## Classifying Elements

### Element Symbols

History of Chemical Symbols - http://www.vanderkrogt.net/elements/chemical_symbols.html

New elements continue to be discovered. Finding a pattern in an unknown helps scientists to organize ideas and information. It also helps scientists to interpret what the information means and explain these ideas, based on what they have learned.

Early chemists used symbols of the sun and the planets to identify the elements known to them. This later was a problem, when more elements were discovered, because they ran out of planets.

| Metal | gold | silver | iron | mercury | tin | copper | lead |
|---|---|---|---|---|---|---|---|
| Symbol | ☉ | ☾ | ♂ | ☿ | | ♀ | |
| Celestial Body | Sun | Moon | Mars | Mercury | Jupiter | Venus | Saturn |

**John Dalton** developed a new set of symbols in the early 1800's to improve communication between chemists.

| Symbol | ⊙ | ○ | ● | G | S | |
|---|---|---|---|---|---|---|
| Element | hydrogen | oxygen | carbon | gold | silver | mercury |

*Daltons 1808AD symbols and formulae.*

| | | |
|---|---|---|
| Hydrogen | Soda | Ammonia |
| Nitrogen | Pot Ash | Olefiant |
| Carbon | Oxygen | Carbonic Oxide |
| Sulphur | Copper | Carbonic Acid |
| Phosphorus | Lead | Sulphuric Acid |
| Alumina | Water | |

http://www.chemsoc.org/exemplarchem/entries/2001/robson/symbolspart1.htm

**Berzelius** later revised **Dalton's** symbols by replacing them with *letters*, instead of pictures. He represented the elements by their first letter (capitalized) or their first two letters (first one capitalized and the second letter lower case).

Elements were listed in order of their atomic mass. **Atomic mass** is the mass of one atom of an element. It is represented in ***atomic mass units*** (**amu**).

John Newland's "***law of octaves***" identified the pattern in which the properties of the elements seemed to repeat at regular intervals, similar to the octave scale in music.

Demitri Mendeleev later revised the pattern in 1869, when he organized the elements into the first periodic table.

## The Periodic Table

### Mendeleev Builds a Table

The system of using atomic mass to classify and organize all the elements known and undiscovered was created based on Dalton's Theory, by Dmitiri Mendeleev (1834-1907)

Mendeleev collected the 63 elements known at the time and arranged them according to their atomic mass - *the average mass of an atom of an element* - (which he wrote on a file card).

He then arranged the cards into a 'solitaire-like' table. He played with them, by sorting and arranging the elements in many different combinations.

Mendeleev was able to identify gaps where elements, not yet discovered, would be able to fit.

Find out more about Dmitri Mendeleev *Blast From The Past* @ http://www.edquest.ca/content/view/214/

| | | | | | |
|---|---|---|---|---|---|
| | | | Ti=50 | Zr=90 | ?[2]=180 |
| | | | V=51 | Nb=94 | Ta=182 |
| | | | Cr=52 | Mo=96 | W=186 |
| | | | Mn=55 | Rh=104,4[3] | Pt=197,4[4] |
| | | | Fe=56 | Ru=104,4 | Ir=198 |
| | | | Ni=Co=59 | Pd=106,6 | Os=199 |
| H=1[5] | | | Cu=63,4 | Ag=108 | Hg=200 |
| | Be=9,4 | Mg=24 | Zn=65,2 | Cd=112 | |
| | B=11 | Al=27,4 | ?[6]=68 | Ur=116[7] | Au=197? |
| | C=12 | Si=28 | ?[8]=70 | Sn=118 | |
| | N=14 | P=31 | As=75 | Sb=122 | Bi=210? |
| | O=16 | S=32 | Se=79,4 | Te=128? | |
| | F=19 | Cl=35,5 | Br=80 | J=127[9] | |
| Li=7 | Na=23 | K=39 | Rb=85,4 | Cs=133 | Tl=204 |
| | | Ca=40 | Sr=87,6 | Ba=137 | Pb=207 |
| | | ?[10]=45 | Ce=92[11] | | |
| | | ?Er=56 | La=94 | | |
| | | ?Yt=60 | Di=95 | | |
| | | ?In=75,6 | Th=118? | | |

### Putting the Elements in Order

When Mendeleev arranged the elements in order of their mass he found that the properties of the elements repeated at periodic intervals. This enabled him to group elements into families. The gaps he left in the organization of the elements in his table were filled in many years later when more elements were discovered. In 1875 gallium was discovered and proved that Mendeleev's organization of the elements worked, because it fit in where he had placed a (**?**). The next (**?**) was not replaced until 1939 when francium was discovered. In 1915 the Modern Periodic Table was reorganized with a focus on atomic structure and included more information about each element.

**Atomic Number** – The number of protons an atom has is called the atomic number. An element is defined by the number of protons it has. Carbon atoms have six protons, hydrogen atoms have one proton and oxygen atoms have eight protons. The chemical behavior of an element depends on the number of protons in an atom.

**Mass Number -** The atomic mass number of an element is simply the sum of the protons and neutrons in the nucleus of 1 atom of the element.

**Atomic Symbol** - These are almost always one or two letters that represent an element. They're used worldwide and usually relate to the name of the element or the Latin name of the element. An example of this is "O" for Oxygen and "Ca" for Calcium.

**Atomic Mass** – To find the average number of neutrons for an element, simply subtract the number of protons (atomic number) The average mass of an element in atomic mass units (amu.) The mass in an atom is roughly the mass of one proton or neutron. The atomic mass is a decimal number on the Periodic Table because it's an average of the various isotopes (one or more atoms that have the same atomic number but different mass numbers) of an

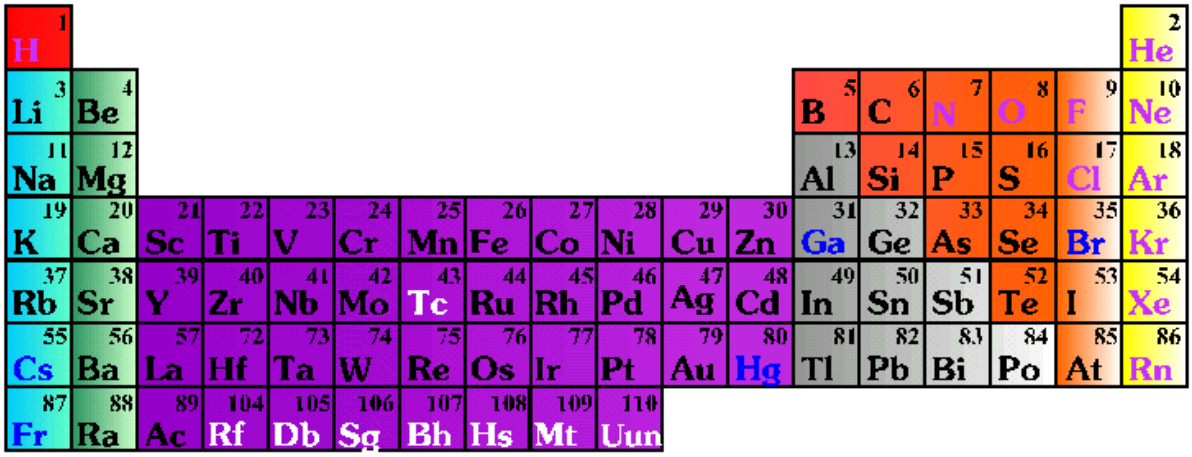
from that atomic mass. element.

## Periodic Table Models

About 112 elements are known today.

They are organized into what is called **'The Periodic Table of Elements'**

### Understanding the Periodic Table ( Web Elements.com )




Horizontal rows are called **periods** (*numbered* 1-7)
Vertical columns form a **group**, or **family** of elements (*numbered* 1-18)

There are so many good resources available to help you look into the details of **The Modern Periodic Table** access to the Internet should help you find many more resources.

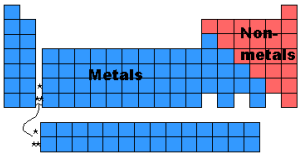
**Periodic City** – A Site that shows many different versions of the Period Table
http://www.mpcfaculty.net/ron_rinehart/periodic.htm

[**Other versions**]
http://chemlab.pc.maricopa.edu/periodic/foldedtable.html
Los Alamos Periodic Table
Visual Elements (Flash Version)

**Pictorial Periodic Table** - http://chemlab.pc.maricopa.edu/periodic/periodic.html

## Different Kinds of Elements

One way of classifying elements is to sort them into categories, based on their distinct properties. Long before anyone knew any detail about the atoms or any of the periodic properties the elements were divided into two broad categories → metals and non-metals.




Distinct properties of *metals* were malleability and ductility, shiny luster and were solid at room temperature (except mercury). *Non-metals*: some were gases, solids or liquids; solid non-metals are brittle; they are flexible, dull and non-conductors of electricity or heat. In-between elements were called *'metalloids'*, having properties of both metals and non-metals.

**Transition Metals** - The 38 elements in groups 3 to 12 are called transition metals. The only elements in this group known to produce a magnetic field are iron, cobalt and nickel.

**Other Metals** - There are 7 elements considered "other metals" in groups 13 to 15. All these elements are solid with a high density. Examples are tin, aluminum and lead.

**Metalloids** - These elements have both metal and non-metal properties. Some of them are semi-conductors, which means, they can carry an electrical charge under special conditions. Metalloids are great for computers and calculators.

**Non-Metals** - These fall into groups 14 to 16 in the periodic table. They can't conduct heat or electricity very well and are brittle. They also can't be made into wire or sheets. At room temperature, non-metals turn into gasses and solids.

**Rare Earth Elements** - There are 30 rare earth elements. Many of them are synthetic or man-made. They're found in group three of the periodic table and the sixth and seventh groups.

## Chemical Families

Chemical family is a term used to describe a group of related elements that have similar properties.

**Alkali Metals** - These are group 1 in the periodic table. They don't occur freely in nature and are softer than most metals. Like all metals, they are great heat conductors and can even explode if exposed to water – they are very reactive and need special storage. They easily give off an unpaired electron by forming a compound.

**Alkaline Earth Metals** - These are group 2 in the periodic table. Because they're extremely reactive, they aren't found freely in nature. An example of an alkaline earth metal is radium.

**Noble Gases** - The 6 noble gases are in group 18. All of them have the maximum number of electrons possible in their outer shell which makes them stable. Examples of noble gases are helium, neon and krypton.

**Halogens** - All 5 halogens are non-metallic elements. Compounds that contain halogen are called *'salts'.* At room temperature, they are in three states of matter: solid, liquid and gas.