Matter, Elements, Molecules, and Compounds

By Cindy Grigg

Directions: Read and highlight important information.

1. What is matter? Matter is the stuff that makes up everything in the universe. Matter has mass and takes up space. Matter is made of atoms. Solids, liquids, gases, and plasma are all matter. When all atoms that make up a substance are the same, then that substance is an element. Elements are made of only one kind of atom. Because of this, elements are called "pure" substances. An atom is the smallest piece of an element that still has the properties of that element. For example, aluminum is a lightweight, shiny metal. If we took a piece of aluminum and cut it into small pieces, it would still be aluminum. It would still be a lightweight, shiny metal. The smallest piece would be called an atom. Atoms are so small they cannot be seen even with a microscope. Atoms consist of a nucleus that has protons and neutrons surrounded by electrons outside the nucleus.

2. Atoms of different elements can combine to make new substances. A molecule is formed when two or more atoms join together chemically. If atoms combine that are of two or more different elements, we call that a compound. All compounds are molecules, but not all molecules are compounds. When two hydrogen atoms combine with one oxygen atom, it becomes the compound water. The oxygen we breathe is actually two atoms of oxygen combined, so it is a molecule of oxygen. We use abbreviations for elements, molecules, and compounds. These abbreviations are called chemical symbols. The chemical symbol for an oxygen molecule is \( \text{O}_2 \).

3. The compound water has a chemical symbol of \( \text{H}_2\text{O} \). This is like the "recipe" for water. It tells us that a water molecule is made of two atoms of hydrogen and one atom of oxygen. Oxygen is a gas that we can’t see, hear, smell, taste, or feel. But it’s in the air we breathe, and without it, we would die. Hydrogen, also a gas, is the lightest substance on Earth. When two atoms of hydrogen join together with one atom of oxygen, those two gases make a liquid compound we call water. Water, a liquid at room temperature, is a very different substance from the two gases that it is made of. Many different compounds can be made when different atoms combine.

4. There are about 92 elements that naturally occur on Earth. Different sources will say different numbers of elements occur naturally. Many elements have been made by scientists in a laboratory. With that many elements to form combinations, many millions of different molecules and compounds can be made. How is that possible? Think of our alphabet. The English alphabet has 26 letters. Those 26 letters can be combined in different ways to make millions of words. Atoms are like the letters of the alphabet and the compounds they make are like words.
Now that you have learned the language of chemistry, you are ready to learn more about
elements, atoms, and the ways they combine.

**Directions**: Answer the questions.

1. What is matter?
   - A. The stuff that makes up everything in the universe
   - B. Has mass and takes up space
   - C. Is made of atoms
   - D. All of the above

2. What is an element?
   - A. A pure substance
   - B. Made of only one kind of atom
   - C. Both A and B

3. What is an atom?
   - A. A metal
   - B. A gas
   - C. The smallest piece of an element that still has the properties of that element

4. Atoms consist of ______.
   - A. Gases
   - B. Solids
   - C. Two or more molecules
   - D. A nucleus that has protons and neutrons with electrons outside

5. Abbreviations for elements, molecules, and compounds are called ______.
   - A. Letters
   - B. Abbr.
   - C. Chemical symbols

6. Elements are called "pure" substances. Which synonym of "pure" best fits the original
   meaning of this sentence?
   - A. Unmixed
   - B. Clean
   - C. Uncontaminated
   - D. Complete

7. Hydrogen, also a gas, is the lightest substance on Earth. What is meant by the word
   "lightest"?
   - A. Having the least amount of color
   - B. Having the most luminosity
   - C. Weighing the least amount