Chapter 3

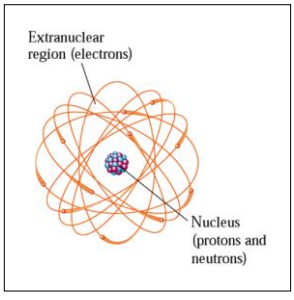
Atomic Structure and the Periodic Table

Periodicity of Element Properties

→ Music consists of a series of tones that build octave after octave. Similarly, elements have properties that recur period after period.

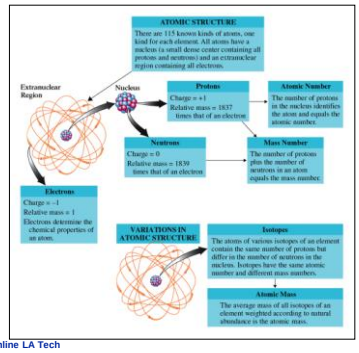
Novastock/PhotoEdit

Nuclear Atom



The protons and neutrons of an atom are found in the central nuclear region, or nucleus, and the electrons are found in an electron cloud outside the nucleus.

Atomic and the Subatomic Particles



Isotopes and their Abundances

1	Hydrogen	2	Helium	3	Lithium
$^{1}_{1}$H 1.008 amu 99.985% $^{2}_{1}$H 2.014 amu 0.015% $^{3}_{1}$H 3.016 amu trace		$^{3}_{2}$He 3.016 amu trace $^{4}_{2}$He 4.003 amu 100%		$^{6}_{3}$Li 6.015 amu 7.42% Li 7.016 amu 92.58%	
4	**Beryllium**	**5**	**Boron**	**6**	**Carbon**
$^{9}_{4}$Be 9.012 amu 100%		$^{10}_{5}$B 10.013 amu 19.6% $^{11}_{5}$B 11.009 amu 80.4%		$^{12}_{6}$C 12.000 amu 98.89% $^{13}_{6}$C 13.003 amu 1.11% $^{14}_{6}$C 14.003 amu trace	
7	**Nitrogen**	**8**	**Oxygen**	**9**	**Fluorine**
$^{14}_{7}$N 14.003 amu 99.63% $^{15}_{7}$N 15.000 amu 0.37%		$^{16}_{8}$O 15.995 amu 99.759% $^{17}_{8}$O 16.999 amu 0.037% $^{18}_{8}$O 17.999 amu 0.204%		$^{19}_{9}$F 18.998 amu 100%	
10	**Neon**	**11**	**Sodium**	**12**	**Magnesium**
$^{20}_{10}$Ne 19.992 amu 90.92% $^{22}_{10}$Ne 20.994 amu 0.26% $^{22}_{10}$Ne 21.991 amu 8.82%		$^{23}_{11}$Na 22.990 amu 100%		$^{24}_{12}$Mg 23.985 amu 78.70% $^{25}_{12}$Mg 24.986 amu 10.13% $^{26}_{12}$Mg 25.983 amu 11.17%	

Mendeleev the Founder of Periodic Table

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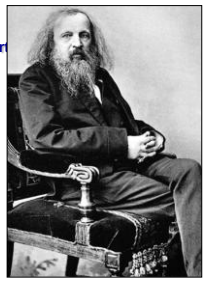
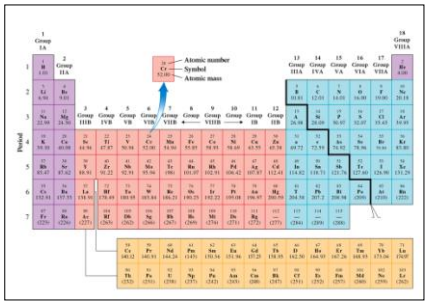
Mendeleev constructed a periodic table as part of his effort to systemize chemistry.



Edgar Fahs Smith Collection, University of Pennsylvania Library

Modern Periodic Table



The periodic table of the elements is a graphical way to show relationships among the elements.

Very Long form of Periodic table

1																	2
3	4											5	6	7	8	9	10
11	12											13	14	15	16	17	18
19	20	21										22	23	24	25	26	27
28	29	30	31	32	33	34	35	36									
37	38	39										40	41	42	43	44	45
46	47	48	49	50	51	52	53	54									
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86			
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	
104	105	106	107	108	109	110	111	112	113	114	115						

In this periodic table, elements 58 through 71 and 90 through 103 are shown in their proper positions.

Metals and Non-metals

(a) **Some familiar metals are aluminum, lead, tin, and zinc.**

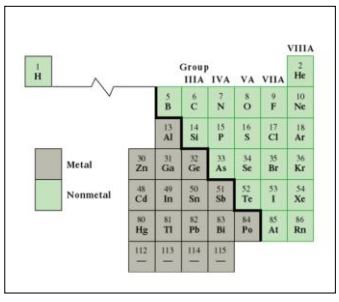
(b) Some familiar nonmetals are sulfur, phosphorus, and bromine.

Differences between Metals/Non-metals

Metals	Nonmetals
1. High electrical conductivity that decreases with increasing temperature	1. Poor electrical conductivity (except carbon in the form of graphite)
2. High thermal conductivity	2. Good heat insulators (except carbon in the form of diamond)
3. Metallic gray or silver luster[a]	3. No metallic luster
4. Almost all are solids[b]	4. Solids, liquids, or gases
5. Malleable (can be hammered into sheets)	5. Brittle in solid state
6. Ductile (can be drawn into wires)	6. Nonductile

[a]Except copper and gold.
[b]Except mercury; cesium and gallium melt on a hot summer day (85°F) or when held in a person's hand.

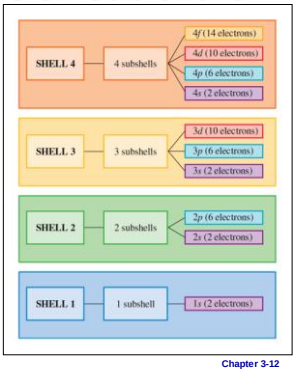
Boarder Line between Metals



This portion of the periodic table shows the dividing line between metals and nonmetals.

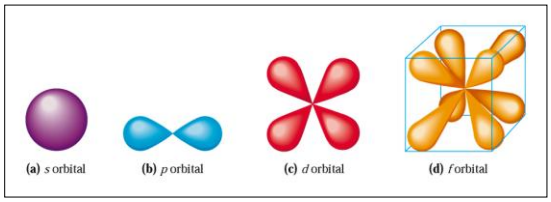
Electronic Shells sn Sub-shells

→ **The number of subshells within a shell is equal to the shell number.**

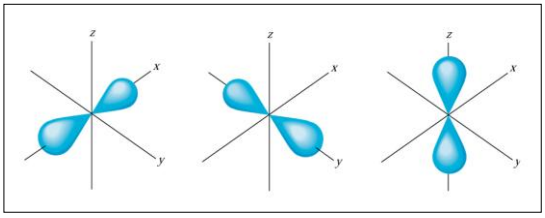


Atomic Orbitals in a Sub-Shell

An s orbital has spherical shape; a p orbital has two lobes; a d orbital has four lobes; and an f orbital has eight lobes.

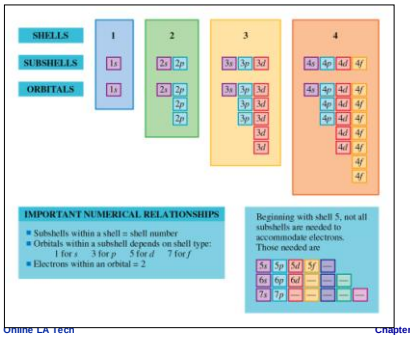


p- atomic Orbitals and their Orientation in Space

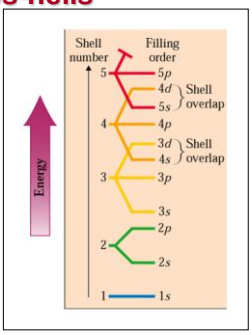


Orbitals within a subshell differ mainly in orientation.

Shell, Sub-shell and Orbital Arrangement



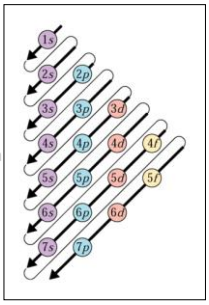
The Order of Filling of Various Atomic Subs-hells



The order of filling various electron subshells. Subshells of different shells "overlap."

Filling Order of Atomic Orbitals

The order of filling various electron subshells with electrons follows the same order given by the arrows in this diagram.



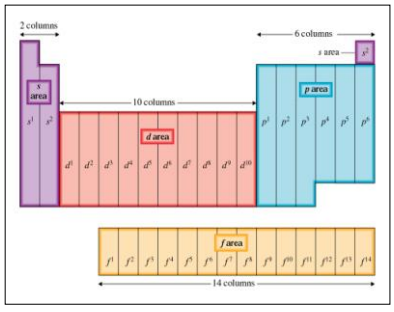
Color comes from Electron Jumps

William S. Helsel/Getty Images

The different colors of fireworks result when heat excites the electrons of different kinds of metal atoms.

Orbital Blocks of the Periodic Table

Electron configuration and the positions of the elements in the periodic table.



Element Types and Electronic Configuration

A classification scheme for the elements based on their electron configurations.