ACS KITCHEN CHEMISTRY

All of the experiments in this packet (Putter Putty, Blueberry Patch Indicator, Household Density Column, Iron for Breakfast, Color Fun, Viscosity of Liquids, Coke(R)/Diet Coke(R)) may be repeated at home. All experimentation should be done only under adult supervision and following all precautions on the labels of the household chemicals/products used. In addition, you may wish to protect surfaces (table or countertop) and clothing while performing the experiments.

VISCOSITY OF LIQUIDS

The viscosity demonstration consists of four bottles containing household materials and marbles to illustrate the relative thickness of each substance.

Flip the bottles over to start the display.

Bottle #1 contains water. It is the least viscous material.

Bottle # 2 contains honey.

Bottle #3 contains roll-on anti-perspirant.

Bottle # 4 contains hair gel. It is the most viscous.

Viscosity is a measure of how much force is required to slide one layer of the fluid over another layer. Substances which do not flow easily (i.e., the gel) have high viscosity. Substances which do flow easily (i.e. water) have low viscosity.

HOUSEHOLD DENSITY COLUMN

What can you make with Karo® syrup, Dawn® detergent, vegetable oil, and rubbing alcohol? This activity shows you how to create a colorful density column from common items available from the supermarket.

Explanation

All materials have characteristic densities. In this activity you are able to observe the relative densities of household liquids, like syrup, oil, and alcohol, and solids, like lead sinkers, rubber stoppers, and corks. As long as the materials do not react or do not mix, a less dense substance will float on a more dense layer. By adding the solids into the column, you can compare their densities to the densities of liquids by observing the position at which each solid comes to rest. The greater a solid's density, the lower it will sink.

Materials

100mL glass cylinder

15mL of each of the following liquids:

- Dark Karo® syrup or maple syrup
- Glycerin
- Dawn® dishwashing liquid
- Water
- Vegetable oil
- Rubbing alcohol

One or more of the following (small pieces):

- Lead sinker
- Rubber stopper
- Oak
- Cork
- Pine
- Plastic

Procedure

1. Slowly pour about 15 mL each of the following liquids into the glass cylinder, letting the liquid run down the side of the cylinder. Be sure to pour the liquids in the order listed.

- Dark Karo® syrup or maple syrup 0=1.37 g/mL
- Glycerin O= 1.26 g/mL
- Dawn® dishwashing liquid O= 1.03 g/mL
- Water O=1.00 g/mL
- Vegetable oil O=0.91 g/mL
- Rubbing alcohol O=0.87 g/mL

If the liquids are carefully poured, one layer on top of another will form. Most liquids can be poured down the side of the cylinder to minimize mixing. Syrup, however, is best poured in without allowing it to run down the side of the cylinder as it is very sticky.

2. Add the small pieces of solid samples to the density column. You can determine their relative densities by noting the position at which they come to rest in the column.
When adding the solid samples, do so carefully so that the layers of liquids do not mix .

IRON FOR BREAKFAST

Do you eat small pieces of iron metal for breakfast? You do if you eat cereal that is fortified to meet 100% of the minimum daily dietary requirement of iron. In this activity, you will extract the food grade iron filings from a cereal and examine their properties.

Explanation - Iron (Fe) is an essential element. Every molecule of hemoglobin has four ions of iron in it. Hemoglobin is the compound in red blood cells that carries oxygen from the lungs to the tissues. Hemoglobin causes our blood to look red. A deficiency of iron in the diet results in fatigue, reduced resistance to disease, and increased heart and respiratory rate. A healthy adult needs about 18 mg of iron each day. Dietary iron is found in large amounts in organ meats such as liver, kidney, and heart. It is also present naturally in egg yolks, some vegetables, and shellfish. In these foods, iron is typically present as iron(III) (Fe) ions. Our body absorbs iron in the small intestine in the form of iron (III), which then is reduced to iron(II). Under normal conditions, our body absorbs only 5-15% of the iron in the food that we eat. Vitamin C can increase the amount of iron absorbed into the body. Cereals are fortified with food grade iron filings as a food supplement. This iron is metallic iron (Fe). In the stomach the metallic iron is oxidized and eventually absorbed through the small intestine. If all of the iron from your body was extracted, you would have enough iron to make up only two small nails. This amount is about 5-7 grams.

Materials

- A non metallic container - about 500 mL volume
- Magnet tape
- Tongue depressor
- Two Ziploc® plastic bags
- 1cup of breakfast cereal with 100% of the minimum daily requirement of iron (i.e., Total or Special K)
- Water

Procedure

1. Attach the magnet tape to one end of the tongue depressor, place in a Ziploc® bag and close.
2. Place the cereal in another Ziploc® bag, crush
3. Pour the crushed cereal into the container, and cover with water
4. Use the magnet/tongue depressor, still in the Ziploc® bag, to stir the cereal slurry for about 10 minutes.
5. Remove the stirrer from the container and observe the fine black iron filings on the outside of the plastic bag.
6. Return the magnet to the slurry and continue stirring for another five minutes, then observe the additional iron filings that have collected.

(Another excellent way to collect the iron is to stir the slurry on a magnetic stirrer with a Teflon coated stir bar. The filings collect on the stir bar and are very easy to see against the white Teflon.)

PUTTER PUTTY

Materials

Borax Solution 30mL (1g 20 Mule Team® Borax to 100mL water)

Elmer's® School Glue 30mL
Food coloring (optional)
Ziploc® plastic sandwich bag

Objective

To demonstrate properties of polymers and to use the properties of a substance to determine which state of matter it characterizes.

Background

Polymers (poly means "many" and mers means "units") are made by combining many repeating units called monomers (mono means "one"). Polymers are a group of chemicals that are found in many forms in the world around us, including plastics, glue, and the biochemical molecules that make up our bodies. The Elmer's® School Glue is a solution containing long polymer chains. Because these chains are long, they interfere with the movement of each other, causing this solution to be rather thick and to pour more slowly than water. This means the solution is more viscous than water. Viscosity is a physical property of a liquid that describes how well it flows. For example, water and alcohol are described as having a low viscosity because they flow quickly; honey and syrup have high viscosities because they flow much more slowly.

The preparation of Putter Putty includes the combining of Elmer's School Glue (polymer) and the solution of crosslinker (sodium borate or Borax solution). The cross-linker bonds different polymer chains together. The Putter Putty becomes more viscous than the beginning glue, making it very gooey, bouncy and strange.

1. Make Borax solution by dissolving 1 g of 20 Mule Team Borax (found in the laundry additives section of the supermarket) in 100 mL of water.
2. Put 30 mL of Borax solution and food coloring (4 drops yellow, 1 drop green) in Ziploc bag.
3. Pour 30 mL Elmer's® School Glue into Ziploc® bag.
4. Zip bag and knead thoroughly.
5. Carefully remove Putter Putty and knead another minute or so.

Try the following:

- Roll the putty into a ball and set it in the palm of your hand. Does the ball keep its shape?
- Pat the putty between your hands and try to form a thin film.
- Hold the film at one end and observe as the putty flows from your hand.
- Roll the putty into a long cylinder shape and slowly pull apart while holding it at the two ends. Reform the shape and pull apart quickly.
- Use coins or small objects to make imprints in the putty.
- Put the putty ball on top of a cup that is upside down and see what happens.
- Form a ball with the putty and see if it bounces.

- Use the putty to pick the print from a newspaper. Use a rapid on and off motion so the putty doesn't stick to the paper.

COLOR FUN (COLOR CHROMOTOGRAPHY)

QUESTIONS TO ASK KIDS:

Is green really green? What is black? What is red? Do you know what primary colors are? If so, which ones are they?

MATERIALS

filter paper, coffee filters or paper towels
water-based (non-permanent) colored markers (water-based Vis-a-Vis® overhead markers work great)
eyedropper
water

W H AT TO DO

1. Draw a circle with the marker on the filter paper.
2. Put a drop of water in the center of the circle and watch it spread throughout the paper.
3. Color will separate into its primary colors.

EXPLANATION

Most dyes and inks are combinations of coloring substances which can be separated by adding water or alcohol. As the water spreads through the paper, it dissolves the colored ring and gradually moves the color outward. However, since the colors don't move at the same rate, they separate.

NOTE: Try doing a primary color too!
BLUEBERRY PATCH INDICATOR

Introduction

Many plants and vegetables contain pigments which change color when the pH is changed. Some of the acid-base pigment sensitive containing plants are the red cabbage, sweet cherries, sour cherries, black raspberries, and blueberries. The general name for this class of pigments is anthocyanase. Both sweet winsor cherries and red cabbage have high concentrations of one of these anthocyanase compounds. In basic solutions these compounds are deep bluish-green while in acid solution they are generally red in color. It should be apparent to most that the color of the fruit is thus indicative of its pH.
There are several ways to obtain this acid - base indicator most striking of which is to take four or five sweet cherries and crush them in front of your audience, squeezing the juice into a beaker or small juice glass. This juice is almost clear red and because of its

concentration can be diluted with water to make approximately 50 - 100 mL. Of course if your hand was clean you can eat the pulp spitting out the pits with the commentary, "waste not want not". Alternately a cloud of blue solution can be obtained from grinding up a quarter of a red cabbage with several cups of water and filtering it with doubled over paper towels. The paper towels may be dried and later used as acid - base indicator paper, while the solution can be clarified with vinegar, refiltered and neutralized with ammonia. Other sources of this pigment are Smuckers® Natural Blueberry Syrup which yields a milky blue solution when diluted, or the red juice from Microwave Ready, Aunt Nellies® Sweet and Sour Red Cabbage.

Materials

Indicator juice from some source both in its red form and blue form
5-10 beakers or small juice glasses
Test fruit juices, vinegar, ammonia and baking soda
Procedure

1. Carry out a discussion with your group about the acid taste of most fruits or the bland taste of such fruits as blueberries or bananas.
2. Set up in pairs several glasses in front of your audience half filled with indicator solution - one set with blue indicator in it and the other with red. Note: the clearer the solutions the better.
3. Place several teaspoons of the juice or aqueous solutions of the fruits or products to be tested in the first set of blue glasses and ask your class to explain the color change if any and if none, why not.
4. To confirm their observations place several teaspoons of the same liquid used (in 3) above in the red indicator solutions.

Reference: Goodwin, T.W. "Chemistry and Biochemistry of Plants and Pigments", Academic Press: New York, 2nd ed. 1976.

Other Expirements:

A. Difference in Weight between Coke & Diet Coke

Put two 12 ounce cans on double beam balance.
Add Packets of Sugar until twelve ounce cans balance 7 - 9 packets.
Coke has Sugar which weighs more than Artifical sweetner.
Put in water Coke will sink, Diet Coke will Float.