1.2: Organization of the Elements - The Periodic Table

The number of protons in the nucleus of an element is called the atomic number of that element. Chemists typically place elements in order of increasing atomic numbers in a special arrangement that is called the periodic table.

The periodic table is not simply a grid of elements arranged numerically. In the periodic table, the elements are arranged in horizontal rows called periods (numbered in blue) and vertically into columns called groups. These groups are numbered by two, somewhat conflicting, schemes. In the simplest presentation, favored by the International Union of Pure and Applied Chemistry (**IUPAC**), the groups are simply numbered 1-18. The convention in much of the world, however, is to number the first two groups 1A and 2A, the last six groups 3A-8A; the middle ten groups are then numbered 1B-8B (but not in that order!). While the IUPAC numbering appears much simpler, in this text we will use the current USA nomenclature (1A-8A). The reason for this choice will become more apparent in Chapter 3 when we discuss "valence" and electron configuration in more detail. The actual layout of the periodic table is based on the grouping of the elements according to chemical properties. For example, elements in each Group of the periodic table (each vertical column) will share many of the same chemical properties. As we discuss the properties of elements and the ways they combine with other elements, the reasons for this particular arrangement of the periodic table will become more obvious.

As you can see, each element in the periodic table is represented by a box containing the chemical symbol, the atomic number (the number of protons in the nucleus) and the atomic mass of the element. Remember that the atomic mass is the weighted average of the masses of all of the natural isotopes of the particular element.

Periodic tables are often colored, or shaded, to distinguish groups of elements that have similar properties or chemical reactivity. The broadest classification is into metals, metalloids (or semi-metals) and nonmetals. The elements in Groups 1A – 8A are called the representative elements and the elements in Groups 3 - 15 are called the transition metals. the metallic elements are shown in purple. Metals are solids (except for mercury), can conduct electricity and are usually malleable (can be rolled into sheets) and are ductile (can be drawn into wires). Metals are usually separated into the main group metals (the elements colored purple in Groups 1A - 5A) and the transition metals (in Groups 3 – 15). Nonmetals (yellow in the Figure) do not conduct electricity (with the exception of carbon in the form of graphite) and have a variety of physical states (some are solids, some liquids and some gasses). Two important subclasses of nonmetals are the halogens (Group 7A) and the inert gasses (or noble gasses; Group 8A). At the border between metals and nonmetals lie the elements boron, silicon, germanium, astatine, antimony and tellurium. These elements share physical properties of metals and nonmetals and are called metalloids, or semi-metals. The common semiconductors silicon and germanium are in this group and it is their unique electrical properties that make transistors and other solid-state devices possible. Later in this book we will see that the position of elements in the periodic table also correlates with their chemical reactivity.