORT Voltage Sensor Coils, 200-turn Coils, 400-turn Coils, 800-turn Magnets, different strengths No-Bounce pad (optional) Rod stand Three-finger clamp *Paper* *Pen or pencil* *Tape*	 PS-2165[4] SF-8909 SF-8910 SF-8911 SE-8604 SE-8687 EM-8648A SE-7347 ME-9355 SE-9445	1 1 1 1 1 3 1 1 1 1 sheet 1 1 roll
	EARTH SCIENCE			
26	**Radiation Energy Transfer** Use a temperature sensor to determine the effect the color of a container has on the temperature of water in the container as it is heated using radiant energy.	Data Collection System PASPORT Temperature Sensor[1] *Graduated cylinder, 100-mL* *Heat lamp (or 150-W lamp)* *Insulated pad* Radiation cans (one black, one silver) Rod stand *Water, room temperature*	 PS-2135[3] TD-8570A ME-9355	1 2 of the same 1 1 2 2 1 0.5 L
27	**Insolation and the Seasons** Use a fast response temperature sensor to determine the effect the angle of the sun has on the temperature of a given surface.	Mobile Data Collection System PASPORT Fast Response Temperature Sensor Rod stand *Black construction paper, 15 x 15 cm* *Cardboard, 15 x 15 cm* *Drinking straw* *Glue* *Protractor* *Scissors* *Sunlight* *Tape* Three-finger clamp	 PS-2135[3] ME-9355 SE-9445	1 1 1 1 1 1 1 1 1 1 small bottle 1 1 1 1
28	**Specific Heat of Sand versus Water** Use a stainless steel temperature sensor to explore the effect energy has on the temperature of sand and water.	Data Collection System PASPORT Stainless Steel Temperature Sensors Balance *Beaker, glass, 500-mL* *Beakers, glass, 250-mL* *Insulated cup and lid, disposable* *Heat lamp or 150-W incandescent lamp* Hot Plate Rod stand	 PS-2170 SE-8757A SE-8830 ME-9355	1 2 1 per class 1 2 2 1 1 1

Act	Title	Materials and Equipment	Part Number	Qty
		Sand		200 g
		Test tube, glass, 18 x 250 mm (large)		1
		Tongs and hot pad		1
		Utility Clamp	SE-9446	2
		Water		750 mL
29	**Soil pH** Use a pH sensor to determine the pH of three soil samples.	Data Collection System		1
		PASPORT pH Sensor	PS-2170	1
		Beaker, 50-mL		2
		Beaker, 250-mL		3
		Buffer solution pH 10	SC-2321	25 mL
		Buffer solution pH 4		25 mL
		Digging tool		1
		Distilled water		400 ml
		Graduated cylinder, 100-mL		1
		Paper towels		1
		Permanent marker		1
		Plastic bag, sealable, small		3
		Soil sample		3
		Stirring rod		1
		Wash bottle with distilled water		1
		Waste container		1
30	**Air Pollution and Acid Rain** Use a pH sensor to determine the effect air pollutants (CO_2, SO_2, and NO_2) have on the pH of water	Data Collection System		1
		PASPORT pH Sensor	PS-2170	1
		Balance	SE-8757A	1 per class
		1.0 M Hydrochloric acid (HCl)		15 mL
		1-hole rubber stopper for flask		1
		Beaker 50-mL		1
		Erlenmeyer flask, 50-mL		1
		Graduated cylinder, 50- or 100-mL		1
		Sodium bicarbonate ($NaHCO_3$)		5 g
		Sodium bisulfite ($NaHSO_3$)		5 g
		Sodium nitrite ($NaNO_2$)		5 g
		Tubing connector		1
		Tubing to fit the tubing connector		20 cm
		Volumetric pipet with bulb, 10-mL		1
		Wash bottle containing distilled or deionized water		1
		Water or deionized water		60 m L

[1]Either the PASPORT Fast Response Temperature Sensor or the PASPORT Stainless Steel Temperature Sensor can be used for this activity.

[2]These items are included with the specific apparatus or sensor used in the experiment.

[3]The PS-2135 is a replacement 3-pack of Fast Response Temperature Probes. The SPARK Science Learning System and Xplorer GLX both come with Fast Response Temperature probes. A probe like the PS-2135 can also be used with the PS-2170 Chemistry Sensor.

[4]The PS-2165 is a replacement voltage probe. The SPARK Science Learning System, Xplorer GLX, and Chemistry Sensor all come with voltage probes.

Calibration Materials

If you want to calibrate various sensors, you will need the following:

pH Sensor

Item	Quantity	Where Used
Buffer solution, pH 4 Buffer solution, pH 10 Beaker, small Wash bottle with deionized or distilled water	25 mL 25 mL 3 1	8, 29

Activities by PASCO Equipment

This list shows the PASCO specific equipment used in each lab activity. The Chemistry Sensor is a MultiMeasure™ sensor that contains a PASPORT Absolute Pressure Sensor, a PASPORT pH Sensor, a PASPORT Stainless Steel Temperature Sensor, and a PASPORT Voltage Sensor.

Items Available from PASCO	Qty	Part Number	Activity Where Used
PASCO Density Set	1	ME-8569	3
PASCO Significant Figure Set	1	ME-9849	2
PASPORT Absolute Pressure Sensor[2]	1	PS-2170	9, 13, 22
PASPORT Conductivity Sensor	1	PS-2116A	5, 6, 7
PASPORT Fast Response Temperature Sensor	1	PS-2135	10, 12, 13, 27
PASPORT Force Sensor	1	PS-2104	17, 18, 20
PASPORT Force Sensor	2	PS-2104	21
PASPORT Motion Sensor	1	PS-2103A	14, 15, 16, 19, 20
PASPORT pH Sensor[2]	1	PS-2170	8, 29, 30
PASPORT Stainless Steel Temperature Sensor[2]	1	PS-2170	4, 28, 26
PASPORT Temperature Sensor[1]	1	PS-2170	1, 23
PASPORT Temperature Sensor[1]	2	PS-2170	26 (2 of the same type)
PASPORT Voltage Sensor[2]	1	PS-2170	24, 25

[1]Either the PASPORT Fast Response Temperature Sensor or the PASPORT Stainless Steel Temperature Sensor can be used for this activity.

[2]This sensor is available as part of the Chemistry Sensor