PHYSICAL AND CHEMICAL CHANGE
EXPERIMENT 1

PURPOSE
To investigate the criteria used to distinguish between physical and chemical changes in matter.

DEFINITIONS
Chemical property, physical property, chemical change, physical change, conservation of mass.

BACKGROUND
Have you ever thought of your eyes as powerful tools for studying chemistry? Many of the properties of matter and the changes it undergoes can easily be determined through careful observation. Physical properties include color, odor, density, solubility, and the state of the matter. Chemical properties describe the changes that take place when new substances are formed during a chemical reaction.

When matter undergoes a change, it is classified as either a physical change or chemical change. During a physical change, only the size, temperature, or physical state of the substance changes. Melting, dissolving, grinding, and evaporating are all physical changes. No new substances are produced during a physical change. However, chemical changes always result in the formation of one or more new substances. The rusting of iron, during which the new substance iron(III) oxide forms from iron (Fe) and oxygen (O₂), is an example of a chemical change.

In this experiment you will observe a variety of materials and describe their physical properties. You will then cause some of the substances to undergo changes. Based upon your observations, you will determine whether the changes are physical changes or chemical changes.

MATERIALS
funnel
magnifying glass
sand
magnet
coarse filter paper
9 pieces paper, 10 cm x 10 cm
sulfur, powdered, S
iron filings, Fe
sodium hydrogen carbonate, NaHCO₃
sodium chloride, NaCl
sucrose, C₁₂H₂₂O₁₁
magnesium ribbon, Mg
2M hydrochloric acid, HCl

SAFETY
• Wear your safety goggles.
• Hydrochloric acid is very corrosive and can cause burns.
• Do not look directly at burning magnesium. The intense light may damage your eyes. Do not inhale the smoke that is produced when magnesium burns.
• Powdered sulfur is irritating to the moist membranes of the eyes, nose, and throat. Avoid getting the dust into the air.
• Do not taste any of the substances or touch them with your hands.
• Hot glass looks just like cool glass. Once a test tube has been heated over an open flame, it may take several minutes for it to cool. Be sure that test tubes are cool before handling them.
• Magnesium is extremely flammable. Keep unused strips away from open flames.
• Return or dispose of all materials according to the instructions of your teacher.
PROCEDURE
NOTE: You must divide the work between lab partners in order to finish.
Part A. The Physical Properties of Matter
Record your observations for Part A in Data Table 1.
1. Label a separate piece of paper for each of the seven substances to be examined. Place two pieces of magnesium on the paper labeled “magnesium.” Using a clean spatula, transfer a pea-sized sample of the other substances to their correctly labeled papers.
2. Examine each substance with a magnifying glass. Record your observations in Data Table 1.
3. Test the effect of a magnet on each substance by passing the magnet under the sheet of paper.
4. In separate small test tubes, test the solubility of each substance by mixing a small amount of each sample with 3 mL of distilled water. “Flick” each test tube to mix the contents.
5. Return the strip of magnesium ribbon in the test tube to its paper. Follow your teacher’s instructions for proper disposal of the other materials.

Part B. Causing a Physical or Chemical Change
Record your observations for Part B in Data Table 2.
6. Mix the iron filings and sulfur on a clean piece of paper. Examine the mixture with a magnifying glass. Test the effect of a magnet by passing the magnet under the paper. Give this mixture to your teacher for use in Part C.
7. Mix the sodium chloride and sand on a clean piece of paper. Transfer the salt-sand mixture to a clean 100-mL beaker. Add 30 mL of tap water and stir. Record your observations. Prepare a filtration setup as shown in Figure 1. Filter the mixture and record your observations. Pour approximately 2 mL of the filtrate into an evaporating dish. Heat the liquid in the evaporating dish by placing the evaporating dish on top of a small beaker of boiling water, as demonstrated by your teacher. Heat the dish until the filtrate has completely evaporated. Examine both the dry residue in the evaporating dish and the wet residue on the filter paper.
8. CAUTION: Do not look directly at burning magnesium as doing so could damage your eyes. Position a watch glass near the gas burner. Using crucible tongs, grasp one end of the 5-cm 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.
9. Put half of your sucrose sample into a test tube. CAUTION: When heating a test tube, never point the mouth of it at yourself or anyone else. 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 2. Now heat the residue in the test tube more vigorously for 1–2 minutes. CAUTION: Be sure the tube is cool before handling it. Throw the test tube away in the scrap glass container.
10. Transfer the sodium hydrogen carbonate sample to a test tube. Carefully add 5 drops of 2M hydrochloric acid. Touch the bottom of the test tube with your hand. Record your observations.
11. Follow your teacher’s instructions for proper disposal of the materials.
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Part C. Conservation of Mass (Teacher Demonstration)

Record your observations for Part C in Data Table 2.

12. Several samples of the iron-sulfur mixture from Part B will be combined in a clean, dry test tube. The mass of the test tube and its contents will be determined and recorded. The test tube is heated gently, then vigorously, for several minutes. CAUTION: This heating must be done in a fume hood. After heating is complete, the mass is remeasured and recorded. Examine the reaction product. The effect of a magnet on the reaction product will be tested.

ANALYSIS

1. State the most important safety concern in this lab and the required precaution you took.
2. The following is a list of changes you observed in Parts B and C. Indicate whether each change was a physical change or a chemical change and give reasons for your answer.
   a. Mixing iron and sulfur. (Part B, Step 6)
   b. Mixing salt, sand, and water. (Part B, Step 7)
   c. Burning magnesium. (Part B, Step 8)
   d. Heating sucrose. (Part B, Step 9)
   e. Mixing sodium hydrogen carbonate and hydrochloric acid. (Part B, Step 10)
   f. Heating iron and sulfur. (Part C, Step 12)
3. Was mass conserved in the reaction of iron and sulfur? Explain.
4. Except for the reaction between iron and sulfur, none of the reactions in this experiment can be used to demonstrate the law of conservation of mass. Explain why.
5. What criteria are used to distinguish between a chemical change and a physical change?
6. State in your own words the law of conservation of mass.
7. Honors: What was the most probable source of error that would lead to incorrect observations?
## PHYSICAL AND CHEMICAL CHANGE
### EXPERIMENT 1

### OBSERVATIONS

#### DATA TABLE 1: PHYSICAL PROPERTIES OF MATTER

<table>
<thead>
<tr>
<th>Substance &amp; Formula</th>
<th>Physical State</th>
<th>Color</th>
<th>Odor</th>
<th>Solubility in Water</th>
<th>Effect of Magnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur, S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron filings, Fe</td>
<td></td>
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<tr>
<td>Sodium hydrogen carbonate, NaHCO₃</td>
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<tr>
<td>Sodium chloride, NaCl</td>
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<tr>
<td>Sucrose, C₁₂H₂₂O₁₁</td>
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<tr>
<td>Sand, SiO₂</td>
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<tr>
<td>Magnesium, Mg</td>
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</tbody>
</table>

#### DATA TABLE 2: OBSERVATIONS OF PHYSICAL & CHEMICAL CHANGES

<table>
<thead>
<tr>
<th>System</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe and S mixture</td>
<td>--tested with magnet</td>
</tr>
<tr>
<td>NaCl and sand mixture</td>
<td>--mixed with water --filtered --filtrate allowed to evaporate</td>
</tr>
<tr>
<td>Mg</td>
<td>--burned in air</td>
</tr>
<tr>
<td>Sugar</td>
<td>--heated</td>
</tr>
<tr>
<td>NaHCO₃</td>
<td>-- reacted with HCl</td>
</tr>
<tr>
<td>Fe and S mixture before heating</td>
<td>• initial mass (g) before heating</td>
</tr>
<tr>
<td>Fe and S after heating</td>
<td>• final mass (g) after heating</td>
</tr>
</tbody>
</table>
TEACHER INFORMATION

1. Must have everyone’s safety contract
2. Investigate physical and chemical properties
   a. Physical properties: observed without changing composition (color, boiling point)
   b. Chemical properties: observed when substance undergoes change (wood burns; sliced apple turns brown, iron rusts)
3. Safety: READ THE PRECAUTIONS
   a. Wear goggles.
   b. Care with HCl. Don’t bring the HCl to your bench, bring your test tube to the HCl.
   c. Don’t look directly at burning Mg. We will not use film viewer.
   d. Don’t agitate S powder when handling.
   e. Demo heating of fluid in test tube.
   f. Wash hands when done.
4. Other notes
   a. Show location and filling of water bottles.
   b. Cut 2 sheets of paper into 6 squares each.
   c. Use only pea-sized samples---no more.
   d. Test with magnet under papers.
   e. Record data in tables.
   f. Demonstrate “flicking” test tube.
   g. Demonstrate heating evaporating dish on a beaker of boiling water.
   h. Demonstrate folding filter paper.
   i. Show how to smell odor from test tube.
   j. Have collection beaker for Fe + S mixture and a separate one for all other solids.
   k. Don’t throw solids in the sink.
   l. Clean-up when finished. Liquids down drain; no solids in the sink.
   m. I will do Part C. Show operation of balance.
   n. Return magnets, funnels, and magnifying glasses to back bench.