# Properties of Matter

## Properties of Matter

There are two classes of properties:

1. Physical properties
2. Chemical properties

**Physical properties:** matter can exist in three different states.

1. **Solid state** - rigid, possesses a definite shape.
2. **Liquid state** - possesses the property of flowing to take the shape of its container.
3. **Gaseous state** - takes both the shape and volume of its container. Gases are readily compressible and capable of infinite expansion.

*Note: Physical properties can be observed and measured without changing the identity of the substance. Name some examples of physical properties.*

**Chemical properties:** cannot be observed and measured only by changing the identity of the substance.
*Note: Chemical properties describe a substance's ability to undergo chemical change.*
*Examples: Flammability - the ability to burn. This property helps to distinguish substances that burn such as iron and table salt. Name other examples of chemical properties.*

**Properties:** those characteristics and features that distinguish a sample from all other kinds of samples. Thus, the properties are used to identify the sample (matter).
**Substances:** this is any variety of matter or all specimens/samples, which have identical properties and composition.
*Example: pure water. All samples of pure water, regardless of their source, have the same composition, two (2) parts by weight of hydrogen and sixteen (16) parts of oxygen, and are identical in melting point, boiling point, and all other properties.*
*Iron, aluminum, carbon, sugar, oxygen, and carbon dioxide are all representative of samples. How can you distinguish one from the other? By studying their characteristic properties.*

**Mixtures:** composed of two or more substances, each of which maintains its identity and specific properties.
*Example: Gunpowder is a mixture of carbon, sulfur, and potassium nitrate. A solution of salt or sugar and water is a mixture.*

There are two classes of substances:

1. Elements
2. Compounds

**Elements:** pure substances that cannot be decomposed by a chemical change.
*Example: Iron, silver, gold, aluminum, sulfur, oxygen, and carbon (see Periodic Table of Elements).*

**Compounds:** substances that can be decomposed by chemical changes. They are also made up of two or more different elements.
*Example 1: Water can be decomposed by an electric current into hydrogen and oxygen.*
*Example 2: Table salt can be broken down by electric current into sodium and chlorine.*

**Molecules:** the smallest particle of an element or compound that can have a stable and independent existence. Are molecules too small to be seen even with very powerful optical microscopes?
**Atoms:** the smallest particle of an element that can enter into a chemical combination.

1. **Monatomic** - when the molecule of an element contains only one atome (see Periodic Table).
2. **Diatomic** - two atoms or molecules.

1. *Example: hydrogen, oxygen, nitrogen, chlorine, bromine (see Periodic Table).*
   *Note: Atom is from the Greek word "Atomos" which means indivisible.*

## Some Properties of Common Substances

| Substance | Physical Properties | | | Chemical Properties |
|---|---|---|---|---|
| | *Physical state* | *Color* | *Melting point, °C* | |
| Acetic acid (component of vinegar) | Liquid | Colorless | 16.6 | Neutralizes lye |
| Iron | Solid | Gray | 1530 | Reacts with oxygen |
| Mercury | Liquid | Gray | -38.9 | Reacts with oxygen |
| Oxygen | Gas | Colorless | -218.8 | Reacts with hydrogen |
| Sodium chloride (table salt) | Solid | White | 808 | Can be decomposed by electricity |
| Wood | Solid | Brown | Decomposes | Flammable |

Using water as an example, this illustration shows the physical state of matter.

1. Ice Cube 
2. Beaker filled with water 
3. Flask filled with water vapor 

*Examples:*

Which of the following is either a physical or a chemical property?

1. Explosiveness
2. Corrosiveness
3. Toxicity
4. Ability to tarnish
5. Freezing
6. Hardness, shiny iron
7. Liquid at room temperature