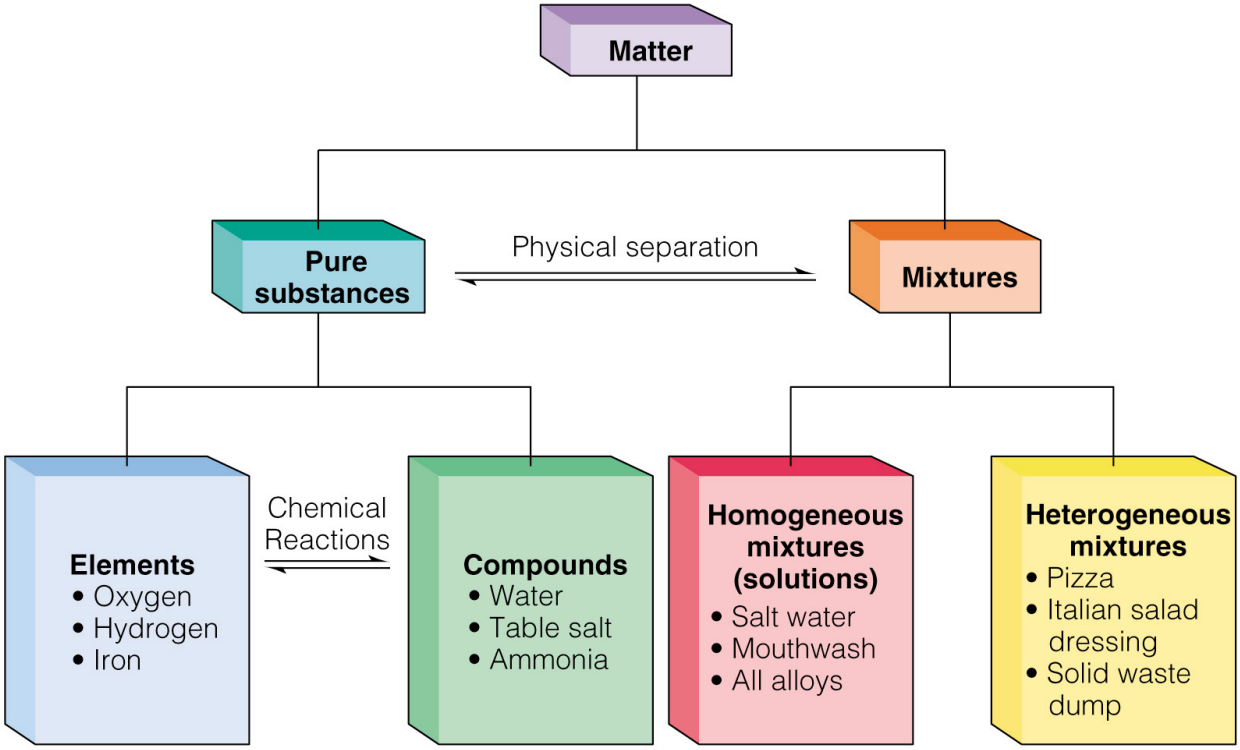
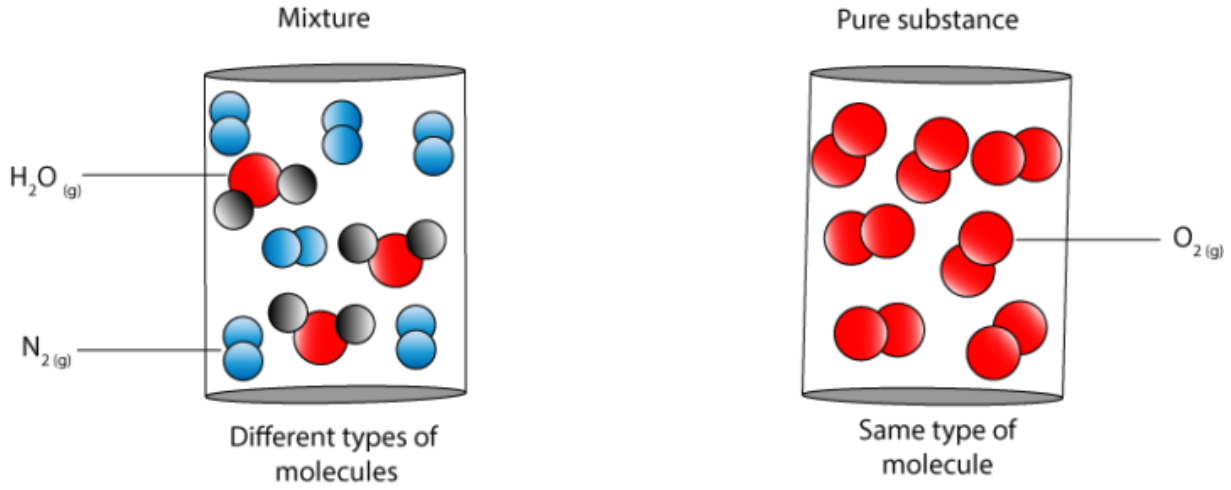
Mixtures

Matter is anything that has mass and volume. Most matter fits into one of two major categories, as illustrated below:

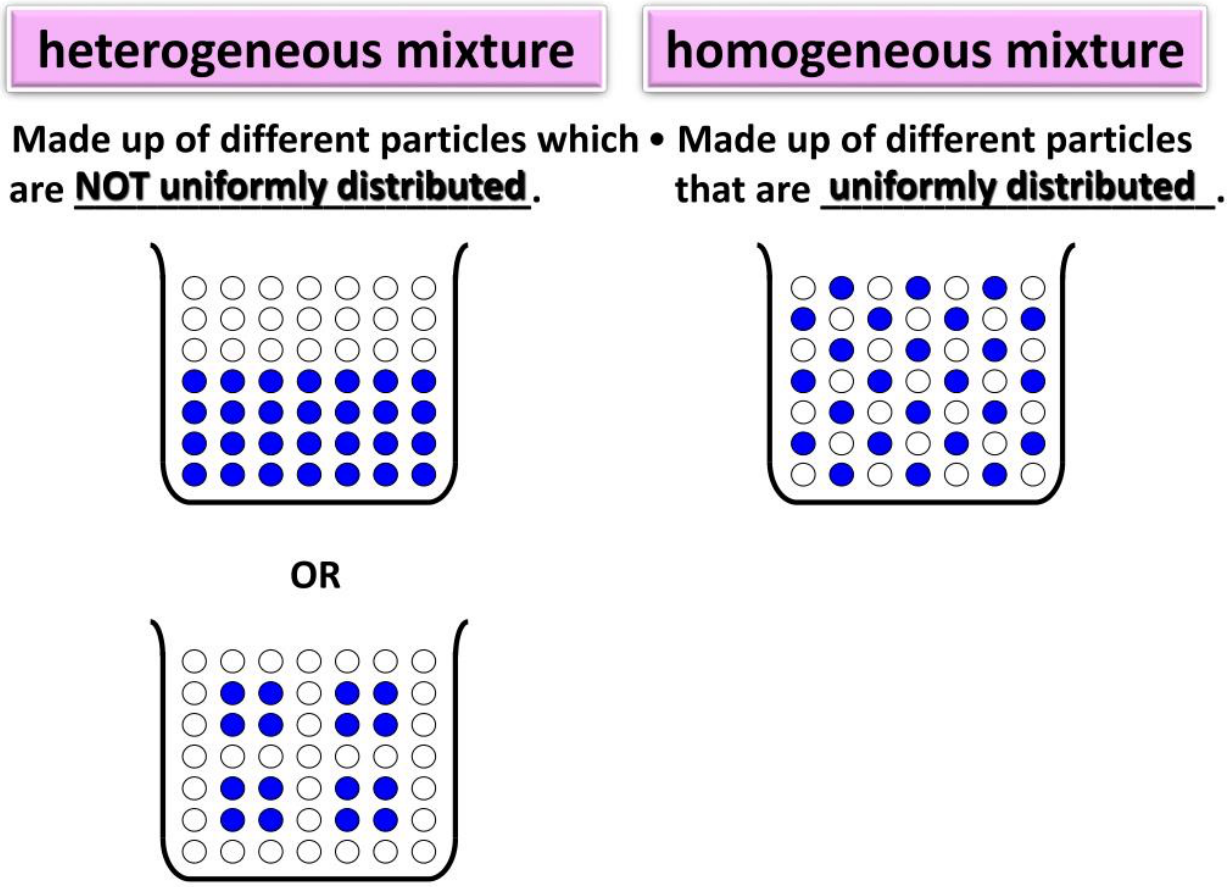


So far, we have focused our attention on pure substances – substances in which every particle is the same. A mixture, on the other hand, contains more than one kind of particle. The image below illustrates the difference.



A **mixture** is a combination of two or more pure substances (elements or compounds) in which each pure substance retains its individual chemical properties. Most of the matter that we encounter on a day-to-day basis occurs as mixtures.

Mixtures are classified as either heterogeneous or homogeneous. The image below illustrates the difference.



In a **heterogeneous mixture**, the substances that make up the mixture are not evenly distributed throughout the mixture. The particles in a heterogeneous mixture are large enough that it is usually possible to visually see the distinct types of particles in the mixture (e.g. raisin bran or vegetable soup).

In a **homogeneous mixture**, the substances that make up the mixture are evenly distributed throughout the mixture. The particles in a homogeneous mixture are smaller, usually the size of individual atoms, so it is usually not possible to visually see the different types of particles (e.g. salt water).

Types of Heterogeneous Mixtures

A **suspension** is a heterogeneous mixture with particles large enough that they will eventually settle to the bottom of the container if allowed to sit. Sand in water is an example of a suspension. If you stir the sand and water mixture, the sand will float (or be suspended) in the water. If you stop stirring and allow it to sit, eventually the sand will all settle to the bottom of the container.

A **colloid** is a heterogeneous mixture with particles large enough to see, but not large enough that they will settle to the bottom of the container. Colloids tend to have a cloudy or milky appearance. Glue, whipped cream, and paint are examples of colloids.

An **emulsion** is a colloid made of two or more liquids. An **emulsifying agent** is usually required to keep the liquids from separating. Mayonnaise is an example of an emulsion. It consists of tiny oil droplets suspended in lemon juice and egg. The egg yolk acts as an emulsifying agent to keep the oil and lemon juice from separating. Other examples of emulsions include peanut butter, shampoo, liquid soap, and margarine.

Types of Homogeneous Mixtures

Most homogeneous mixtures are known as **solutions**. We will be discussing solutions in more detail in our next lesson.

Separating Mixtures

There are several laboratory methods that can be used to separate a mixture into two (or more) pure substances.

Heterogeneous mixtures composed of liquids and solids can be separated by **filtration**. The mixture is poured through a piece of paper (often shaped into a hollow cone), which lets the liquid part pass through but catches the solid.

Homogeneous mixtures cannot be separated by filtration. Instead, three techniques are commonly used to separate homogeneous mixtures: distillation, crystallization, and chromatography.

Distillation takes advantage of differences in boiling points. In a mixture of two liquids, you heat the mixture until one of the liquids boils (the one with the lower boiling point). The liquid changes into a gas, which you collect in a separate container. Once the gas cools, it changes back into a liquid. The liquid with the lower boiling point is now in the new container, while the liquid with the higher boiling point is in the original container.

Distillation can also be used to separate solid impurities from water and other liquids. As the liquid is boiled, the dissolved solids are left behind.

Crystallization is the process by which solid crystals form from another phase (e.g. a liquid solution). In a typical example, a solution consisting of a solid dissolved in a liquid is allowed to either cool. As it cools, the dissolved solid will form crystals which can then be filtered out of the solution.

Chromatography separates a solution by allowing it to flow along a stationary medium. For example, the pigments in an ink solution can be separated by passing the ink through a piece of paper. Different pigments move through the paper at different rates, resulting in a pattern of colors that shows the separate pigments.

Mixtures Worksheet

1. What is a mixture?

2. What is the difference between a heterogeneous mixture and a homogeneous mixture? Give an example of each.

3. Describe how you would separate a mixture of sand and water. What is this process called?

4. Name three methods of separating homogeneous mixtures.