2 Investigating Elements

LABORATORY

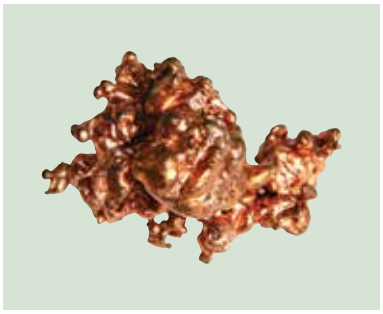
CHEMICALS ARE THE substances that make up all living and nonliving things (together known as **matter**). **Elements** are the simplest pure substances. They cannot be broken down into simpler substances. Elements are the building blocks for all other types of matter. Elements are made of a single type of atom. **Atoms** are the basic building blocks of matter. A sample of aluminum is made up of many aluminum atoms.

Scientists have assigned a chemical symbol to each element. Sometimes the symbol is one uppercase letter. For example, the symbol for carbon is C. Sometimes the symbol is one uppercase letter and one lowercase letter. For example, cobalt is Co. Sometimes the symbol is based on an element's Latin name. Copper's symbol is Cu—from cuprum, the Latin name for copper. The symbol CU would never be used for an element, because an element symbol can contain only one uppercase letter.

In this activity, you will investigate the physical properties of several elements: aluminum (Al), carbon (C), copper (Cu), germanium (Ge), iron (Fe), mercury (Hg), nitrogen (N), and sulfur (S). A **physical property** is one that you can identify without knowing if the material reacts with another substance.

Carbon (C)

Cobalt (Co)



Copper (Cu)

GUIDING QUESTION

How can scientists use physical properties to identify elements?

MATERIALS

For each group of four students

- 1 set of 4 elements: aluminum, carbon, copper, and iron
- 1 9-ounce plastic cup
- 1 stir stick
- water
- paper towels

For each student

- 1 Student Sheet 2.1, "Physical Properties of Elements"
- 1 pair of chemical splash goggles

SAFETY

Follow all safety rules. Pay close attention as your teacher demonstrates where to find and how to use classroom safety equipment. Wear safety eyewear. If a material does not bend easily, do not use more force because you could break or tear it. Watch out for sharp edges. Wash your hands after you complete the activity.

PROCEDURE

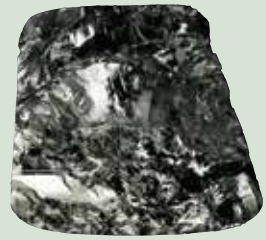
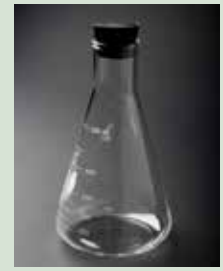
1. With your group, carefully observe the four element samples provided. Do not damage the element samples; other classes will use them too.
2. Use the information in the following "Testing Physical Properties" table to guide you as you investigate the physical properties of each element sample. Record your observations of the elements in the data table on Student Sheet 2.1, "Physical Properties of Elements."

Testing Physical Properties

PHYSICAL PROPERTIES	PROCEDURE	INTERPRETING TEST RESULTS
State at room temperature—whether the element is solid, liquid, or gas.	1. Observe the sample of the element. 2. Record its state.	Describe your observations in detail.
Appearance	1. Observe the sample of the element. 2. Record its color and whether it is shiny or dull.	Describe your observations in detail.
Malleability—whether the element is flexible and can be hammered or bent without breaking	1. Try to bend the element gently. 2. Record how easily it bends.	If it does not bend, it is *not malleable*. If it bends slightly, it is *somewhat malleable*. If it bends easily, it is *very malleable*.
Solubility in water—whether the element **dissolves** (mixes evenly to form a clear mixture) in water	1. Fill the plastic cup half full of water and place the material in the cup. 2. Leave the material in the water for at least 1 minute (min). Check to see if the material mixes with the water. 3. Once you have recorded your results, remove and dry the material.	If none of the material dissolves, it is *not soluble*. If some of the material dissolves, it is *somewhat soluble*. If all the material dissolves, it is *very soluble*.
Density—how compact the matter is in the element	1. Fill the plastic cup half full of water, and place the material in the cup. 2. Check to see if the material sinks or floats. With your stir stick, push underwater any material that floats, and see if it returns to the surface. 3. As soon as you have recorded your results, remove and dry the material.	If it floats, it is *less dense* than water. If it sinks, it is *more dense* than water.

3. Examine the photos and information about four more elements in the "Properties of Four Elements" table that follows.

Properties of Four Elements

SULFUR (S)	MERCURY (Hg)	GERMANIUM (Ge)	NITROGEN (N)
			
Sulfur is a brittle solid. It floats in water and does not dissolve. Many compounds with sulfur have an unpleasant smell.	Mercury is a liquid. It sinks in water and does not dissolve.	Germanium is a brittle solid. It sinks in water and does not dissolve.	Nitrogen is a gas. If mixed with water, it forms bubbles that rise to the surface. It does not dissolve.

4. Add what you have learned about these four elements to the data table on Student Sheet 2.1.

ANALYSIS

1. Why do you think it is important for scientists to observe multiple physical properties in order to identify an element? Use examples from the data you collected in this activity to support your ideas.
2. Copy the following list of words:

element	gas	metal
iron	solid	property
carbon	liquid	malleable
water	metal	soluble
nitrogen	state	dense

   a. Look for a relationship between the words in each list. Cross out the word that does not belong.
   b. Circle the word or phrase that includes all the other words.
   c. Explain how the word or phrase you circled is related to the other words in the list.
3. Based on the eight elements you have observed so far, and assuming that the rest of the elements fit the same pattern, would you expect most elements to be solid, liquid, or gas at room temperature? Explain.
4. When added to water at room temperature, most gases form bubbles that float to the top of the water and release into the air. What does this tell you about the density of gases?
5. **Revisit the issue:** Describe what you have learned about the physical properties of aluminum in this activity and the "Exploring Materials" activity. What information, if any, from these activities would be helpful in deciding if aluminum would be a good choice for making a drink container?
6. In this activity, you recorded the appearance of each element you observed. Think of and explain two examples from this activity in which appearance does not help identify an element.