

Chemical changes and reactions, such as combustion and decomposition, form products whose properties differ greatly from those of the reactants. However, chemical changes do not affect the total amount of matter present before and after a reaction. The amount of matter, and therefore the total mass, remains the same.

Energy and Changes in Matter

When physical or chemical changes occur, energy is always involved. The energy can take several different forms, such as heat or light. Sometimes heat provides enough energy to cause a physical change and sometimes heat provides enough energy to cause a chemical change. Although energy can be absorbed or released in a change, it is not destroyed or created. It simply assumes a different form. This is the law of conservation of energy.

Classification of Matter

Matter exists in an enormous variety of forms. Any sample of matter, however, can be classified either as a pure substance or as a mixture. The composition of a pure substance is the same throughout and does not vary from sample to sample, and can be an element or a compound. Mixtures, in contrast, contain more than one substance. They can vary in composition and properties from sample to sample and sometimes from one part of a sample to another part of the same sample. All matter can be classified in terms of uniformity of composition and properties of a given sample.

Mixtures

A **mixture** is a blend of two or more kinds of matter, each of which retains its own identity and properties. The parts, or components, of a mixture are simply mixed together physically and can usually be separated.

Some mixtures are *uniform in composition*; that is, they are said to be **homogeneous**. They have the same proportion of components throughout. *Homogeneous mixtures are also called solutions*. Other mixtures are *not uniform throughout*; that is, they are **heterogeneous**.

Some mixtures can be separated by filtration or vaporized to separate the different components.

Pure Substances

Any sample of a pure substance is homogeneous. A **pure substance** has a fixed composition and differs from a mixture in the following ways:

1. Every sample of a given pure substance has exactly the same characteristic properties. All samples of a pure substance have the same characteristic physical and chemical properties. These properties are so specific that they can be used to identify the substance.
2. Every sample of a given pure substance has exactly the same composition.

Pure substances are either compounds or elements. A compound can be decomposed, or broken down, into two or simpler compounds or elements by a chemical change.

Laboratory Chemicals and Purity

The chemicals in laboratories are generally treated as if they are pure. However, all chemicals have some impurities. The purity ranking of the grades can vary when agencies differ in their standards. However, the primary standard reagent grade is always purer than the technical grade for the same chemical. Chemists need to be aware of the kinds of impurities in reagent because these impurities could affect the results of a reaction.

- ACS (American Chemical Society—specified reagents)
- USP (United States Pharmacopoeia standards)
- CP (chemically pure; purer than technical grade)
- NF (National Formulary specifications)
- FCC (Food Chemical Code specifications)
- Technical (industrial chemicals)