

General Items Needed Throughout the Experiments						
Item	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes
alcohol burner	sciencecompany.com	NC-3787	5.95	1	In the absence of a natural gas Bunsen burner, this is the best substitute for general purpose heating. Experiment 3 will need to use a natural gas or propane stove or burner.	None.
balance	homesciencetools.com	BS-DB0200	49.95	1	200 g capacity; 0.01 g resolution. If you can afford a 0.001 g scale, get one. If not, this is the best deal on a 0.01 g scale.	None.
beaker, 50 mL	sciencecompany.com	NC-5584	3.20	2	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	Pyrex measuring cup.
beaker, 100 mL	sciencecompany.com	NC-7865	3.75	1	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	Pyrex measuring cup.
beaker, 250 mL	sciencecompany.com	NC-5583	4.50	4	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	Pyrex glass.
beaker, 400 mL	sciencecompany.com	NC-7866	4.95	1	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	Pyrex glass.
buret, 25 mL	sciencecompany.com	NC-9825	31.95	1	Purchasing 2 will expedite Experiment 11.	None.
buret clamp	amazon.com		8.00	1	Schools may wish to purchase the American Educational double buret clamp instead for \$15.61.	None.
clamp, 3-finger, with ring stand clamp	amazon.com	Clamp Retort	9.00	1		None.
dropper, glass	sciencecompany.com	NC-0363-PK	2.35	1 pk	Pack contains 4 glass droppers.	Eye dropper.
dropper bottle	sciencecompany.com	NC-0343	1.95	10		Small jars or bottles with non-metallic screw-on lids.
Erlenmeyer flask, 125 mL	sciencecompany.com	NC-9166	3.95	3	For school classrooms, 6 flasks per student group are recommended.	None.
filter funnel, glass, 50 mm	sciencecompany.com	NC-0472	3.75	1	If possible, purchase 2 to expedite Experiments 8 and 11.	None.
filter paper, 9 cm	sciencecompany.com	NC-12142	6.95	1 pk		Coffee filters.
funnel support ring, 2 inch iron ring	onlinesciencemail.com		6.25	1	Search under "cast iron support ring"	None.

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glass stirring rod, 10 inch	sciencecompany.com	NC-5604	1.35	1		None.
graduated cylinder, 10 mL	sciencecompany.com	NC-7874	2.50	2	If possible, purchase 4.	None.
graduated cylinder, 100 mL	sciencecompany.com	NC-7832	5.50	2	Recommend that schools purchase six of these per student team.	None.
iron burner ring, 3 inch	sciencecompany.com	NC-11223	5.95	1		None.
ring stand	amazon.com	American Educational	12.91	1		None.
test tube set	sciencecompany.com	Z0039	15.95	1 or 2	Purchasing 2 will be convenient, but experiments can be performed with one. Includes 6 test tubes, test tube rack, test tube clamp holder, and test tube brush.	Small jars or bottles with non-metallic screw-on lids.
thermometer	sciencecompany.com	NC-1005	4.15	1	Celsius, 12-inch, alcohol, glass thermometer.	Any thermometer that reads in °C from 0 to 100°C. Glass thermometers will fit better in the two-hole rubber stopper.
tongs	sciencecompany.com	NC-7038	5.95	1	These are general purpose beaker tongs.	None.
volumetric flask, 50 mL	sciencecompany.com	NC-13090	4.95	1	Used repeatedly for preparing the solutions needed for various experiments.	None.
volumetric flask, 250 mL	sciencecompany.com	NC-10977	10.95	1	Used repeatedly for preparing the solutions needed for various experiments.	None.
wash bottle	sciencecompany.com	NC-9129	4.90	1 (or 3, see note)	Schools performing Experiment 18 should purchase 3 wash bottles per student group. (We recommend that students studying at home skip Experiment 18.)	
watch glass, 4 inch	sciencecompany.com	NC-11087	1.95	1	If possible, purchase 2 to expedite the experiments.	Small dish or plate.
weigh boat, medium, approx 3"	sale-fire.com		7.50	1 pk	Weigh boats are also called <i>weighing dishes</i> and <i>pour boat weighing dishes</i> .	Coffee filters.
wire gauze	sciencecompany.com	NC-7859	1.85	1		None.

Apparatus Needed for Specific Experiments									
Item	Exp. Needed	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes		
boiling chips	1, 7	amazon.com	—	0.25	(1) 1 g	Aluminum oxide boiling chips. These make boiling smoother.	None.		
capillary tubes	1	amazon.com	Dynalox SMP10/1	9.85	(1) 100 pk	Capillary tubes for melting point device, closed on one end.	None.		
glass tubing, 6 mm OD	1, 7, 9	sciencecompany.com	NC-10889	6.00	(1) 2 pk	To bend this tubing as required in the experiments will require a propane burner or Bunsen burner. The alcohol burner does not produce a hot enough flame.	None.		
rubber stopper, size 4, two-hole	1, 7	sciencecompany.com	NC-0973	1.25	1	If possible, purchase 2 to expedite the experiment.	None.		
test tube, 25 mm × 150 mm	1, 7	sciencecompany.com	NC-2592	1.50	1	If possible, purchase 2 to expedite the experiment.	None.		
test tube stopper, #000	1, 18	sciencecompany.com	NC-0969	0.35	6	If you have 12 test tubes, purchase 12.	None.		
latex tubing, 3/16" ID	1, 7, 9	sciencecompany.com	NC-1243-PK5	7.25	1	This is one 5-ft section of tubing.	None.		
evaporating dish, 100 mL	2, 18	amazon.com	SEOH brand	6.75	1		None.		
propane stove	3	amazon.com	Coleman PerfectFlow	23.88	1	This stove is not needed if a natural gas stove or other natural gas or propane stove is available.	Natural gas cook stove.		
24-well plate	5, 10	onlinesciencemall.com	"polystyrene well plate"	2.95	2		Plastic artist's paint palette.		

Apparatus Needed for Specific Experiments							
Item	Exp. Needed	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes
weigh boat, small	9, 13	onlinesciencemall.com		6.95	1 pk	This is a pack of 100, and we only need 1 for Experiment 9. These small weigh boats may also be used for Experiment 13. Weigh boats are also called <i>weighing dishes</i> and <i>pour boat weighing dishes</i> .	Any small, open plastic dish or container small enough to fit through the neck of the Erlenmeyer flask.
graduated cylinder, 500 mL	9	sciencecompany.com	NC-8069	7.50	1	This model is polypropylene for light weight and low cost.	None.
barometer	9	amazon.com	ETA brand	11.18	1	If a barometer is not available, the local barometric pressure in any city is easy to obtain online. However, if the weather is changing at the moment the experiment is performed, online data will probably not accurately reflect laboratory conditions.	Online data.
rubber stopper, #5, 1-hole	9	sciencecompany.com	NC-0974	1.45	1		None.
rubber stopper, #5, solid	11	sciencecompany.com	NC-0960	0.80	1	The solid stopper is used in the preparation of the low-CO ₂ NaOH. See Notes for Experimenters for details.	
12-well plate	14	labdepotinc.com	JSC012	6.29	1		The 24-well plate from Experiment 5, or a plastic artist's paint palette.
digital pH meter	15	amazon.com	Etekcity PH-009	11.81	1	There are many different models of inexpensive pH meters.	None.
magnetic stir plate	15	labdepotinc.com	86152003	110.50	1	This item is completely optional. Schools may wish to consider hot plate stirrers, which are much more expensive but combine heat with stirring functions.	None, but this item is optional.
Erlenmeyer flask, 250 mL	16	sciencecompany.com	NC-7884	4.85	1	Schools should consider providing at least three of these per student lab group.	None.
forceps	17	sciencecompany.com	NC-7830	3.50	1		Large tweezers.
voltmeter	17	frys.com	5427439	11.99	1		Any DC voltmeter that will read to 0.01 VDC.
Petri dish	17	sciencecompany.com	NC-12131	2.95	1		Flat-bottomed plate or dish.

Apparatus Needed for Specific Experiments									
Item	Exp. Needed	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes		
filter paper, 12.5 cm	17, 18	sciencecompany.com	NC-12168	8.85	1 pk		Coffee filters.		
beaker, 600 mL	18	sciencecompany.com	NC-5582	5.95	2		None.		
filter funnel, glass, 75 mm	18	sciencecompany.com	NC-0473	4.50	1	Search under "glass funnel."	Medium-sized plastic funnel.		
iron burner ring, 4 inch	18	sciencecompany.com	NC-11222	7.95	1	Search under "ring clamp."	None.		
thermometer clamp	19	onlinesciencemall.com	—	9.95	1		Clamp, 3-finger, with ring stand clamp.		
cork stopper, #16	19	craft store		2.99	1	Price shown is for a pack of 2 #16 cork stoppers from hobbylobby.com.	Any other cork, such as from a wine bottle. However, do not use synthetic wine bottle corks.		

Chemicals List

The chemicals needed are listed in the tables on the next five pages. General notices regarding toxicity and flammability are also indicated.

Chemicals Needed for Specific Experiments									
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
ethanol, C ₂ H ₅ OH (denatured)	1, 7	sciencecompany.com	NC-0026	12.95	1 L	medium	high	This ethanol may also be used in the alcohol burner. See Chemical Notes for info on ethanol.	
acetone, CH ₃ CH ₃ CO	1, 7, 14	sciencecompany.com	NC-0007	14.95	16 oz	low	high	Primary ingredient in old-fashioned fingernail polish remover; quantity adequate for Experiments 1, 7, and 14.	
hexane, C ₆ H ₁₂	1, 7	amazon.com	—	25.00	1 L	low	high	Buy high purity solvent from Univar or Consolidated Chemical and Solvents.	
lauric acid, C ₁₂ H ₂₄ O ₂	1	goodearthspa.com	—	5.05	4 oz.	low	low	A common fatty acid found naturally in oils such as coconut oil.	
toluene, C ₇ H ₈	1	hms-beagle.com	9552	2.00	25 mL	med (1)	high	Common solvent.	
naphthalene, C ₁₀ H ₈	1	hms-beagle.com	4169	2.15	15 g	low	med	Primary ingredient in old-fashioned moth balls.	
benzoic acid, C ₇ H ₆ O ₂	2	hms-beagle.com	1317	3.00	15 g	low	low		
lithium chloride, LiCl	3	sale-fire.com	—	5.50	30 g	low	none		
magnesium chloride, MgCl ₂	3, 6	labdepotinc.com	BDH9244-500G-EA	38.91	500 g	low	none	Because small quantity not available, this compound is expensive but needed for two experiments.	
potassium chloride, KCl	3	hms-beagle.com	1303	2.00	15 g	low	none		
calcium chloride, CaCl ₂	3	hms-beagle.com	9878	2.25	25 g	low	none		
strontium chloride hexahydrate, SrCl ₂ ·6H ₂ O	3	hms-beagle.com	1179	5.00	15 g	low	none	Informational note: Throughout this chemicals list, "hydrate" means there are water molecules in the compound. Since the compounds are dissolved in water anyway for the experiment, this is fine.	
copper (II) chloride, CuCl ₂	3	hms-beagle.com	3287	5.00	25 g	low	none		
zinc chloride	3	hms-beagle.com	4267	4.00	30 g	low	none		

*Refers to general hazard from skin contact or vapors, not to ingestion or hazard to eyes.

Notes:

(1) Avoid breathing vapors. Use in well-ventilated area. (2) Highly corrosive. (3) Can cause severe skin burns. (4) can cause skin irritation (5) hazardous to environment

Chemicals Needed for Specific Experiments									
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
hydrochloric acid, concentrated, HCl, 11.6 M	4, 5, 9, 11, 12, 13, 14	sciencecompany.com	NC-1193	34.95	1 L	high (1, 2)	none	This concentrated acid will be used to prepare the HCl solutions for all experiments requiring HCl. The product is labeled 36–37% strength, which translates to 11.6 M.	
copper chloride dihydrate, $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$	4, 18	sale-fire.com	—	4.80	100 g	low	none		
zinc, mossy, Zn	4, 5	sciencecompany.com	NC-9848	9.95	100 g	none	none		
calcium metal, Ca	5	sale-fire.com	—	11.12	50 g	none	low		
magnesium, Mg	5, 17	hms-beagle.com	2439	4.10	0.9 g	none	med	Keep this material away from flames.	
tin, Sn	5	hms-beagle.com	3905	9.39	2 oz	none	none		
calcium nitrate, $\text{Ca}(\text{NO}_3)_2$	5	amazon.com or ebay	—	7.99	5 lb	low	none	Fertilizer; some lower prices found on eBay.	
copper sulfate pentahydrate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	5	hms-beagle.com	1144	4.60	25 g	low	none		
magnesium nitrate hexahydrate, $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	5	hms-beagle.com	9102	6.00	20 g	low	none		
iron (III) nitrate nonahydrate, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	5, 17	hms-beagle.com	1331	2.50	10 g	high (1, 3)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.	
iron (II) sulfate heptahydrate, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	5, 8	hms-beagle.com	1236	2.45	15 g	low	none		
tin (IV) chloride pentahydrate, $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$	5	hms-beagle.com	5762	5.50	15 g	high (1, 3)	none		
zinc nitrate hexahydrate $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	5	sale-fire.com	—	4.85	30 g	high (1, 3)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. Do not subject to shock.	
silver nitrate, AgNO_3	5, 6, 8, 10, 17	hms-beagle.com	1204	30.40	10 g	high (1, 3, 5)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.	

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Chemicals Needed for Specific Experiments								
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes
glycerol	7	high end drug store		10.59	177 mL	low	low	
mineral oil	7	grocery store		3.49	473 mL	low	low	
potassium permanganate, KMnO_4	8, 16	sciencecompany.com	NC-0744	10.95	100 g	medium	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and other materials.
sodium carbonate, Na_2CO_3	8, 10	hms-beagle.com	1174	4.00	60 g	medium	none	
sulfuric acid, H_2SO_4 , 18 M	8, 16, 18	hms-beagle.com	4047	4.00	25 mL	high (1, 2, 3)	none	This concentrated acid (95–98%) will be used to prepare the acid for all experiments requiring H_2SO_4 .
acetic acid, CH_3COOH	9, 15	hms-beagle.com	4503	4.00	25 mL	high (1, 2, 3)	medium	This glacial (pure) acetic acid is 17.4 M and is used to prepare the 0.1 M solutions in exp. 9 and 15.
sodium iodide, NaI	10	hms-beagle.com	11279	2.75	25 mL	low	none	This 1.0 M solution is used to prepare the 0.1 M solution required.
sodium sulfate, Na_2SO_4	10	hms-beagle.com	3258	2.00	15 g	low	none	
barium nitrate, $\text{Ba}(\text{NO}_3)_2$	10	hms-beagle.com	1201	3.20	25 g	high (1, 5)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.
lead nitrate, $\text{Pb}(\text{NO}_3)_2$	10	hms-beagle.com	8404	3.00	25 mL	high (1, 5)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. This is a 0.1 M solution and can be used in experiment 11 as is.
copper (II) nitrate hemipentahydrate, $\text{Cu}(\text{NO}_3)_2 \cdot 2.5\text{H}_2\text{O}$	10, 17	hms-beagle.com	1329	2.50	10 g	high (1)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.
nitric acid, HNO_3	10	hms-beagle.com	1186	3.00	25 mL	high (1, 2, 3)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. This is a 1.0 M solution for use in Experiment 10 as is.

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Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
potassium hydrogen phthalate (KHP)	11	onlinesciencemall.com	—	4.75	10 g	low	none		
sodium hydroxide, NaOH	11, 12, 13, 15	sale-fire.com	—	7.99	8 oz (226 g)	high (1, 2, 3)	none	This quantity of pellets adequate for 4 experiments. Also known as lye.	
bromothymol blue solution	11	hms-beagle.com	4386	4.00	30 mL	medium	low		
litmus solution, 0.5%	12	amazon.com		10.00	60 mL	none	none	Search under "litmus 0.5% aqueous solution."	
iodine, pure elemental	14	sale-fire.com		7.86	0.5 oz	medium (4, 5)	none		
oxalic acid, H ₂ C ₂ O ₄	15	hms-beagle.com	5022	3.50	15 g	high (1, 2, 3, 5)	low		
phosphoric acid, H ₃ PO ₄ , 1 M	16	hms-beagle.com	4178	4@3.00	25 mL	high (1, 2, 3)	none	The 25 mL quantity is enough to perform three test trials on one iron supplement. To test four supplements you will need four of these.	
aluminum metal	17	hms-beagle.com	3115	1.35	1 strip	none	none	Any piece of aluminum metal or wire (readily available at hardware stores) will do. Item shown here is an inexpensive source.	
nickel metal	17	sale-fire.com		6.99		none	none	Any small strips or pieces of nickel metal will do. At sale-fire.com there are nickel cubes and balls for various prices.	
silver metal	17	goldleafproducts.com		9.00	1 book	none	none	This is for a book of 25 small sheets of real silver leaf.	
aluminum nitrate nonahydrate	17	hms-beagle.com	11449	10.00	25 g	medium	see note	Not flammable itself, but an oxidizer. Keep away from flame and organic materials.	
nickel nitrate	17	sale-fire.com		7.20	50 g	medium	see note	Not flammable itself, but an oxidizer. Keep away from flame and organic materials.	

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acetic anhydride	18	sale-fire.com		27.00	30 mL	high (1, 4)	high	Reacts with water; keep separate.	
absolute ethanol, C ₂ H ₅ OH	18	amazon.com		23.95	16 oz	medium	high	This ethanol may also be used in the alcohol burner. See Chemical Notes for info on ethanol.	
salicylic acid	18	hms-beagle.com	1192	4.85	15 g	medium (4)	low		
iron chloride hexahydrate, FeCl ₃ ·6H ₂ O	18	hms-beagle.com	7974	3.50	15 g	low	none		

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