

Magnets

<i>Equipment</i>	<i>Quantity required for 20 students working:</i>		<i>Unit cost</i>	<i>Supplier and catalog number</i>	<i>Comments</i>	<i>First use</i>
	<i>together as a class</i>	<i>semi-self paced</i>				
Clear plastic ruler, (1 ft. length)	20	20		Local stores/supply	Students can supply. The ruler should be clear plastic with both inch and centimeter scales.	
Clear plastic protractor Semicircular with 0.5 degree divisions	20	20		Local stores/supply	Students can supply.	
Magnetizer to remagnetize magnets: Use one of the following: (A) High strength, 115VAC ETP (Uses electric current pulses; includes 3 keepers and instructions) (B) Remagnetizer (tm) (Uses permanent neodymium magnets; requires no electricity)	1 1	1 1	\$128.50 \$38.15	Frey 15583539 NASCO SB22516M	Several times during the quarter it may be necessary for the instructor to remagnetize the magnets used by the students.	
Iron nails, 3-4" long	20	10		Local hardware store		1.1
Paper clips, small and large	10 boxes each size	5 boxes each size		Local stores/supply		1.1
Aluminum nails, 3-4" long	10	5		Local hardware store		1.1
Collection of nonmagnetic materials	10 sets	5 sets		Delta ESS Sink or Float (see Comments) or general lab supplies	See <i>Properties of Matter</i> equipment list for description of objects (aluminum, wooden, and plastic) from Delta ESS Sink or Float Kits. These objects, or other objects made of similar materials, are suitable for this experiment.	1.1
Small pieces of various types of metal:	10 of each	10 of each	\$10.80/kit	NASCO SB14273M	Electrodes can be used. This equipment can also be used in <i>Properties of Matter</i> and <i>Electric Circuits</i> . Kit contains electrodes: copper, lead, zinc, aluminum, iron, carbon, nickel; all measure 4" x 3/4"	
Cylindrical magnet, Alnico 12.5 cm x 1.0 cm	20	10	\$12.65/pk 2	Frey 15562364		1.1

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Bar Magnets Use one of the following: (A) steel, with marked poles (150 x 19 x 7 mm, boxed with separator and keeper) (B) zinc-plated chrome alloy, with marked poles (6" x 3/4" x 1/4", boxed with keepers) (C) Alnico alloy bar magnet (150 mm x 19 mm x 7 mm) (D) Alnico (1") (E) 2" marked N/S (F) Magnet, 3" L x 1/2" diameter (G) ceramic (2" length) (H) Bar magnet unmarked, 1.375" length	 20 20 10 40 20 12 20 20	 10 5 20 10 6 10 10	 \$7.50/pk 2 \$9.50/pk 2 \$7.65/ea \$6.95/pk 10 \$6.95/pk 2 \$3.25 \$4.95/pk 2 \$11.95/pk 10	 Frey 15501488 NASCO SB15358M Frey 15569831 Delta WW-130-0320 Delta WW-130-7569 NASCO CO9784M Delta WW-130-0419 Delta WW-130-0090	Bar magnets with unmarked poles are ideal. If you use bar magnets with marked poles, cover up the markings.	1.1
Soft iron sample: Either or both of these may be purchased. (A) cylindrical (152 mm x 35 mm) (B) rectangular (95 x 19 mm x 6 mm)	 10	 10	 (A) \$26.00/pk 10 (B) \$28.55/pk 10	 (A) Sargent Welch S44370-35 (B) Sargent Welch S44370-37	For Experiment 1.4, at least one object should be the same size and shape as one of the magnets listed above.	1.4
Colored adhesive dots				Local stores/supply		2.1
Magnets of various shapes An assortment is needed, but you can start with just a few shapes and build your collection over time. Suggestions: 1. U-shaped magnet (5.5"L x 3" W x 3/4" thick; poles 2" apart with keeper) 2. Cylindrical magnet, Alnico V (1/4" x 3"; N pole identified by groove)	 10 10	 5 6	 \$15.60 \$9.05/pk 2	 NASCO S06109M NASCO SB16491M		2.4

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3. Circular disc magnet, Alnico (pair with ground flat surfaces for close contact; 1.625" diameter x 0.25" thick; poles located at opposite ends of diameter)	20	10	\$10.00/pk 2	NASCO SB14079M		
4. Refrigerator magnets	20	10		Local stores/supply	We suggest refrigerator magnets that have many poles lined up parallel to each other.	
5. Horseshoe magnet with keeper	6	3	\$12.95	Delta WW-130-3092		
6. Ceramic magnets					Note: Ceramic magnets are magnetized along the largest dimension unless otherwise noted.	
- disk (1" x 0.25")	20	20	\$7.95/pk 40	Edmund Scientific 3053579		
- ring (1.25" x 0.25", 0.5" center hole)	20	10	\$5.75/pk 10	Edmund Scientific E35,746		
- ring (1.25" x 0.188", 0.188" center hole, mag. on side)	24	24	\$2.75/pk 4	Edmund Scientific E42,159		
- rectangular, no pole pieces (1.88" x 0.88" x 0.38" thick)	20	10	\$4.00/pk 2	Edmund Scientific E41,798		
- rectangular, pole pieces (1.88" x 0.88" x 0.38" thick)	20	10	\$5.75/pk 2	Edmund Scientific E40,818		
- U-shaped	20	10	\$11.95/pk 10	Delta WW-130-0463		
7. Magnetic marbles (5/8" diameter, 100 marbles in assorted colors, with bag)	2 pk	2 pk	\$8.85/pk 36	Delta WW-130-9824		
8. Horseshoe magnet, Alnico (2" high with keeper; lifts 4 lb.)	10	5	\$5.80	Frey 13325692		
String and nylon cord	2-3 spools of each	1-2 spools of each		Local stores/supply		3.1
Magnetic compasses Use some of the following:					A large assortment is suggested, but about 10 for any pair of students is necessary.	3.3
(A) Compasses, 23 mm diameter (with clear plastic case and top)	90	30	\$12.85/pk 30	NASCO SB16729M		
(B) Compasses, 35 mm diameter	100	50	\$2.25/ea	Frey 15568397		
(C) Magnetic detection compasses, 1/2" diameter	100	50	\$4.95/pk 10	Delta WW-032-2410		
(D) Magnetic detection compasses, 1 3/8" diameter	100	50	\$18.95/pk 12	Delta WW-030-5887		
Earth globes: Use one of the following:					See also AbS, Volume 1.	3.5
(A) 23 cm diameter, without meridian	10	5	\$18.95	Frey 155344324		
(B) 30 cm diameter, with half-meridian and tilted axis	10	5	\$35.95	Frey 15360984		

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Stacking magnets: Use one of the following: (A) rectangular 1.88" x 0.88" x 0.38" (B) 1/2" button (C) 1" rectangular (D) 1 1/2" round	20 100 100 100	10 50 50 50	\$0.99/ea \$1.59/pk 5 \$1.99/pk 5 \$1.99/pk 5	Radio Shack 64-1877 Radio Shack 64-1883 Radio Shack 64-1879 Radio-Shack 64-1888	If an assortment of magnets is used, be sure each student has 10 to 20 of at least one type.	5.1
Rubber bands	20	10		Local stores/supply		5.4
Iron filings, 500 g bottle	3 bottles	2 bottles	\$4.80/bottle	Frey 15568031	Degreased; packed with sifter top.	6.2
Dip needle	1	1	\$65.00	PASCO SF-8619	Students use as a standard compass (held horizontal) and vertically to find dip of the earth's field.	OPT 7.5
Magnaprobe A small bar magnet in a gimbal mounting.	10	5	\$15.25	Frey 15593235 (Instructions included.)	Optional: Demonstrates 3 dimensional nature of magnetic fields. Can be used to show direction of fields around wire and coils.	7.5
Soft iron rod (approx. 20 cm, 6 mm diameter)	10	5	\$28.85/pk 10	Sargent-Welch WLS 44370-37		8.3
Hammer	10	5		Local hardware store		8.3
Alcohol burners Burners and stand kit (2 burners & stand) Replacement wicks Ethyl alcohol, denatured (burner fuel)	10 kits 2 pk 12 4.0 L	5 kits 2 pk 12 500 mL	\$13.95 \$4.10 \$24.30 \$ 8.90	Frey 15576468 Frey 15576621 NASCO KM01030M NASCO KM01029M	See also H & T	8.4
Buret clamp (single), (A) with plain jaws or (B) with plastic-coated jaws	10	5	(A) \$6.95 (B) \$6.95	(A) Frey 15574110 (B) Frey 15574266	See also POM.	8.4
Wooden slab, 1/2"-1" thick	10	5		Local hardware store		8.6
Ring stands Support rings, 5" diameter	10 10	5 5	\$10.95 \$6.00	Frey 15574176 Frey 15574104	Ring stands are used to hold a magnet above a paper clip suspended by string. Other methods of support may also be used. See also POM.	9.8