



## Core Lab: Properties of Ionic and Molecular Compounds

### Unit 3: Chemical Reactions

#### Teacher Notes:

- The main purpose of this lab is for the students to determine the differences between ionic and molecular compounds.
- The key is to select compounds that will be a representative sample, to illustrate the desired properties (Some compounds are listed but many may be substituted). To help define operationally, students should be able to complete the following table\*.

#### Generalizations:

Classification of substances	phase at room temp	solubility in water	color of solution (if applicable)	conductivity of solution
<i>ionic</i>	<i>solid</i>	<i>yes, to varying degrees</i>	<i>colored or colorless</i>	<i>yes, to varying degrees</i>
<i>molecular</i>	<i>solid, liquid or gas</i>	<i>yes or no</i>	<i>colorless</i>	<i>no</i>

\* sample responses are in italics.

- When attempting to dissolve solids in water be sure to use a small amount of solid. If a large amount is used, often times some of it will dissolve but the student will interpret the result as if it wasn't soluble, because they still see the solid in the water.
- It may be practical to set this activity up in stations (each having one or two substances) and get the students to rotate from station to station
- If student use of the conductivity apparatus is not feasible at each station, the teacher may go around and test each station as the activity proceeds and share the results with the class.
- At the conclusion of the lab it should be pointed out that acids do not have the physical characteristics of either ionic or molecular compounds. Acids may be solid, liquid, or gas; dissolve in water to varying degrees; form colorless solutions; and form conducting solutions (to varying degrees).

Compounds can often be categorized based on the properties they possess. In this activity you will be given a number of compounds which you will first categorize as ionic or molecular based on their chemical formula. You will then determine a number of properties of these compounds and on that basis make generalizations for distinguishing between ionic and molecular substances.

**Problem:** Given a number of compounds, make observations and carry out tests to distinguish between ionic and molecular compounds

**Materials:** Samples of the following compounds in labeled covered containers (these are only suggestions):

ammonium chloride	ethanol	methanol	potassium chloride
n-pentane	zinc sulfate	copper(II) sulfate	potassium chromate
sucrose	potassium iodide	mineral oil	sodium phosphate
propane	sodium hydroxide	sodium chloride	potassium permanganate

**Procedure:**

1. Add 25 mL of deionized water to a 50 mL beaker
2. Add a **small** quantity (size of a pea) of the substance to the water (if it is a gas simply allow some to bubble through the water)
3. Use a stirring rod to stir the water and substance added
4. Record in the data table the following:
  - (i) phase at room temperature
  - (ii) whether or not you believe the substance dissolved in water (soluble)
  - (iii) color of solution (if substance was soluble). Note: clear is not a color (all solutions are clear), use the term colorless if there is no color
  - (iv) conductivity of solution (if substance was soluble). Note: You should compare the conductivity of the solution to that of the deionized water (this is the control)
5. Pour the water off any substance that did not dissolve and add the undissolved substance to the waste beaker provided
6. Pour any solutions down the sink.
7. Rinse the beaker and test the next substance

**Results:**

Table 1

Prelab Exercise			phase at room temp. (s, l, or g)	soluble in water (yes/no)	color of solution	conductivity of solution
Name of substance	formula	ionic or molecular				
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						

Table 2

Generalizations				
Classification of substances	phase at room temp	solubility in water	color of solution	conductivity of solution
ionic				
molecular				

- Questions:**
- Electrical conductivity was used in this activity to test solutions of various compounds. Why should the electrical conductivity of deionized water be tested before testing the conductivity of the solution?
  - Can a substance be classified as ionic or molecular based on its phase at room temperature? Explain.
  - Can a substance be classified as ionic or molecular based on whether it dissolves in water? Explain.
  - Can a substance be classified as ionic or molecular based on the color of its solution (assuming it dissolves in water)? Explain.
  - Can a substance be classified as ionic or molecular on the basis of the electrical conductivity of its solution (assuming it dissolves in water)? Explain.
  - Complete the following table:

Table 3

properties of the pure substance	ionic, molecular, or ?
a solid which dissolves in water to form a colorless, nonconducting solution	
a liquid which dissolves in water to form a colorless solution	
a solid which dissolves in water to form a colorless solution	
a solid which dissolves in water to form a colored solution	
a solid which does not dissolve in water	
a gas at room temperature	
a substance which forms a conducting solution	

