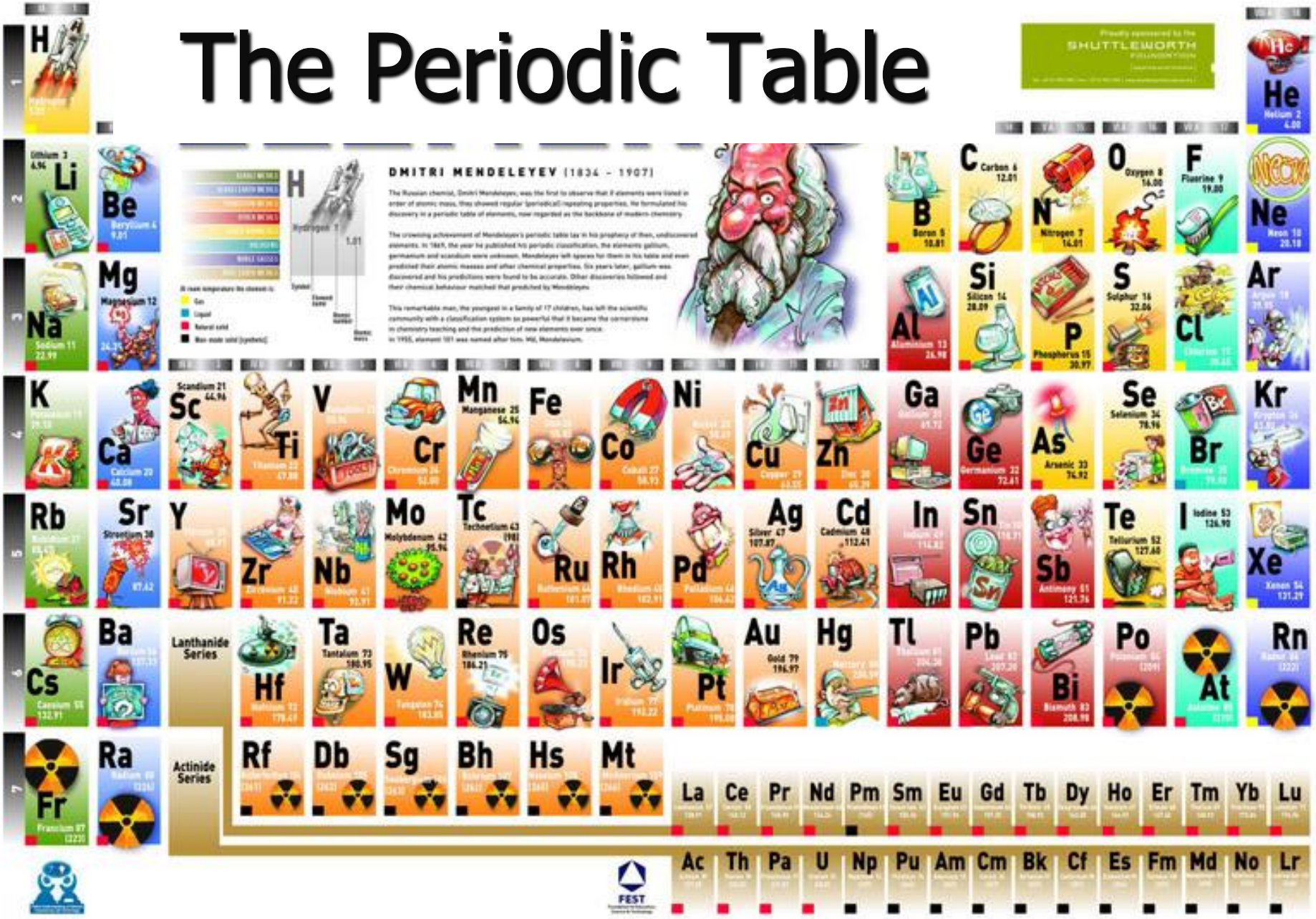
The Periodic Table



Early Thoughts

- **Dobereiner** – arranged elements with similar chemical properties into triads.
- **Newlands-** arranged elements by increasing atomic mass. Came up with groups of 8 called them octaves.

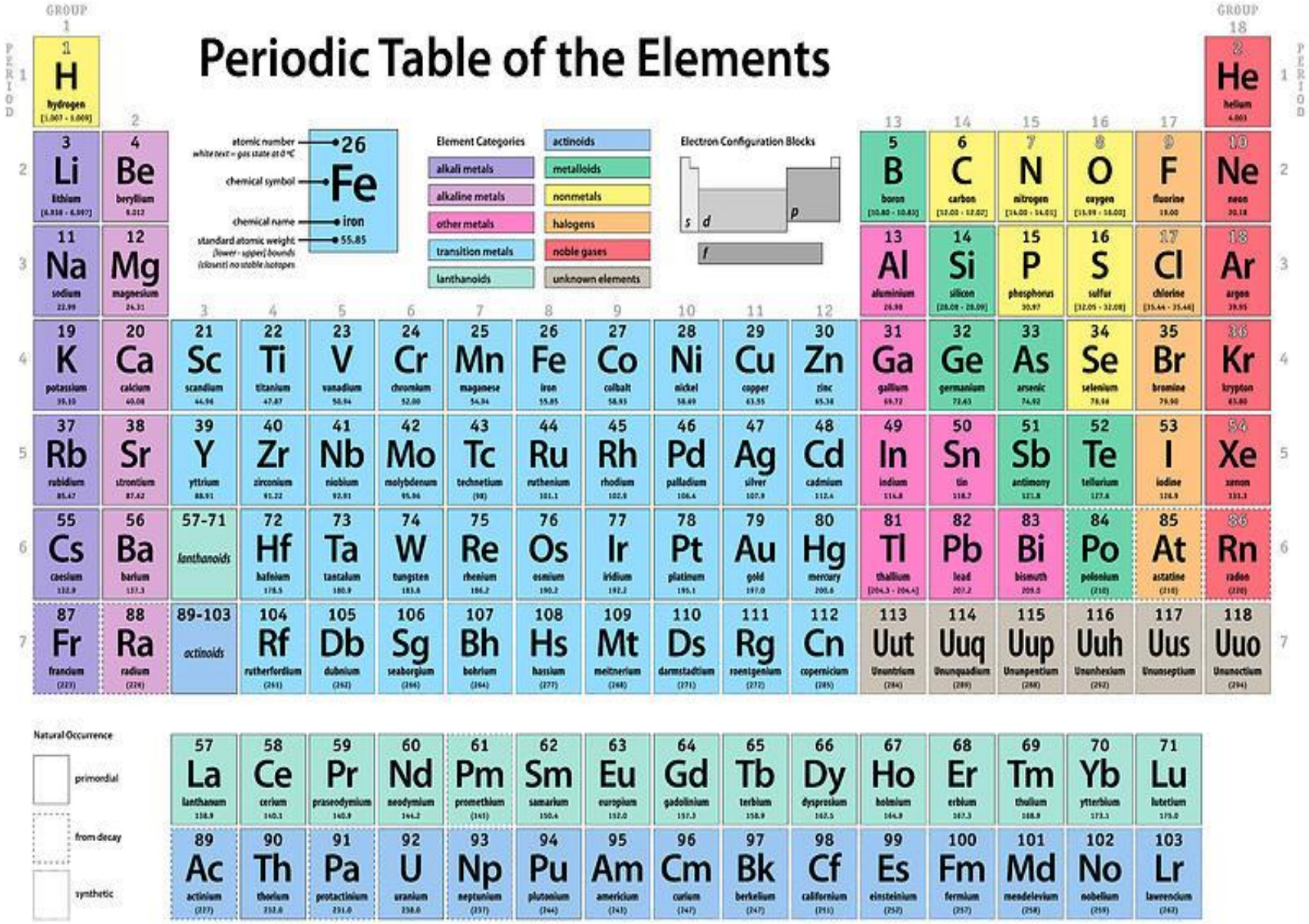
Early Thoughts (continued)

- **Mendeleev** – Arranged elements by atomic mass
- **Moseley -** discovered each element had a unique positive charge in the nucleus – Atomic number.

Useful Terms

- **Groups or families** – the vertical columns on the periodic table
- **Periods** – The horizontal rows of the periodic table
- **Valence Electrons** – electrons in the highest principal energy level.

- http://www.ptable.com/#Writeup/Wikipedia


Periodic Table of the Elements
GROUP
PERIOD
atomic number
white text = gas state at 0 °C
chemical symbol
chemical name
standard atomic weight
[lower - upper] bounds
(closest) no stable isotopes
26
Fe
iron
55.85
Element Categories
alkali metals
alkaline metals
other metals
transition metals
lanthanoids
actinoids
metalloids
nonmetals
halogens
noble gases
unknown elements
Electron Configuration Blocks
s
d
p
f
H hydrogen
He helium
Li lithium
Be beryllium
B boron
C carbon
N nitrogen
O oxygen
F fluorine
Ne neon
Na sodium
Mg magnesium
Al aluminium
Si silicon
P phosphorus
S sulfur
Cl chlorine
Ar argon
K potassium
Ca calcium
Sc scandium
Ti titanium
V vanadium
Cr chromium
Mn manganese
Fe iron
Co cobalt
Ni nickel
Cu copper
Zn zinc
Ga gallium
Ge germanium
As arsenic
Se selenium
Br bromine
Kr krypton
Rb rubidium
Sr strontium
Y yttrium
Zr zirconium
Nb niobium
Mo molybdenum
Tc technetium
Ru ruthenium
Rh rhodium
Pd palladium
Ag silver
Cd cadmium
In indium
Sn tin
Sb antimony
Te tellurium
I iodine
Xe xenon
Cs caesium
Ba barium
57-71 lanthanoids
Hf hafnium
Ta tantalum
W tungsten
Re rhenium
Os osmium
Ir iridium
Pt platinum
Au gold
Hg mercury
Tl thallium
Pb lead
Bi bismuth
Po polonium
At astatine
Rn radon
Fr francium
Ra radium
89-103 actinoids
Rf rutherfordium
Db dubnium
Sg seaborgium
Bh bohrium
Hs hassium
Mt meitnerium
Ds darmstadtium
Rg roentgenium
Cn copernicium
Uut ununtrium
Uuq ununquadium
Uup ununpentium
Uuh ununhexium
Uus ununseptium
Uuo ununoctium
La lanthanum
Ce cerium
Pr praseodymium
Nd neodymium
Pm promethium
Sm samarium
Eu europium
Gd gadolinium
Tb terbium
Dy dysprosium
Ho holmium
Er erbium
Tm thulium
Yb ytterbium
Lu lutetium
Ac actinium
Th thorium
Pa protactinium
U uranium
Np neptunium
Pu plutonium
Am americium
Cm curium
Bk berkelium
Cf californium
Es einsteinium
Fm fermium
Md mendelevium
No nobelium
Lr lawrencium
Natural Occurrence
primordial
from decay
synthetic

Mendeleev Song… get ready!

- http://www.bing.com/videos/search?q=Mendeleev+Periodic+Table+Song&FORM=RESTAB&adlt=strict#view=detail&mid=D6CFCA6D88CA4A1FD322D6CFCA6D88CA4A1FD322

Periodic Law

- **Periodic Law** – When elements are arranged in order of increasing **atomic numbers**, their physical and chemical properties show a periodic pattern.

- **Periodic Trends**-Allow us to see the relationships between the elements and their position on the periodic table

- Such as…
  - http://www.youtube.com/watch?v=QSZ-3wScePM&feature=player_embedded

Valence Electrons

- Elements in a group have the **SAME** number of valence electrons
- s and p blocks
  - s blocks have the same number of valence electrons as their group number
  - p blocks have the same number of valence electrons as the ONES place of their group number
- d block and f block (most)
  - have two valence electrons

This explains it all…

- **Electron shielding** – as you look down a group there are more energy levels, this *blocks* the outer electrons from the nucleus
- **Nuclear affect** – as you look across a period electron configurations have the same highest energy level and more protons. Makes the nuclear attraction greater

Atomic Radius

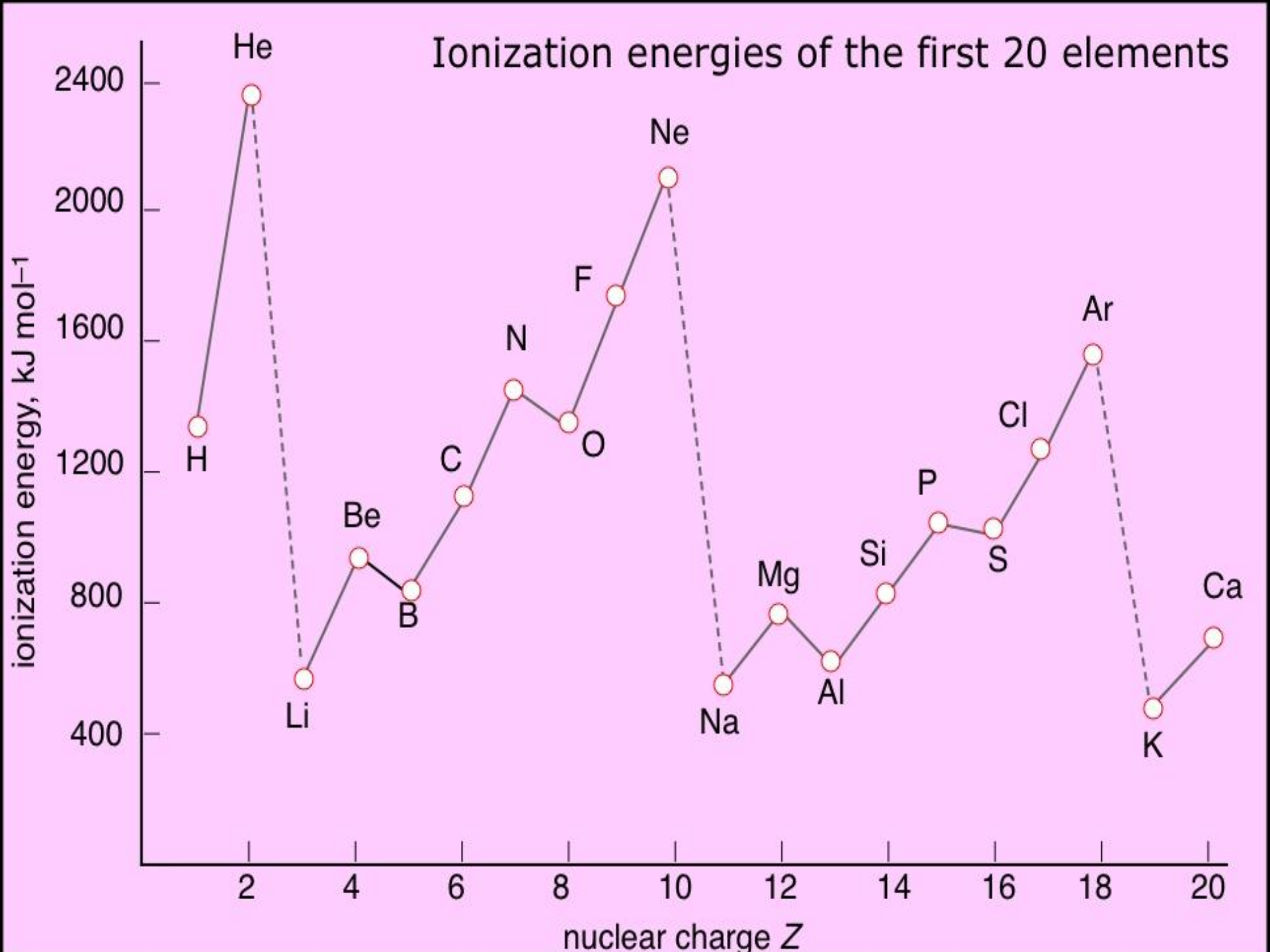
- **Definition -** the size from the center of the atom to the outermost electron.
- **Trends…**
  - **Period (across the table)** the atomic radius DECREASES
  - **Group- (down the table)** the atomic radius INCREASES.
- The largest atomic radius is **Fr**
- The smallest atomic radius is **He**

Ion Size

- **Ion-** an atom that has gained or lost one or more electrons
  - All Metals form "+" ions (losers)
  - All Nonmetals form "-" ions (gainers)
  - Elements in a group form ions of the same charge
- **Trend…**
  - "+" ions are smaller than their corresponding atoms
  - "-" ions are larger than their corresponding atoms

Ionization energy

- **Ionization Energy**-Tells us how much energy is required to remove one electron from an atom. (measured in joules)
  - $A + \text{energy} \rightarrow A^{+} + e^{-}$
- **Trends**
  - **Period-**Increase across the period.
  - **Group-** decreases as you go down the group.


Ionization energies of the first 20 elements
ionization energy, kJ mol–1
2400
2000
1600
1200
800
400
nuclear charge Z
2
4
6
8
10
12
14
16
18
20
H
He
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
K
Ca

Removing multiple electrons.

- **Example**, Boron [He] $2s^2 2p^1$
- IE_1 801 J, IE_2 2427 J, IE_3 3660 J, IE_4 25026 J, IE_5 32827 J
- Where is the big jump in energy and why?
  - Between 3 and 4
  - You lose all the valence electrons and are removing core electrons after IE_3

Electron Affinity

- **Electron Affinity**-The energy change that occurs when an electron is acquired by a neutral atom. Most atoms give off energy when an electron is gained

Electron Affinity trends

- **General**
  - Metals have a low E.A.
  - Nonmetals have a high E.A.
- **Period -** as you move across the period, the electron affinity increases until you reach the halogens.
- **Group -** As you move down a group, the electron affinity decreases.

Electron affinities in kJ released per mole of mononegative ions formed

IA 1	IIA 2	IIIB 3	IVB 4	VB 5	VIB 6	VIIB 7	VIII 8	VIII 9	VIII 10	IB 11	IIB 12	IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	VIIIA 18
H 73																	He −21
Li 60	Be −19											B 27	C 122	N −7	O 141	F 328	Ne −29
Na 53	Mg −19											Al 43	Si 134	P 72	S 200	Cl 349	Ar −35
K 48	Ca −10	Sc 18	Ti 8	V 51	Cr 64	Mn	Fe 16	Co 64	Ni 112	Cu 118	Zn −47	Ga 29	Ge 116	As 78	Se 195	Br 325	Kr −39
Rb 47	Sr	Y 30	Zr 41	Nb 86	Mo 72	Tc 53	Ru 101	Rh 110	Pd 54	Ag 126	Cd −32	In 29	Sn 116	Sb 103	Te 190	I 295	Xe −41
Cs 45	Ba	La	Hf	Ta 31	W 79	Re 14	Os 106	Ir 101	Pt 205	Au 223	Hg −61	Tl 20	Pb 35	Bi 91	Po 183	At 270	Rn −41
Fr 44	Ra	Ac	Db	Jl	Rf	Bh	Hn	Mt									

S.K. Lower

Electronegativity

- **Definition -** the ability of an atom in a molecule to attract electrons to itself
- **Trends**
  - **Period -** increases across the period. The metals tend to give electrons away rather than attract them.
  - **Group Trend**- decreases or stays about the same
- Noble gases aren't electronegative
- **F** is the most electronegative element.

Humor: On the Fun Side

"What elements think of each other, a conversation between elements."