A.P.E.S. LAB ~ TESTING PLASTICS

MATERIALS

samples of plastic (recycling codes 1-7)	flint striker	crucible tongs or forceps
matches	copper wire	safety glasses
burner with tubing	test solutions of isopropyl alcohol	foil
400 or 600 mL beaker	50 mL beakers	ceramic tile

PART 1: DENSITY

A material that is denser than a given liquid will sink in that liquid, while a material that is less dense than the given liquid will float in that liquid. For example, cork and oil float on water because they are less dense than water; pennies and syrup will sink in water because they are denser than water.

It is possible to estimate the density of a material by observing its sinking or floating behavior in solutions of known densities. In this activity, the approximate densities of plastic samples will be determined by making such observations. For example, if it is observed that a plastic sinks in Solution B (density = 0.93 g/mL) but floats in Solution C (density = 1.00 g/mL) then the density of the plastic must be greater than Solution B, but less than Solution C. Therefore, the density of the plastic sample must lie between 0.93 g/mL and 1.00 g/mL, which can be averaged for our purposes.

PROCEDURE

1) Obtain 10 small beakers.
2) Fill the 10 beakers approximately 3/4 full with solution.
3) Arrange the test solutions in the order given below:

Number	Description	Specific Gravity
1	Glycerin	1.2613
2	Ethylene Glycol	1.1090
3	Water	1.0000
Stock isopropanol/water:		
4	20/80	0.9624
5	30/70	0.9436
6	40/60	0.9248
7	50/50	0.9061
8	60/40	0.8873
9	65/35	0.8779
10	100/0	0.8121

(Note: specific gravity = density of substance / density of water)

4) Obtain a plastic sample, one from each category, small enough to fit into the beakers.
5) Determine the specific gravity range of each type of plastic (codes 1-7, plus one unknown given by the teacher) by finding consecutive solutions, one in which the plastic sinks and one in which the plastic floats. Find the average specific gravity between those two solutions.
6) NOTE: Each plastic sample should be rinsed and dried before being put into a new solution. You may use clean tongs or forceps to handle the wet plastics.
7) Record the density range of each plastic type in Data Table 1.
8) Do not discard the plastic pieces. Keep them in order: codes 1-7 and the unknown

Data Table 1							
Coded Plastic Type	**Average specific gravity**	**Bielstein Test (+) or (-)**	**Rigidity**	**Appearance - Translucence**	**Flammability**	**Drips when melted? (Y/N)**	**Smoke color**
1							
2							
3							
4							
5							
6							
7							
UNKNOWN							

PART 2: BIELSTEIN TEST

BACKGROUND INFO.

Bielstein Copper Wire Test for Halogenated Organics – from www.uwstout.edu

"A classic organic qual test for the presence or absence of a halogen in an organic molecule is the copper-wire test… If a halogen is present (Cl, Br, or I) the wire will impart a green color to the flame.

This test has several environmental applications. In most labs these days, [there are] waste containers for both halogenated and non-halogenated organic solvents. If there is ever a question as to whether an unknown solvent is halogenated, the Bielstein test is quick and sensitive. It can also be used to test plastic films and bottles… Finally, this test might be used to determine whether transformer oil is a polychlorinated biphenyl (PCB).

The Bielstein test is very sensitive and generally does not produce false negative results. It may produce a false positive if halogen traces are present or if a previous sample has not been thoroughly cleaned from the wire."

PROCEDURE – You may use the same plastic samples from Part 1.

1) Heat a copper wire loop to a dull red color in a burner flame long enough to burn off any salts from perspiration and other contamination. The wire may be heated to a dull red, but more intense heating will cause the wire to melt.
2) Quickly touch the plastic sample, removing some of the plastic with the wire.
3) Place the plastic-coated wire in the flame and look for a green flame as evidence of chlorine. If the flame turns green or blue-green when the plastic is burned, record a positive for the Bielstein Test. If the flame does not turn green at all, record a negative for the Bielstein Test.
4) Between samples, the wire should be heated thoroughly to remove traces from previous samples.
5) Do not discard the plastic pieces. Keep them in order: codes 1-7 and the unknown.

PART 3: GENERAL APPEARANCE and COMBUSTION

You may use the same plastic samples from Parts 1 and 2.

1) Examine samples of each recycle-coded plastic listed in Data Table 1.
2) Record the rigidity and the appearance of each plastic type.
3) Cover a tile with aluminum foil. Obtain a large beaker to use as a cover.
4) Burn a small piece of each plastic type with a match over the foil. Use the beaker to catch the fumes. Release fumes in the fume hood.
5) Record if the plastic burns when lit. Record if the plastic drips when melted and the color of any smoke (black/white) given off.

QUESTIONS

1) Find a diagram of the monomers (repeating chemical structures) for the following types of plastic. Copy-&-paste from a reliable internet source. Remember to cite your source.
    a) Code 1 PETE: Polyethylene Terephthalate
    b) Code 2 HDPE: High density polyethylene
    c) Code 3 V: Polyvinylchloride (or PVC)
    d) Code 4 LDPE: Low density polyethylene
    e) Code 5 PP: Polypropylene
    f) Code 6: PS: Polystyrene
    g) Code 7: polycarbonate (PC)
    h) Code 7: polymethyl-methacrylate (PMMA)
    i) Code 7: nylon-66 (N-66)
2) What types of containers have you seen at home, school, or elsewhere that have the following recycling codes? Be specific.

a) 

b) 

c) 

d) 

e) 

f) 

g)