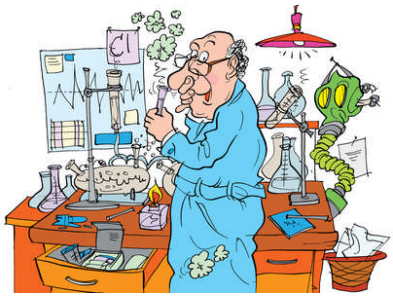
Physical and Chemical Properties



Background

Chemistry is the study of matter and its changes in composition. So, it is very important to recognize both the physical and chemical properties of matter. **Physical properties** are those characteristics that can be observed without chemically changing the substance. Weight, volume, color, texture, temperature, buoyancy, solubility and density are all physical properties and can be measured or observed **without** creating a new substance.

Also, matter is divided into two main categories: **mixtures** and **pure substances**. Mixtures are physical combinations of matter and are grouped as either homogeneous or heterogeneous. Using simple ordinary methods, such as filtration or distillation, you can easily separate mixtures. Pure substances are combinations of matter that are chemically combined and are grouped as either elements or compounds. Pure substances can only be separated by chemical reactions. Therefore, it is necessary to distinguish between physical and chemical properties.

Chemical reactions are the processes by which matter changes. The changes that are observable are called macro changes. Often these changes, such as color changes, the formation of a solid (precipitate), or the formation of gas bubbles, are visible. So, even though we cannot see the atoms and molecules reacting, we can see indications that a chemical change has taken place. This lab activity will focus on identifying the physical properties of several different substances.

Check up

Describe the following:

mixture –

physical property –

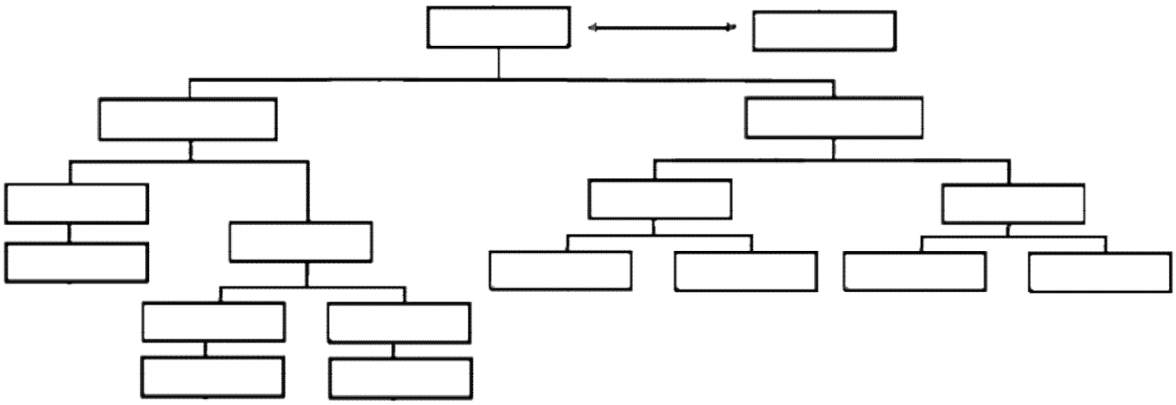
physical change –

pure substance –

chemical property –

chemical change –

Fill in the matter flow chart below.



Pre-Lab

Purpose

The objective of this activity is to observe and recognize physical properties, while practicing lab techniques.

Materials

sulfur (S)	magnesium ribbon (Mg)	sodium hydrogen carbonate ($NaHCO_3$)
sand (SiO_2)	sucrose ($C_{12}H_{22}O_{11}$)	sodium chloride (NaCl)
iron filings (Fe)	distilled water (H_2O)	hydrochloric acid (HCL)
filter paper		

Tools

goggles	test tubes (7)	test-tube rack	100 mL beakers (2)
funnel	scoopula	glass stirring rod	evaporating dish
magnet	wire gauze	crucible tongs	ring stand and ring

Procedure

Part One (Record your observations in Data Table 1)

CAUTION: Do not taste or touch the substances (exception: magnesium) with your hands.

1. Using the pre-labeled pieces of paper provided, retrieve small samples of each of the following samples from the front of the classroom.

sulfur (S) magnesium ribbon (Mg) sodium hydrogen carbonate ($NaHCO_3$)
sand (SiO_2) sucrose ($C_{12}H_{22}O_{11}$) sodium chloride (NaCl)
iron filings (Fe)

For the magnesium, place two pieces of magnesium ribbon on the paper.

2. Examine each substance on the piece of paper. Record your observations in Table 1.

3. Test the effect of a magnet on each substance by passing the magnet under the sheet of paper.

4. Using a clean scoopula, transfer half of each sample from the papers into each of the seven test tubes.

DO NOT USE THE ENTIRE SAMPLE. Be careful not to cross contaminate the substances.

5. Test the solubility of each substance by mixing a small amount of each sample with 3mL of distilled water in the test tubes. With your fingers, "Flick" each test tube to mix the contents.

6. Return the strip of magnesium ribbon in the test tube to its paper.

Instructor initials _____

Part Two (Record your observations in Data Table 1)

1. Mix the iron filings and sulfur on a clean piece of paper. Examine the mixture. Test the effect of a magnet by passing the magnet under the paper. Place this mixture in the garbage can when you are finished.

2. Mix the sodium chloride and sand on a clean piece of paper. Examine the mixture, and test the effect of a magnet.

3. Transfer the salt-sand mixture to a clean 100-mL beaker. Add 30mL of tap water and stir. Record your observations.

4. Prepare a filtration setup. Filter the mixture and record your observations.

5. Pour 10 mL of the filtrate into a clean 50mL beaker. Prepare a setup to heat the liquid in the beaker. Heat the beaker, until the water has completely evaporated. Examine both the dry residue in the beaker and the wet residue on the filter paper.

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Data Table 1 **S**-soluble, **SS**-slightly soluble, **I**-insoluble

Substance and Formula	Physical State	Color	Odor	Solubility in Water	Magnetic
Sulfur, S					
Iron filings, Fe					
Sodium Hydrogen Carbonate, $NaHCO_3$					
Sodium Chloride, NaCl					
Sucrose, $C_{12}H_{22}O_{11}$					
Sand, SiO_2					
Magnesium, Mg					

Part Three (Record your observations in Data Table 2)

CAUTION: Do not look directly at burning magnesium, use your peripheral vision.

6. Position a watch glass near the gas burner. Using crucible tongs, grasp one end of a strip of magnesium ribbon and hold it in the burner flame until the magnesium ignites. Quickly position the burning magnesium so that the combustion products fall on the watch glass. Compare the appearance of this product with that of the original magnesium ribbon.

DO NOT DISCARD THE COMBUSTION PRODUCT.

7. Place the unburned strip of magnesium ribbon and the combustion product from the watch glass into separate test tubes. CAUTION: Hydrochloric acid is corrosive. Add 10 drops of 6M hydrochloric acid to each tube. Feel the bottom of each test tube. Record your observations.

CAUTION: When heating a test tube, never point the mouth of it at yourself or anyone else.

8. Put your sucrose sample into a test tube. Heat the tube gently in a burner flame and watch carefully for changes. Periodically remove the tube from the flame and check for odors by fanning the fumes toward your nose, as shown in Figure 3. Now heat the residue in the test tube more vigorously for 1-2 minutes. Record your observations.

CAUTION: Hot glass looks just like cool glass. Be sure the tube is cool before handling it.

9. Transfer the sodium hydrogen carbonate sample to a test tube. Carefully add 5 drops of 6M hydrochloric acid. Touch the bottom of the test tube with your hand. Record your observations.

CAUTION: Hydrochloric acid is corrosive.

Instructor initials _____

Data Table 2

Experiment	**Observations**
Fe and S mixture tested with magnet	
NaCl and Sand Mixture Mixed with water Filtered Filtrate allowed to evaporate	
Mg Burned in air	
Mg Unburned Mg Reacted with HCl Ash reacted with HCl	
$C_{12}H_{22}O_{11}$ Heated	
$NaHCO_3$ reacted with 6 M HCl	

Disposal

1. Magnesium products – Solid in garbage, liquid in sink.
2. Solubility test materials – down the sink (but save the 1 cm piece of Mg)
3. Iron and Sulfur mixture – in garbage
4. Sand – solid in garbage
5. Filtrate solid – rinse into sink, make sure it is cool or the beaker will crack.
6. Heated sucrose – cool completely and throw test tube in the garbage can.

QUESTIONS

1. How do you decide whether an observed property of matter is a physical or a chemical property?

2. What criteria are used to distinguish between a chemical and a physical change?

3. Tell whether each of the following changes are **chemical** or **physical** and **why** (based off of what you observed in the lab).

   Iron and Sulfur
   Salt and sand
   Mg burned
   Mg (unburned) reacted with HCl
   Mg combustion product (ash) with HCl
   Sugar heated
   Sodium Hydrogen carbonate with HCl

"Let your performance do the talking." --HJB