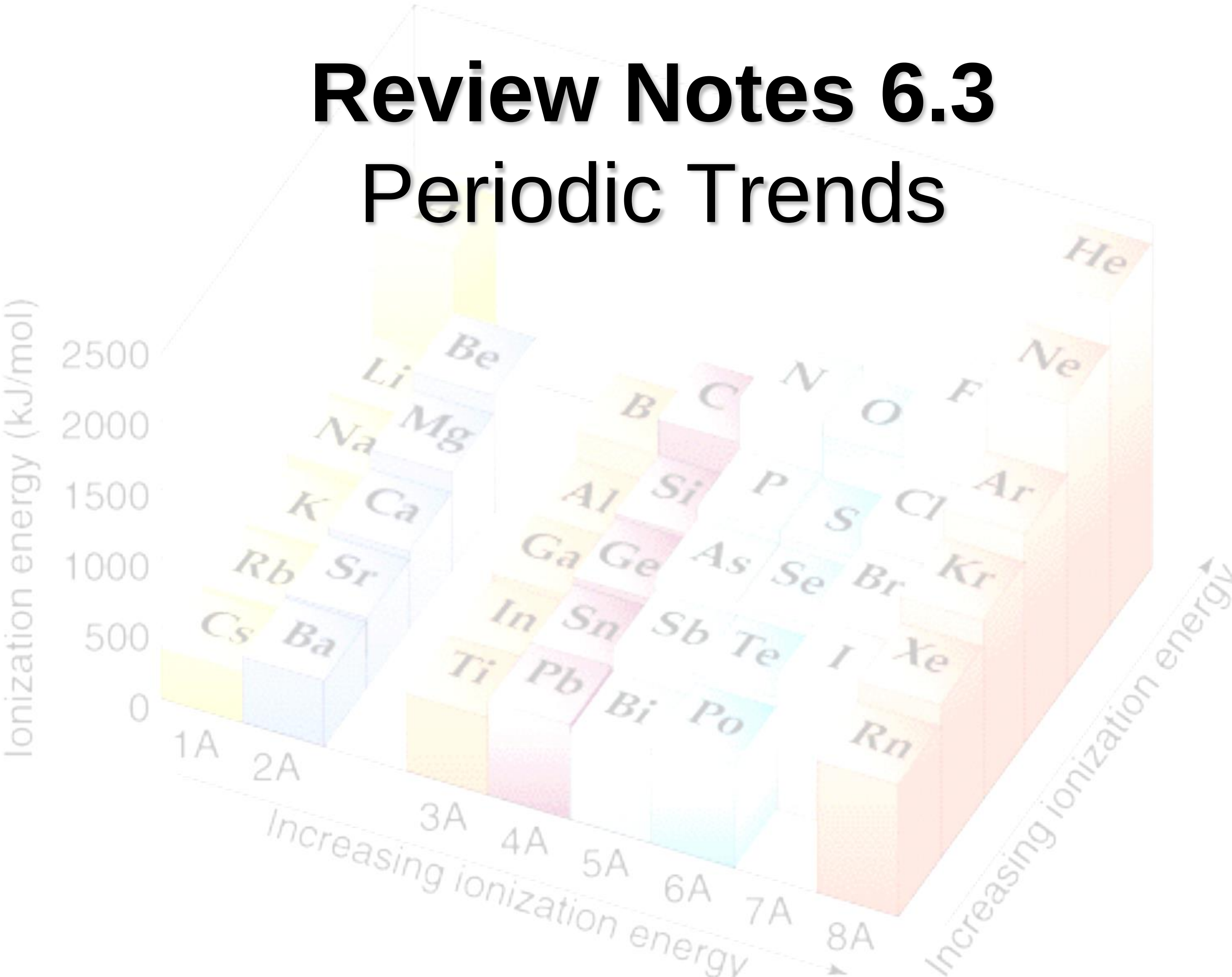
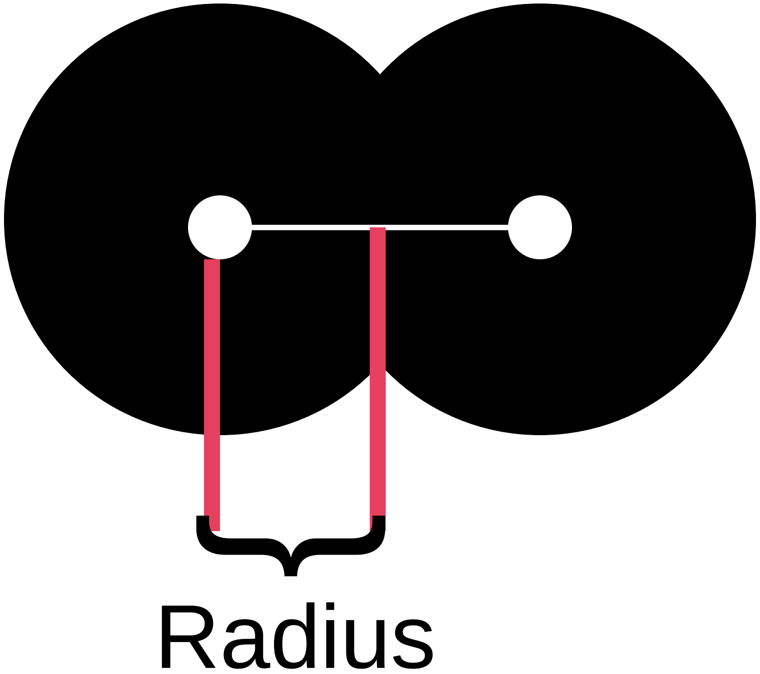
Review Notes 6.3
Periodic Trends

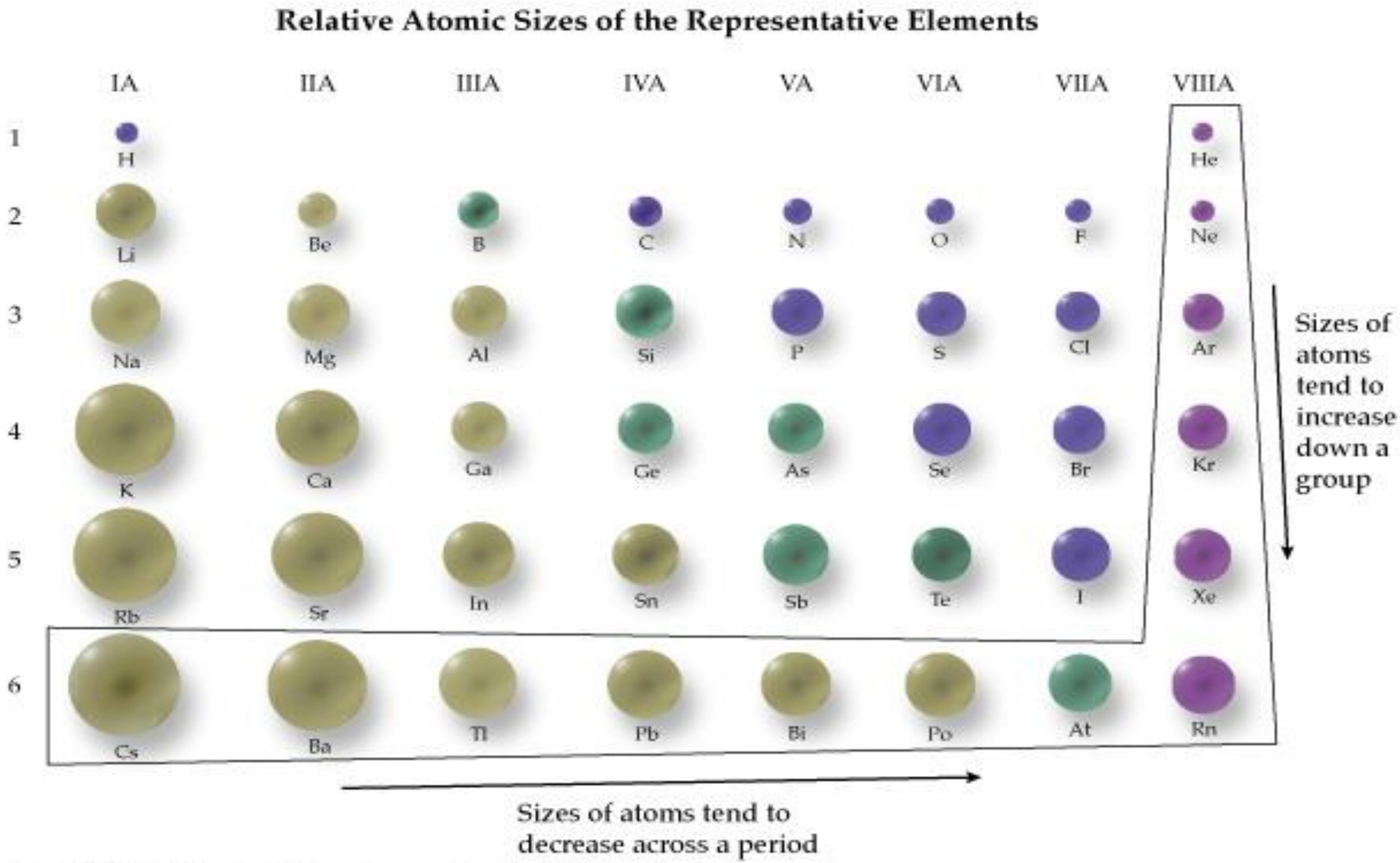


Atomic Size



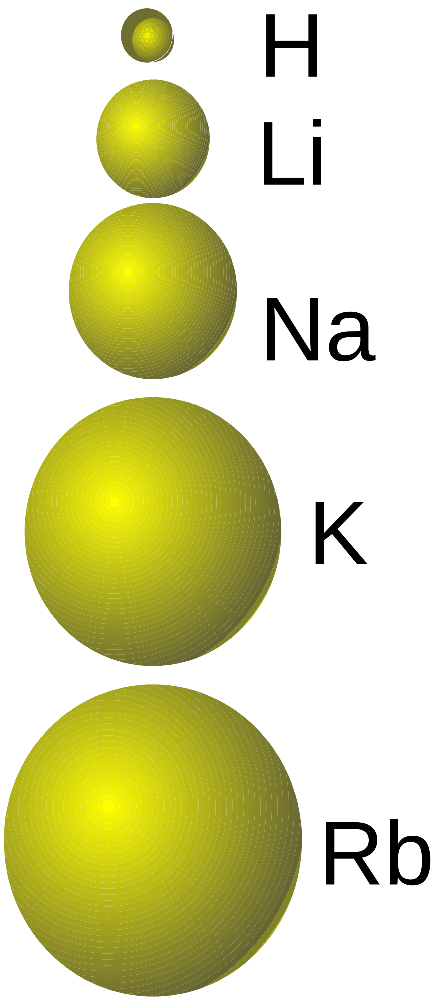
Atomic Radius - half the distance between the two nuclei of a diatomic molecule.

Trend in Atomic Radius



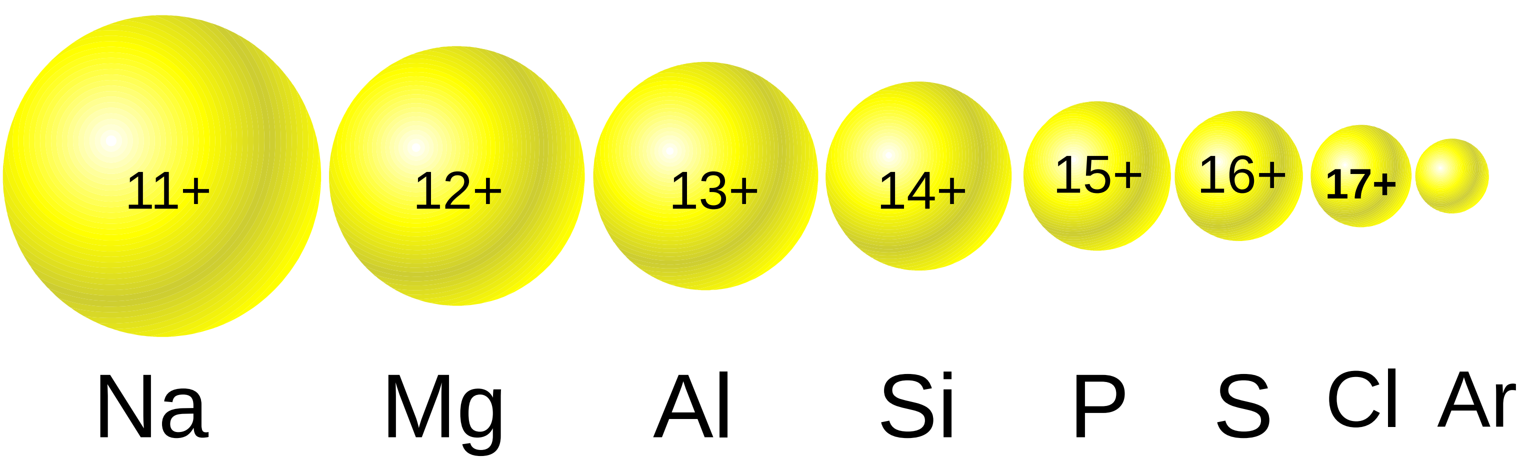
#1. <u>Atomic Size</u> - Group trend

- Down a group, atoms have <u>another energy level.</u>
- Valence electrons are further from the nucleus.
- So the atoms get *bigger*.



#1. Atomic Size - Period Trend

- Electrons are in the same energy level.
- Nucleus is stronger as you move right!
  - electrons are pulled closer.
- So… across a period, get **smaller**



Ions

- An **ion** is an atom *(or group of atoms)* with a *positive or negative charge.*

Atoms *are neutral! ($p^+ = e^-$)*

- Ions form when electrons are *transferred*.

Determining the Ion Formed

- Atoms try to achieve a ___noble___ ___gas___ configuration.

  (s^2p^6 = *stable*)

  – *Locate the nearest noble gas*

  – *Count how many e^-'s either gained or lost, skip the d-block!!*

Practice Problem: **How many electrons are gained or lost when forming an ion from the following elements?**

a) Magnesium: 2 = **+2** (gain or lose)   b) Iodine: 1 = **-1** (gain or lose)

c) Gallium: 3 = **+3** (gain or lose)   d) Boron: 3 = **+3** (gain or lose)

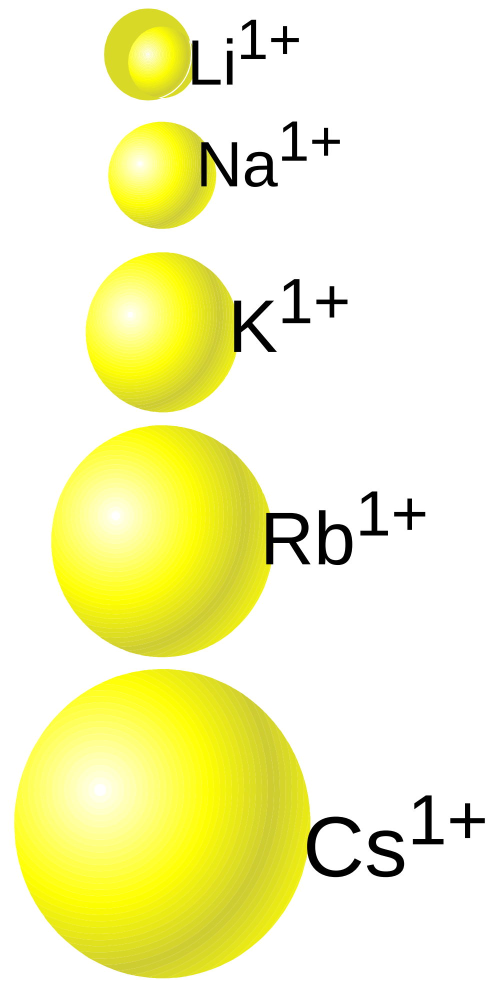
Review Notes 6.3 (pt.2)

Periodic Trends

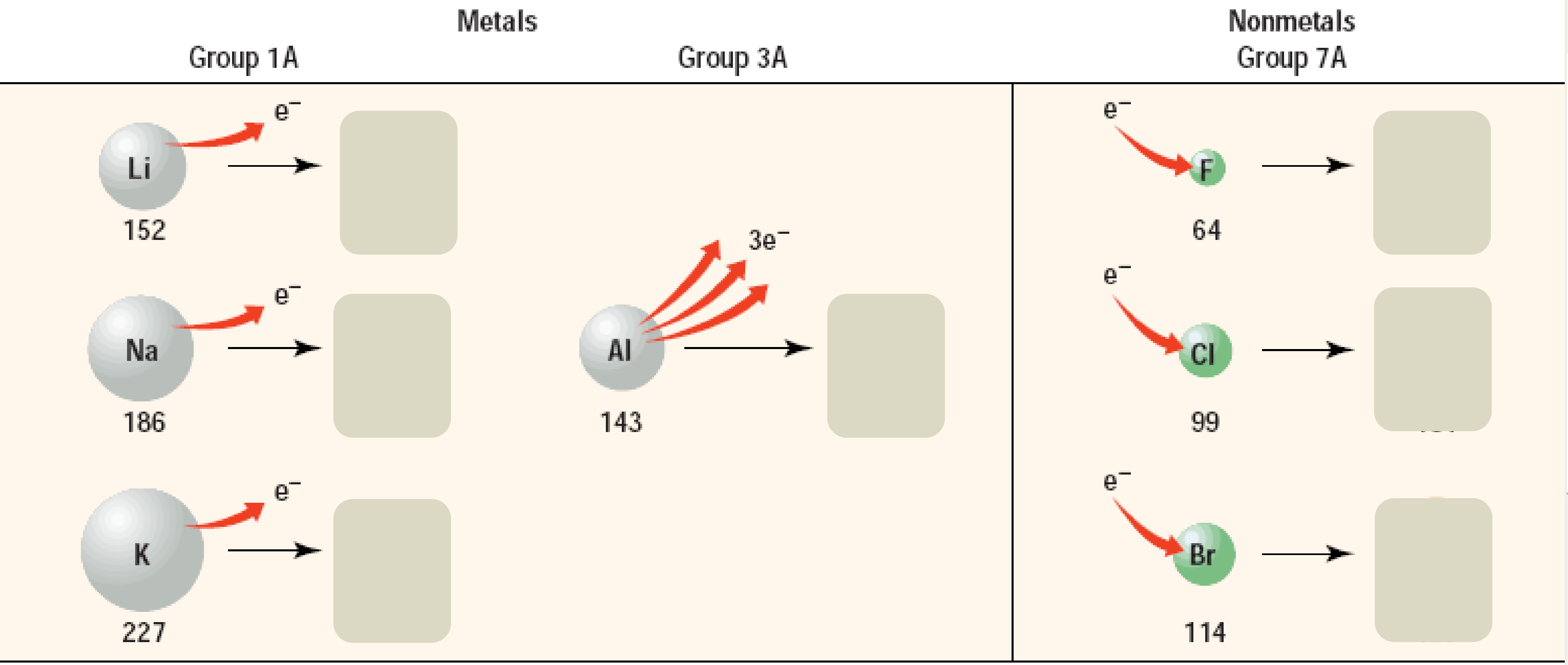
#2. Ionic Radii - Group trend

- Down a group, atoms have another energy level.
- So the ions get *bigger*.
  - Metal ions are smaller than atoms.

Ionic and atomic group trend are the same!



#2. Ionic Radii - Period Trend



Li^{1+} Be^{2+} B^{3+}

N^{3-} O^{2-} F^{1-}

Lost e- (lost valence shell!)

Atomic Size vs. Ion Size

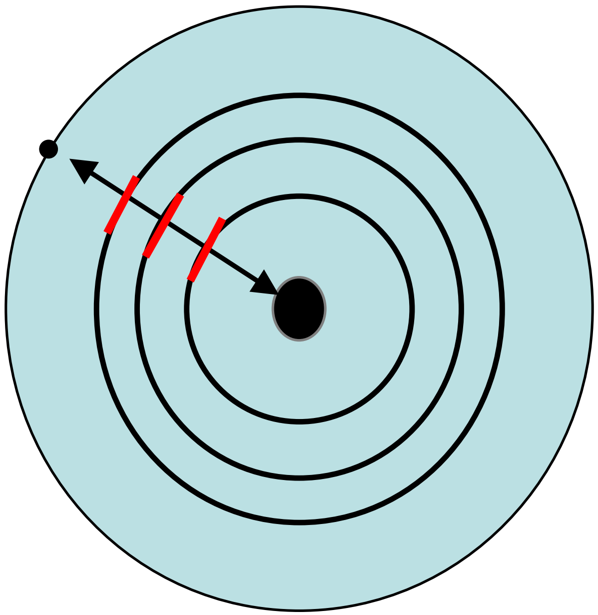
Cation = (__+__) charged atom created by __removing__ e-'s.

- Cations are __smaller__ than the original atom.
- __Metals__ generally form cations.

- **Anion** = (__–__) charged atom created by __adding__ e-'s.
  - Anions are __larger__ than the original atom.
  - __Nonmetals__ generally form anions.

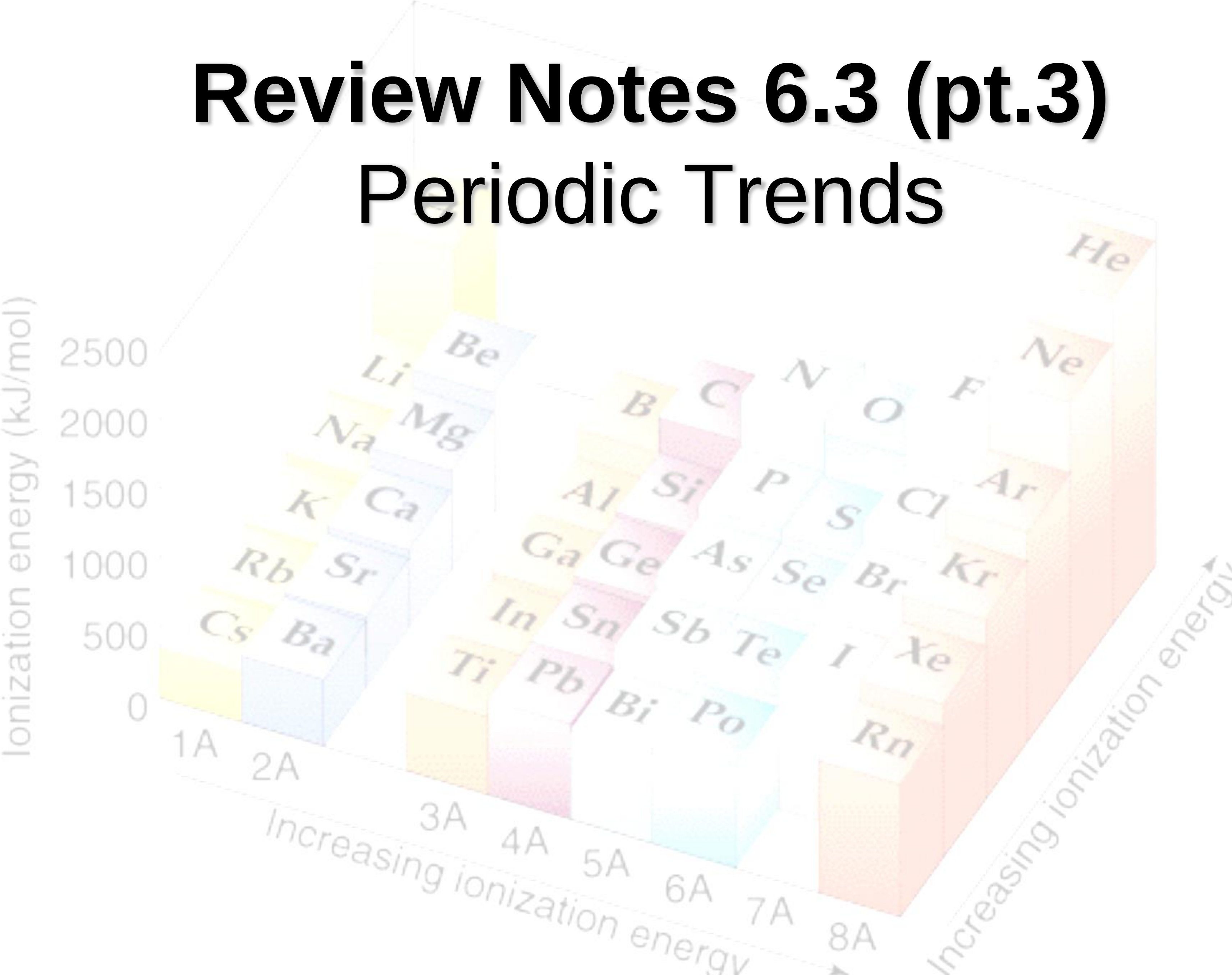
Shielding Effect

- Valence electrons are shielded from the nucleus by the energy levels.
- More energy levels = less attraction.



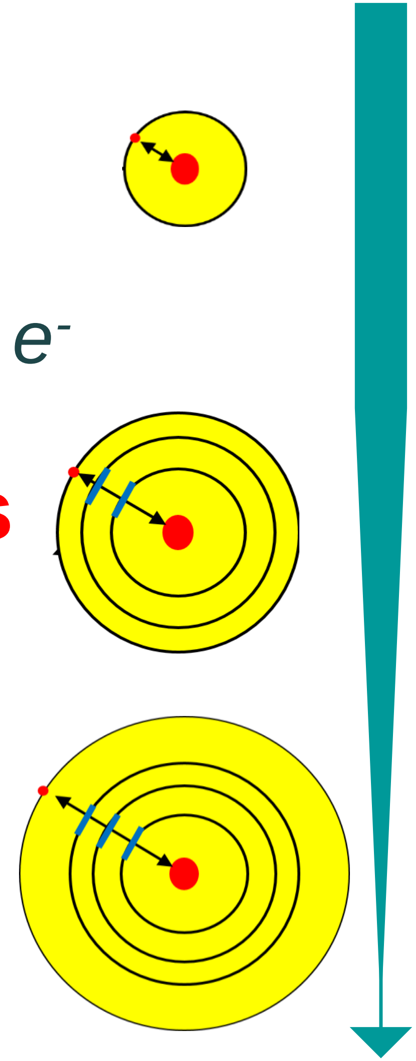
Review Notes 6.3 (pt.3)

Periodic Trends



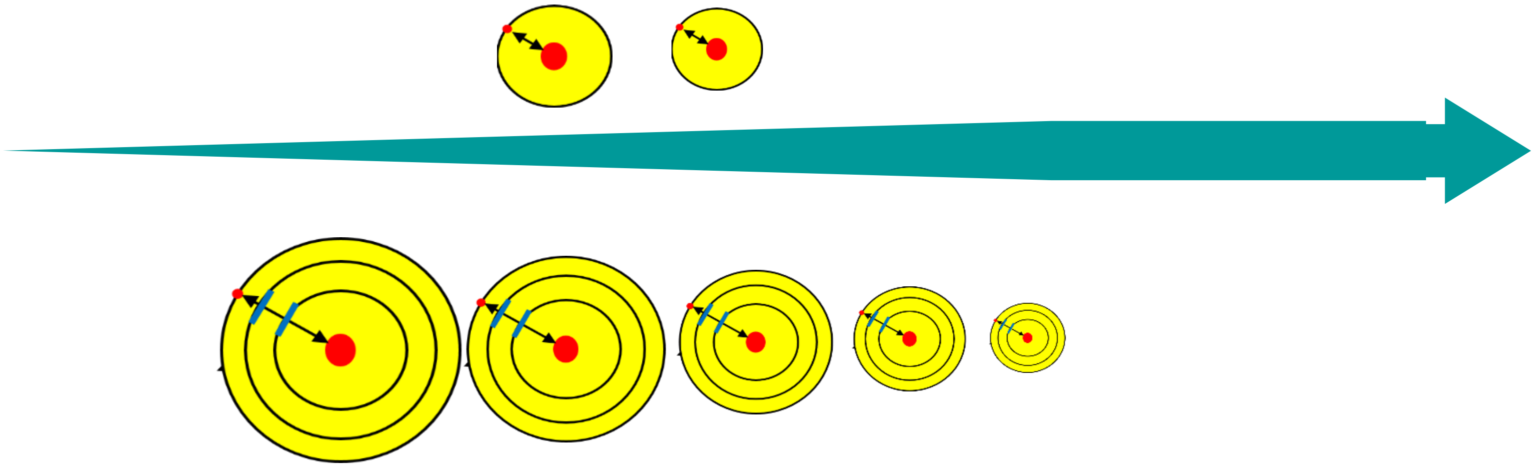
#3. Ionization Energy - Group trend

- Energy required to remove an e^-
  - –*First ionization energy = first e^-*
  - –*Second ionization energy = second e^-*
- Down a group, the **IE decreases** because...
  - –*Electron is further from nucleus.*
  - –***More shielding**.*



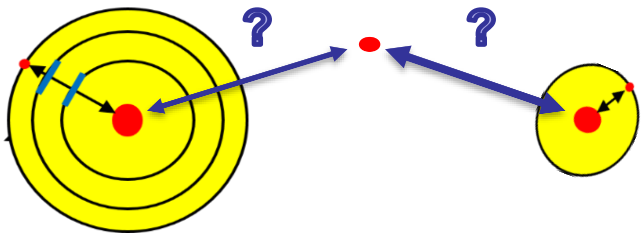
#3. Ionization Energy - Period trend

- Same energy level = same shielding.
- Stronger nucleus = greater attraction!
  - So **IE increases**



#4. Electronegativity- Group Trend

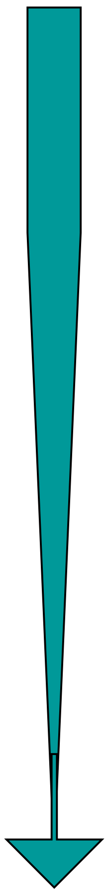
- Tendency for an atom to attract adjacent electrons.



- Less energy levels = less shields

  = greater attraction to nucleus

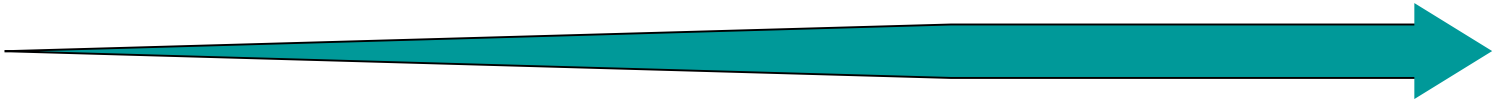
  = higher electronegativity



Electronegativity Period Trend

- Metals lose electrons
  - Thus, **low electronegativity**

- Nonmetals gain electrons.
  - **High electronegativity.**



Question 1

For each of the following pairs, predict which atom or ion is larger.

a. Mg, Mg^{2+} Mg

b. S, S^{2-} S^{2-}

c. Ca^{2+}, Ba^{2+} Ba^{2+}

d. Cl^{-}, I^{-} I^{-}

e. Na^{+}, Al^{3+} Na^{+}

Question 2

For each of the following pairs, predict which atom has the higher …

a. IE: Mg, Na Mg

b. En: S, O O

c. IE: Ca, Ba Ca

d. En: Cl, I Cl

e. En: Na, Al Al

f. IE: Se, Br Br

Trends in the Periodic Table

Ionization Energy

- Ionization energy is the energy required to ____remove____ the outer most electron in an atom.
- Moving Down a Group= ____decreases____
  - less energy is needed
  - Why? You are trying to remove an electron that is farther and farther out (for larger and larger atoms).
  - These e^-'s are not as ____attracted____to the nucleus.
  - In general, the larger the atom, the less attracted it is to its e^-'s.

Trends in the Periodic Table

Ionization Energy

- Moving Across a Period= generally __increases__________
  - Why? Moving across a period takes us from metals to nonmetals. More ionization energy is needed for __nonmetals______ compared to __metals______.
  - Also, since metals generally form __cations______, it won't take as much energy to remove it's outer most electron.
  - Remember that as you move across the period, the atoms get smaller______ and therefore __more__ attracted to the electrons.

Trends in the Periodic Table

Atomic Size (Atomic Radius)

Moving Down a Group= the size of the atoms __increases__

Why? You are adding ____more____ electrons to higher and higher energy levels (farther and farther out.)

Moving Across a Period= the size generally __decreases__

Why? You are adding more e^- and p^+ to the same energy level.

This causes more _____attraction_____ of opposite charges and it _____pulls_____ the electron cloud inward.

Trends in the Periodic Table

"Successive Ionization Energies"

- "Successive Ionization Energies" means the energy required to remove a __2nd__ or a __3rd__ electron from an atom.
  - Removing more and more e^-'s requires __more__ and __more__ energy.
  - Why? The remaining e^-'s are more __tightly__ __bound__ to the nucleus.

Trends in the Periodic Table

Electronegativity

- Electronegativity is a relative value (from__0 – 4.0__) which compares how much an atom is attracted to _electrons
- Moving Down a Group= generally ___decreases__ (less attraction)
  - Why? The outer electron is farther and farther away from the nucleus. These e^-'s will not be as attracted to the larger and larger atoms.
- Moving Across a Period= generally __increases__
  - Why? Again, the atoms are getting _smaller_ so they are _more__ attracted to the outer electrons.
  - Also, moving across a period takes us from metals to nonmetals. Since nonmetals generally form ___anions_, they tend to _____gain__ e^-'s anyway, and this makes them ______highly_____ attracted to e^-'s when forming a chemical bond.