

# Periodic Trends 5C

The Trends: You will need to Identify and Explain the trends in atomic radius, ionic radius, electronegativity and ionization potential (energy) within a group and a period.

## The Why:

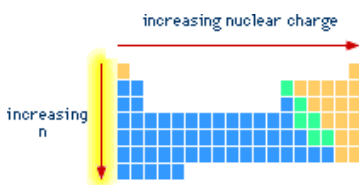
To understand the explanations you need to know negative electron energy levels (cloud) are attracted to the positive nucleus and this attraction weakens as the distance between the outer electrons and the nucleus increases. This attraction may be referred to as an electrostatic attraction. Just like when you increase the distance between two magnets, the greater the distance between the nucleus and the electron cloud the weaker the attraction (and visa versa). Focus on the number of protons in the nucleus and the distance between the nucleus and outer energy level.

There are **just three whys** that are applied over and over again for each trend except for ionic radius.

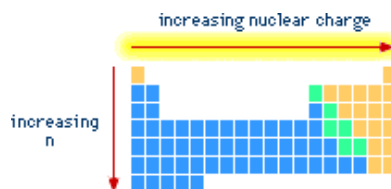
- Down a Group:** The orbitals get further from the nucleus as you go down a group (outer orbital further from nucleus) causing the outer electrons to be less attracted by the nucleus down a group.
- Down a Group** the electrons in the inner energy levels repel the electrons in the outer energy level reducing the attraction the nucleus has on the outer energy level. This is called **electron shielding**.
- Across a Period:** The outer orbitals get are closer to the nucleus as you go left to right across a period because they have the same number of energy levels but the nucleus has a greater number of protons this increased attraction pulling the outer energy level closer to the nucleus.

Group:

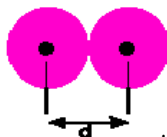
Period:



1. Orbitals are larger.
2. Electrons are farther from the nucleus.
3. Valence electrons are less tightly bound.



1. Electrostatic attraction increases.
2. Electrons are pulled closer to the nucleus
3. Valence electrons are more tightly held.

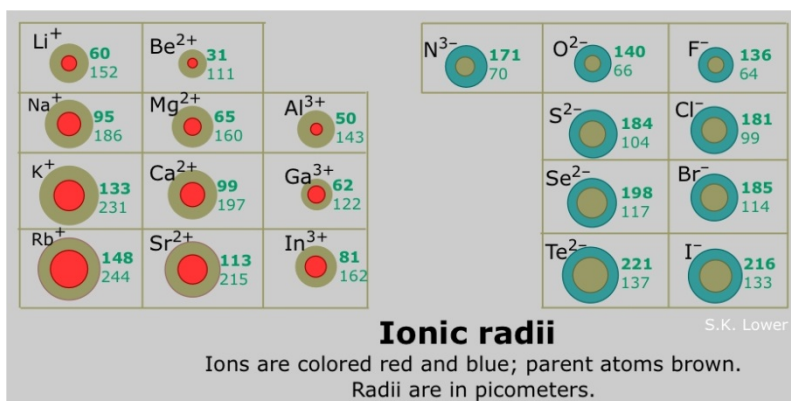


**Atomic Radius:** Unlike a ball, an atom doesn't have a fixed radius. The radius of an atom can only be found by measuring the distance between the nuclei of two touching atoms, and then halving that distance.

1A		2A		3A		4A		5A		6A		7A		8A	
Li	Be	B	C	N	O	F	Ne								
152	112	85	77	75	73	72	71								
Na	Mg	Al	Si	P	S	Cl	Ar								
186	160	143	118	110	103	100	98								
K	Ca	Ba	Ge	As	Se	Br	Kr								
227	197	135	122	120	119	114	112								
Rb	Sr	In	Sn	Sb	Te	I	Xe								
248	215	167	140	140	142	133	131								
Cs	Ba	Tl	Pb	Bi	Po	At	Rn								
265	222	170	146	150	168	(140)	(141)								

- Group:** Radius of atoms increase as you move from one atom to the next down a group because each atom has an additional energy level and electron shielding increases (the inside energy level electrons repel the outer electrons reducing the ability of the nucleus to attract the outer energy level) making it which is further away.

- Period:** Radius decreases across a period because the atoms in a period have the same number of energy levels but the number of protons increase as you go from atom to atom across a period causing an increased attraction between the nucleus and the outer electrons resulting in the outer energy being pulled toward the nucleus making the radius smaller.

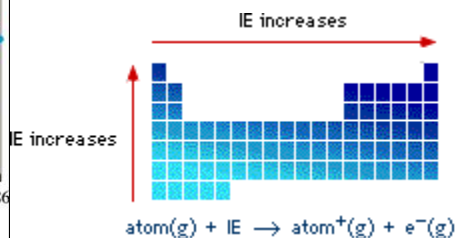
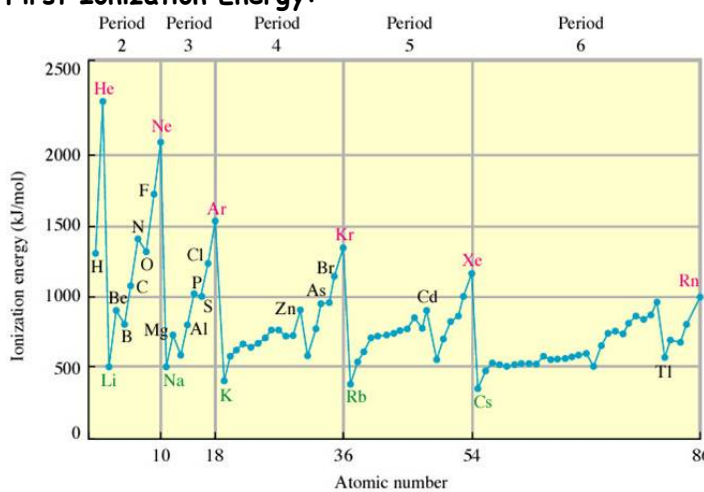


### Ionic Radius:

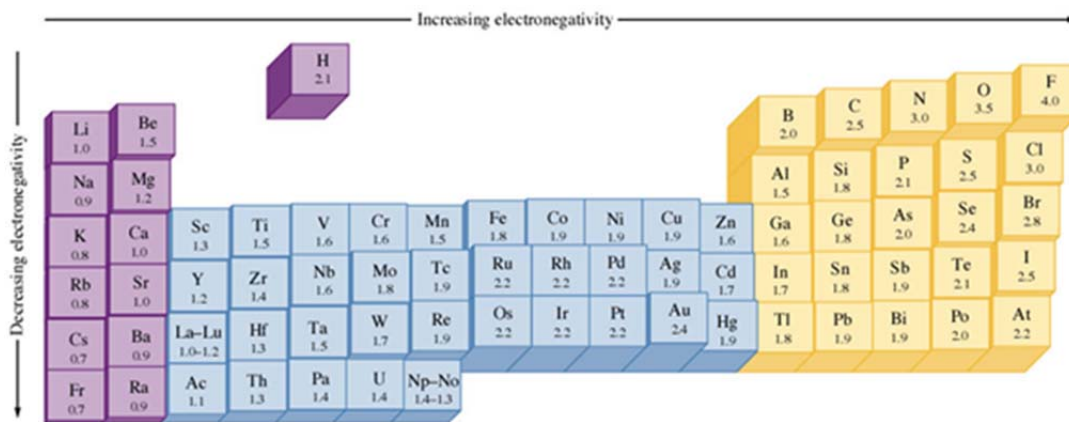
- **Cations** (positive charged ions, formed when metals lose electrons) have smaller radii than their neutral atoms.
- **Anions** (negatively charged ions formed when nonmetals gain electrons) have larger radii than their neutral atoms.

- **Cations** are smaller because they lose the electron(s) in their outer energy level when forming ions. The nucleus has an increased ability to pull the energy levels even closer to the nucleus because there is a greater positive charge than negative charge.
- **Anions** are larger because they gain electrons when becoming ions increasing the negative charge of the outer energy level. The nucleus has less ability to pull the energy levels towards the nucleus because there is a smaller positive charge than a negative charge.

### First Ionization Energy:



- **First Ionization energy (IE)** is the energy necessary to remove the most loosely held electron (outer most) from an atom.
- **GROUP:** Moving down a group, 1<sup>st</sup> ionization energy decreases because the distance between the most loosely held electron and the nucleus increase from atom to atom as you go down a group resulting in a decrease attraction between the nucleus and outer electrons therefore less energy is required to remove the electron down a group.
- **Period:** Moving across a period from left to right 1<sup>st</sup> ionization energy increases because the atoms in the same period have the same number of energy levels but the number of protons increase as you go from atom to atom across a period resulting in an increased attraction between the nucleus and the outer electrons therefore more energy is required to remove the outer most electron.



### Electronegativity:

- **Electronegativity:** is a measure of the ability of an atom to attract additional electron to it.
- **Group:** Electronegativity decreases down a group because the outer energy level is further away from the nucleus which results in a weaker nuclear charge available to attract additional electrons or less ability for an atom to attract electrons to it.
- **Period:** Electronegativity increases moving across a period from left to right because the atoms in the same period have the same number of energy levels but the number of protons increase as you go from atom to atom across a period increasing the attraction between the nucleus and the outer energy level resulting in a greater ability for atoms to attract electrons to it.

### Summary of the Trends:

