The Periodic Table

In 1860 (Civil War Time) a Russian chemist named Demitri Mendeleev published a paper on the nature of the elements then known.

In his paper he described a pattern, a periodic trend, in the properties of the elements.

From this trend he proposed a table that would predict properties of other yet undiscovered elements.

Mendeleev's Periodic Table

Ueber die Beziehungen der Eigenschaften zu den Atomgewichten der Elemente. Von D. Mendelejeff. — Ordnet man Elemente nach zunehmenden Atomgewichten in verticale Reihen so, dass die Horizontalreihen analoge Elemente enthalten, wieder nach zunehmendem Atomgewicht geordnet, so erhält man folgende Zusammenstellung, aus der sich einige allgemeinere Folgerungen ableiten lassen.

			Ti = 50	Zr = 90	? = 180	
			V = 51	Nb = 94	Ta = 182	
			Cr = 52	Mo = 96	W = 186	
			Mn = 55	Rh = 104,4	Pt = 197,4	
			Fe = 56	Ru = 104,4	Ir = 198	
			Ni = Co = 59	Pd = 106,6	Os = 199	
H = 1			Cu = 63,4	Ag = 108	Hg = 200	
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112		
	B = 11	Al = 27,4	? = 68	Ur = 116	Au = 197?	
	C = 12	Si = 28	? = 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		
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204	
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207	
		? = 45	Ce = 92			
		?Er = 56	La = 94			
		?Yt = 60	Di = 95			
		?In = 75,6	Th = 118?			

1. Die nach der Grösse des Atomgewichts geordneten Elemente zeigen eine stufenweise Abänderung in den Eigenschaften.

2. Chemisch-analoge Elemente haben entweder übereinstimmende Atomgewichte (Pt, Ir, Os), oder letztere nehmen gleichviel zu (K, Rb, Cs).

3. Das Anordnen nach den Atomgewichten entspricht der *Werthigkeit* der Elemente und bis zu einem gewissen Grade der Verschiedenheit im chemischen Verhalten, z. B. Li, Be, B, C, N, O, F.

4. Die in der Natur verbreitetsten Elemente haben *kleine* Atomgewichte

The Periodic Law

Mendeleev proposed a "Periodic Law" that states the properties of the elements show a repeating (periodic) pattern when the elements are arranged in order of increasing atomic mass.

There were some problems with this because in order to show the repeating pattern he needed to leave gaps in the table and some of the elements had to switch positions indicating that the atomic mass that was accepted may be wrong.

Mendeleev's Prediction

*This slide and the next should NOT be copied into your notes, just pay attention.

Mendeleev left three gaps in his periodic table because otherwise the elements would not fit the periodic property pattern. Because of these gaps he predicted that elements would be discovered to fill in these gaps. He further predicted the properties of these elements.

Mendeleev's Prediction

Property	Predicted	Observed
Atomic Mass	72	72.60
Density	5.5 g/cm^3	5.36 g/cm^3
Color	dark gray	gray
Formula of oxide	GeO_2	GeO_2
Density of oxide	4.7 g/cm^3	4.703 g/cm^3
Formula of chloride	$GeCl_4$	$GeCl_4$
Density of chloride	1.9 g/cm^3	1.887 g/cm^3
Boiling point of chloride	below 100 °C	86 °C
Formula of ethyl the compound	$Ge(C_2H_5)_4$	$Ge(C_2H_5)_4$
Boiling Point of the ethyl compound	160 °C	160 °C

The Modern Periodic Table

The modern periodic table is arranged by atomic number instead of atomic mass. The design of the modern periodic table reflects our understanding of the atom by being organized according to electron configurations of the Quantum Mechanical Model of the atom.

The Modern Periodic Table

The modern periodic table has periods or series (they are the same thing) arranged in rows – horizontal, across, left to right.

Groups or families (they are the same thing) are arranged in columns – vertical, up & down.

All elements of a group have the same ending electron configuration. This is on purpose, the design of the modern table.

The Modern Periodic Table

The modern periodic table arranged by ending electron configurations.

http://www.chemcollective.org/applets/pertable.php

Or check page 119 of your textbook.

Valence Electrons

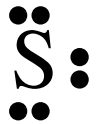
Electrons in the highest occupied energy level are called valence electrons.

All of the atoms in a group have the same number of valence electrons.

Lewis Electron Dot Configurations

A Lewis Electron Dot Configuration is a "really shorthand" electron configuration that uses the symbol of the element and one "dot" for each valence electron.

lithium $1s^2 2s^1$ Li•

sulfur $1s^2 2s^2 2p^6 3s^2 3p^4$ 

Group Names

Some of the groups on the periodic table have special names. You need to know 4 of these:

The first column – the alkali metals

Li, Na, K, Rb, Cs, Fr

The second column – the alkaline earth metals

Be, Mg, Ca, Sr, Ba, Ra

Group Names

The second to the last column – the halogens

F, Cl, Br, I, At

The last column – the noble gases

He, Ne, Ar, Kr, Xe, Rn