Classifying Matter: Elements, Compounds and Mixtures

You and the world around you are made of matter! The smallest unit of matter is an atom. All matter is classified into one of three categories: elements, compounds or mixtures. (A mixture can be further classified as homogeneous or heterogeneous.) These classifications are based on how the atoms in a substance are arranged.

Elements

An element is a substance that is made entirely from one type of atom. They cannot be changed into simpler substances by physical or chemical means. All known elements are arranged on a chart called the Periodic Table of Elements. Examples of elements are Carbon (C), Oxygen (O_2) and Iron (Fe).

Compounds

Most elements take part in chemical changes fairly easily, so few elements are found alone in nature. Instead, most elements are found chemically combined with other elements as compounds. A compound is a pure substance composed of two or more different elements that are chemically combined. Compounds are not random combinations of elements. When a compound forms, the elements join in a specific ratio according to their valence electrons. In order for elements to combine, they must *react,* or undergo a chemical change, with one another. The compound is a new pure substance that has different chemical and physical properties from the elements that reacted to form it. Unlike the elements that make them up, some compounds can be broken down into either their original elements, or simpler compounds through chemical changes only. Most substances you encounter every day are compounds. Below are some common compounds:

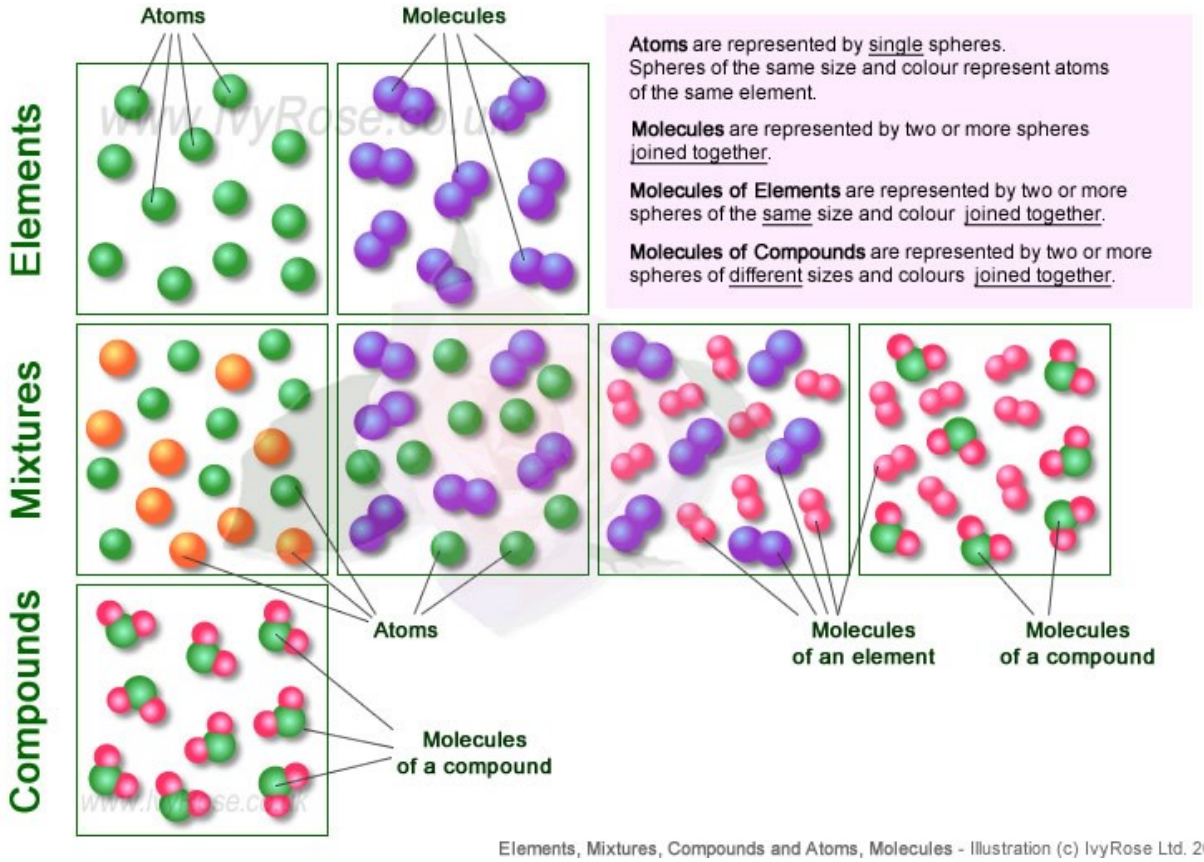
- table salt—sodium and chlorine (NaCl)
- water—hydrogen and oxygen (H_2O)
- sugar—carbon, hydrogen, and oxygen ($C_6H_{12}O_6$)
- carbon dioxide—carbon and oxygen ($CO_{2)}$
- baking soda—sodium, hydrogen, carbon, and oxygen ($NaHCO_3$)

Mixtures

A mixture is a physical combination of two or more substances; they are **NOT** chemically combined. Two or more materials together form a mixture if they do not react to form a compound. Because no chemical change occurs, each substance in a mixture has the same chemical makeup it had before the mixture formed. That is, each substance in a mixture keeps its identity. For example, cheese and tomato sauce do not react when they are used to make a pizza, and each ingredient you add to the pizza contributes to the mixture. Because mixtures are a physical combination of substances, they can be physically separated into their components using different processes such as filtering, sifting and evaporation. Unlike compounds, the components of many mixtures are not combined in a definite ratio.

Different Types of Mixtures: Heterogeneous & Homogeneous (Solutions)

Some mixtures are described as ***heterogeneous*** because you can physically see the different components of the mixture. For example, If you don't like mushrooms on your pizza, you can pick them off. A **solution** is a type of mixture that appears to be a single substance but is composed of particles of two or more substances that are distributed evenly amongst each other. Solutions are often described as ***homogeneous*** mixtures because they have the same appearance and properties throughout the mixture. The process in which particles of substances spread evenly throughout a solution is known as ***dissolving***. Solutions have two components. The **solute** is the substance that is dissolved (smaller quantity), and the **solvent** is the substance in which the solute is dissolved (larger quantity). A solute is *soluble,* or able to dissolve, in the solvent. The amount of solute dissolved in a solvent is ***concentration***. Solutions can be described as being *concentrated (meaning they have a large amount of solute in the solution)* or ***dilute*** *(they have a small amount of solute in the solution).* A solution that contains the maximum amount of solute it can hold at a given temperature is *saturated.* The **solubility** of a solute is the amount of solute needed to make a saturated solution using a given amount of solvent at a certain temperature. You may think of solutions as being liquids, and in fact, tap water, soft drinks, gasoline, and many cleaning supplies are liquid solutions. However, solutions may also be gases, such as air, or solids, such as steel. **Alloys** are solid solutions of metals or nonmetals dissolved in metals. Brass is an alloy of the metal zinc dissolved in copper.

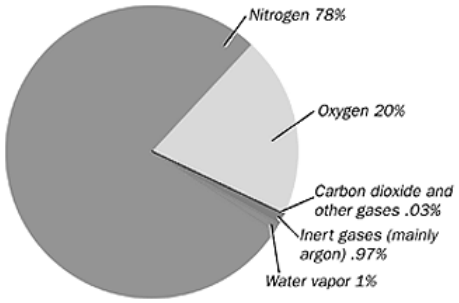


Elements, Mixtures, Compounds and Atoms, Molecules - Illustration (c) IvyRose Ltd. 2011.

What criteria are used to classify matter?

Compare and contrast elements, compounds and mixtures. Use evidence from the text to support your answer.

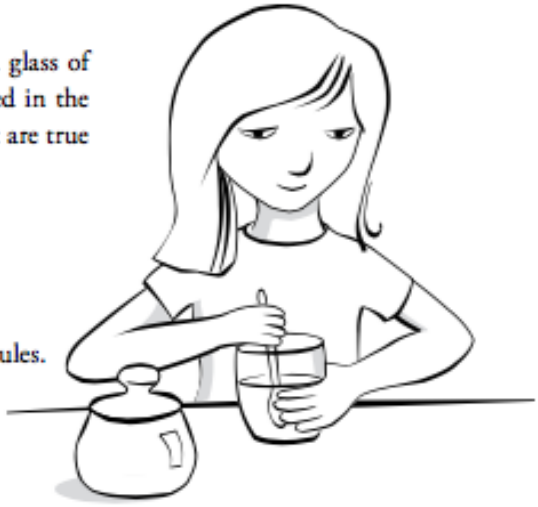
Using the diagram below, classify the air you breathe as an element, compound or mixture. Use evidence from the text to support your answer, be specific and use all appropriate vocabulary



When sweetening her iced tea, Emma stirs sugar is into the glass. She tastes it and decides she would like it to be sweater and adds even more sugar. No matter how long she stirs, she is unable to get all the additional sugar to dissolve. Using evidence from the text, explain why Emma cannot get all the sugar to dissolve in the ice tea. Use scientific vocabulary in your answer.

Additional thoughts:

Sugar Water



Deanna stirred a teaspoon of sugar into a glass of warm water. The sugar completely dissolved in the water. Put an X next to the statements that are true about the dissolved sugar.

____ **A** The sugar melts.

____ **B** The sugar loses mass.

____ **C** The sugar turns into water molecules.

____ **D** The sugar forms a mixture with the water.

____ **E** The sugar can be separated from the water.

____ **F** The sugar disappears and no longer exists.

____ **G** The sugar molecules are spread among the water molecules.

____ **H** The sugar breaks down into the individual atoms that make up sugar.

____ **I** The sugar chemically combines with the water to form a new substance.

Explain your thinking. Describe what happens to sugar when it dissolves in water.