MASTER MATERIALS AND EQUIPMENT LIST

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

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

Lab	Title	Materials and Equipment	Part No.	Qty
1	MODELING CHEMISTRY Students use temperature, pH, and conductivity sensors to explore chemical and physical changes and analyze them for ambiguity while also gaining understanding of sensors and representing reactions at the particulate level.	**MODEL 1**		
		Data Collection System		1
		PASCO Temperature Sensor[1]	PS-2125	1
		PASCO pH Sensor[1]	PS-2102	1
		PASCO Conductivity Sensor	PS-2116A	1
		Graduated cylinder, 100-mL		1
		Beakers (6), glass, 100-mL		1
		Stirring rod		1
		Unknowns 1A–1D: *blue food coloring,* *yellow food coloring,* *0.5 M HCl,* *0.5 M NaOH*		100 mL
		Distilled water wash bottle		1
		MODEL 2		
		Data Collection System		1
		PASCO Absolute Pressure Sensor[1,2]	PS-2107	1
		Tubing and tubing connector [1,2]		2
		Quick release connector[1,3]		1
		Sensor extension cable[3]		1
		Test tube rack		1
		Test tubes, 20mm × 150 mm, glass		2
		Rubber stopper, #2, two-hole		1
		Syringe, 10-mL, to fit stopcock		1
		Stopcock to fit two-hole stopper		1
		Graduated cylinder, 10 mL		1
		Unknown 2A: ethanol		2 mL
		Unknown 2B: steel wool		¼ test tube
		Glycerin		Several drops
		Tongs		1
		Paper towel		1
		MODEL 3		
		Data Collection System		1
		PASCO Temperature Sensor[1]	PS-2125	1
		PASCO pH Sensor[1]	PS-2102	1
		PASCO Conductivity Sensor	PS-2116A	1
		Graduated cylinder, 100-mL		1
		Beaker, glass, 100-mL		1

Lab	Title	Materials and Equipment	Part No.	Qty
		Stirring rod		1
		Distilled water, 50 mL		1
		Distilled water wash bottle		1
		Each group selects one of the following: *Sucrose ($C_{12}H_{22}O_{11}$),* *Sodium chloride (NaCl),* *Sodium acetate ($NaCH_3COO$),* *Calcium (Ca) metal turning, about the size of half a pea*		0.5 g
		Ammonium nitrate (NH_4NO_3)		0.5 g

Lab	Title	Materials and Equipment	Part No.	Qty
2	LIGHT, COLOR, AND CONCENTRATION Students use a colorimeter to learn how to use visible light to determine the concentration of colored ion species in a solution	**MODEL 1**		
		Data Collection System		1
		PASCO Colorimeter	PS-2121	1
		Cuvette		1
		Sensor extension cable		1
		Pipet with pump or bulb, 10-mL		1
		White 3 × 5 index card or piece of paper		1
		Colored pencils		1 each
		Scissors		1
		Distilled water and wash bottle		1
		Kimwipes® or lint free tissues		As needed
		One of the following: *0.10 M Cobalt(II) nitrate ($Co(NO_3)_2$)* *0.10 M Nickel(II) nitrate ($Ni(NO_3)_2$)* *0.10 M Iron(III) nitrate ($Fe(NO_3)_3$)* *0.10 M Zinc nitrate ($Zn(NO_3)_2$)*		30 mL
		MODEL 2		
		Data Collection System	PS-2121	1
		PASCO Colorimeter		1
		Cuvette		1
		Sensor extension cable	PS-2500	1
		Distilled water and wash bottle		1
		Test tubes, large		5
		Test tube rack		1
		Pipet with pump or bulb, 10-mL		1
		Glass stirring rod		1
		Kimwipes or lint free tissues		1
		One of the following: *0.10 M Cobalt(II) nitrate ($Co(NO_3)_2$)* *0.10 M Nickel(II) nitrate ($Ni(NO_3)_2$)* *0.10 M Iron(III) nitrate ($Fe(NO_3)_3$)* *0.10 M Copper(II) sulfate ($CuSO_4$)*		30 mL
		APPLYING YOUR KNOWLEDGE		
		Data Collection System		1
		PASCO Colorimeter	PS-2121	1
		Sensor extension cable	PS-2500	1
		Cuvette		1
		Pipet with pump or bulb, 10-mL		1
		Distilled water and wash bottle		1
		Kimwipes or lint free tissues		As needed
		0.10 M Copper(II) nitrate ($Cu(NO_3)_2$)		30 mL
		Copper(II) nitrate ($Cu(NO_3)_2$), unknown concentration		6 mL

Lab	Title	Materials and Equipment	Part No.	Qty
3	GRAVIMETRIC ANALYSIS Students use a balance and the Solubility Rules to identify an unknown alkali metal carbonate.	**MODEL 1**		
		Beakers, glass, 100-mL		4
		Beral pipets		4
		Unknown A (K_2CO_3)		5.0 g
		0.10 M Sodium nitrate, ($NaNO_3$)		5 drops
		0.10 M Potassium chloride, (KCl)		5 drops
		0.10 M Ammonium nitrate, (NH_4NO_3)		5 drops
		0.10 M Calcium chloride, ($CaCl_2$)		5 drops
		Stirring rod		1
		Marking pen (to label beakers)		1
		Distilled water		200 mL
		MODEL 2 AND APPLYING YOUR KNOWLEDGE		
		Beaker, glass, 100-mL		1
		Filtration funnel		1
		Erlenmeyer flask, glass, 250-mL		1
		Filter paper, Whatman® Ashless, #42		1
		Watch glass, 100-mm		1
		Analytical balance, 0.001 g precision		1 per class
		Stirring rod		1
		Pencil		1
		Wash bottle with distilled water		1
		Drying oven		1 per class
		MODEL 2		
		Unknown A (K_2CO_3)		1 g
		0.25 M Calcium chloride ($CaCl_2$)		50 mL
		Distilled water		100 mL
		APPLYING YOUR KNOWLEDGE		
		Unknown B (Li_2CO_3)		2.00 g
		0.50 M Potassium nitrate (KNO_3)		20 mL
		0.50 M Lithium chloride (LiCl)		20 mL
		0.50 M Calcium nitrate ($Ca(NO_3)_2$)		20 mL
		0.50 M Sodium chloride (NaCl)		20 mL
		Distilled water		As needed

Lab	Title	Materials and Equipment	Part No.	Qty
4	STOICHIOMETRY OF SOLUTIONS Students use a drop counter, a conductivity sensor, and temperature sensor to determine the concentration of dissolved ions by titration.	**MODELS 1, 2, AND APPLYING YOUR KNOWLEDGE**		
		Data Collection System		1
		PASCO Conductivity Sensor	PS-2116A	1
		PASCO High Accuracy Drop Counter	PS-2117	1
		PASCO Fast-response Temperature Sensor	PS-2135	1
		Drop dispenser:		
		Syringe, 60-mL		1
		Stopcock		2
		Drop tip		1
		Beaker, glass, 150-mL		1
		Beaker, 250-mL		1
		Graduated cylinder, 50-mL		1
		Mohr pipet, 25-mL		1
		Pipet pump		1
		Magnetic stirrer (stir plate)		1
		Micro stir bar		1
		Multi clamp		1
		Ring stand		1
		Three-finger clamp		1
		Phenolphthalein		3 drops
		2.0 M Sodium hydroxide (NaOH)		120 mL
		Distilled water		As needed
		Wash bottle		1
		Materials for drop counter and pH sensor calibration (Refer to Appendix A, below)		
		MODEL 1		
		1.0 M Hydrochloric acid (HCl)		25 mL
		MODEL 2		
		Hydrochloric Acid (HCl), one of several possible concentrations		25 mL
		APPLYING YOUR KNOWLEDGE		
		Monoprotic acid of an unknown concentration (HCl is used)		25 mL

Lab	Title	Materials and Equipment	Part No.	Qty
5	POLAR AND NONPOLAR SUBSTANCES Students use a pH sensor to learn how a compound's structure influences its solubility in water and oil.	**MODEL 1**		
		Data Collection System		1
		PASCO pH Sensor	PS-2102	1
		Beaker, 100-mL		5 per class
		Stirring rod		1
		Beral pipet		1
		Mineral oil		30 mL
		Distilled water		30 mL
		Colored pencils or camera		As needed
		SET 1 COMPOUNDS		
		Copper(II) sulfate ($CuSO_4 \cdot 5H_20$)		0.5 g
		Iron(III) chloride ($FeCl_3$)		0.5 g
		Cobalt(II) chloride ($CoCl_2$)		0.5 g
		NOTE: Use a blender or food processor to shorten preparation time.		
		Beta-carotene , ($C_{40}H_{56}$, carrot pigment) from raw carrots		10 mL
		Capsanthin ($C_{40}H_{56}O_3$, paprika pigment) from powdered paprika		10 mL
		Riboflavin ($C_{17}H_{20}N_4O_6$, vitamin B) from tablets		10 mL
		Lycopene ($C_{40}H_{56}$, tomato pigment) from canned tomatoes		10 mL
		Betanin ($C_{24}H_{27}N_2O_{13}$, beet pigment) from canned beets		10 mL
		Mineral oil for preparing the solutions		300 mL
		Ethanol for preparing the solutions		150 mL
		SET 2 COMPOUNDS		
		Acetylsalicylic acid ($C_9H_8O_4$) Aspirin tablets		10 mL
		Stearic acid ($C_{17}H_{35}COOH$)		0.5 g
		Oleic acid ($C_{17}H_{33}COOH$)		10 mL
		Acetic acid (CH_3COOH)		10 mL
		Citric acid ($C_6H_8O_7$)		0.5 g
		MODEL 2		
		Beaker, 100-mL		2
		Mineral oil		20 mL
		Lycopene ($C_{40}H_{56}$, tomato pigment)		10 mL
		Betanin ($C_{24}H_{27}N_2O_{13}$), beet pigment)		10 mL

Lab	Title	Materials and Equipment	Part No.	Qty
6	SOLUBILITY Students use a conductivity sensor and the mass of dissolved solute to determine the saturation concentration of a compound.	**MODEL 1**		
		Data Collection System		1
		PASCO Conductivity Sensor	PS-2116A	1
		Beakers, 150-mL		3
		Balance		1 per class
		Stirring rod		1
		Graduated cylinder, 100-mL		1
		Unknown A, solid (glucose, $C_6H_{12}O_6$)		1.0 g
		Unknown B, solid (potassium bitartrate, $KHC_4H_4O_6$)		1.0 g
		Unknown C, solid (sodium sulfate (Na_2SO_4)		1.0 g
		Distilled water		300 mL
		Wash bottle with distilled deionized water		1
		MODEL 2		
		Data Collection System		1
		PASCO Conductivity Sensor	PS-2116A	1
		Magnetic stir bar		1
		Stir plate		1
		Ring stand		1
		Graduated cylinder, 100-mL		1
		Balance (1 per class)		1 per class
		Beaker, 150-mL		1
		Clamp		1
		Potassium bitartrate ($KHC_4H_4O_6$), solid		4.2 g
		Distilled water		100 mL
		MODEL 3		
		Erlenmeyer flask, 125-mL		1
		Mohr pipet, 25-mL		1
		Pipet bulb		1
		Beaker, 150-mL		2
		Buret		1
		Buret clamp		1
		Funnel		1
		Quantitative filter paper		1
		Magnetic stir bar		1
		Stir plate		1
		Phenolphthalein		3 drops
		0.10 M Sodium hydroxide (NaOH)		80 mL
		Distilled water		20 mL

Lab	Title	Materials and Equipment	Part No.	Qty
7	EMPIRICAL FORMULA Students use a colorimeter and stoichiometric calculations to obtain the chemical formula of a compound.	**MODEL 1**		
		Hot plate per group or an oven for the class		1
		Crucible and cover		1
		Crucible tongs		1
		Unknown copper hydrate: $CuCl_2 \cdot 2H_2O$		1.0 – 1.5 g
		Balance		1–2 per class
		MODEL 2		
		Data Collection System		1
		PASCO Colorimeter	PS-2121	1
		Sensor extension cable	PS-2500	1
		Graduated cylinder, 25-mL		1
		Volumetric flask, 100-mL		1
		Unknown copper hydrate: $CuCl_2 \cdot 2H_2O$		1.0 – 1.5 g
		0.10 M Copper(II) chloride ($CuCl_2 \cdot 2H_2O$), 60 mL		60 mL
		Distilled water		25 mL

Lab	Title	Materials and Equipment	Part No.	Qty
8	MEASURING VITAMIN C —REDOX TITRATION Students use an oxidation reduction potential probe to expand their understanding of titrations, carry out a redox titration, and then use the redox titration method to answer a question of their own design	**MODEL 1**		
		Data Collection System		1
		PASCO Oxidation Reduction Potential (ORP) Probe	PS-2147	1
		Beaker, 250-mL		5 for the class
		Beaker, 150-mL		1
		0.25 % Iodine (I_2) solution, from povidone iodine or from solid I_2 and KI		50 mL for the class
		0.01 M L-Ascorbic acid ($C_6H_8O_6$), L-ascorbic acid or vitamin C tablets		50 mL for the class
		3% Hydrogen peroxide (H_2O_2)		50 mL for the class
		0.01 M Potassium permanganate ($KMnO_4$)		50 mL for the class
		1.0 M Sodium chloride (NaCl)		50 mL for the class
		Distilled water		50 mL
		MODEL 2 AND APPLYING YOUR KNOWLEDGE		
		Data Collection System		1
		PASCO High Accuracy Drop Counter	PS-2117	1
		PASCO Oxidation Reduction Potential (ORP) Probe	PS-2147	1
		Beaker, 150-mL		1
		DROP DISPENSER:		
		Syringe, 60-mL		1
		Stopcock		2
		Drop tip		1
		Multiclamp		1
		Three-finger clamp		1
		Ring stand		1
		Magnetic stir plate and micro stir bar		1
		Analytical balance		1 per class
		Materials for drop counter and pH sensor calibration (Refer to Appendix A below)		
		MODEL 2		
		0.25 % Iodine (I_2) solution, from povidone iodine or from solid I_2 and KI		70 mL
		L-Ascorbic acid ($C_6H_8O_6$), L-ascorbic acid or vitamin C tablets		0.040 – 0.060 g
		Distilled water		75 mL
		APPLYING YOUR KNOWLEDGE		
		0.25 % Iodine (I_2) solution, from povidone iodine or from solid I_2 and KI		As needed
		Foods or juices for vitamin C analysis		As needed
		Juicer		1
		Knife (for slicing fruit)		1

Lab	Title	Materials and Equipment	Part No.	Qty
9	FACTORS THAT AFFECT REACTION RATE Students use a pressure sensor and temperature sensor to explore several variables that affect the rate of a chemical reaction.	**MODEL 1 AND MODEL 2**		
		Data Collection System		1
		PASCO Temperature Sensor[1]	PS-2125	1
		PASCO Absolute Pressure Sensor	PS-2107	1
		Quick-release connector[2]		1
		Tubing, 1- to 2-cm[2]		2
		Tubing connectors[2]		2
		Two-hole stopper to fit flask		1
		Erlenmeyer flask, 125-mL		1
		Graduated cylinder, 50-mL		1
		Syringe, 60-mL		1
		Mortar and pestle		1
		MODEL 1		
		Calcium carbonate ($CaCO_3$), solid		0.2 g
		3.0 M Hydrochloric acid (HCl)		1 mL
		Distilled water		50 mL
		MODEL 2		
		Equipment and amounts depend on the variable:		
		Beaker for ice bath		As needed
		Beaker (4), 50-mL		As needed
		Graduated cylinder, 10-mL		As needed
		Magnetic stir bar		As needed
		Stir plate		As needed
		Hot plate		As needed
		Calcium carbonate ($CaCO_3$)		As needed
		3.0 M Hydrochloric acid (HCl)		As needed
		Ice		As needed
		Distilled water		As needed

Lab	Title	Materials and Equipment	Part No.	Qty
10	MEASURING THE SPEED OF A REACTION Students use a colorimeter sensor to determine the order of a reaction and the effect of variables on the reaction rate.	**MODEL 1**		
		Data Collection System		1
		PASCO Colorimeter	PS-2121	1
		Cuvette		1
		Test tubes, 20- to 25-mL		2
		Volumetric pipets, 10-mL		2
		Beaker, 50-mL		1
		5.0 × 10^{-3} M Crystal violet ($C_{25}H_{30}N_3Cl$)		10 mL
		0.2 M Sodium hydroxide (NaOH)		10 mL
		Distilled water for calibration		10 mL
		Kimwipes or lint free tissues		As needed
		MODEL 2		
		Data Collection System		1
		PASCO Colorimeter Sensor	PS-2121	1
		PASCO Temperature Sensor[1]	PS-2125	1
		Cuvette		1
		Beakers (2), 50-mL		2
		Beakers (2), 400-mL		2
		Volumetric pipets (2), 10-mL		2
		0.2 M Sodium hydroxide (NaOH)		40 mL or as needed
		5.0 × 10^{-3} M Crystal violet ($C_{25}H_{30}N_3Cl$)		40 mL or as needed
		Hot plate		1
		Ice		1
		Distilled water for calibration		10 mL
		Kimwipes or lint free tissues		As needed

Lab	Title	Materials and Equipment	Part No.	Qty
2wtsn011	ENERGY IN CHEMICAL REACTIONS Students use a temperature sensor to demonstrate that the heat q is dependent on reaction conditions but the change in enthalpy ΔH is a constant quantity.	**CALORIMETER FOR MODEL 1, MODEL 2, MODEL 3, AND APPLYING YOUR KNOWLEDGE**		
		Data Collection System		1
		PASCO Stainless Steel Temperature Sensor[1]	PS-2153	1
		Polystyrene cup, 8 oz		1
		Ring stand		1
		Beaker, 250-mL		1
		Clamp, utility		1
		Graduated cylinder, 50-mL or 100-mL		1
		10 cm × 10 cm cardboard lid		1
		MODEL 1		
		Ammonium nitrate (NH_4NO_3), solid		2, 4, or 6 g
		Distilled water		50 or 100 mL
		MODEL 2		
		1.0 M Sodium hydroxide (NaOH)		100 mL
		1.0 M Hydrochloric acid (HCl)		100 mL
		Distilled water		100 mL
		MODEL 3		
		1.0 M Sodium hydroxide (NaOH)		100 mL
		1.0 M Hydrochloric acid (HCl)		100 mL
		Sodium hydroxide (NaOH)		4 g
		APPLYING YOUR KNOWLEDGE		
		2.0 M Hydrochloric acid (HCl)		100 mL
		Magnesium ribbon (Mg)		About 0.5 g

Lab	Title	Materials and Equipment	Part No.	Qty
12	CHEMICAL EQUILIBRIUM Students use the results of a colorimeter and a temperature sensor to control the direction of a reversible chemical reaction.	**MODEL 1**		
		Data Collection System		1
		PASCO Colorimeter	PS-2121	1
		Sensor extension cable	PS-2500	1
		Cuvettes		3
		Beakers, 50-mL		3
		Mohr pipet, 10-mL		1
		Pipet bulb		1
		0.0080 M Iron(III) nitrate ($Fe(NO_3)_3 \cdot 9H_2O$)		3.0 mL
		0.0010 M Potassium thiocyanate (KSCN)		3.0 mL
		Kimwipes or lint free tissues		As needed
		MODEL 2		
		Test tube rack		1
		Distilled water		2 mL
		Plastic pipets		3
		Test tubes, 19 × 150 mm (medium)		3
		Gloves		1 pair
		Marking pen(to label beakers)		1
		Cobalt chloride ($CoCl_2 \cdot 6H_2O$)		1.5 g
		0.10 M Silver nitrate ($AgNO_3$)		2 mL
		6.0 M Hydrochloric acid (HCl)		2 mL
		Scoop		1
		Glass stirring rod		1
		MODEL 3		
		Data Collection System		1
		PASCO Fast-response Temperature Sensor	PS-2135	1
		Beakers(2), 250-mL		2
		Hot plate		1
		Cobalt solution from Model 2		1
		Water for water baths		As needed
		Ice		As needed
		APPLYING YOUR KNOWLEDGE		
		Data Collection System		1
		PASCO Colorimeter	PS-2121	1
		Sensor extension cable	PS-2500	1
		Cuvettes (6 come with the colorimeter)		As needed
		Mohr pipet, 10-mL		1
		Pipet bulb		1
		Equipment and amounts depend on the procedure:		
		Test tube, 19 × 150 mm (medium)		As needed
		Beakers, 50-mL		As needed
		Graduated cylinder, 10-mL		As needed
		0.0010 M Potassium thiocyanate (KSCN)		As needed
		0.0080 M Iron(III) nitrate ($Fe(NO_3)_3$)[1]		As needed
		Kimwipes or lint free tissues		As needed

Lab	Title	Materials and Equipment	Part No.	Qty
13	SHAPE OF TITRATION CURVES Students use a pH Sensor and drop counter to determine the fundamental shape of a titration curve and the parameters that can cause it to change.	**MODELS 1, 2, AND APPLYING YOUR KNOWLEDGE**		
		Data Collection System		1
		PASCO pH Sensor[1]	PS-2102	1
		PASCO High Accuracy Drop Counter	PS-2117	1
		Drop dispenser:		
		Syringe, 60-mL		1
		Stopcock		2
		Drop tip		1
		Beaker, glass, 150-mL		1
		Beaker, 250-mL		1
		Mohr pipet, 25-mL		1
		Pipet pump		1
		Magnetic stirrer (stir plate)		1
		Micro stir bar		1
		Multi clamp		1
		Ring stand		1
		Three-finger clamp		1
		Distilled water		As needed
		Wash bottle		1
		Materials for drop counter and pH sensor calibration (Refer to Appendix A, below)		
		MODEL 1		
		0.10 M Sodium hydroxide (NaOH)		260 mL
		0.10 M Hydrochloric acid (HCl)		20 mL
		Phenolphthalein ($C_{20}H_{14}O_4$) indicator solution		2 drops
		MODEL 2		
		0.10 M Sodium hydroxide (NaOH)		260 mL
		0.10 M Hydrochloric acid (HCl)		20 mL
		0.05 M Hydrochloric acid (HCl)		20 mL
		0.025 M Hydrochloric acid (HCl)		20 mL
		0.10 M Acetic acid (CH_3COOH)		20 mL
		0.10 M Potassium hydrogen tartrate ($KC_4H_5O_6$),		20 mL
		APPLYING YOUR KNOWLEDGE		
		0.10 M Sodium hydroxide (NaOH)		260 mL
		Unknown acid of unknown concentration (0.2 M HCl)		15 mL

Lab	Title	Materials and Equipment	Part No.	Qty
14	WEAK ACID TITRATION Students use a drop counter and pH sensor to titrate monoprotic and polyprotic weak acids and determine the relationship between the shapes of the curves and K_a.	**MODEL1, MODEL 2, AND APPLYING YOUR KNOWLEDGE**		
		Data Collection System		1
		PASCO pH Sensor[1]	PS-2102	1
		PASCO High Accuracy Drop Counter	PS-2117	1
		Drop dispenser:		
		Syringe, 60-mL		1
		Stopcock		2
		Drop tip		1
		Beaker, glass, 150-mL		1
		Beaker, 250-mL		1
		Mohr pipet, 25-mL		1
		Pipet pump		1
		Magnetic stirrer (stir plate)		1
		Micro stir bar		1
		Pipet pump		1
		Multi clamp		1
		Ring stand		1
		Three-finger clamp		1
		0.5 M Sodium hydroxide		160 mL
		Distilled water		As needed
		Wash bottle		1
		Materials for drop counter and pH sensor calibration (Refer to Appendix A, below)		
		MODEL 1		
		1.0 M Acetic acid (CH_3COOH)		20 mL
		MODEL 2		
		0.05 M Maleic Acid ($C_3H_4O_4$)		50 mL
		APPLYING YOUR KNOWLEDGE		
		Aspirin		1
		Mortar and Pestle		1

Lab	Title	Materials and Equipment	Part No.	Qty
15	INTRODUCTION TO BUFFERS Students use a pH sensor to create and analyze a buffer system.	**MODEL 1**		
		Data Collection System		1
		PASCO pH sensor[1]	PS-2102	1
		Beaker (glass), 50-mL		1
		Graduated cylinder 25-mL		1
		Acetic acid (CH_3COOH)		20 mL
		Sodium acetate ($NaCH_3COO$)		Approx. 1 g
		Stirring rod		1
		Scoopula™ spatula		1
		Materials for drop counter and pH sensor calibration (Refer to Appendix A, below)		
		MODEL 2		
		Data Collection System		1
		PASCO pH sensor	PS-2102	1
		Beakers, 50-mL		5
		Graduated cylinder, 25-mL		1
		Graduated cylinder, 10-mL or volumetric pipet, 5-mL		1
		Solution 1: Distilled water		20 mL
		Solutions 2–4, below, are prepared with 1.0 M Acetic acid, sodium bisulfate, sodium bicarbonate, and sodium hydroxide		
		Solution 2: 0.01 M Acetic acid (CH_3COOH)		20 mL
		Solution 3: 0.01 M Acetic acid (CH_3COOH) and 0.01 M Sodium acetate ($NaCH_3COO$)		20 mL
		Solution 4: 0.01 M Sodium bisulfate ($NaHSO_3$) and 0.01 M Sodium sulfate (Na_2SO_3)		20 mL
		Solution 5: 0.01 M Sodium bicarbonate ($NaHCO_3$) and 0.01 M Sodium carbonate (Na_2CO_3)		20 mL
		0.01 M Sodium hydroxide ($NaOH$)		25 mL
		Stirring rod		1
		Wash bottle		1
		APPLYING YOUR KNOWLEDGE		
		Data Collection System		1
		PASCO pH sensor	PS-2102	1
		Beakers, 100-mL		2
		Stirring rod		1
		Bufferin™ tablet, 325 mg		1
		Aspirin tablet, 325 mg		1
		Mortar and pestle		1
		Distilled water		100 mL

Lab	Title	Materials and Equipment	Part No.	Qty
16	BUFFER PROPERTIES Students use a pH sensor to analyze the nature of buffers as they prepare buffer solutions of a specified pH and test their efficacy.	**MODEL 1**		
		Data Collection System		1
		PASCO pH Sensor[1]	PS-2102	1
		Analytical balance		1
		Volumetric flask, 100-mL or 250-mL		1
		Beakers, glass, 50-mL		2
		Sodium acetate ($NaCH_3COO$)		Approx. 1 g
		Ammonium chloride (NH_4Cl)		Approx. 1 g
		0.3 M Acetic acid (CH_3COOH)		100 mL
		0.3 M Ammonia (NH_3), formulated from NH_4OH		100 mL
		Distilled water		150 mL
		Marking pen (to label beakers)		1
		MODEL 2		
		Universal indicator		4 drop
		Beral pipets		2
		Test tubes, 20 mm × 150 mm, glass, 25-mL		3
		0.10 M Hydrochloric acid (HCl)		20 mL
		0.10 M Sodium hydroxide (NaOH)		20 mL
		Buffer solution from Model 1		10 drops
		Distilled and deionized water		50 mL
		APPLYING YOUR KNOWLEDGE		
		Data Collection System		1
		PASCO pH sensor[1]		1
		Beakers, 50-ml		2
		Volumetric flask, 100-ml		1
		Two of the following, to create 100 mL of buffer: *0.3 M Acetic acid (CH_3COOH)* *0.3 M Sodium acetate ($NaCH_3COO$)* *0.3 M Sodium phosphate dibasic (Na_2HPO_4)* *0.3 M Sodium phosphate monobasic (NaH_2PO_4)* *0.3 M Ammonia (NH_3) from NH_4OH* *0.3 M Ammonium chloride (NH_4Cl)* *0.3 M Potassium phosphate (K_3PO_4)* *0.3 M Phosphoric acid (H_3PO_4)*		50 mL of each used
		6 M Sodium hydroxide (NaOH)		5 drops
		6 M Hydrochloric acid (HCl)		5 drops
		Stirring rod		1

Lab	Title	Materials and Equipment	Part No.	Qty
17	MOVING ELECTRONS Students use a voltage–current sensor to electrolyze a variety of aqueous solutions to determine a relationship between current, electric charge, and quantity of electrons.	**ALL MODELS**		
		Data Collection System		1
		PASCO Voltage–Current Sensor	PS-2115	1
		Wire leads		2 red, 1 black
		Electrodes		2
		Alligator clips		2 red, 2 black
		9 V Battery		1
		9 V Battery cap with leads		1
		Beaker, glass, 400-mL		1
		Stirring rod		1
		Wash bottle with distilled water		1
		MODEL 1		
		Test tubes (2), 10 mm × 75-mm		2
		Universal indicator		20 drops
		Scoopula™ spatula		1
		Epsom salt (Magnesium sulfate, $MgSO_4$), 4–6 marble-size scoops (one scoop is approximately 3 g)		As specified
		Distilled water		600 mL
		MODEL 2		
		Potassium iodide, KI, 1 marble-size scoop (one scoop is approximately 3 g)		As specified
		Scoopula™ spatula		
		Copper(II) bromide, ($CuBr_2$), 1 marble-size scoop (one scoop is approximately 3 g)		As specified
		Distilled water		600 mL
		MODEL 3		
		Copper strip		1
		Steel wool		1
		Metals strip, spoon, or key		1
		1.0 M Copper(II) sulfate ($CuSO_4$)		100 mL
		Analytical balance		1 per class
		APPLYING YOUR KNOWLEDGE		
		Copper strip		1
		Steel wool		1
		Metal strip, spoon, or key		1
		1.0 M Copper(II) sulfate, ($CuSO_4$)		100 mL
		Analytical balance		1 per class

Lab	Title	Materials and Equipment	Part No.	Qty
A	APPENDIX A: SENSOR CALIBRATION	**CALIBRATING A DROP COUNTER**		
		Data Collection System		1
		PASCO High Accuracy Drop Counter	PS-2117	1
		Drop dispenser:		
		Syringe, 60-mL		1
		Stopcock (2)		2
		Drop tip		1
		Graduated cylinder, 10-mL		1
		Beaker, for waste		1
		Multi clamp		1
		Ring stand		1
		Three-finger clamp		1
		Titrant		> 10 mL
		CALIBRATING A pH SENSOR		
		Data Collection System		1
		PASCO pH Sensor	PS-2102	1
		Buffers, pH 4 and pH 10		1 of each

[1]Included with the PASCO Chemistry Sensor.

[2]Included with most PASCO Absolute Pressure sensors.

ACTIVITY BY PASCO SENSORS

This list shows the sensors used in each lab activity.

Items Available from PASCO	Qty	Activity Where Used
PASCO Absolute Pressure Sensor[1]	1	1, 9
PASCO Colorimeter	1	2, 7, 10, 12
PASCO Conductivity Sensor[1]	1	1, 4, 6
PASCO High Accuracy Drop Counter	1	4, 8, 13, 14
PASCO pH Sensor[1]	1	1, 5, 13, 14, 15, 16
PASCO Oxidation Reduction Potential (ORP) Probe	1	8
PASCO Fast-response Temperature Sensor	1	4, 12
PASCO Stainless Steel Temperature Sensor[1]	1	11
PASCO Temperature Sensor[2]	1	1, 9, 10
PASCO Voltage–Current Sensor	1	17

[1]This sensor is part of the PASCO Chemistry Sensor.

[2]In this lab either the fast-response temperature sensor or the stainless steel temperature sensor can be used.