PERIODIC TABLE

gold, silver, tin, copper, lead, mercury
sulfur, carbon

Elements known since antiquity

PERIODIC TABLE

phosphorous

PERIODIC TABLE

Isolated from
60 buckets of urine
Greek: *phôs* (light)
and *phoros* (bearer)

PERIODIC TABLE

White, non-metallic; used by alchemists attempting to make gold.

Was also used as a spell component
Extremely poisonous: 50 mg fatal

Must be stored in water
exposure to air causes ignition

Over the next 200 years, much learned about the properties of elements and their compounds

LAW OF TRIADS

Johann Dobereiner (1817): groups of 3 similar elements

Ca, Sr, Ba
Cl, Br, I
Li, Na, K

Proposed nature contained triads of elements. The middle element had properties that were an average of the other two members when ordered by the atomic weight.

Law of Octaves

1863 - John Newlands, an English chemist, classified the known elements into groups based on similar physical properties

Law of Octaves

"any given element will exhibit similar behavior to the eighth element following it in the table"

H	F	Cl	Co/Ni	Br	Pd	I	Pt/Ir
Li	Na	K	Cu	Rb	Ag	Cs	Tl
G	Mg	Ca	Zn	Sr	Cd	Ba/V	Pb
Bo	Al	Cr	Y	Ce/La	U	Ta	Th
C	Si	Ti	In	Zn	Sn	W	Hg
N	P	Mn	As	Di/Mo	Sb	Nb	Bi
O	S	Fe	Se	Ro/Ru	Te	Au	Os

"Father" of the periodic table

Lothar Meyer

"Father" of the periodic table

Dmitri Mendeleev

"Father" of the periodic table

Both chemists produced remarkably similar results at the same time working independently of one another.

Mendeleev's table published 1869, Meyer's appeared 1870

What Did Mendeleev Do?

Made a card for each of the 63 known elements

Each contained element's symbol, atomic weight and characteristic chemical and physical properties

Arranged the cards in order of ascending atomic weight. Elements fell into vertical groups of elements of similar properties

What Did Mendeleev Do?

Mendeleev's table showed similarities in vertical, horizontal, and diagonal groupings (not just triads)

Gaps in table - predicted existence and properties of unknown elements which he called eka-aluminum, eka-boron, and eka-silicon.

What Did Mendeleev Do?

Group / Period	I	II	III	IV	V	VI	VII	VIII
1	H=1							
2	Li=7	Be=9.4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27.3	Si=28	P=31	S=32	Cl=35.5	
4	K=39	Ca=40	?=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56,Co=59 Ni=59
5	Cu=63	Zn=65	?=68	?=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	?Yt=88	Zr=90	Nb=94	Mo=96	?=100	Ru=104,Rh=104 Pd=106
7	Ag=108	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	?Di=138	?Ce=140				
9								
10			?Er=178	?La=180	Ta=182	W=184		Os=195,Ir=197 Pt=198
11	Au=199	Hg=200	Tl=204	Pb=207	Bi=208			
12				Th=231		U=240		

What Did Mendeleev Do?

Later named gallium, scandium and germanium which fit his predictions

Predicted 10 elements would be discovered

Rayleigh and Ramsey

Lord Rayleigh (1842-1919) and William Ramsey (1852-1916) greatly enhanced the periodic table by discovering the "inert gases”

Rayleigh and Ramsey

In 1895 Rayleigh reported the discovery of a new gaseous element named argon

This element was chemically inert and did not fit any of the known periodic groups

Ramsey followed by discovering the remainder of the inert gases and positioning them in the periodic table.

The Inert Gases

- Helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon(Xe), radon (Rn)
- Very inert and combine with very few elements
- All are colorless, odorless gases

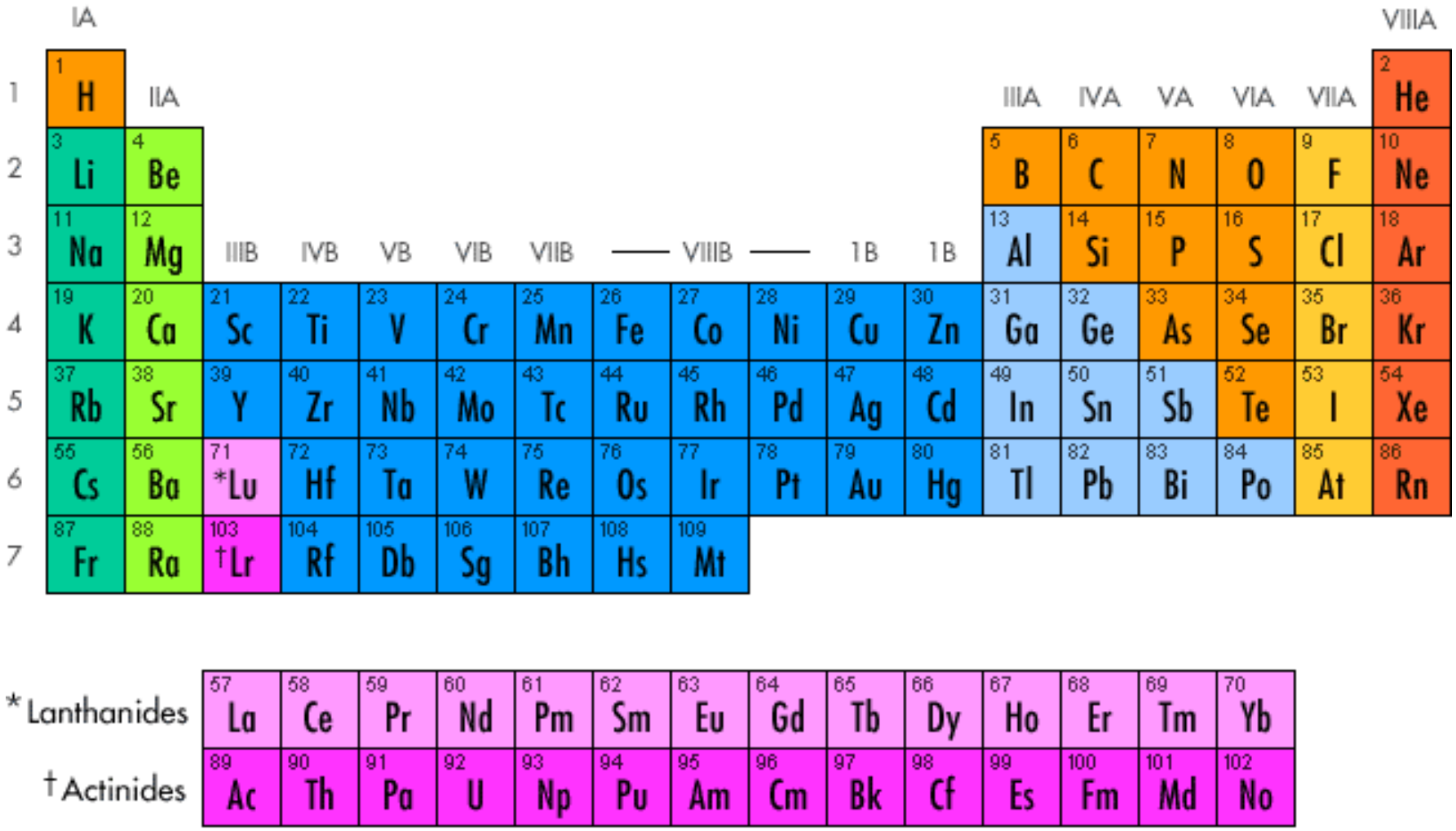
The Inert Gases

Neon gas normally glows red

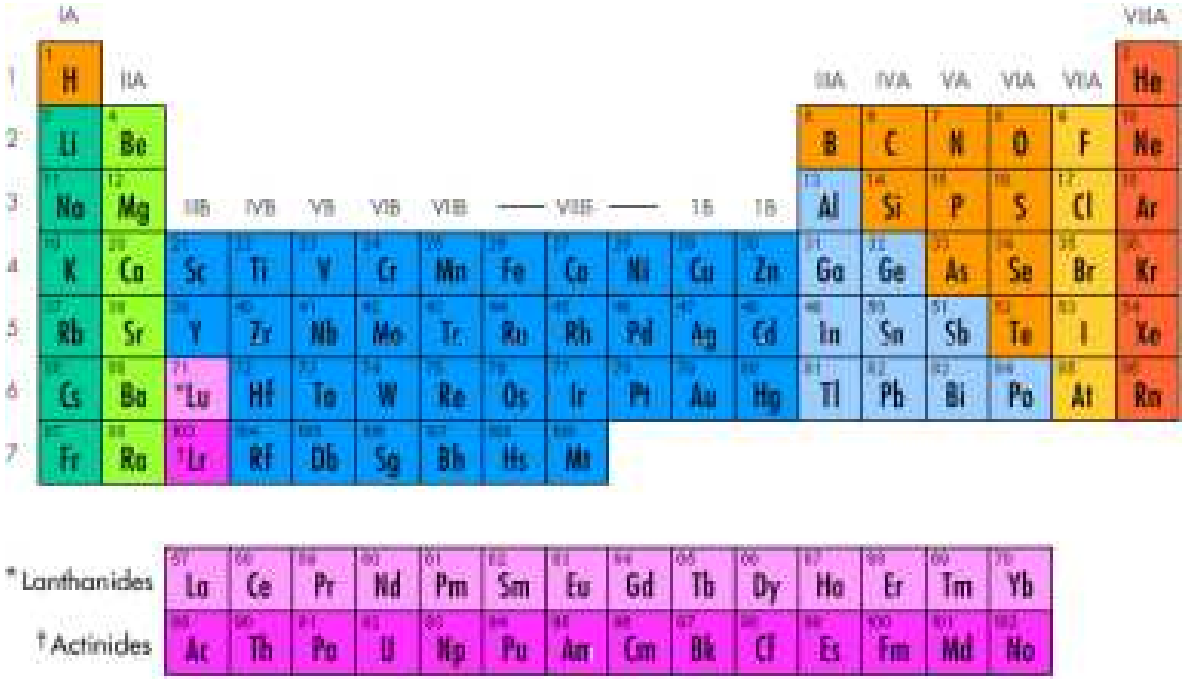
Colors other than red produced using argon, mercury and phosphor

Eric Ehlenberger

Modern Periodic Table



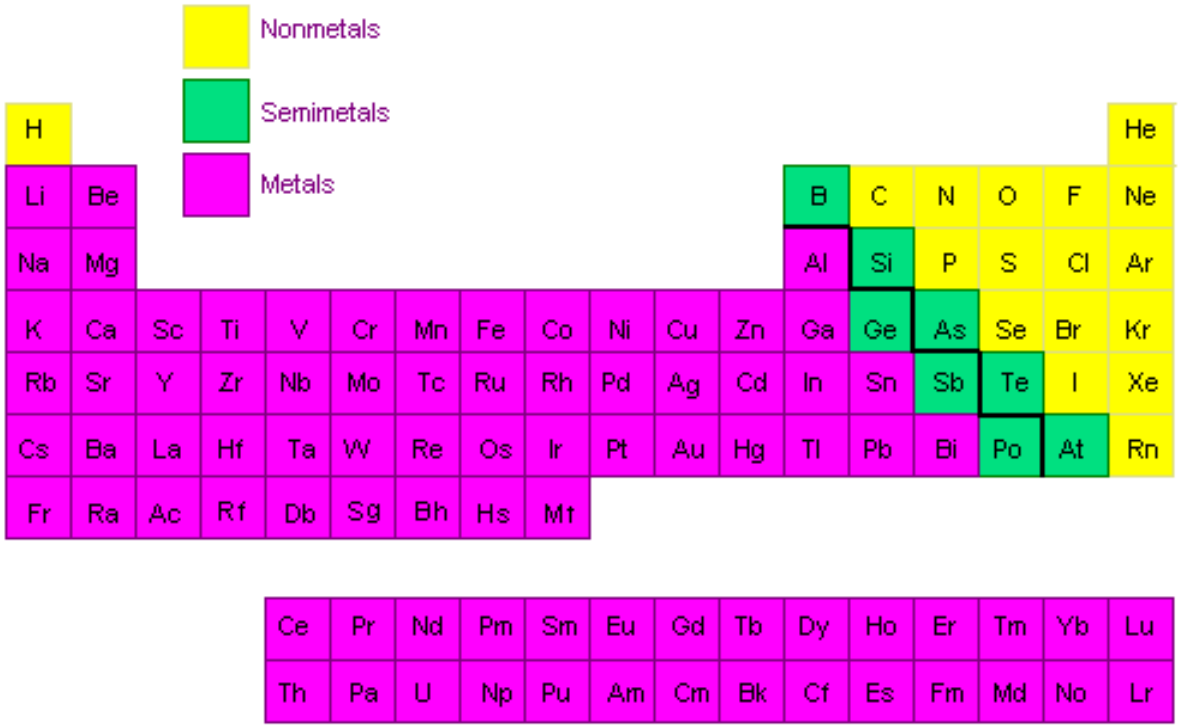
Modern Periodic Table



Of these 109 elements:

9 naturally radioactive 16 artifical radioactive

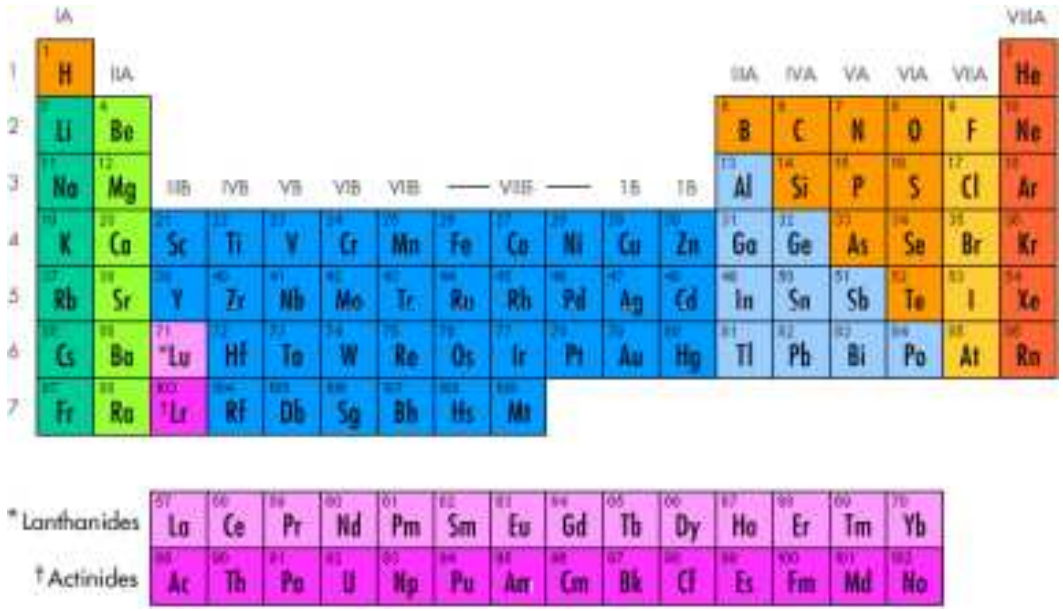
Modern Periodic Table



Of these 109 elements:

87 metals **8 semimetals** **17 nonmetals**

Modern Periodic Table



Of these 109 elements:

11 gases **2 liquids**

Properties of Metals

Lustrous, malleable, ductile

Conductors of heat and electricity

Solids at room temperature, except mercury

Lose electrons when reacting with nonmetals

Properties of Non-metals

Physical state varies

Poor conductors of heat and electricity

Gain electrons when reacting with metals; share electrons when reacting with other nonmetals

Many exist as diatomic molecules

Can divide elements into other categories:

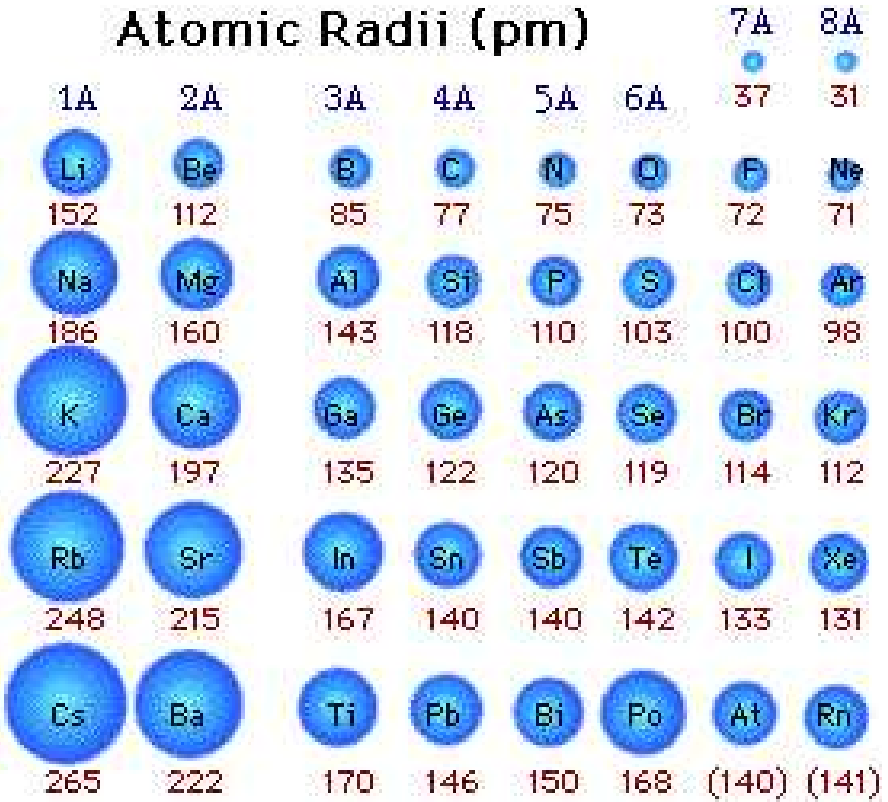
Representative elements
transition metals
inner transition

Group Similarities

Certain properties of elements exhibit a gradual change in properties as we go down a group or across a period.

Knowing these trends helps to understand chemical properties

1. Atomic Size (Radius)



Within a group

Trend - Atoms get larger

Why? - Electrons go into new shells

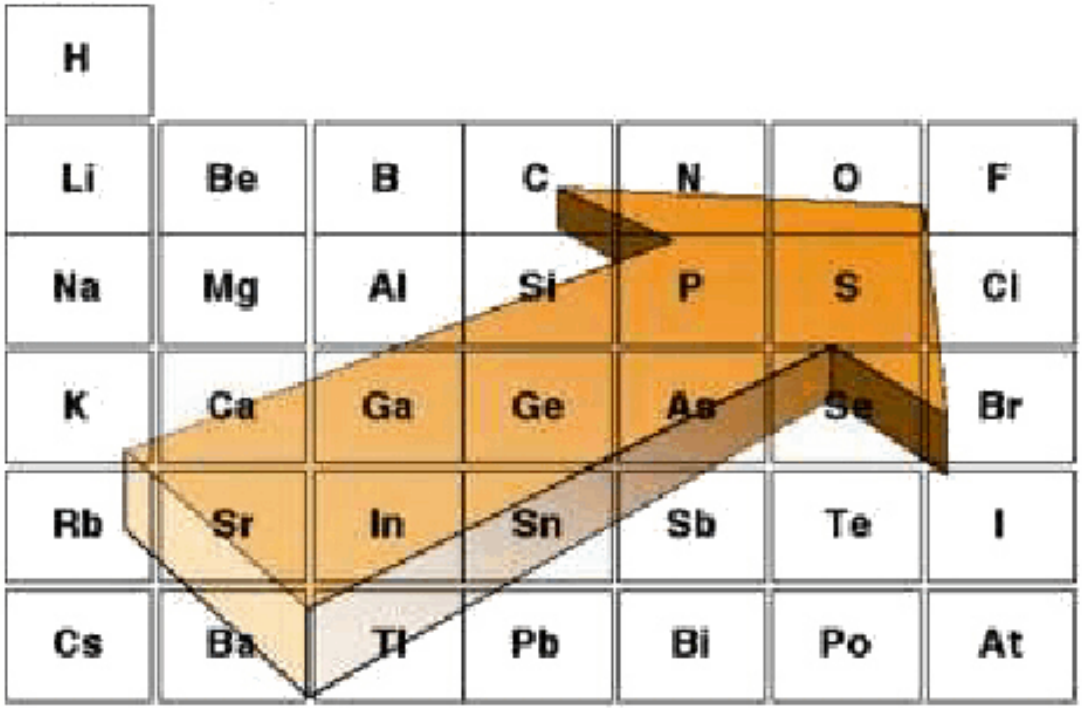
Across a period

Trend - Atoms get smaller

Why? - There are more protons which attract the electrons, making the atom smaller

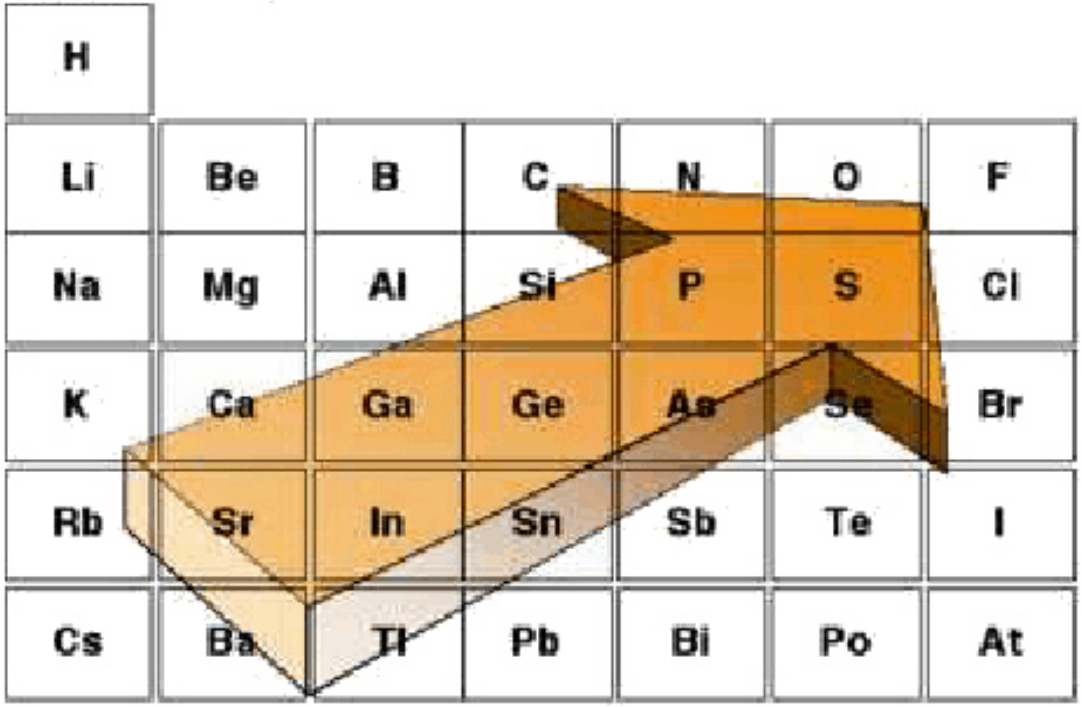
2. Ionization Energy

Energy required to remove an electron from valance (outer) shell

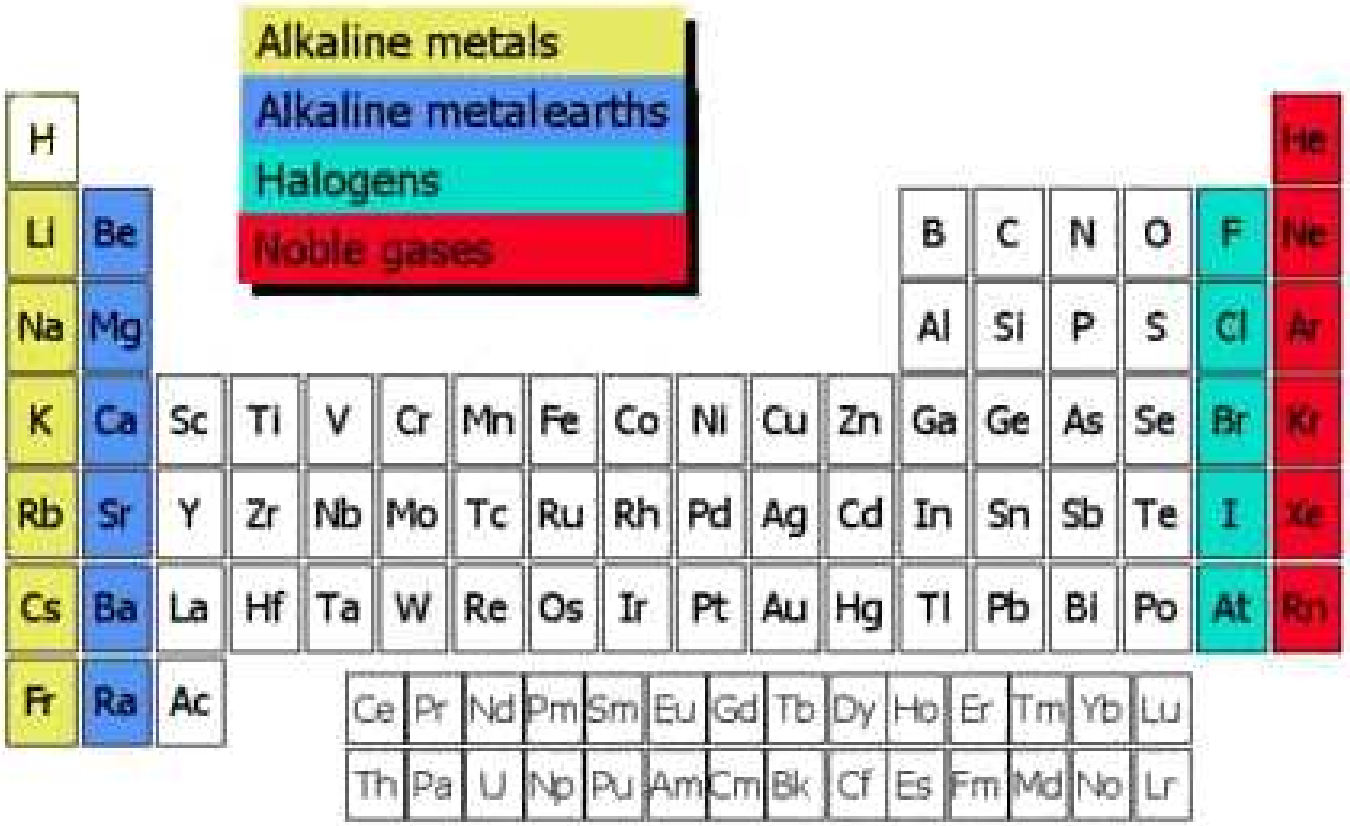


3. Electronegativity

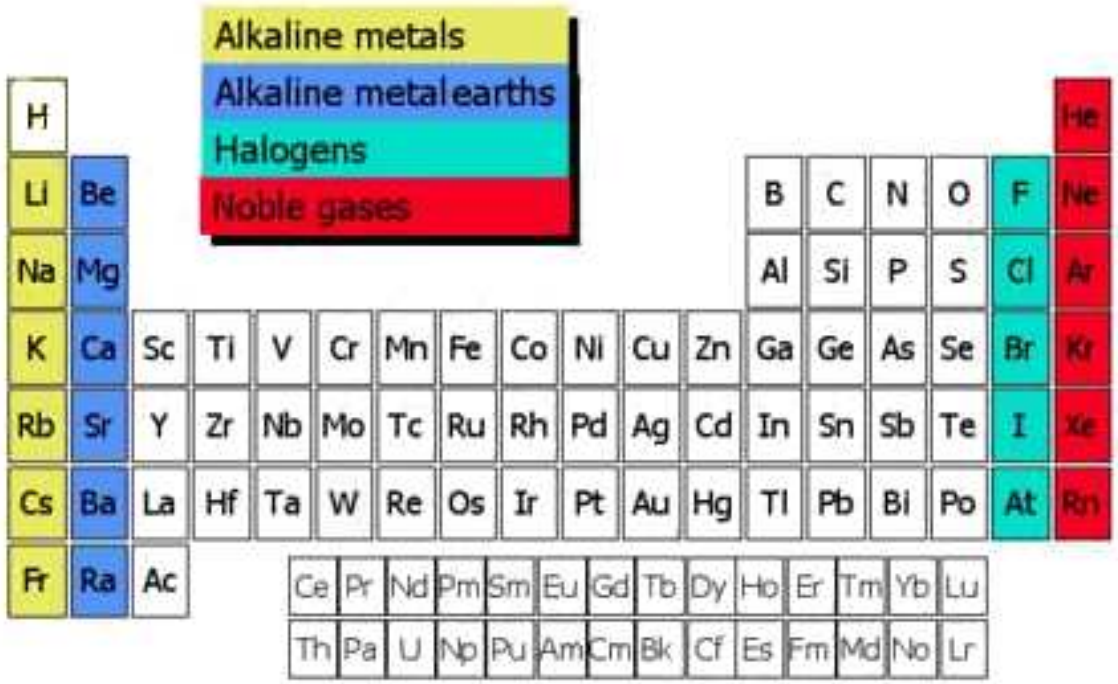
Ability of an atom to attract electrons



Common Group Names



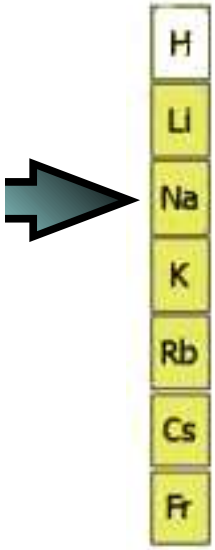
Group Similarities



Elements in a group have similar chemical & physical properties.
Reason: Outer shell has same number of electrons

Group Similarities

Alkali metals



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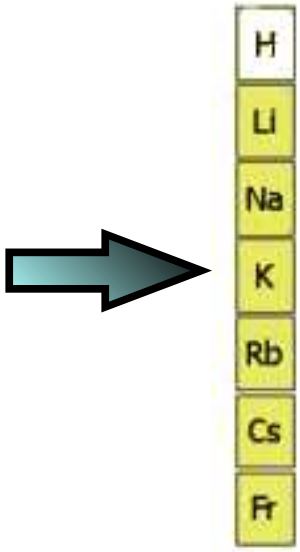
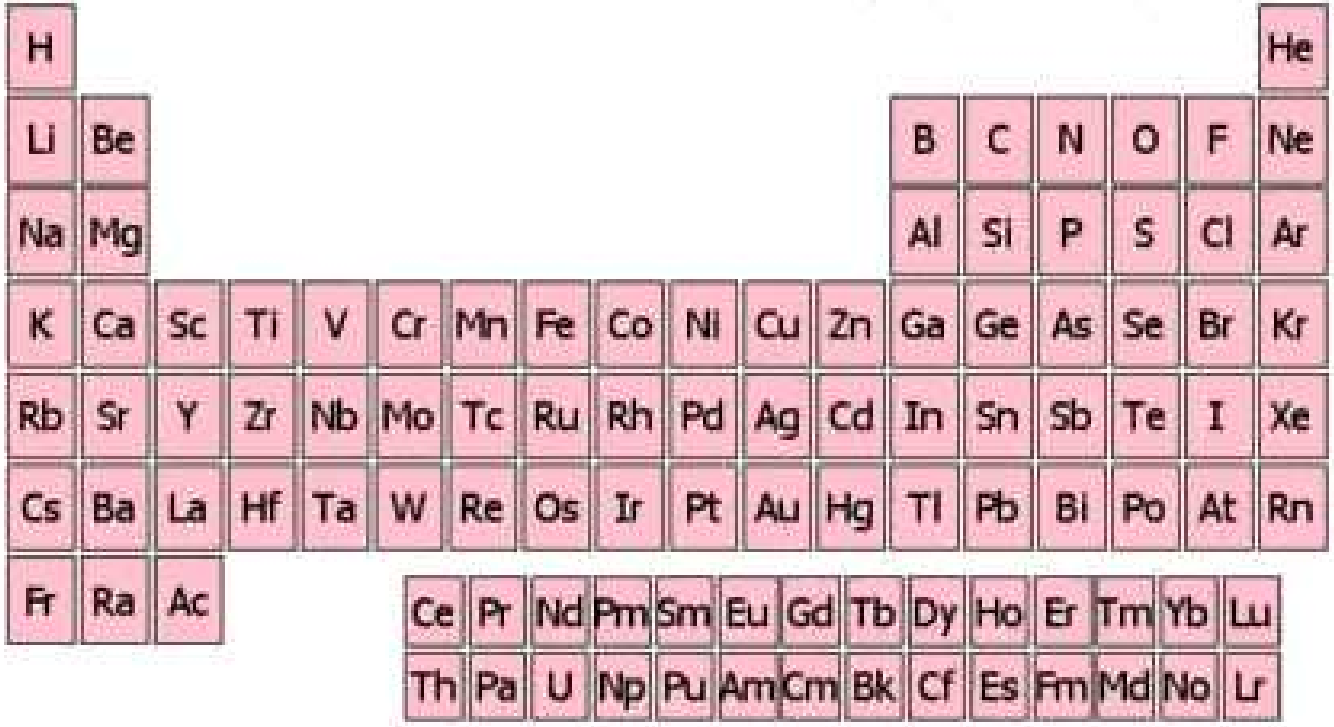
Alkali metals



Why are there rows on the bottom of the periodic table ?



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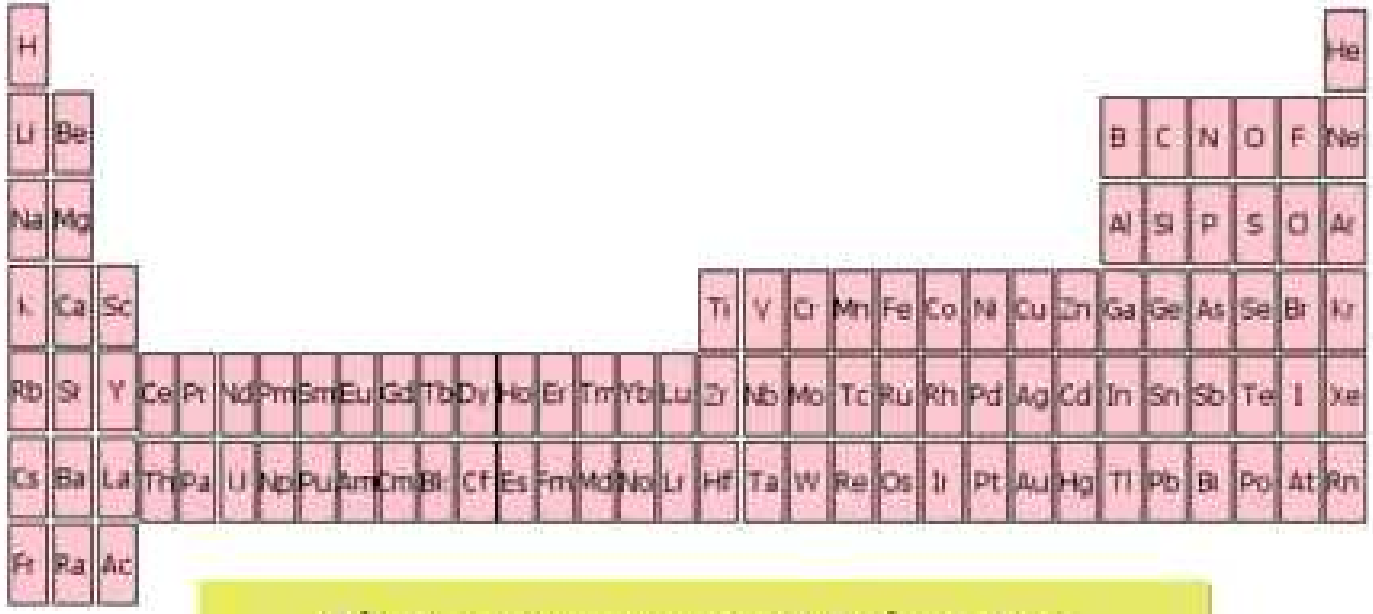

This arrangement takes too much space and is hard to read.