Periodic Table of Elements

By Tim Sharp - LiveScience Reference Editor August 29, 2017

The periodic table of elements arranges all of the known chemical elements in an informative array. Elements are arranged from left to right and top to bottom in order of increasing atomic number. Order generally coincides with increasing atomic mass.

The rows are called periods. The period number of an element signifies the highest energy level an electron in that element occupies (in the unexcited state), according to the Los Alamos National Laboratory. The number of electrons in a period increases as one moves down the periodic table; therefore, as the energy level of the atom increases, the number of energy sub-levels per energy level increases.

Elements that occupy the same column on the periodic table (called a "group") have identical valance electron configurations and consequently behave in a similar fashion chemically. For instance, all the group 18 elements are inert gases. [Related: How Are the Elements Grouped?]

'Father' of the periodic table

Dmitri Mendeleev, a Russian chemist and inventor, is considered the "father" of the periodic table, according to the Royal Society of Chemistry. In the 1860s, Mendeleev was a popular lecturer at a university in St. Petersburg, Russia. Since there were no modern organic chemistry textbooks in Russian at that time, Mendeleev decided to write one, and simultaneously tackle the problem of the disordered elements.

Putting the elements in any kind of order would prove quite difficult. At this time, less than half of the elements were known, and some of these had been given wrong data. It was like working on a really difficult jigsaw puzzle with only half of the pieces and with some of the pieces misshapen.

Mendeleev ultimately wrote the definitive chemistry textbook of his time, titled "Principles of Chemistry" (two volumes, 1868–1870), according to Khan Academy. As he was working on it, he came upon a significant discovery that would contribute greatly to the development of the current periodic table. After writing the properties of the elements on cards, he began ordering them by increasing atomic weight, according to the Royal Society of Chemistry. This is when he noticed certain types of elements regularly appearing. After intensely working on this "puzzle" for three days, Mendeleev said that he had a dream in which all of the elements fell into place as required. When he woke up, he immediately wrote them down on a piece of paper — only in one place did a correction seem necessary, he later said.

Mendeleev arranged the elements according to both atomic weight and valence. Not only did he leave space for elements not yet discovered, but he predicted the properties of five of these elements and their compounds. In 1869, he presented the findings to the Russian Chemical Society. His new periodic system was published in the German chemistry periodical Zeitschrift für Chemie (Journal of Chemistry).

Reading the table

The periodic table contains an enormous amount of important information:

Atomic number: The number of protons in an atom is referred to as the atomic number of that element. The number of protons defines what element it is and also determines the chemical behavior of the element. For example, carbon atoms have six protons, hydrogen atoms have one, and oxygen atoms have eight.

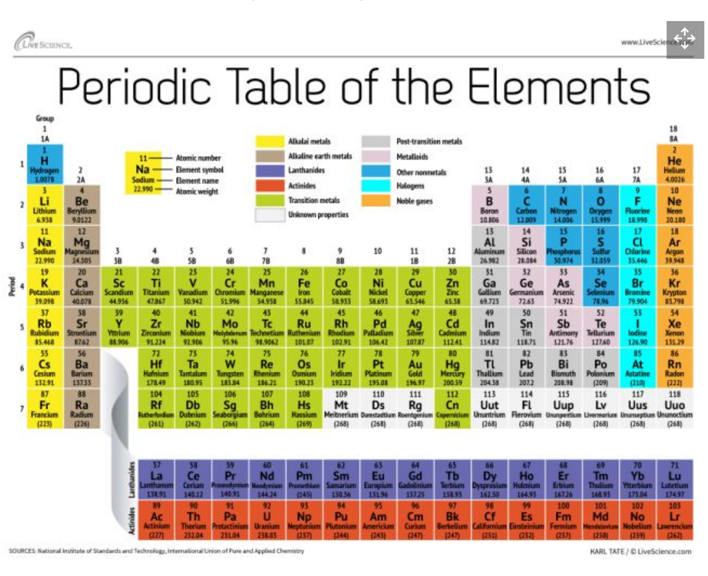
Atomic symbol: The atomic symbol (or element symbol) is an abbreviation chosen to represent an element ("C" for carbon, "H" for hydrogen and "O" for oxygen, etc.). These symbols are used internationally and are sometimes unexpected. For example, the symbol for tungsten is "W" because another name for that element is wolfram. Also, the atomic symbol for gold if "Au" because the word for gold in Latin is *aurum*.

Atomic weight: The standard atomic weight of an element is the average mass of the element in atomic mass units (amu). Individual atoms always have an integer number of atomic mass units; however, the atomic mass on the periodic table is stated as a decimal number because it is an average of the various isotopes of an element. The average number of neutrons for an element can be found by subtracting the number of protons (atomic number) from the atomic mass.

Atomic weight for elements 93-118: For naturally occurring elements, the atomic weight is calculated from averaging the weights of the natural abundances of the isotopes of that element. However, for lab-created trans-uranium elements — elements with atomic numbers higher than 92 — there is no "natural" abundance. The convention is to list the atomic weight of the longest-lived isotope in the periodic table. These atomic weights should be considered provisional since a new isotope with a longer half-life could be produced in the future.

Within this category are the superheavy elements, or those with atomic numbers above 104. The larger the atom's nucleus — which increases with the number of protons inside — the more unstable that element is, generally. As such, these outsized elements are fleeting, lasting mere milliseconds before decaying into lighter elements, according to the International Union of Pure and Applied Chemistry (IUPAC). For instance, superheavy elements 113, 115, 117 and 118 were verified by the IUPAC in December 2015, completing the seventh row, or period, on the table. Several different labs produced the superheavy elements. The atomic numbers, temporary names and official names are:

- 113: ununtrium (Uut), nihonium (Nh)
- 115: ununpentium (Uup), moscovium (Mc)
- 117: ununseptium (Uus), tennessine (Ts)
- 118: ununoctium (Uuo), oganesson (Og)



The classic Periodic Table organizes the chemical elements according to the number of protons that each has in its atomic nucleus. (Image credit: Karl Tate, Livescience.com contributor)

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