

A Classification Scheme for Matter

The word "matter" describes everything that has physical existence.

We can successively separate matter into categories by asking a sequence of "yes/no" questions.

I. Matter

Question #1: All matter can be separated into two categories by asking the question "Is only one chemical substance present in the sample being considered?"

YES - Pure Substance

NO - Mixture

A **mixture** is one in which two or more pure substances retain their chemical identity. For example, if you dissolve some sugar into water, the sugar molecules and water molecules remain as sugar and water, it is just that the two are now dispersed in each other.

IIa. Pure Substances

Question #2: All pure substances can be separated into two categories by asking the question "Can the sample be further broken down (decomposed) by chemical means?"

YES - Compound

NO - Element

Atoms are the building blocks of matter.

An **element** is a type of matter made up of only one type of atom.

A **compound** is a substance comprised of atoms of two or more elements chemically linked together in fixed proportions. For

example, water has the formula H_2O . This implies that two atoms of hydrogen are chemically linked with one atom of oxygen.

Ib. Mixtures

Question #3: All mixtures can be separated into two categories based on the question "Is the sample of constant composition?"

YES - Homogeneous mixture

NO - Heterogeneous mixture

Constant composition means that all parts of the mixture are the same. For example, dissolve sugar in water and mix it completely. Now take several samples from random areas. They will be the same, therefore this is a homogeneous mixture. Take some sand and some water and mix it up well. Take some samples and **MAYBE** they are the same. Allow the water to stand undisturbed and then sample it. One portion will be more sand than water and another will be more water than sand. This is heterogeneous.

Generally speaking, heterogeneous mixtures can be separated by allowing them to stand undisturbed. The technical name for a heterogeneous mixture is a **suspension**. The solid pieces which are dispersed in the suspension are sometimes able to be seen with the naked eye and can definitely be seen under a light microscope.

In chemistry, homogeneous mixtures are more often found, so we will pretty much end our heterogeneous mixture discussion at this point.

III. Homogeneous Mixtures

Homogeneous mixtures do not settle out upon standing undisturbed and they cannot be separated by filtering or centrifuging. There are two broad categories of homogeneous mixtures.

Question #4: All homogeneous mixtures can be separated into two categories based on the question "Are the constituents of the sample at a molecular or ionic level?"

YES - Solution

NO - Colloid

Solutions: these are, by far, the most important homogeneous mixture in chemistry. Only in more advanced classes will you start to study the characteristics of colloids.

Solutions are made up of a solute and a solvent. The solvent (usually liquid water) is the component present in greater amount and the solute (usually, but not always, a solid) is the component present in the lesser amount. In solutions, the solute is present either as individual ions or individual molecules. There is no "clumping" into pieces made of many ions or molecules.

The word homogeneous is important: the solute is dispersed in an equal manner throughout the solvent. If you sampled two equal-sized regions of the solution, they would contain identical amounts of solute.

Colloids: this is a state intermediate between solutions and suspensions. The dispersed phase IS NOT at the molecular level nor is it of such a size to be visible under the microscope. Generally speaking, the dispersed colloidal particles are on the order of nanometers (10^{-9} meters), anywhere from about 1 nm to about 100 nm. They are sometimes called colloidal suspensions.

Types of Colloids

		Dispersing Medium		
		Gas	Liquid	Solid
Dispersed Phase	Gas		Foam	Foam
	Liquid	Aerosol	Emulsion	Gel
	Solid	Aerosol	Sol	Solid Sol

Colloids which are transparent are characterized by something called the "**Tyndall Effect**." When the sun sometimes rises or sets with all the brilliant reds and oranges; the colors come about due to the Tyndall Effect. When you see "rays of sunlight," like on a misty day or in the forest, this is caused by the Tyndall Effect. Mist is tiny drops of water suspended in air and, in the forest, dust plays the same role as the mist.

Examples of Colloids

		Dispersing Medium		
		Gas	Liquid	Solid
Dispersed Phase	Gas		shaving cream, whipped cream	foam rubber, sponge, pumice
	Liquid	fogs, clouds, aerosol can spray	mayonnaise, milk, face cream	jelly, cheese, butter
	Solid	smoke, car exhaust, airborne viruses	Gold in water, milk of magnesia, river silt	alloys of metals (steel, brass)