

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

# Identifying Mystery Substances

## Learner Outcomes:

- Investigate and describe properties of materials
- Describe and apply different ways of classifying materials based on their composition and properties, including:
  - o Identifying and applying other methods of classification

## Key Terms:

Matter

Lustre

Crystal shape

Properties

Melting point

Solubility

Physical properties

Boiling point

Density

Chemical properties

Hardness

Conductivity

State

Malleability

Colour

Ductility

**Background Information:** To understand how substances differ, we can observe their properties. Properties are characteristics used to describe a substance. All substances have two types of properties. Physical properties refer to the physical characteristics such as color, luster, malleability, ductility, melting point, boiling point, conductivity, hardness, shape, solubility and density. Chemical properties refer to how a substance behaves when combined with other substances. In this investigation, we will use a variety of physical and chemical properties to identify matter.

## Research Question:

How can the properties of a mystery substance be used to identify it?

This investigation / activity has been adapted from:

Mah K, Martha J, McClelland L, et al. *Science in Action 9*. Toronto, ON: Addison Wesley.

**Materials:**

Spot plate	Sugar	Iodine solution
Magnifying lens	Sodium nitrate	Black paper
Salt	Sodium thiosulfate	Toothpicks
Baking soda	Water	Conductivity tester
Corn starch	Acetic acid (5%)	

**Procedure:**

1. Observe the state, appearance and crystal shape of each substance by placing a small amount of each powder on a sheet of black paper and examining the crystals using a hand lens. Record your observations.
2. Place a small amount of each substance in a well on a spot plate and add a few drops of water to each. Stir gently using a toothpick. Record how the substance behaves in water (i.e. sinks, floats, dissolves, etc).
3. Place a small amount of each substance in a well on a spot plate and add a few drops of acid to each. Stir gently using a toothpick. Record how the substance behaves in acid (i.e. sinks, floats, dissolves, bubbles, etc).
4. Place a small amount of each substance in a well on a spot plate and add a few drops of iodine to each. Stir gently using a toothpick. Record how the substance behaves in iodine.
5. Your teacher will mix a small amount of each substance with 50 mL of water and test with a conductivity tester. Record whether the substance conducts electricity when dissolved in water.
6. Obtain an unknown sample from your teacher and repeat steps 1-5. Record your observations and try to identify the sample.

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**Observations:**

<b>Substance</b>	<b>State</b>	<b>Appearance</b>	<b>Crystal Shape</b>	<b>Behaviour in Water</b>	<b>Conductivity in water</b>	<b>Behaviour in Acid</b>	<b>Behaviour in Iodine</b>
<b>Salt</b>							
<b>Baking soda</b>							
<b>Corn starch</b>							
<b>Sugar</b>							
<b>Sodium nitrate</b>							
<b>Sodium thiosulfate</b>							
<b>unknown</b>							

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### Analysis:

1. For each substance, one or two tests clearly identified it as being unique from the others. What were those tests for each of the white powders?
2. Which of the tests / observations you made investigated physical properties, and which investigated chemical properties of each substance?
3. Which substances seemed to be similar in their characteristics or behavior? Suggest at least two or more groupings you would use to classify all of the substances and describe the basis for classification.
4. What substance(s) were in your unknown sample? What data did you use to make this conclusion?

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**Conclusion:**

**Extension:**

1. Identify the conditions under which the physical properties of a pure substance are changed and using two specific examples, describe the changes you would expect to see.

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