

## The periodic table of the elements

During the 19<sup>th</sup> century it became clear that certain chemical elements have similar chemical properties so scientists started putting them into groups according to their similarities. It was known that elements are made up of atoms of specific masses and that atoms of different elements differ in their masses.

In **1869** the Russian chemist **Dmitri Mendeleev** developed a table containing all the chemical elements known at that time. He arranged the elements according to their increasing atomic mass and put elements with the same chemical properties in the same vertical column.

In the **modern periodic table** all the elements are arranged in order of their increasing atomic number. The vertical columns in the periodic table are referred to as **groups** and the horizontal rows are known as **periods**. The elements in groups 1 and 2 and those in groups 13 to 18 are called **main-group elements**. Elements in groups 3 to 12 are known as **transition elements** and the ones belonging to the two additional rows are called **lanthanides** and **actinides**.

All the elements belonging to the same group have the same number of **valence electrons**, that is the same number of electrons in the outer shell. All the elements in the same period have the same number of **electron shells**. For example Carbon, which belongs to group 14 and period 2 has four (14 minus 10) valence electrons and 2 electron shells.

The elements situated in group 18 are known as **noble gases**. They all have eight electrons in the outer shell, a highly stable **octet**.

Besides classification into groups and periods, the periodic table is also subdivided into four blocks of elements: *s*, *p*, *d* and *f*. Elements whose outer electrons fill an *s* orbital form the **s block** (groups 1 and 2). Elements in the **p block** have outer electrons in the *p* orbitals (group 13 to 18). The **d block** contains elements where the last subshell to be filled is *d* (groups 3 to 12) and in the **f block** we find elements whose last electrons fill the *f* orbitals (lanthanides and actinides).

Looking at the periodic table, we can find some periodic trends in the properties of the elements.

**Atomic radius** (*pl.* radii) decreases from left to right across a period and increases from top to bottom across a group.

**Electronegativity**, which is a measure of the ability of atoms to attract electrons in a chemical bond, depends on the dimension of a given atom, on the number of valence electrons and on the nuclear charge. More electronegative elements attract electrons more strongly than the less electronegative ones. Electronegativity increases from left to right across a period and decreases from top to bottom across a group.

**Electron affinity** is a measure of the energy usually released when a neutral atom picks up an electron to form an ion. It increases from left to right across a period and decreases from top to bottom across a group.

**Ionization energy** is the energy required to remove an electron from an atom. It increases from left to right across a period and decreases from top to bottom across a group.

Elements with a low ionization energy are called **metals** and they conduct heat and electricity well. The majority of the elements are metals.

Elements with high ionization energy are named **non-metals** and they are bad conductors of heat and electricity. Only the elements on the far right of the table are non-metals.