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 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).

Act	Title	Materials and Equipment	Part Number	Qty
1	**Scientific Inquiry** Use a fast response temperature probe to design a simple experiment in which students attempt to slow the cooling rate of the water by adding insulation to the cup.	Data Collection System PASPORT Fast Response Temperature Probe *9-12 oz. cup* *Hot water* *Insulating devices readily available in the laboratory (styrofoam, foil, plastic wrap, cloth, wool, packing peanuts)*	 PS-2135	1 1 1 1 A variety
2	**Enzyme Action** Use an oxygen gas sensor to understand how optimal environmental conditions, such as temperature, play a key role in enzyme function.	Data Collection System PASPORT Oxygen Gas Sensor *Beaker, 1-L* *Beaker, 500-mL* *Catalase Source/Yeast Suspension* *Distilled water* *Graduated cylinder, 25-mL* *Hydrogen Peroxide, 3%* *Ice, crushed or cube* Sampling bottle (provided with the sensor) *Test tube* *Tongs* *Water*	 PS-2126	1 1 2 1 30 mL 500 mL 1 30 mL 1 L 1 2 1 500 mL
3	**Membrane Permeability** Use a pH sensor to explore the permeability of a cell-like membrane to hydrogen (H^+) and hydroxide (OH^-) ions. Observe that not all materials are able to pass through the membrane.	Data Collection System PASPORT pH Sensor* *0.1 M hydrochloric acid (HCl),15 mL* *0.1 M sodium hydroxide (NaOH)* *Beaker, 250-mL* *Binder clip* *Dialysis tubing, 15-cm length* *Distilled water* Large Base and Support Rod *Lugol's iodine* Magnetic Stirrer and Magnetic Spin Bar *Starch solution* *String* Utility clamp *Wash bottle*	 PS-2102* ME-9355 SE-7700 SE-9446 	1 1 15 mL 15 mL 1 1 2 1 L 1 3 mL 1 50 mL 50 cm 2 1

Act	Title	Materials and Equipment	Part Number	Qty
4	**Organisms and pH** Use a pH sensor to determine how effective various substances are at buffering large changes in pH.	Data Collection System PASPORT pH Sensor* *Beaker , 50-mL* *Beaker, 250-mL* *Erlenmeyer flask 1-L* *Graduated cylinder, 10-mL* *Disposable pipets* *Detergent solution* *Lemon juice* *Distilled water* *Liver suspension* *Buffer solution*	 PS-2102* 	1 1 6 1 2 1 2 15 mL 15 mL 1 L 50 mL 50 mL
5	**Osmosis** Use a barometer/low pressure sensor to explore the concept of cell membranes and how water and other substances pass through a membrane through the process of osmosis.	Data Collection System PASPORT Barometer/low pressure Sensor PASPORT Sensor Extension Cable *Beaker, 100-mL* *Beaker, 400-mL* *Dialysis tubing ,15 cm* *Distilled water* Electronic Balance *Funnel* *Graduated cylinder, 10-mL* *Graduated cylinder, 50-mL* *Paper towels* *Plastic tubing, 5 cm* Quick-Release Connector (comes with the sensor) Ring Stand with Test Tube or Three Finger Clamp *Syrup (maple or corn)* *Thread (or dental floss) to tie dialysis tubing*	 PS-2113A PS-2500 SE-8823 ME-9355 SE-9446 	1 1 1 2 1 2 1 L 1 1 1 1 3 or 4 1 1 1 10 mL 1
6	**Plant Respiration and Photosynthesis** Use a carbon dioxide gas sensor to understand the comparative concentrations of CO_2 gas for a small plant in darkness and in bright light and what this says about photosynthesis and the CO_2 cycle.	Data Collection System PASPORT Carbon Dioxide Gas Sensor PASPORT Sensor Extension Cable *Aluminum foil* *Box or heavy cloth (to cover the bottle)* *Lamp, 100-watt (or equivalent)* *Large beaker or aquarium (to keep the light source from heating the sample)* *Mint plant* Sampling Bottle (included with sensor) *Water*	 PS-2110 PS-2500 	1 1 1 1 foot 1 1 1 1 1 2 L
7	**Respiration of Germinating Seeds** Use a carbon dioxide gas sensor to understand the comparative rates of CO_2 gas production for dry,	Data Collection System PASPORT Carbon Dioxide Gas Sensor PASPORT Sensor Extension Cable *Beaker, 1000-mL* *Ice, cubed or crushed*	 PS-2110 PS-2500 	1 1 1 1 1 L

Act	Title	Materials and Equipment	Part Number	Qty
	dormant seeds; for wet, germinating seeds at room temperature; and for wet, cold, germinating seeds.	*Pea or dry bean seeds* Sampling bottle (included with sensor) *Water*		30 1 1 L
8	**The Role of Buffers in Biological Systems** Use a pH sensor to determine which solution is the best buffer.	Data Collection System PASPORT pH Sensor* *Beaker, 250 mL* *Club soda* *Distilled water* *Graduated cylinder (10 mL)* Large Base and Support Rod Magnetic Stirrer and Magnetic Spin Bar Utility Clamp *Vinegar, 5% acetic acid* *Wash bottle*	 PS-2102* SE-7700 SE-9446 	1 1 3 200 mL 1 L 1 1 1 1 20 mL 1
9	**Acid Rain** Use a pH sensor to determine the effect of several gases that cause acid rain on the pH of water. Discuss the effect of changes in the pH of water on the environment.	Data Collection System PASPORT pH Sensor* *1 M HCl* *1-hole rubber stopper for flask* *Beaker, 100-mL* Electronic Balance *Erlenmeyer flask, 100-mL* *Flexible tubing to fit glass tubing, 20 cm* *Glass tubing for rubber stopper* *Graduated cylinder, 25-mL* *Graduated pipet and pipet bulb* *Sodium bicarbonate ($NaHCO_3$)* *Sodium bisulfite ($NaHSO_3$)* *Sodium nitrite ($NaNO_2$)* *Wash bottle containing distilled or deionized water* *Water or deionized water*	 PS-2102* SE-8823 	1 1 15 mL 1 1 1 1 1 1 1 1 5 g 5 g 5 g 1 60 mL
10	**Cellular Respiration in Yeast** Use a dissolved oxygen sensor to measure the dissolved oxygen concentration in yeast solutions in the presence and absence of sugar. Calculate the rate of oxygen consumption of yeast during aerobic cellular respiration at different temperatures.	Data Collection System PASPORT Dissolved Oxygen Sensor* PASPORT Fast Response Temperature Sensor *Activated Yeast Solution* *Beaker, 250-mL* *Distilled water* Electronic Balance *Graduated cylinder, 25mL* Hot Plate *Ice bath (1-L Beaker filled with ice)* *Labeling tape* *Marker* *Stirring rod* *Sugar* *Weighing papers*	 PS-2108* PS-2135 SE-8823 SE-8830 	1 1 1 45 mL 3 1 L 1 1 1 1 1 roll 1 1 30 g 3

Act	Title	Materials and Equipment	Part Number	Qty
11	**Energy Content of Food** Use a temperature sensor to measure the change in temperature of water that is heated by burning samples of food and to compare the energy content of those samples.	Data Collection System PASPORT Temperature Sensor* PASPORT Sensor Extension Cable *Aluminum can, 354-mL (12 ounce)* *Distilled water* Electronic Balance *Food holder (10 x 10 cm cardboard, aluminum foil, paperclips)* *Food sample* *Graduated Cylinder, 100-mL* Large Base and Support Rod *Matches* *Wood Splint*	 PS-2125* PS-2500 SE-8823 ME-9355 	1 1 1 1 100 mL 1 1 2 1 1 1 book 4
12	**Exploring Microclimates** Use a weather anemometer sensor and current local weather conditions to measure relevant weather conditions at different locations. Determine the impact that a location's environmental conditions have on the microclimate of a given area.	Data Collection System PASPORT Weather Anemometer Sensor (or PASPORT Weather Sensor) PASPORT Sensor Extension Cable *Cardboard box (or other covering)*	 PS-2174 PS-2500 	1 1 1 1
13	**Exploring Microclimates Through Temperature** Use a temperature sensor and current local weather conditions to measure relevant weather conditions at different locations. Determine the impact that a location's environmental conditions have on the microclimate of a given area.	Data Collection System PASPORT Temperature Sensor*	 PS-2125*	1 1
14	**Exploring Microclimates with a GPS** Use a weather anemometer sensor, a GPS position sensor, and current local weather conditions to measure relevant weather conditions (such as temperature, barometric pressure, relative humidity and dew point) at different locations. Students also collect GPS data and transfer the collected data to a computer to visualize how the weather conditions varied on a satellite image.	Data Collection System PASPORT Weather Anemometer Sensor PASPORT GPS Position Sensor PASPORT Sensor Extension Cable MyWorld GIS ™ *USB flash drive*	 PS-2174 PS-2175 PS-2500 SE-7382C or SE-7352C or SE-7351C Or SE-7353C 	1 1 1 1 1 1

Act	Title	Materials and Equipment	Part Number	Qty
15	**Metabolism of Yeast** Use a carbon dioxide gas sensor to measure the production of carbon dioxide gas by yeast in aerobic and anaerobic conditions. Determine if high temperatures effect the respiration of yeast.	Data Collection System		1
		PASPORT Carbon Dioxide Gas Sensor	PS-2110	1
		PASPORT Sensor Extension Cable	PS-2500	
		Beaker, 250-mL		2
		Graduated cylinder 10-mL		1
		Graduated cylinder, 100-mL		1
		Grape juice		150 mL
		Hot Plate	SE-8830	1
		Mineral oil		5 mL
		Sampling bottle (included with sensor)		1
		Stirring rod		1
		Water		1 L
		Yeast, dry		1 package
16	**Rate of Photosynthesis of an Aquatic Plant** Use a dissolved oxygen sensor to understand the amount of oxygen produced through photosynthesis in an aquatic plant in ambient light, bright light and darkness.	Data Collection System		1
		PASPORT Dissolved Oxygen Sensor*	PS-2108*	1
		PASPORT Fast Response Temperature Sensor*	PS-2135*	1
		Cloth, heavy, about 50-cm by 50-cm		1
		Elodea		5 or 6
		Lamp, 100 W (or equivalent)		1
		Magnetic Stirrer and Magnetic Stir Bar	SE-7700	1
		Photosynthesis Tank or similar setup	PS-2521A	1
		Rubber stopper, #3		1
		Water		2 L
17	**Soil pH** Use a pH sensor to understand what kinds of soil in the local community would support agricultural crops, based on pH level.	Data Collection System		1
		PASPORT pH Sensor *	PS-2102*	1
		PASPORT Sensor Extension Cable	PS-2500	1
		Beaker, 250-mL		3
		Digging device		1
		Distilled water		400 mL
		Graduated cylinder, 100-mL		1
		Marking pen		1
		Measuring spoons		1 set
		Paper towels		3 or 4
		Sealable plastic bag		3
		Soil sample, 60 mL		3
		Stirring rod		1
		Wash bottle		1
18	**Transpiration** Use a barometer/low pressure sensor to explore the effects of environmental factors such as air movement on the rate of transpiration.	Data Collection System		1
		PASPORT Barometer/Low Pressure Sensor	PS-2113A	1
		PASPORT Sensor Extension Cable	PS-2500	1
		Bowl		1
		Fan		1
		Glycerin		1 mL
		Knife		1
		Large Base and Support Rod	ME-9355	1
		Petroleum jelly		2 to 3 g
		Pipet		1

Act	Title	Materials and Equipment	Part Number	Qty
		Plant seedling, 12 to 15 cm tall		1
		Three-Finger Clamp	SE-9445	1
		Utility Clamp	SE-9446	1
		Water		1 L
19	**Water and pH** Use pH and conductivity sensors to analyze the differences in how water pH changes when "acid rain" is added.	Data Collection System		1
		PASPORT pH Sensor*	PS-2102*	1
		PASPORT Conductivity Sensor*	PS-2116A*	1
		Beaker, 250-mL		4
		Distilled water		250 mL
		Graduated cylinder, 100-mL		1
		Labels		6
		Marking pen		1
		Pipet		1
		Small container (for diluted vinegar solution)		1
		Stirring rod		1
		Water sample, 250 mL		3
		White vinegar		250 mL
20	**Water Purification** Use a pH sensor to understand the effectiveness of various treatments for improving the quality of water.	Data Collection System		1
		PASPORT pH Sensor*	PS-2102*	1
		PASPORT Conductivity Sensor*	PS-2116A*	1
		Beaker, 250-mL		2
		Coffee filter		2
		Distilled water		500 mL
		Egg whites		5 mL
		Erlenmeyer flask, 250-mL		1
		Funnel		1
		Polluted water		1 L
		Stirring rod		1
21	**Weather in a Terrarium** Use a weather anemometer sensor in the microclimate of a terrarium to understand changes in temperature, absolute and relative humidity, dew point, and barometric pressure.	Data Collection System		1
		PASPORT Weather Anemometer Sensor	PS-2174	1
		PASPORT Sensor Extension Cable	PS-2500	1
		Small box or other support		1
		Terrarium (or suitable alternative)		1
22	**EKG and Factors that Affect the Heart** Use an EKG sensor to measure and observe the electrical activity of the heart muscle.	Data Collection System		1
		PASPORT EKG Sensor	PS-2111	1
		Electrode patches (included with sensor)		3
23	**Exercise and Heart Rate** Use a heart rate sensor to monitor the effect of physical exertion in relation to level of fitness. Determine the average heart rate before, during, and after exercise.	Data Collection System		1
		PASPORT Hand Grip Heart Rate Sensor	PS-2186	1
24	**Exercise and Respiration Rate** Use a breath rate sensor to	Data Collection System		1
		PASPORT Breath Rate Sensor	PS-2187	1

Act	Title	Materials and Equipment	Part Number	Qty
	measure the resting respiration rates of individuals and determine whether exercise causes a change in respiration rate.			
25	**Muscle Fatigue** Use a force sensor to determine grip strength and compare muscle fatigue in hand muscles caused by isotonic ("same tension") and isometric ("same length") exercise.	Data Collection System PASPORT Force Sensor *Rubber ball, tennis ball, or equivalent (approximately 7 cm diameter)* *Timer (stopwatch or equivalent)*	 PS-2104	1 1 1 1
26	**Regulation of Body Heat*** Use a temperature sensor to understand the extent that external conditions, such as ice water, moving air, or wearing gloves, cause changes in skin temperature. * This activity requires 2 fast response temperature probes to be connected simultaneously. Please see the Lab Preparation section for details.	Data Collection System PASPORT Fast Response Temperature Probe *Fan* *Glove or mitten* *Ice, crushed or cube* *Large bowl (or similar container)* *Tape or adhesive covers* *Paper Towel* *Water*	 PS-2135	1 2 1 1 1 L 1 2 pieces 5 to 6 1 L
27	**Volume of Breath** Use a spirometer to explore the pulmonary function test (PFT) and the volume of breath.	Data Collection System PASPORT Spirometer Spirometer Mouthpiece	 PS-2152 PS-2522	1 1 1 per student

*PASCO recommends the purchase of the Water Quality Sensor (PS-2169) as an alternative to purchasing these items separately. The Water Quality Sensor comes with pH, dissolved oxygen, temperature and conductivity probes, all in one convenient package.

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	4,3,8,9,17,19,20

Dissolved Oxygen Sensor

Item	Quantity	Where Used
Clean electrode storage bottle Distilled water	1 5 mL	10,16

Oxygen Gas Sensor

Item	Quantity	Where Used
Sampling Bottle (included with the sensor)	1	3

Carbon Dioxide Gas Sensor

Item	Quantity	Where Used
Sampling Bottle (included with the sensor)	1	7,6,15

Equipment List by Item

This list shows each item needed for the activities and where the item is used.

Items Available from PASCO	Qty	Where Used
PASPORT Carbon Dioxide Gas Sensor (with Sampling Bottle)	1	7,6,15
PASPORT Barometer/Low Pressure Sensor	1	5,18
PASPORT Oxygen Gas Sensor	1	2
PASPORT Fast Response Temperature Probe	1	1,10,16
PASPORT Hand Grip Heart Rate Sensor	1	23
PASPORT Sensor Extension Cable	1	5,7,6,12,14,18,11,15,21,17
PASPORT pH Sensor	1	4,3,8,9,17,19,20
PASPORT GPS Position Sensor	1	14
PASPORT Temperature Sensor	1	13,11,26
PASPORT Dissolved Oxygen Sensor	1	10,16
PASPORT Conductivity Sensor	1	19,20
PASPORT Force Sensor	1	25
PASPORT Breath Rate Sensor	1	24
PASPORT EKG Sensor	1	22
PASPORT Weather Anemometer Sensor	1	12,14,21
PASPORT Spirometer	1	27
Spirometer Mouthpiece	1 per student	27
Photosynthesis Tank	1	16
MyWorld GIS ™	1	14
Quick Release Connector	1	5
Large Base and Support Rod	1	3,8,18,11
Magnetic Stirrer with Magnetic Stir Bar	1	3,8,16
Electronic Balance	1	5,9,11,10
Hot Plate	1	15,10
Three-Finger Clamp	1	5,18
Utility Clamp	1	3,8,18