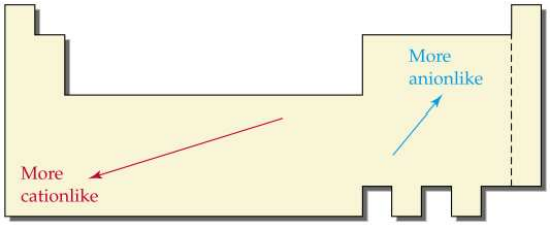
Periodic Trends

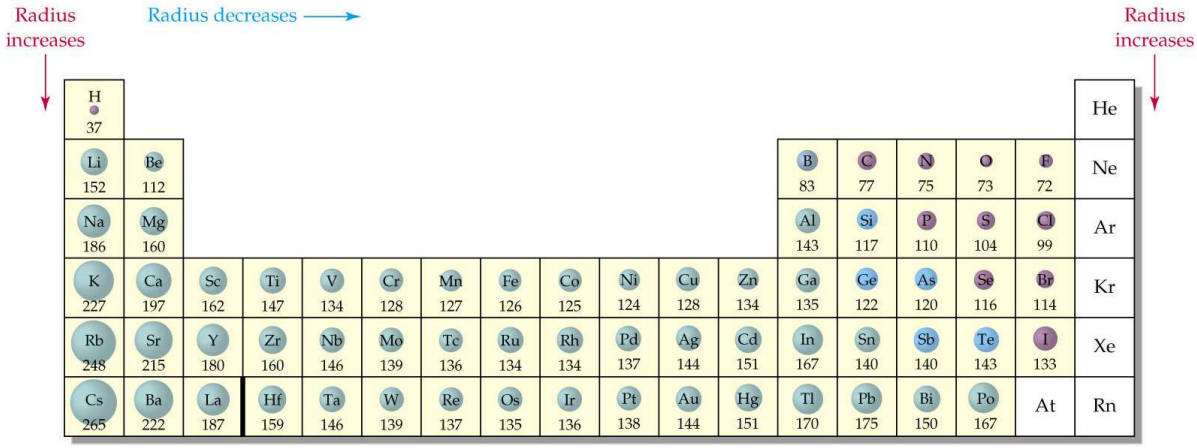
- ***Atomic Radius***

-- recall this figure



-- it turns out the more anionic an atom is the more tightly its electrons are held to the nucleus - larger Z_{eff}

-- the opposite is also true, the more cationic an atom is the less tightly the e-'s are held - hence the reason they loose electrons while the non-metals gain them - smaller Z_{eff}



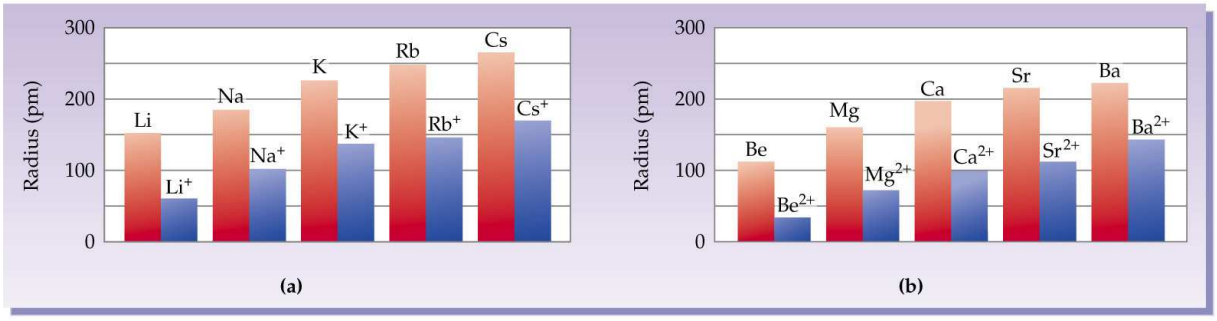
-- using this trend we can predict which atomic radius will be larger

-- Ex: Which of the following has a smaller Z_{eff}?

a.) Mg or *Ba* b.) *W* or Au c.) Si or *Sn*

d.) *Ce* or Lu

- Ionic Radius

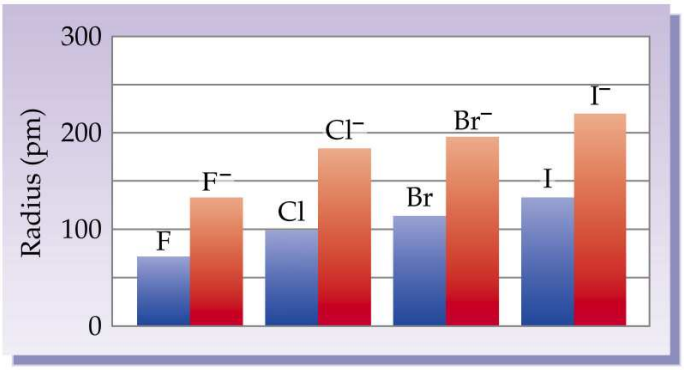


-- cations: created when electron(s) are removed

--- they are smaller than their parent atom because the electrons are less shielded from the nucleus

--- in other words the positive nucleus attracts the remaining electrons more strongly

-- anions: are when electron(s) are added to the atom



--- they are larger than their parent atom because the electrons are more shielded from the nucleus

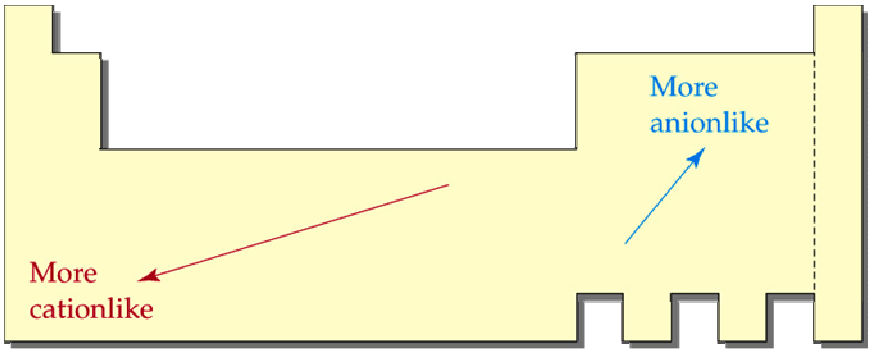
--- repulsion between these electrons causes the radius to expand

- ***Ionization Energy***

-- amount of energy required to remove an electron: $X \rightarrow X^{+} + e^{-}$

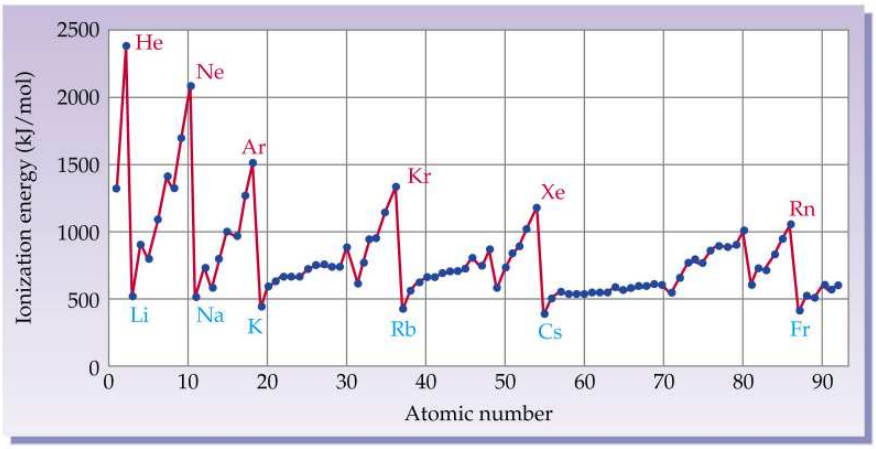
-- several factors:

--- the electronegative (the anionic) an atom is the more energy it takes to remove an electron (most electronegative element is fluorine)



--- if removing an electron makes an atom obtain a noble gas configuration it will take less energy - e.g. the alkali metals

--- if removing an electron will lead to a half filled (e.g. O) or empty subshell (e.g. B) then it will take less energy



-- noble gases are very stable and do not want to lose their electrons since they have a filled subshell

- ***Electron Affinity***

-- in simple terms it's the attraction between an electron and an atom: $X + e^- \rightarrow X^-$

-- technically it is the energy change that occurs when a mole of gaseous atoms combine with a mole of electrons - creating a -1 ion

-- several factors:

--- when the addition of an electron will lead to a noble gas configuration then the atom will have a very high EA (e.g. halogens)

--- when the addition of an electron will lead to half-filled subshell then the atom will have a higher EA (e.g. C & Si)

--- and of course noble gases don't want electrons so they have very low EAs

-- one other point – EA is negative since energy is released when an electron is gained

--- this is the opposite of IE where it takes energy to remove an electron and so energy must be input into the atom

--- therefore, while the sign of EA is negative we refer to a large EA and being large and negative whereas a large IE is large and positive

-- Ex: Which of the following atoms has the larger EA?

a.) F or O … F b.) S or P … S c.) Si or P … Si (now has half-filled subshell) d.) B or C … C (again half-filled subshell) e.) Li or Be … Li (has a filled 2s orbital if an electron is gained

Circle the species having the highest, largest, or greatest of the indicated property. If they are equal, circle "same."

(a) first ionization energy	N	P	same
(b) first ionization energy	K	Ca	same
(c) second ionization energy	Na	Mg	same
(d) atomic radius	O	F	same
(e) atomic radius	Mg	Ca	same
(f) electron affinity	F	N	same
(g) electron affinity	Na	Cl	same
(h) electronegativity	S	O	same
(i) electronegativity	S	Cl	same