###### The Periodic Table and *Periodicity*

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**Background on the Organization of the Periodic Table**

*Dmitri Mendeleev*: given credit for Periodic Table (~1870)

* organized Table by increasing \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* left blank spaces and predicted properties of undiscovered elements

*Henry Moseley*: put elements in order of increasing \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Interpreting the Periodic Table**

**periodic law**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**period**: the horizontal rows (represents *\_\_\_\_\_\_\_\_* *\_\_\_\_\_\_\_\_*)

each period has one more occupied energy level with valence electrons:

Li 🡪 2nd E.L. / 2nd period Na 🡪 3rd E.L. / 3rd period

Li Na

**group** (family): vertical columns

* *main groups* have similar properties *because*…

Li 1s2 2s1 Na 1s2 2s2 2p6 3s1

O 1s2 2s22p4 S 1s2 2s2 2p6 3s23p4

***Arrangement of the Periodic Table***

**metals**: left side of the “straircase”; form cations (\_\_\_\_\_\_\_\_\_ electrons to form a stable octet)

*properties*: good conductors of heat and electricity, lustrous, malleable, ductile

**nonmetals**: right side of the “staircase”; form anions (\_\_\_\_\_\_\_\_\_ electrons to form a stable octet)

*properties*: nonconductors (good insulators), typically gases or brittle solids

**metalloids (semimetals)**: touching “staircase” between metals and nonmetals

*properties*: some properties of metals and nonmetals

“semiconductors”

Si and Ge 🡪 computer chips

s & p orbital

**main block elements**: groups 1, 2, 13–18

**alkali metals**: group 1 (except H); forms a +1 ion; *very* reactive

**alkaline earth metals**: group 2; forms a +2 ion; less reactive than alkali metalss

**pnictogens**: group 15; forms a -3 ion

**chalcogens**: group 16; forms a -2 ion

**halogens**: group 17; forms a -1 ion; most reactive of the nonmetals

**noble gases**: group 18; full *octet* = unreactive

**lanthanides**: elements 57–71

f orbital

**actinides**: elements 89–103

d orbital

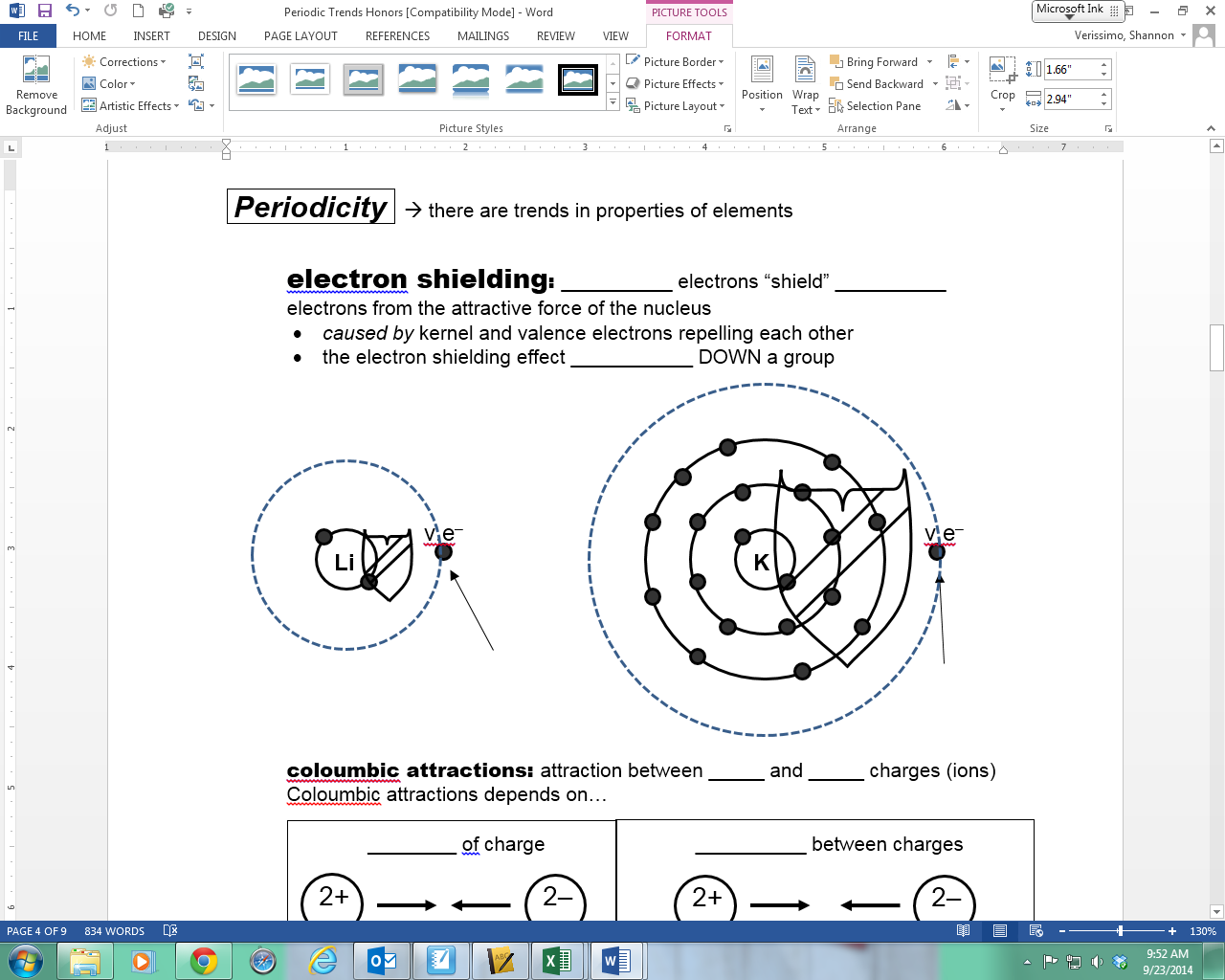
**transition elements**: groups 3–12; variable charges

**coinage metals**: group 11(*Cu, Ag, Au*)

***Periodicity***  🡪 there are trends in properties of elements

**electron shielding:** \_\_\_\_\_\_\_\_\_\_ electrons “shield” \_\_\_\_\_\_\_\_\_\_ electronsfrom the attractive force of the nucleus

* *caused by* kernel and valence electrons repelling each other
* the electron shielding effect \_\_\_\_\_\_\_\_\_\_\_ DOWN a group



**Coloumbic attractions:** attraction between \_\_\_\_\_ and \_\_\_\_\_ charges (ions)

*Coloumbic attractions depends on…*

\_\_\_\_\_\_\_\_ of charge \_\_\_\_\_\_\_\_\_\_ between charges

2–

2+

2–

2+

2–

1–

1+

2+

**effective nuclear charge:** the magnitude of the *electrostatic* attraction between negative \_\_\_\_\_\_\_\_\_\_\_ and positive \_\_\_\_\_\_\_\_\_\_\_ in the nucleus

* Across the periodic table, effective nuclear charge (Z) \_\_\_\_\_\_\_\_\_\_\_, *because*…

**ATOMIC RADIUS** (pages 134-137 in text)

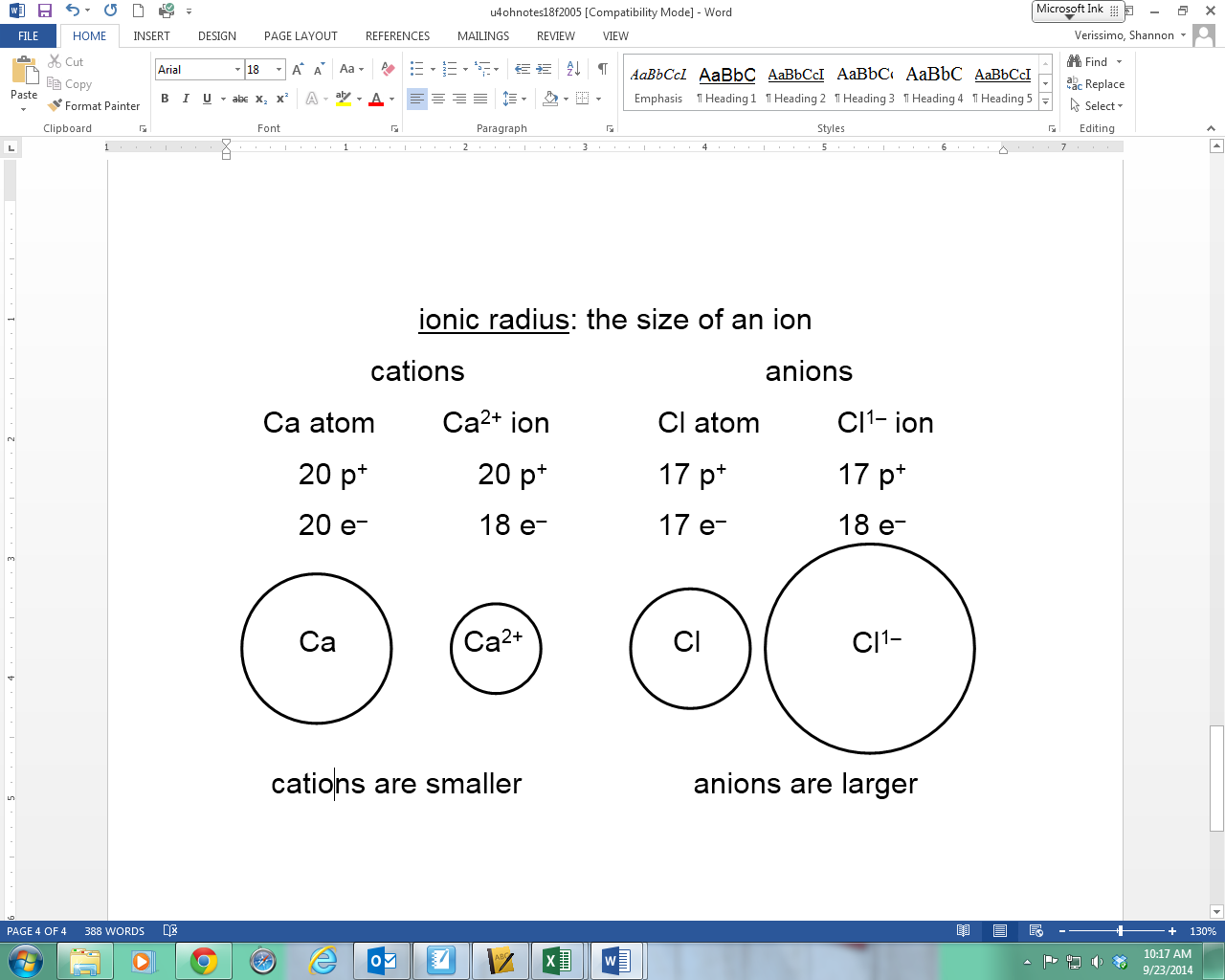
1. **Define Atomic Radius:**
2. **In general, what is the trend in atomic radius as you go down a group?**

**Explain in terms of *electron shielding*:**

1. **In general, what is the trend in atomic radius as you go across a period?**

**Explain the trend in terms of *effective nuclear charge*:**

1. Rank the following elements in order of increasing atomic radius:
   1. Na, Cl, Al, S
   2. Be, Ba, Ca, Mg, Sr
   3. Mg, P, S, Cl
   4. N, Se, Po, Te
   5. Cs, K, As, In
   6. Na, Pb, Se, Ne



**IONIC RADIUS**

1. When an atom becomes an *anion*,

what happens to its radius? Why?

1. When an atom becomes a *cation*,

what happens to its radius? Why?

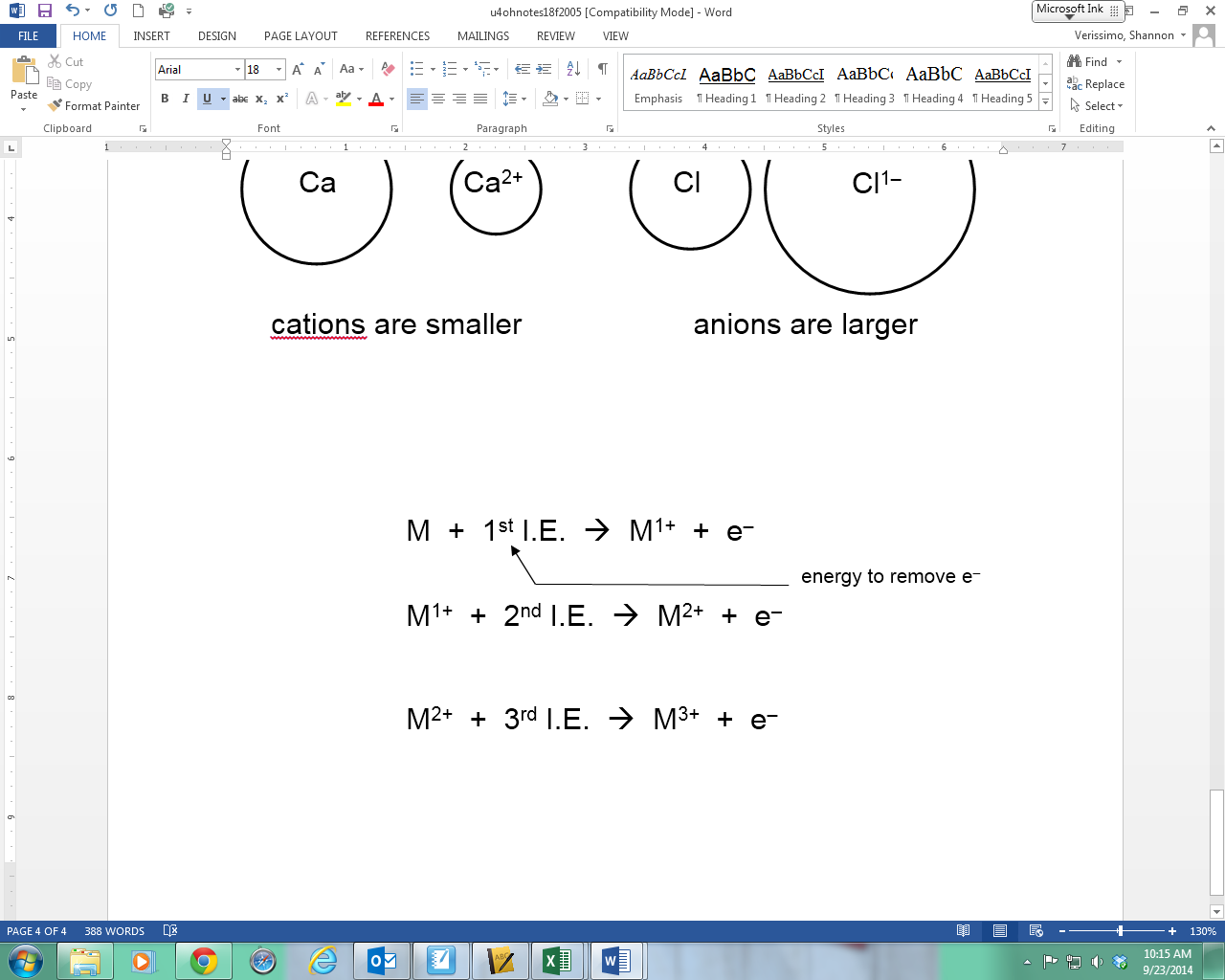
1. For each pair, circle which atom or ion has the larger radius:
   1. S or O
   2. Ca or Ca2+
   3. Na+1 or K+1
   4. Na or K
   5. S2- or O2-
   6. F or F-1
   7. K+1 or Ca2+
   8. F-1 or Cl-1
   9. C4+ or C4-
   10. S2- or F-1
   11. O2- or F-1
   12. Fe2+ or Fe3+

**IONIZATION ENERGY** (pages 137-139 in text)

1. **Define Ionization Energy:**
2. Metals form \_\_\_\_\_\_\_\_\_ by \_\_\_\_\_\_\_\_\_\_\_ electrons.

Nonmetals form \_\_\_\_\_\_\_\_\_ by \_\_\_\_\_\_\_\_\_\_\_ electrons.

1. Which takes more energy, removing an electron from an atom where the nucleus has a tight hold on its electrons, or a weak hold on its electrons?
2. Why do the second, third, or each successive ionization energy require more energy than the previous one?



1. **In general, what is the trend in first ionization energy as you go down a group? Explain:**
2. **In general, what is the trend in ionization energy as you go across a period? Explain:**
3. Which element has the highest first ionization energy: Sn, As, or S?
4. Rank the following elements in order of increasing ionization energy:
   1. Na, Cl, Al, S
   2. Be, Ba, Ca, Mg, Sr
   3. Mg, P, S, Cl
   4. N, Se, Po, Te
   5. Cs, K, As, In
   6. Na, Pb, Se, Ne

**ELECTRONEGATIVITY** (pages 198 in text)

1. **Define Electronegativity:**
2. **What is the trend in electronegativity going down a group? Explain why:**
3. **What is the trend in electronegativity going across a period? Explain why:**
4. What is the most electronegative element? \_\_\_\_ What is its value? \_\_\_\_
5. Who determined the scale of electronegativity? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. List the atoms in order of increasing electronegativity: O, Al, Ca
7. List the atoms in order of increasing electronegativity: Cl, K, Cu
8. Rank the elements in order of increasingelectronegativity and explain your reasoning:
   1. Ba, Br, Fe
   2. O, Se, K
   3. Mg, P, S, Cl
   4. N, Se, Po, Te
   5. Cs, K, As, In
   6. Na, Pb, Se, Ne

**Electron Affinity** (pages 139-140 in text)

1. **Define Electron Affinity:**
2. **What is the trend in Electron Affinity going down a group? Explain why:**
3. **What is the trend in electronegativity going across a period? Explain why:**
4. Rank the elements in order of increasingelectron affinity and explain your reasoning:
   1. Ba, Br, Fe
   2. O, Se, K
   3. Mg, P, S, Cl
   4. N, Se, Po, Te
   5. Cs, K, As, In
   6. Na, Pb, Se, Ne

**Summarizing Concepts**

1. Why is it still beneficial for chemists to understand periodic trends?
2. Sketch the trends on the periodic table with diagonal arrows:

