Experiment 1
Analysis of Matter using the Scientific Method

Matter can be separated into two categories: mixtures and substances. Two or more substances comprise mixtures and can be separated by physical methods. There are two types of mixtures, homogeneous mixtures of uniform composition and heterogeneous mixtures, which are composed of two or more phases or discernable components. Substances can be described as either compounds or elements. Compounds are substances that can be separated into simpler substances by using chemical methods. Elements cannot be broken down into simpler substances. Elements are composed of only one kind of atom. Compounds are composed of two or more kinds of atoms in small, whole number ratios.

The purpose of this experiment is to analyze household items which are either mixtures (heterogeneous or homogeneous) or substances (compound or element) using both physical and chemical methods, then to test your power of deduction by analyzing unknown samples.

Section 1: Scientific Method using Paper Chromatography

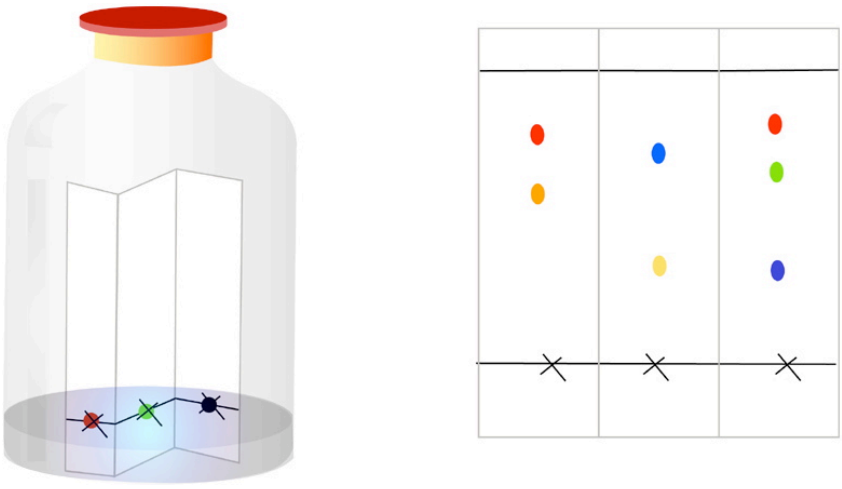
Commercial food dyes are mixtures composed of individual compounds. If you read the label for the ingredients for a commercial food dye you would probably find terms like FD&C Yellow 5 or just simply BLUE 1 or RED 40. The purpose of this experiment is to separate the dye mixture into its respective compounds (or components) and observe the effect solubility has on compounds. Chromatography is a method of separating the components of a mixture by distributing them between two phases; in general a moving phase passing a stationary phase. The moving phase in this experiment is the solvent (a 0.1 % sodium chloride solution) and the stationary phase is the cellulose of the chromatography paper. The attraction the mixture components have to either the moving phase or stationary phase depends on the properties of that specific compound. Substances with similar properties will be more attracted to each other than substances that are intrinsically different from each other. In paper chromatography the substances whose properties are most similar to the solvent (the moving phase in this experiment) will move up the stationary phase by capillary action along with the solvent. The height to which the components of the mixture rise depends upon the relative attraction of the substance to the moving phase as well as its relative attraction to the stationary phase. If the substance is more attracted to the stationary phase (the paper in this experiment) then there will be little movement. Since the different components of the mixture are not attracted to the paper and to the solvent to the same degree, they will move with dif_ ferent speeds along the paper and thus be separated.

In this section you will observe the effect chromatography has on four different dye mixtures (yellow blue, red, and green) from McCormick, Shilling, or a generic brand. You will want to deduce the extent of relative attraction each component or compound of the food dye has to both the moving phase and stationary

phase. Each lab partner will analyze a different manufacturer enabling you to compare the dye composition of an expensive brand name dye with that of the cheap generic dye. Lastly, you will analyze an unknown mixture composed of two or more of the dye mixtures.

Preparation of the filter paper:

Prepare the pre-cut chromatography paper (11 cm x 20 cm) by drawing a pencil line 1.5 cm from one long (20 cm) edge and another line exactly 8.0 cm above the first. The lower line is your baseline and the upper line is your ending point (for the moving phase). Place five evenly spaced pencil "X" marks along the lower line, 3 cm from each side and 3.5 cm away from each other. Under each "X" mark use the pencil to label the paper for the dye, which will be dropped on that "X". R is for red, B is for blue, G for green, Y for yellow, and UK for your unknown. Be sure to record the unknown number.



www3.moe.edu.sg/edumall/tl/digital_resources/chemistry/images/paper_chromatography.jpg

Preparation of the chromatographic developing chamber:

Measure out 30 mL of solvent (a 0.1 % solution of sodium chloride in water) into a 600 mL beaker. Cover the beaker with a large watchglass to slow down the evaporation of the solvent.

Spotting the chromatography paper:

Place one drop of each of the different colors of food dye in different depressions of your spot plate also include a place for your unknown. Use an open ended capillary tube (1 mm, O.D.) to practice applying small spots (about 3 to 5 mm) on a piece of paper towel. Use a different capillary tube for each different dye. When you are finished with the capillary tubes place them in the container, provided by the instructor, filled with water. These tubes can be washed and reused. When you have mastered the technique of spotting with a capillary tube, place a small spot of each dye on the appropriately labeled "X". Make sure the spots are applied exactly over the "X" mark for two reasons. First, if the spot is in the solvent this experiment will not work and secondly, for direct comparison you need to have all the spots start from the same reference point. Allow the spots to dry for 5 minutes.

The Experiment:

Roll the paper into a cylinder and staple the sides without overlap. Place the lower staple above the baseline. Place the cylinder in the beaker with the solvent, make sure the spots are above the solvent line. Cover it with a watch glass to slow down the evaporation of the solvent. Leave the beaker undisturbed for about 20 to 30 minutes and allow the solvent to flow up the paper until it reaches the top line.

At this point proceed to the next experiment but remember to keep an eye on the chromatogram.

After 30 minutes:

When the solvent in the beaker reaches the 8.0 cm level, remove the paper from the beaker an allow it to dry on a paper towel or watch glass. When the paper is completely dry, remove the staples and outline the different colored spots lightly with a pencil. Fill out Table A on the report sheet then attach your chromatogram to the report form.

Section 2: Scientific Method on Household Items

In this section you will identify common household chemicals by their chemical properties then analyze a mixture of unknown composition. In general, a chemist will add a reagent (a known starting material) to a sample being tested and wait to see if a reaction occurs. A chemist will know a reaction has happened because some form of change will be observed (a positive result). Changes may include the formation of a gas, a color change, the formation of a solid, or the production of heat. If no change is observed, then a chemist may conclude the absence of a substance (a negative result). You will need to look for both positive and negative results in order to theorize what your unknown sample is.

In this experiment you will be using the following chemicals:

Powders: Baking Soda, Corn Starch, Alka Seltzer, Table Salt

Liquid Reagents: White Vinegar, Iodine Tincture, Distilled Water

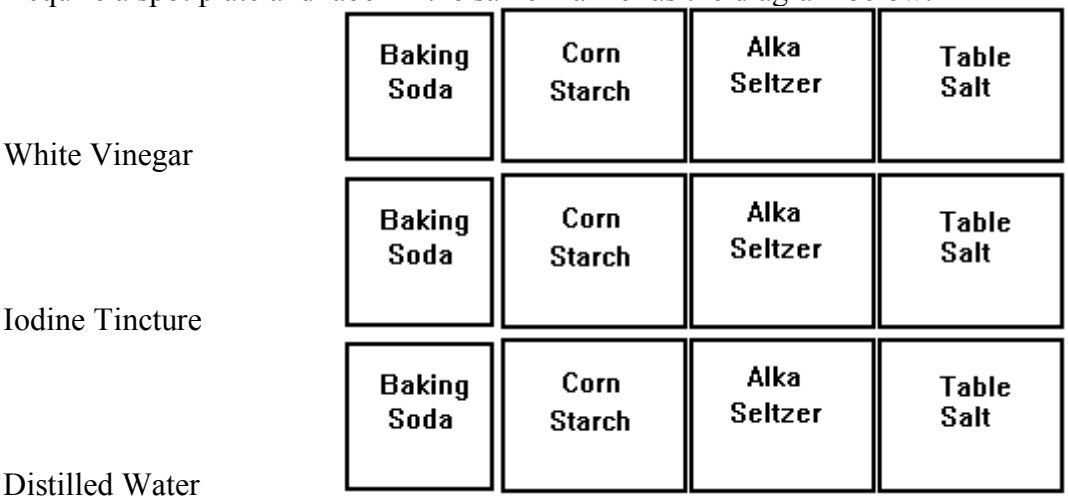
A series of chemical tests will be performed that will help you discover how each of these powders react with each of the liquid reagents. It will be necessary for you to be very observant when you perform each of these tests. Make sure you record both positive results and negative results. Make note of occurrences such as the production of bubbles, a color change or no change at all. All observations you make are important. Your unknown sample is a mixture containing two of the above powders.

Collect the following equipment:

A) Spot plate
B) Disposable Pipets
C) chemicals (powders & liquids)
D) 3 small test tubes

PART A Observation and Identification of known samples

Acquire a spot plate and label in the same manner as the diagram below:



Next record the composition and color of the four powders and of the three liquids reagents on the diagram above. The information can be found on the commercial packages. Using a spatula, place a small amount of each powder in each compartment following the diagram above. If the powders are not already crushed, grind the chunks into powder using the mortar and pestle provided.

If the reagents are not already in dropper bottles then in three clean labeled test tubes, place about 2 mL of white vinegar into test tube #1, pour about 2 mL of iodine tincture into test tube #2, and in test tube #3 pour about 2 mL of distilled water. Do not contaminate or mix these reagent liquids. Place into each of these test tubes a disposable pipette. Throughout the experiment make sure that the same pipette is always used for the same reagent.

Now you are ready to start making observations on TABLE B. Briefly describe each powder prior to adding any liquid. Add a few drops of white vinegar to the first powder, baking soda. What happens? Next add white vinegar to the next powder, corn starch. What did you observe? Continue adding drops of reagent liquid to each of the 12 powder samples as indicated in the above diagram. Record all of you observations in the following table. Summarize how you would chemically distinguish each powder.

PART B Analysis of unknown samples: Using Scientific Method

Obtain two unknowns from your instructor. Record both of your unknown numbers on TABLE C. Clean & dry the spot plate and re-label it similar to the table below. Again place a small amount of each unknown powder into spot plate. When you are ready, test each powder sample with each of the three liquids. Record your observations in the table below. Remember to watch carefully, be observant. The unknown numbered 1-50 contains one (1) of the four powders, and unknown numbered 51 - 100 contains a mixture composed of two of the powders. Determine the composition of your unknown samples.

Experiment 1 _____

Analysis of Matter using Scientific Method

Data and Report Sheet:

Section 1: Scientific Method using Paper Chromatography

Unknown # _____

Table A: Observations & results of paper chromatography

Brand name of known dyes: _____

1. Which dye component (compound) has particle properties most similar to saltwater? _____
2. Which dye component (compound) has particle properties least like saltwater? _____
3. Water is considered a polar molecule and cellulose is mostly a nonpolar molecule (or the opposite of water). Based on the above statement, which component (compound) is mostly like a polar molecule? _____
4. Inspect your lab partners chromatogram. Compare the results from the different brands. Describe any similarities or differences.

5. Per dye mixture, do you believe the different brands use the same chemical (compounds) to manufacture their dyes?

6. Based on the results of your chromatographic analysis, your unknown is a mixture of which two dye mixtures?

_____ & _____

Section 2: Scientific Method on Household Items

Unknown # _____ and Unknown # _____

TABLE B: INITIAL OBSERVATIONS & EXPERIMNENTAL RESULTS

	Baking Soda	**Starch**	**Table Salt**	**Alka Seltzer**
White Vinegar				
Distilled water				
Iodine of tincture				

TABLE C: RESULTS for the UNKNOWNS

	Vinegar	**Deionized water**	**Iodine of tincture**
UK#			
UK #			

1. Form a hypothesis about each of your unknowns. Record your conclusions and explain how you came to that conclusion using your experimental evidence.

Unknown # _____ contains _____ because _____

Unknown # _____ contains _____&_____ because _____