

## Interactive Periodic Trends: A Graphical Experience

This activity explores a variety of properties of the chemical elements as they vary based on position on the periodic table. You should have completed the Group Activity. You will need a copy of the periodic table and the interactive Excel spreadsheet.

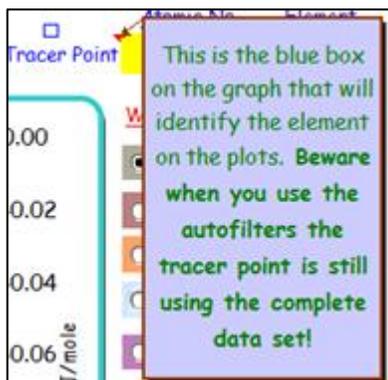
We will examine properties as a function of **increasing atomic number** in two fashions:

- (1) across a period and
- (2) down a group

The tabs as shown in the illustration below will be used to navigate the spreadsheet. **Today**, you will be using the atom properties tab and the ion properties tab.



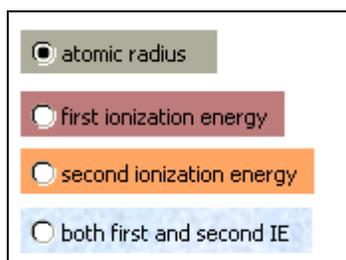
The following interactive Excel features will be found on this spreadsheet.



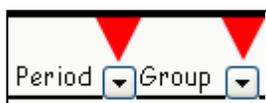
**Comment Boxes** - look for **red** triangles on a cell for info



**Spinner** - click on the up or down arrow to move the tracer points on the graphs



**Option Buttons** - to select what data that is graphed - click on a button (you can only select one at a time)



**Autofilters** - click on black arrow to get a dropdown menu, select the period or group you want to plot (select all to get the full data set)



**Check Boxes** - click on for action (you may select any number of these)

There are four factors that affect the periodic trends:

- A. Positive Protons like Negative Electrons. Electrons do not like other electrons.
- B. **Nuclear Charge** (# protons in the nucleus): the more protons in the nucleus result in the atom having more strength to pull the electrons closer. (affects period trends)

**Example:** Nitrogen has 7 protons and Boron has 5 protons. Nitrogen has a stronger nuclear charge.

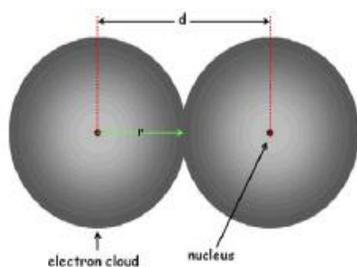
- C. **Energy Level** : The more energy levels an atom has the farther away the valence electrons are from the nucleus (affects group trend)

**Example:** Lithium:  $1s^2 2s^1$  & Cesium:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^1$  Cesium and Lithium both have 1 valence electron but cesium has 6 energy levels whereas lithium has 2 energy levels.

- D. **Shielding Effect**: The change in energy levels causes the inner electrons to block the positive charge of the nucleus (nuclear charge) from reaching the valence electrons. (affects group trends)

**Example:** Cesium has 6 energy levels whereas lithium has 2 energy levels; therefore, cesium has more nuclear charge shielding than does lithium.

The Trends:

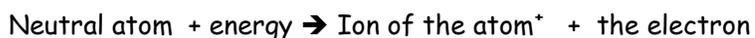


### 1. Atomic Radius (Atomic Size)

The atomic radius or "size of an atom" can be found experimentally by dividing the distance between two nuclei of an element measured by x-ray diffraction. The radii are measured in units of picometers, pm, where  $1 \text{ pm} = 10^{-12} \text{ m}$ .

### 2. Ionization Energy (IE)

An atom will gain, lose, or share electrons to become stable, like a noble gas  $ns^2 np^6$  (Except for energy level 1) this is known as the **octet rule**. An electron can be removed if enough energy is supplied.



An **ion** is an atom that has lost or gained an electron resulting in a positive or negative charge. The process of making an ion is called ionization. Therefore, the **ionization energy** (IE) is the energy needed to remove an electron.



Ionization energy is measured in Mega Joules per Mole (MJ/mole).

### 3. Electronegativity (EN)



Atom A wants the valence electrons from atom B. **Valence electrons** are the electrons on the outermost energy level of an atom. Therefore, **electronegativity** is the likelihood that a bonded atom WANTS to take valence electrons from the other atom in the bond. It is like tug of war over the electrons. The atom that is closer to having a full octet will **win** the electrons.

### 4. Ionic Radius (Ionic Size)

Remember an atom will gain, lose, or share electrons to obey the octet rule and an **ion** is an atom that has lost or gained an electron. Therefore, after an atom has gained or lost an electron the resulting radius/size of is called **ionic radius**/ ionic size. There are two types of ions, cation and anion. **Cation** is an atom that has lost an electron. There are more protons than electrons. + charge. **Anion** is an atom that has gained an electron. The atom has more electrons than protons. - charge.