Chapter 7: Electromagnetic Radiation (Light Energy)

November 15, 2022

Chemistry Department, Cypress College

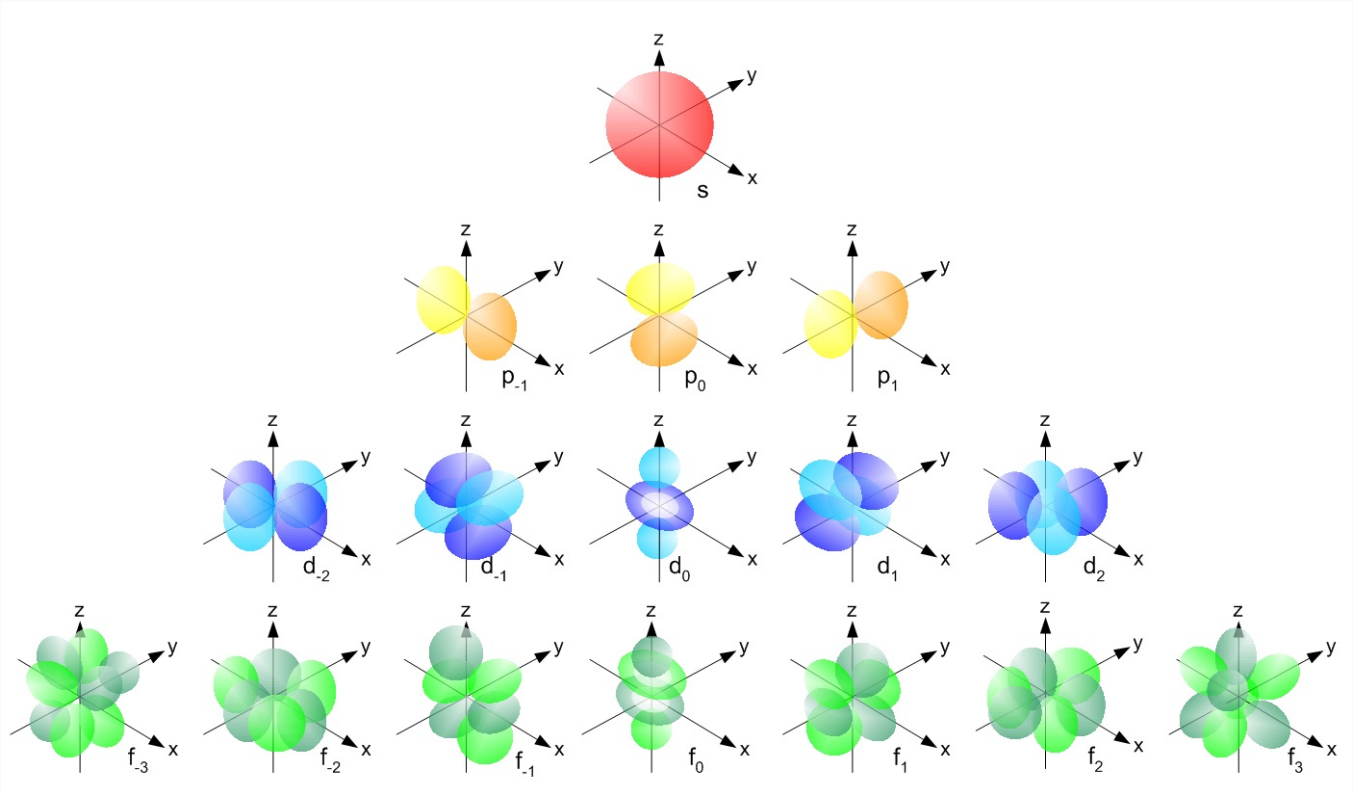
Class Announcements

Lecture

- Finish Ch 7 and begin Ch 8
- Quiz and Homework assignment released Fri, Nov 18th at 3pm
- Exam 3 on Nov 22nd; 10 questions covering Exam 2 and Chs 7-8

Outline

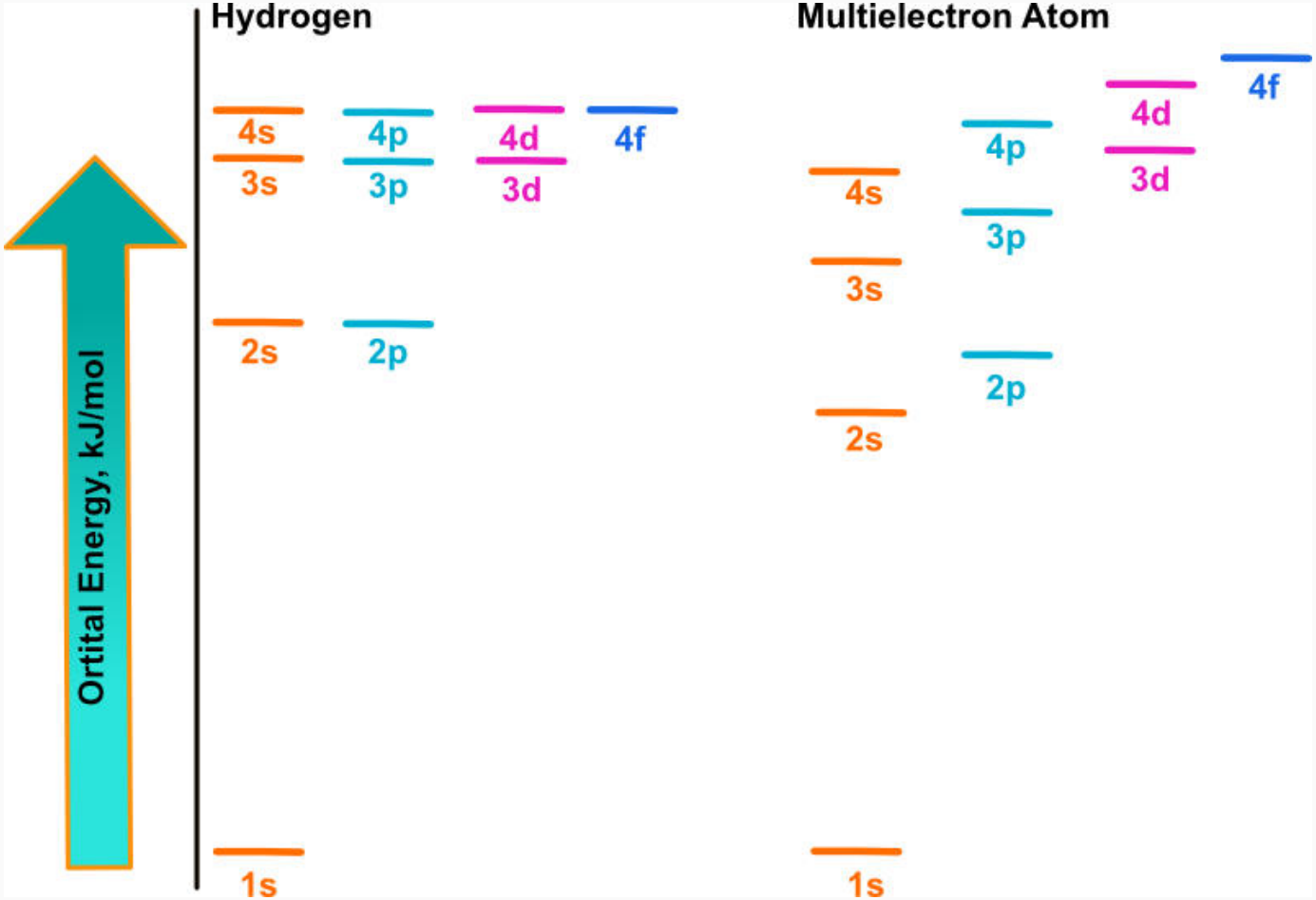
Atomic Orbitals



- Specific orbitals occupy certain **principal energy level** e.g. $n = 1, 2, 3, \cdots$
- Basis in which atoms form bond; atomic orbitals combine to make molecular orbitals

Orbital Diagram - Multielectron Element

Q: What do notice about the relative atomic orbital energies?



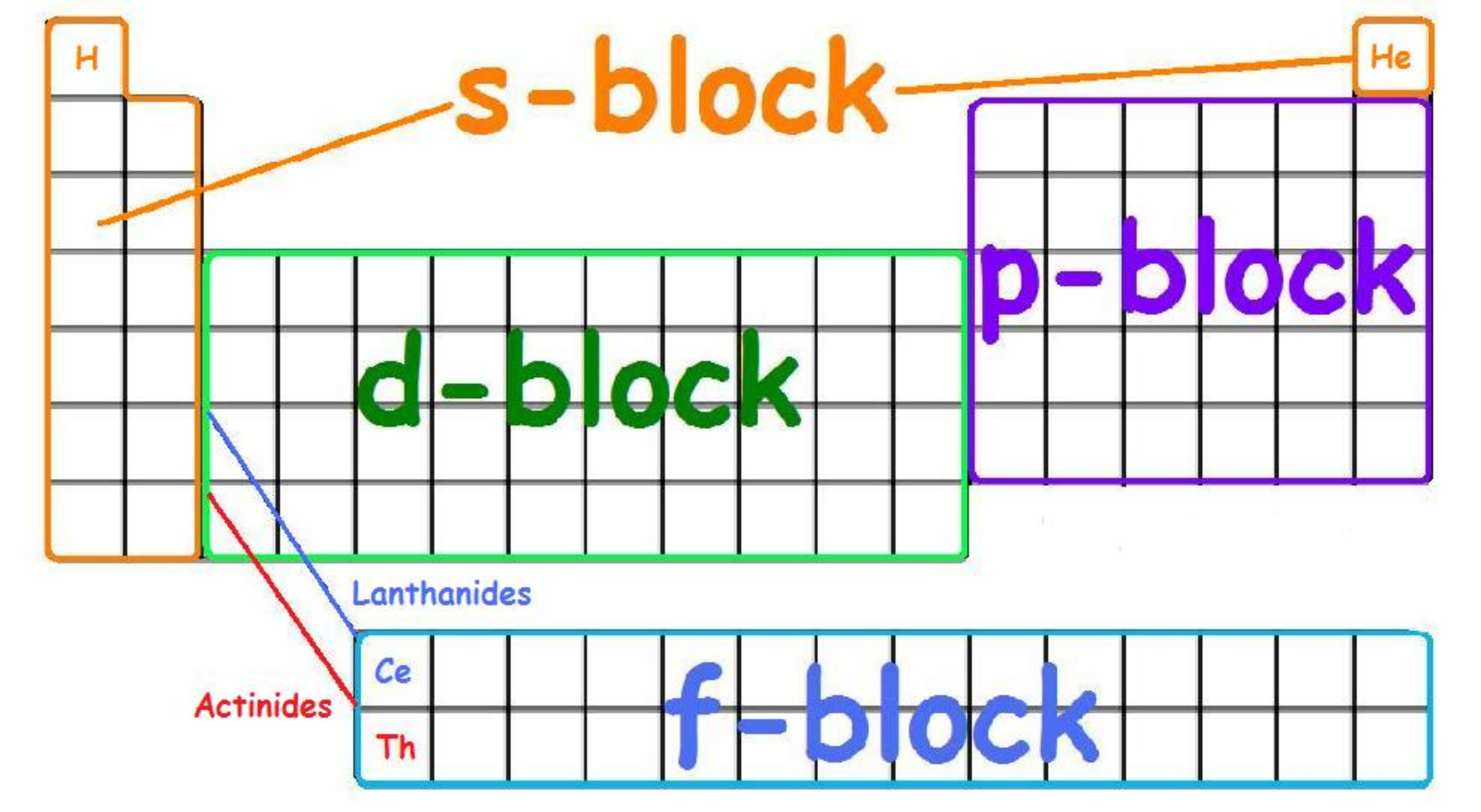
Principles for Filling Atomic Orbitals

Aufbau principle - electrons fill an orbital starting with the lowest energy level

Pauli exclusion princple - No two electrons with the same spin can occupy the same orbital

Hund's Rule - Maximize the number of unpaired electrons

Relating to Periodic Table



Purpose of Electron Configurations

- Outermost shell is referred to as the valence electrons (**Q:** What is special about valence electrons?)
- Innermost shell is the core electrons
- Predicts stability of the atom e.g. unfilled orbitals indicate instability
- Make predictions how elements react forming new chemical compounds

Core and Valence Electrons

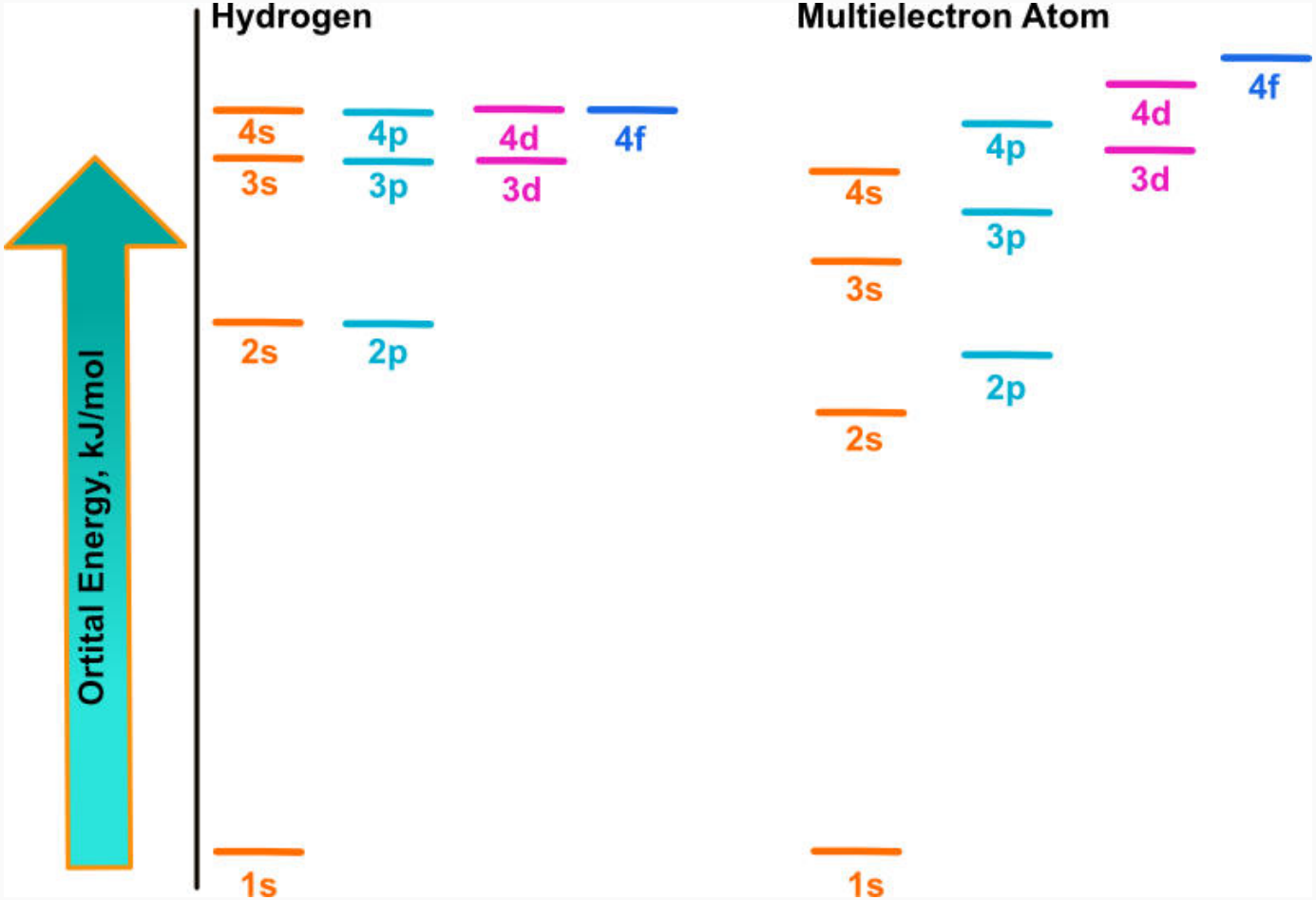
Core Electrons - Energy level n below the valence electrons and these are completely filled orbitals

Valence Electrons - Outermost electrons above the energy level n of the core electrons

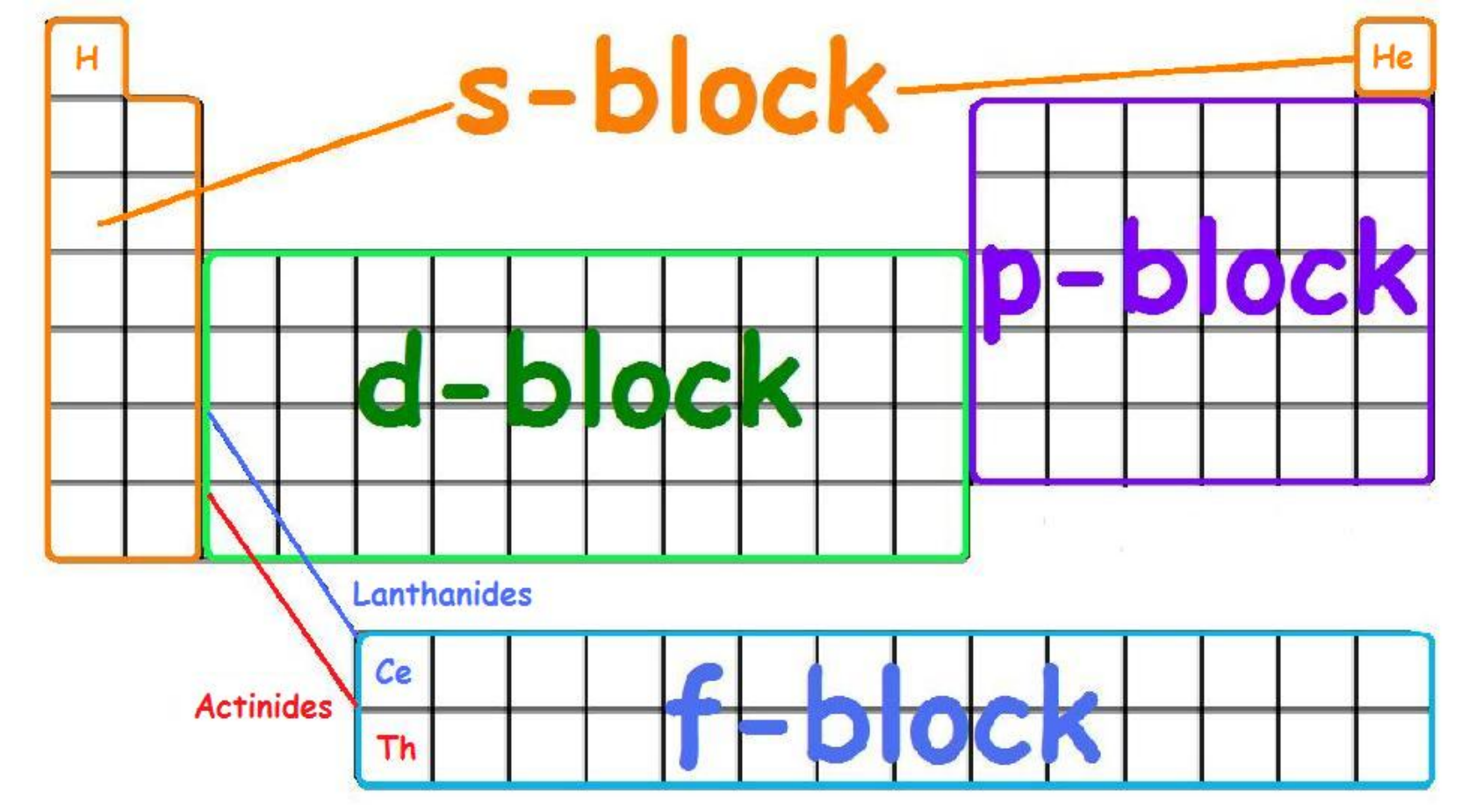
Example: Si - $1s^2 2s^2 2p^6 3s^2 3p^2$

Special Note about d-orbitals

Energy levels of 4s and 3d are close along with subsequent n levels e.g. 5s and 4d, 6s and 5d

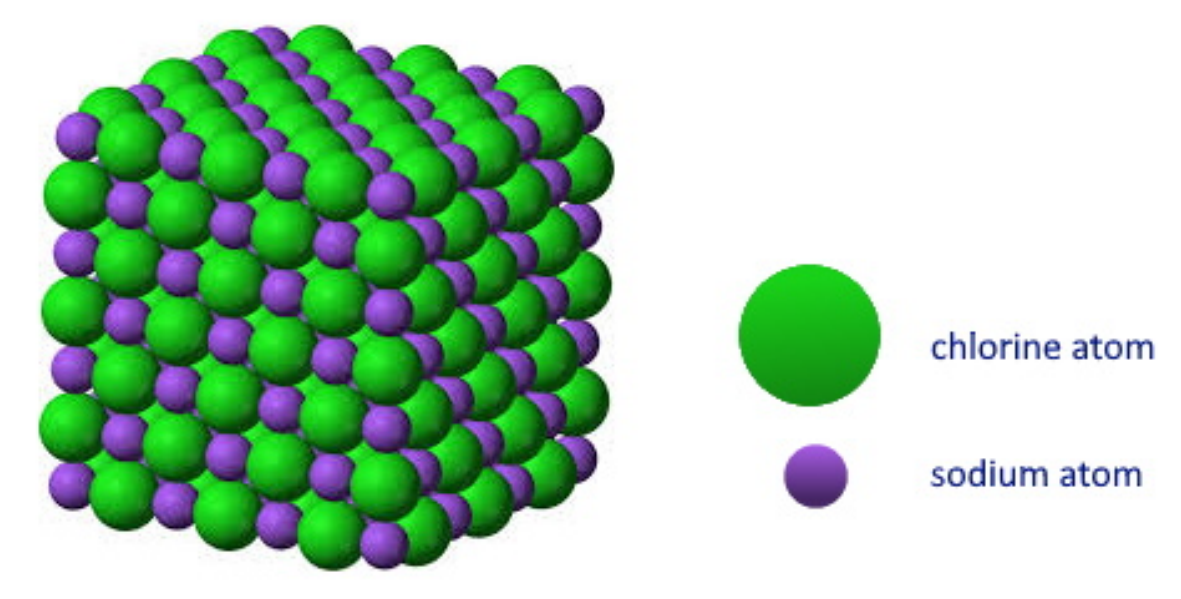


Relating to Periodic Table



Electron Configuration of Ions

Q: What is a cation? What is an anion?



Cation: Sodium ion (Na^+) **Anion:** Chloride ion (Cl^-)

Q: For electron configuration, how do we add/remove electrons from atomic orbitals for anion/cation?

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Practice: Writing Electron Configurations

$\mathbf{F}^{-}$

$\mathbf{Al}^{3+}$

$\mathbf{Na}^{+}$

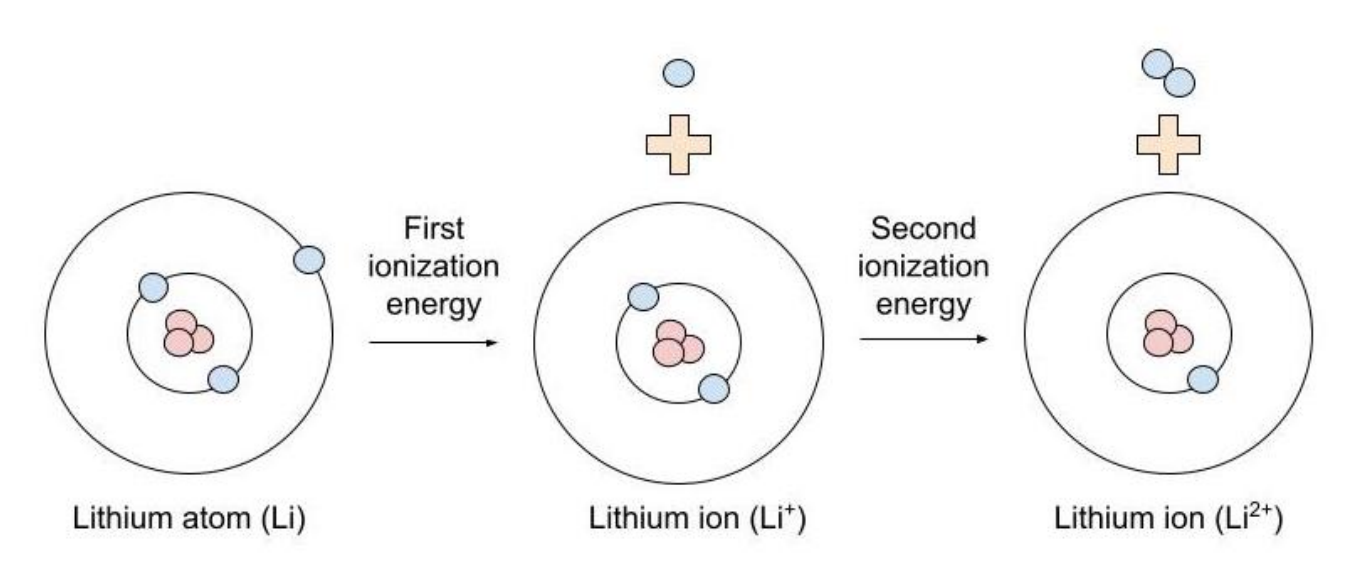
$\mathbf{Fe}^{3+}$

$\mathbf{S}^{2-}$

Outline

Meaning of Ionization

Ionization energy - Energy required to eject an electron



First ionization takes 520 kJ/mol and second ionization takes 7298 kJ/mol

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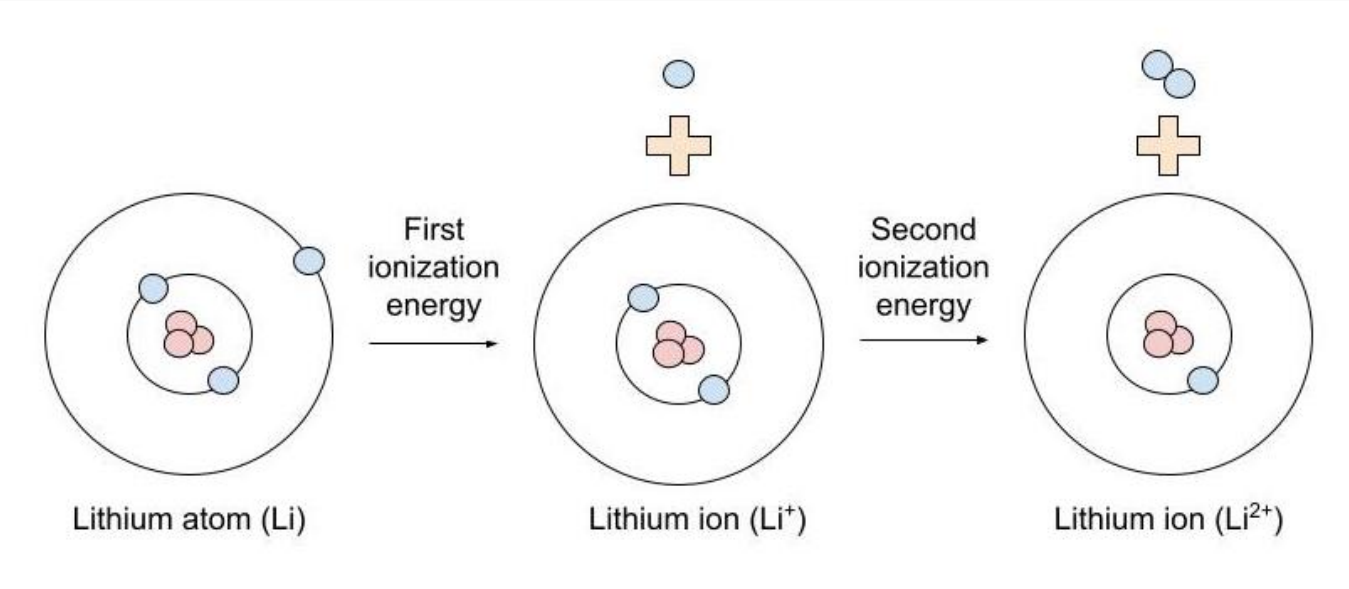

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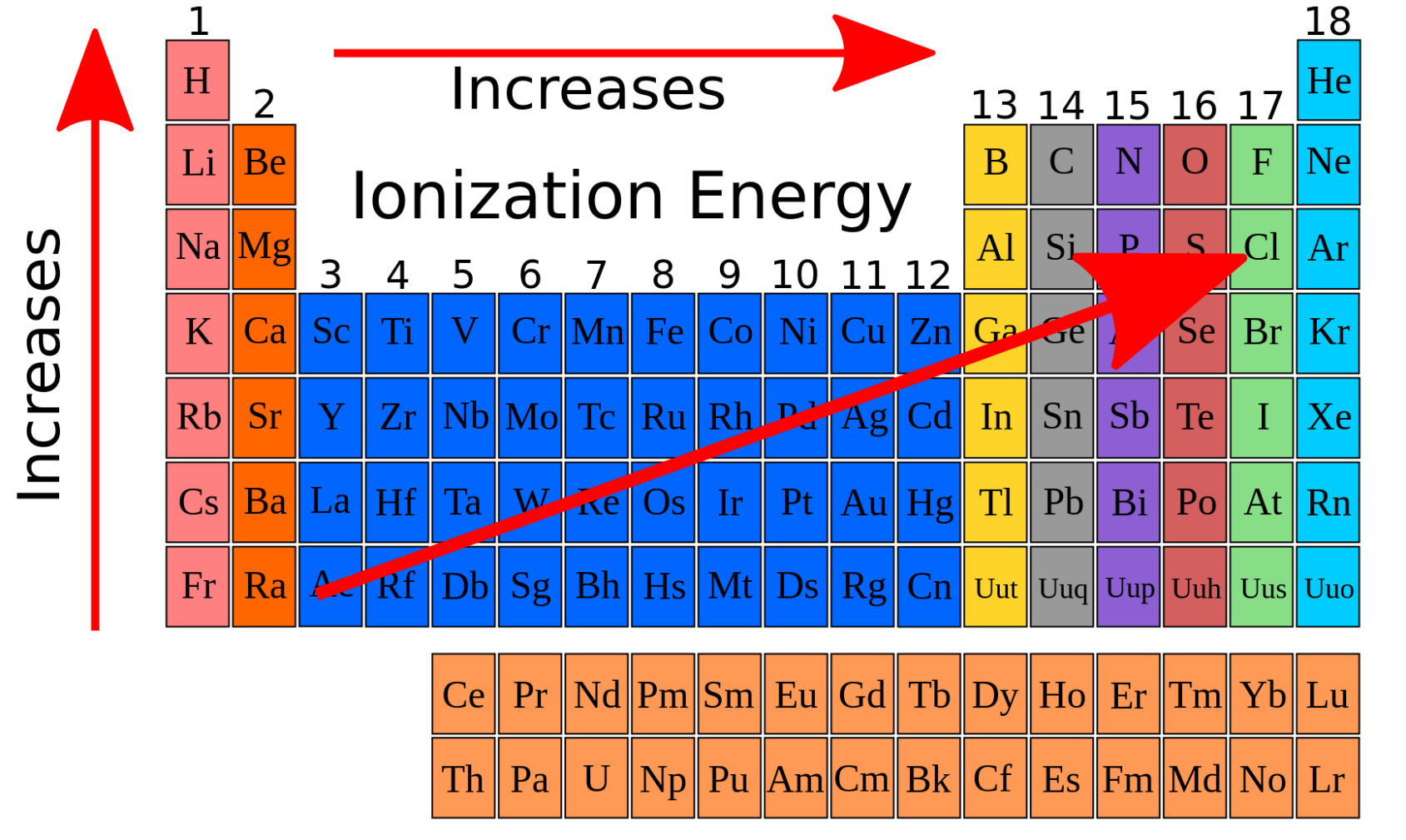
Q: Why is the second ionization energy significantly higher?

First Ionization Energy Trends



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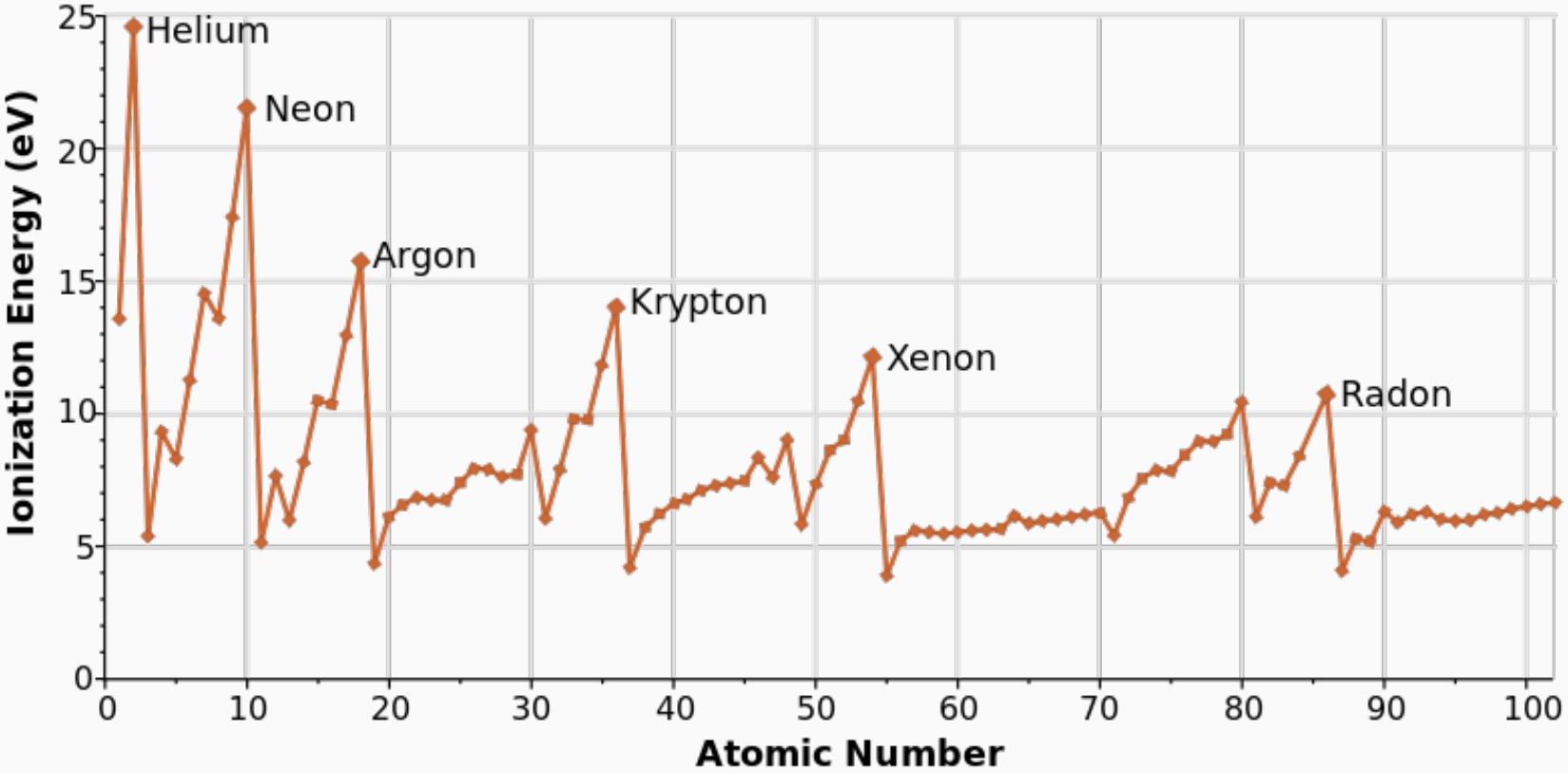
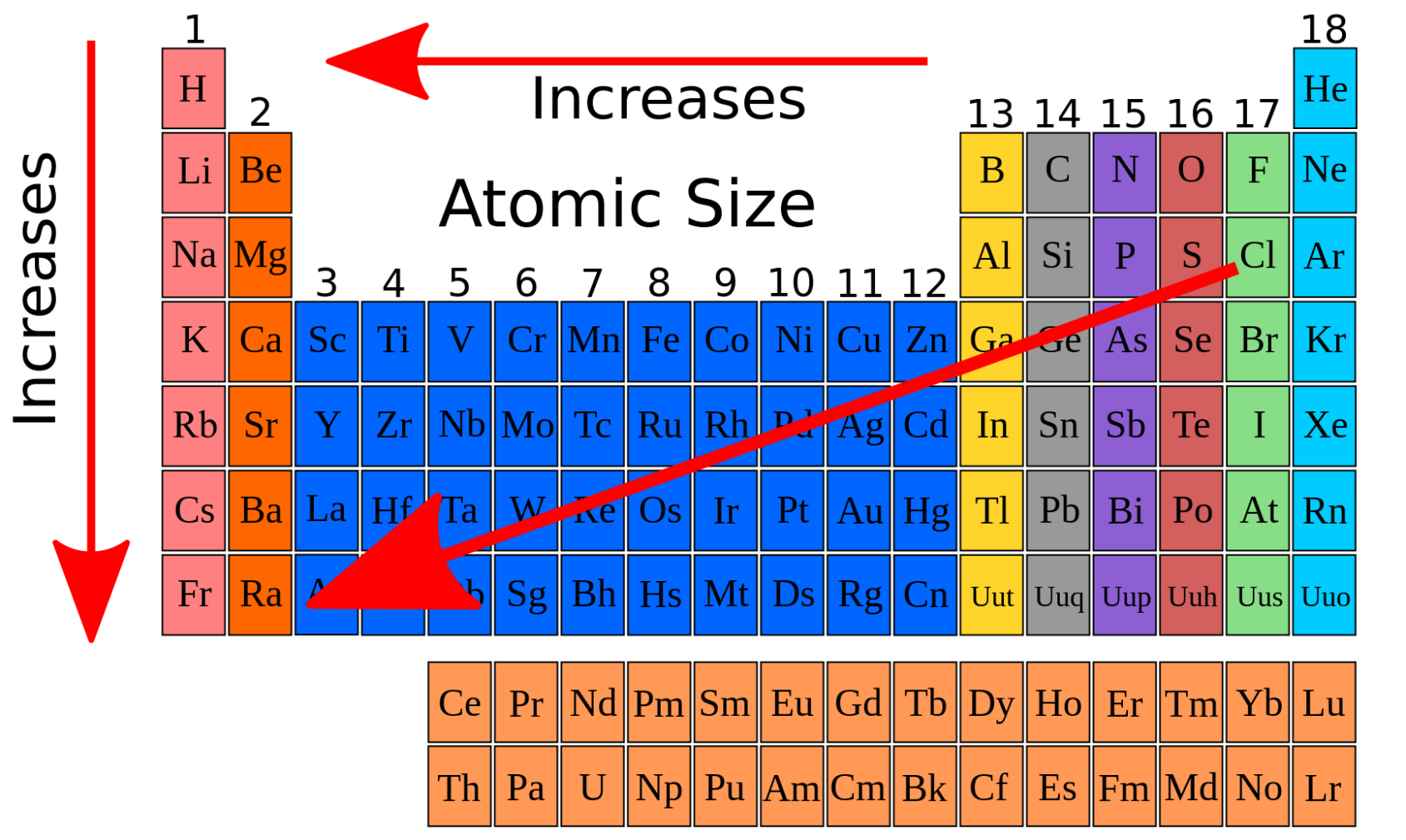


Atomic Sizes of Neutral Atoms



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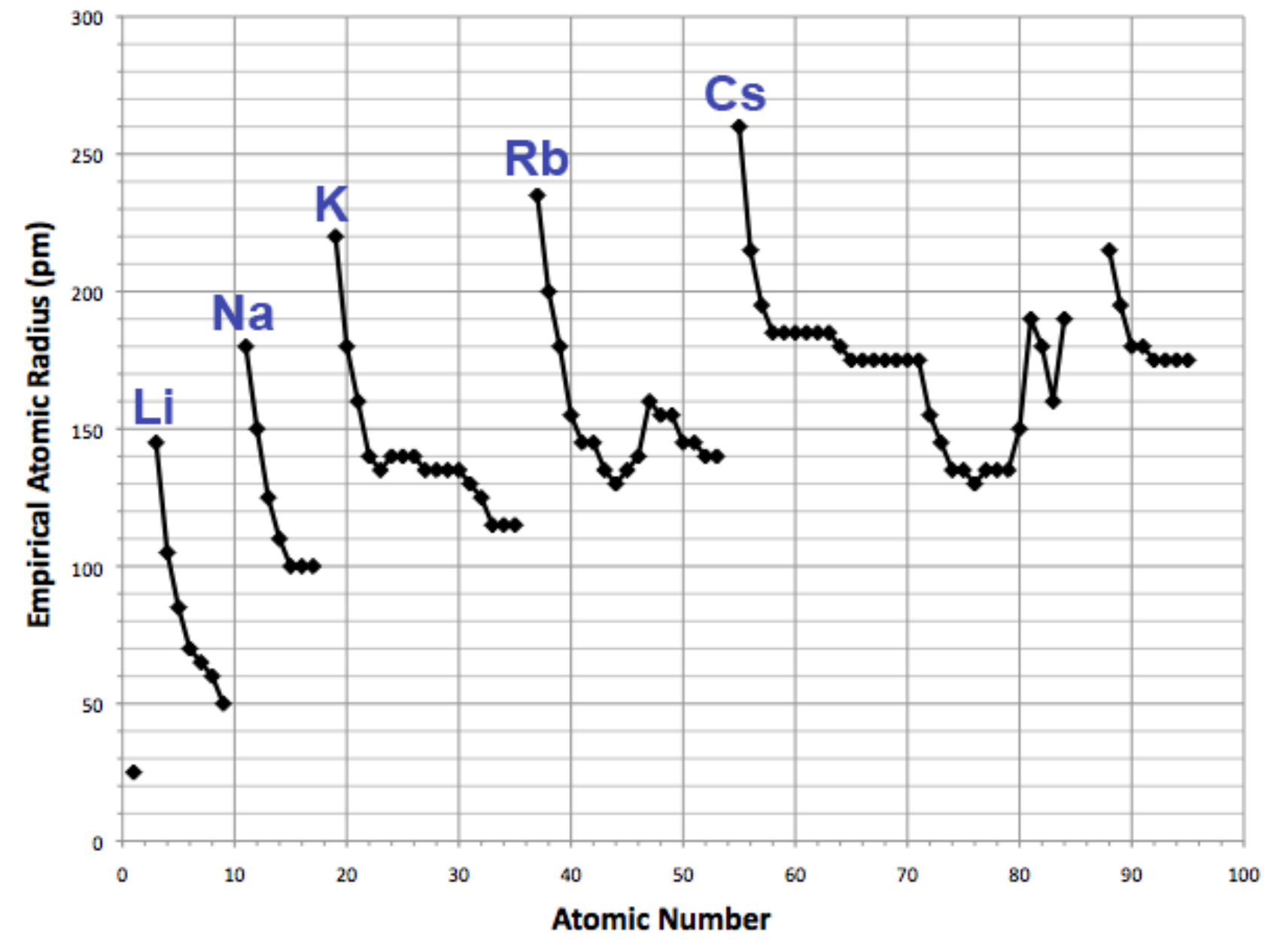

Atomic Sizes of Ions