

Physics with Inquiry Lab Manual

Master Materials and Equipment List

Italicized entries indicate items not available from PASCO. The quantity indicated is per student or group. NOTE: Some 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 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	PASCO Part Number	Qty
1	Scientific Inquiry Use a temperature sensor in the design of a simple experiment as students attempt to slow the cooling rate of the water by adding insulation to the cup.	Data Collection System PASPORT Temperature Sensor ¹ <i>Cup, 270-mL (9-oz)</i> <i>Hot water</i> <i>Insulating materials readily available in the laboratory (polystyrene, foil, plastic wrap, cloth, wool, packing peanuts)</i>	PS-2146	1 1 1 500 mL A variety
Force and Motion				
2	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 Rod stand (optional) <i>Object to hold (textbook, basket ball) (optional)</i>	PS-2103A ME-9355	1 1 1 1
3	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 track Dynamics track end stop Dynamics cart	PS-2103A ME-6960 ME-8971 ME-6950	1 1 1 1 1
4	Relative Motion Use a motion sensor to apply the concepts of relative motion and frames of reference to understanding velocity as a vector quantity in one-dimensional motion.	Data Collection System PASPORT Motion Sensor Dynamics track Cart adapter accessory Variable speed motorized cart <i>Note card (card stock, 10 cm × 15 cm)</i>	PS-2103A ME-6960 ME-6743 ME-9781	1 1 1 1 2 1
5	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 track Dynamics cart Dynamics track pivot clamp Dynamics track end stop Rod Stand	PS-2103A ME-6960 ME-6950 ME-9810 ME-8971 ME-9355	1 1 1 1 1 1 1

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Act	Title	Materials and Equipment	PASCO Part Number	Qty
6	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) Right-angle clamp Rod Stand Short Rod Masses (at least three different values) <i>Objects (textbook, ball, carts, et cetera)</i>	PS-2104 SE-8757A SE-9444 ME-9355 ME-8736 (Part of SE-8759)	1 1 1 per class 1 1 1 3 Several
7	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 Overflow can Right-angle clamp Rod Stand Short Rod String <i>Cup or beaker to catch water from overflow can</i> <i>Graduated cylinder, 25-mL (optional)</i> <i>Objects to submerge</i> <i>Ruler</i> <i>Small cup to add water to the overflow-can</i> <i>Water</i>	PS-2104 SE-8757A SE-8568 SE-9444 ME-9355 ME-8736 SE-8050	1 1 1 per class 1 1 1 1 1 25 cm 1 1 2 1 1 500 mL
8	Hooke's Law Use a force sensor to observe the relationship between the extension of a spring and the resulting force required to extend the spring.	Data Collection System PASPORT Force Sensor Spring Meter stick	PS-2104 Part of ME-8999 SE-8827	1 1 1 1
9	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 Dynamics track Dynamics track end stop Mass and hanger set Super pulley with clamp String	PS-2103A ME-6950 ME-6960 ME-8971 ME-8979 ME-9448A SE-8050	1 1 1 1 1 1 1 ~1 m
10	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 Mass Right-angle clamp Rod stand Short Rod Spring	PS-2104 PS-2103A SE-8757A SE-8759 SE-9444 ME-9355 ME-8736 Part of ME-8999	1 1 1 per class 1 1 1 1 1 1

Act	Title	Materials and Equipment	PASCO Part Number	Qty
11	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 Sensor Balance Dynamics cart Dynamics track Compact cart mass, 250 g Discover friction accessory Spring force sensor bumper Collision cup force sensor bumper <i>Rubber band</i>	PS-2104 SE-8757A ME-6950 (pair) ME-6960 ME-6755 ME-8574 (Part of CI-6545) (Part of CI-6545)	1 2 1 per class 2 carts 1 1 1 1 1 1
12	Static and Kinetic Friction Use a force sensor to investigate static friction and kinetic (sliding) friction.	Data Collection System PASPORT Force Sensor Balance Dynamics track Dynamics cart Dynamics cart masses ² Discover friction accessory String (optional)	PS-2104 SE-8757A ME-6960 ME-6950 (Part of ME-6950) ME-8574 SE 8050	1 1 1 per class 1 1 at least 2 1 10 cm
13	Conservation of Energy Use a motion sensor to detect how energy is transformed in a cart and track system and to observe that the total energy of the system is conserved.	Data Collection System PASPORT Motion Sensor Balance Dynamics track Dynamics track end stop Dynamics cart with plunger Dynamics track angle indicator Dynamics Track Pivot clamp Rod stand	PS-2103A SE-8757A ME-6960 ME-8971 ME-6950 ME-9495A ME-9810 ME-9355	1 1 1 per class 1 1 1 1 1
14	Conservation of Momentum Use two motion sensors to explore the concept of momentum and its conservation during common types of collisions.	Data Collection System PASPORT Motion Sensor Balance Dynamics track Dynamics carts with magnet bumpers, Velcro [®] bumpers, and plungers	PS-2103A SE-8757A ME-6960 ME-6950 (pair)	1 2 1 per class 1 2 carts
15	Impulse Momentum Use a motion sensor and force sensor to explore the change in momentum that occurs in a collision, and how that change is related to the impulse associated with the collision.	Data Collection System PASPORT Motion Sensor PASPORT Force Sensor Balance Dynamics cart Dynamics track Force accessory bracket	PS-2103A PS-2104 SE-8757A ME-6950 ME-6960 CI-6545	1 1 1 per class 1 1 1
16	Work and Energy Use a motion sensor and force sensor to develop an understanding of the work-energy theorem that relates the work done on an object by a net force to the change in the object's kinetic energy.	Data Collection System PASPORT Motion Sensor PASPORT Force Sensor with hook Dynamics track Dynamics cart Dynamics track end stop Super pulley with clamp	PS-2103A PS-2104 ME-6960 ME-6950 ME-8971 ME-9448A	1 1 1 1 1 1 1

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Act	Title	Materials and Equipment	PASCO Part Number	Qty
		Mass and hanger set Balance String	ME-8979 SE-8757A SE-8050	1 1 per class 1.5 m

Act	Title	Materials and Equipment	PASCO Part Number	Qty
17	Simple Harmonic Motion Use a force sensor and motion sensor to determine the spring constant by measuring the spring extension due to each of three different masses suspended from the spring.	Data Collection System PASPORT Force Sensor PASPORT Motion Sensor Balance Assorted masses Meter stick Right-angle clamp Rod stand Short rod Spring	PS-2104 PS-2103A SE-8757A (Part of SE-8759) SE-8827 SE-9444 ME-9355 ME-8736 Part of ME-8999	1 1 1 1 per class At least 3 1 1 1 1 1
18	Pendulum Use a motion sensor to determine how the mass and length of a simple pendulum affect its period of oscillation.	Data Collection System PASPORT Motion Sensor Balance Large table clamp <i>Metric tape measure</i> Pendulum bob (same size but made of different materials) Pendulum clamp Rod stand Short rod String	PS-2103A SE-8757A ME-9472 SE-8712A ME-8752 (set of 3) SE-9443 ME-9355 ME-8736 SE-8050	1 1 1 per class 1 1 3 bobs 1 1 1 4 m
19	Circular Motion Use a force sensor to develop a kinesthetic understanding of circular motion by measuring the period of rotation of a mass in uniform circular motion	Data Collection System PASPORT Force Sensor Balance Meter stick <i>Plastic Tie</i> <i>Plastic tube</i> Rubber stopper, #10, one-hole Short rod String Table clamp Timer <i>Marker</i> <i>Scissors</i>	PS-2104 SE-8757A SE-8827 (included with ME-9837) ME-8736 (included with ME-9837) ME-9472 ME-1234	1 1 1 per class 1 1 1 1 1 3 m 1 1 1 1
20	Centripetal Force Use a force sensor to understand the factors that affect the centripetal force experienced by an object in uniform circular motion.	Data Collection System PASPORT Force Sensor Balance Meter stick <i>Plastic tube</i> Rubber stopper, #10, one-hole Short rod String Table clamp Timer <i>Marker</i> <i>Scissors</i>	PS-2104 SE-8757A SE-8827 (included with ME-9837) ME-8736 (included with ME-9837) ME-9472 ME-1234	1 1 1 per class 1 1 1 1 3 m 1 1 1 1

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Act	Title	Materials and Equipment	PASCO Part Number	Qty
21	Projectile Motion Use two photogates to learn how two independent motions, horizontal and vertical, are descriptions of the motion of a projectile.	Data Collection System		1
		Photogate	ME-9498A	2
		PASPORT Digital adapter	PS-2159	1
		Digital extension cable (optional)	PI-8117	1
		Time of flight accessory (Pad)	ME-6810	1
		Projectile launcher	ME-6825A	1
		Projectile		1
		Photogate mounting bracket	ME-6821A	1
		<i>Carbon Paper (optional)</i>		1
		Large table clamp	ME-9472	1
		Plumb bob		1
		Ram rod		1
		Short rod	ME-8736	1
		Metric tape measure	SE-8712A	
		<i>Tape</i>		1 roll
<i>Pencil or pen</i>		1		
<i>Sheet of white paper</i>		10		
Thermodynamics				
22	Temperature versus Heat Use a temperature sensor to explore the relationship between heat transfer and temperature change in various substances.	Data Collection System		1
		PASPORT Temperature Sensor ¹	PS-2146	2
		Balance	SE-8757A	1 per class
		Aluminum mass, 200-g	Part of TD-8557A	2
		Calorimetry cup	Part of TD-8557A	2
		Copper mass, 200-g	Part of TD-8557A	2
		Hot plate	SE-8830	1
		String, 15-cm	SE-8050	4
		<i>Paper clip</i>		2
		<i>Beaker, 600-mL</i>		1
		<i>Vegetable oil</i>		500 g
		500 g		
23	Phase Change Use a stainless steel temperature sensor to observe physical changes in a system undergoing a phase change.	Data Collection System		1
		PASPORT Stainless Steel Temperature Sensor	PS-2146 with PS-2153	2
		Hotplate	SE-8830	1
		Rod stand	ME-9355	1
		Utility clamp	SE-9446	2
		<i>Beaker, 150-mL</i>		2
		<i>Test tube, 20-mm × 150-mm</i>		1
		<i>Ice cube</i>		1
		<i>Ice, crushed</i>		~120 g
		<i>Lauric acid</i>		8 g
		<i>Stirring rod</i>		1
<i>Water</i>		200 mL		

Act	Title	Materials and Equipment	PASCO Part Number	Qty
24	Specific Heat of a Metal Use a stainless steel temperature sensor to compare the heat transferred by different metals to water.	Data Collection System PASPORT Stainless Steel Temperature Sensor Balance Calorimetry cup Hot plate Metal sample String, <i>Beaker, 600-mL</i> <i>Tongs</i> <i>Water</i>	PS-2153 with PS-2146 SE-8757A Part of TD-8557A SE-8830 Part of TD-8557A SE-8050	1 1 1 per class 3 1 3 15-cm 1 1 1 L
25	Heat of Fusion Use a temperature sensor to understand heat as energy and the transfer of heat during the phase change from solid to liquid.	Data Collection System PASPORT Temperature Sensor ¹ Balance Hot plate Calorimetry cup Stir station (optional) <i>Beaker, 600-mL</i> <i>Ice cubes</i> <i>Paper towel</i> <i>Stirring rod</i> <i>Water</i>	PS-2146 SE-8757A SE-8830 Part of TD-8557A SE-7700	1 1 1 per class 1 1 1 1 3 or 4 1 sheet 1 300 mL
26	Heat of Vaporization Use a temperature sensor to develop a better understanding of the phase change from gas to liquid.	Data Collection System PASPORT Temperature Sensor ¹ Balance Calorimetry cup Water trap Steam generator Stir station (optional) Tubing, 1/4 inch inner diameter ² <i>Clip or rigid U-shaped tube</i> <i>Scissors</i> <i>Stirring rod (optional)</i> <i>Tape (optional)</i> <i>Water</i>	PS-2146 SE-8757A Part of TD-8557A (included with TD-8556A) TD-8556A SE-7700 (included with TD-8556A) 1 1 1 1 1 1 1 1 1 1 L	1 1 1 per class 1 1 1 0.5 m 1 1 1 1 roll 1 L
27	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, 20 mL ² Tubing ²	PS-2146 (Part of PS-2146) (Part of PS-2146) (Part of PS-2146)	1 1 1 1 1

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Act	Title	Materials and Equipment	PASCO Part Number	Qty
28	Absolute Zero Use an absolute pressure sensor and a temperature sensor to experimentally determine a numerical value for absolute zero in degrees Celsius.	Data Collection System		1
		PASPORT Absolute Pressure Sensor	PS-2146	1
		PASPORT Temperature Sensor ¹	PS-2146	1
		PASPORT Sensor Extension Cable	PS-2500	1
		Barbed quick-release connector ²	(Part of PS-2146)	1
		Barbed tubing-to-rubber stopper ²	(Part of PS-2146)	1
		Hot Plate	SE-8830	1
		Rod Stand	ME-9355	1
		Three-finger clamp	SE-9445	1
		Tubing ²	Part of PS-2146	~ 15 cm
		Utility clamp	SE-9446	1
		Beaker, 600 mL		1
		Disposable pipet		1
		Glycerin		1
		Oven Mitt		1
Rubber stopper, 1-hole #2		1		
Tape		~ 6 cm		
Test tube, 20 mm X 150 mm		1		
Electricity and Magnetism				
29	Charge and Electric Field Use a charge sensor to observe the nature of charging different objects by contact and to explore the electric field produced by a variety of charged objects.	Data Collection System		1
		PASPORT Charge Sensor	PS-2132	1
		Charge producers	ES-9057C	1 pair
		Faraday ice pail	ES-9042A	1
		Proof plane	(included with 9057C)	2
		Aluminum rod		1
		Fur cloth		1
		Glass rod		1
Plastic rod		1		
Silk cloth		1		
30	Voltage: Fruit Battery/Generator Use a voltage sensor to explore both the chemical and physical production of a potential difference.	Data Collection System		1
		PASPORT Voltage Sensor	PS-2115	1
		Alligator clips (one red, one black)	Part of PS-2115	2
		Series/Parallel battery holders	SE-8799 (10-pack)	3 holders
		Copper		1 piece
		Zinc		1 piece
		Batteries, "D" cell		3
Variety of fruit		Minimum 1 piece per student group		
31	Ohm's Law Use a voltage sensor and current sensor to investigate the	Data Collection System		1
		PASPORT Current Sensor	PS-2115	1
		PASPORT Voltage Sensor	Part of PS-	1

Act	Title	Materials and Equipment	PASCO Part Number	Qty
	relationship between current, voltage, and resistance in a circuit.	Charge/Discharge circuit board Patch cord, 4 mm banana plug <i>AA cell battery</i>	2115 EM-8678 SE-9750 (5-pack)	1 5 patch cords 2

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Act	Title	Materials and Equipment	PASCO Part Number	Qty
32	Series and Parallel Circuits Use a voltage sensor and current sensor to explore the properties of both series and parallel circuits.	Data Collection System PASPORT Current Sensor PASPORT Voltage Sensor Alligator clip adapters (optional) DC power supply, 10 V, 1 A minimum Patch cord, 4 mm banana plug Resistors, at least 3 different known values Switch, single-pole single-throw	PS-2115 Part of PS-2115 SE-9756 (10 pack) SE-8828 SE-9750 (5-pack) and SE-9751 (5-pack) Part of EM-8784	1 1 1 10 clips 1 10 patch cords 3 to 6 1
33	RC Circuit Use a voltage sensor and current sensor to explore the behavior of a simple circuit of a resistor and capacitor in series.	Data Collection System PASPORT Current Sensor PASPORT Voltage Sensor Charge/discharge circuit board Banana plug patch cord, 4mm <i>AA cell batteries</i>	PS-2115 Part of PS-2115 EM-8678 SE-9750 (5-pack)	1 1 1 5 patch cords 2
34	Magnetic Field: Permanent Magnet Use a magnetic field sensor to investigate the magnetic field strength of a permanent magnet as a function of distance from the magnet.	Data Collection System PASPORT Magnetic Field Sensor PASPORT Sensor Extension Cable Meter stick (non-metallic) Neodymium magnet (1/2 or 3/4")	PS-2112 PS-2500 SE-8827 EM-8648A (8-pack)	1 1 1 1 1
35	Magnetic Field: Coil Use a current sensor and magnetic field sensor to understand some of the factors affecting the electromagnetic field strength within a solenoid.	Data Collection System PASPORT Current Sensor PASPORT Magnetic Field Sensor PASPORT Sensor Extension Cable (optional) Coils of varying turns but the same radius DC power supply, 10 V, 1 A minimum Meter stick Patch cord, 4 mm banana plug	PS-2115 PS-2112 PS-2500 SF-8609 SF-8610 SF-8611 SE-8828 SE-8827 SE-9750 (5-pack)	1 1 1 3 coils 1 1 3 patch cords
36	Faraday's Law of Induction Use a voltage sensor to observe the electromotive force generated by passing a magnet through a coil.	Data Collection System PASPORT Voltage Sensor No-Bounce pad (optional) Coils of varying turns but the same radius Magnets, different strengths	PS-2115 SE-7347 SF-8609 SF-8610 SF-8611 SE-8687, SE-8604 EM-8648A (8-pack)	1 1 1 3 coils 3 magnets

Act	Title	Materials and Equipment	PASCO Part Number	Qty
		Three-finger clamp Rod stand <i>Paper</i> <i>Pen or pencil</i> <i>Tape</i>	SE-9445 ME-9355	1 1 1 sheet 1 1 roll
Light				
37	Inverse Square Law Use a light sensor to experience the concept of light intensity varying inversely as the square of the distance from a point source of light.	Data Collection System PASPORT Light Sensor PASPORT Sensor Extension Cable Basic optics bench Basic optics light source Basic optics Aperture bracket	PS-2106A PS-2500 OS-8508 OS-8470 OS-8534A	1 1 1 1 1 1 1

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Act	Title	Materials and Equipment	PASCO Part Number	Qty
38	Polarization Use a light sensor to study the effects of polarization on light intensity and to explore Malus' Law.	Data Collection System		1
		PASPORT Light Sensor	PS-2106A	1
		PASPORT Sensor Extension Cable	PS-2500	1
		Basic optics diode laser	OS-8525A	1
		Basic optics aperture bracket	OS-8534A	1
		Basic optics bench	OS-8508	1
		Polarizing disks	OS-8473	2
		Polarizing disk accessory holder	Part of OS-8473	1
Sound				
39	Sound Intensity Use a sound level sensor to investigate the sound intensity from devices such as tuning forks, musical instruments, and the human voice.	Data Collection System		1
		PASPORT Sound Level Sensor	PS-2109	1
		PASPORT Sensor Extension Cable (optional)	PS-2500	1
		Power amplifier/function generator	WA-9867	1
		Meter stick	SE-8827	1
		Speaker	WA-9900	1
		Tuning fork	SE-7343	1
		<i>Musical instrument</i>		1
Nuclear Physics				
40	Radiation Use a Geiger-Müller tube to measure radiation intensity and to discover how radioactive particles react with various materials.	Data Collection System		1
		PASPORT Geiger-Müller Tube with Power Supply	SN-7927A	1
		Digital adapter		1
		Radioactive sources (alpha, beta, gamma)	SN-8110 (set of 3)	3 (1 of each type)
		Three-finger clamp	SE-9445	1
		Meter stick	SE-8827	1
		Rod stand	ME-9355	1
		Shielding materials (paper, plastic, lead)	SN-8111A	Various

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

²Included with the PASCO Sensor or Apparatus

Activity by PASCO Equipment

This list shows the sensors and other PASCO equipment used in the lab activities.

Items Available from PASCO	Qty	Part Number	Activity Where Used
Data Collection System	1	varies	All activities
PASPORT Absolute Pressure Sensor	1	PS-2146	27, 28
PASPORT Charge Sensor	1	PS-2132	29
PASPORT Current Sensor (Voltage-Current)	1	PS-2115	31, 32, 33, 35
PASPORT Force Sensor	1	PS-2104	6, 7, 8, 10, 12, 15, 16, 17, 19, 20
PASPORT Force Sensors	2	PS-2104	11
PASPORT Light Sensor	1	PS-2106A	37, 38
PASPORT Magnetic Field Sensor	1	PS-2112	34, 35
PASPORT Motion Sensor	1	PS-2103A	2, 3, 4, 5, 9, 10, 13, 15, 16, 17, 18
PASPORT Motion Sensors	2	PS-2103A	14
PASPORT Sound Level Sensor	1	PS-2109	39
PASPORT Stainless Steel Temperature Sensor	1	PS-2146 with PS-2153	24
PASPORT Stainless Steel Temperature Sensor	2	PS-2146 with PS-2153	23
PASPORT Temperature Sensor ¹	1	PS-2146	1, 25, 26, 28
PASPORT Temperature Sensors ¹	2	PS-2146	22
PASPORT Voltage Sensor	1	PS-2115	30, 31, 32, 33, 36
PASPORT Sensor Extension Cable	1	PS-2500	28, 34, 35, 37, 38, 39
PASPORT Digital Adapter	1	PS-2159	21, 40
Geiger-Müller Tube with Power Supply	1	SN-7927A	40
Photogates	2	ME-9498A	21
Time of Flight Pad	1	ME-6810	21

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