Family Ties

Student Worksheet

Follow the instructions below to label the major groups and divisions of the periodic table.

1. The vertical columns on the periodic table are called groups / families.
2. The horizontal rows on the periodic table are called periods.
3. Most of the elements in the periodic table are classified as metals.
4. The elements that touch the zigzag line are classified as metalloids.
5. The elements in the far upper right corner are classified as nonmetals.
6. Elements in the first group have one outer shell electron and are extremely reactive. They are called alkali metals.
7. Elements in the second group have 2 outer shell electrons and are also very reactive. They are called alkaline earth metals.
8. Elements in groups 3 through 12 have many useful properties and are called transition metals.
9. Elements in group 17 are known as "salt formers". They are called halogens.
10. Elements in group 18 are very unreactive. They are said to be "inert". We call these the noble gases.
11. The elements at the bottom of the table were pulled out to keep the table from becoming too long. The first period at the bottom called the lanthanides.
12. The second period at the bottom of the table is called the actinides.

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Periodic Table Worksheet

1. Tell which element is located in the following groups and periods.

   a. Zr group 4, period 5

   b. Be group 2, period 2

   c. W group 6, period 6

   d. He group 18, period 1

   e. Sn group 14, period 5

   f. Zn group 12, period 4

   g. Fr group 1, period 7

   h. Po group 16, period 6

   i. Cl group 17, period 3

   j. Ag group 11, period 5

   k. V group 5, period 4

   l. Pt group 10, period 6

   m. Al group 13, period 3

   n. Bi group 15, period 6

2. For each of the following, label as a *metal, nonmetal, metalloid*.

   a. nonmetal poor conductor of electricity

   b. metal usually a solid at room temp

   c. metal ductile

   d. nonmetal chlorine

   e. metalloid semiconductor

   f. metalloid silicon

   g. metal malleable

   h. nonmetal usually a gas at room temp

   i. metal cobalt

   j. metal good conductor of heat

   k. nonmetal brittle

   l. nonmetal oxygen

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3. Vertical columns on the periodic table are called groups.

4. Horizontal rows on the periodic table are called periods.

5. The number of protons in an atom is that element's atomic number.

6. The number of protons and neutrons in an atom is that atom's mass number.

7. The ability of a material to be drawn into a thin wire is called ductile.

8. The ability of a material to be pounded into thin sheets is called malleable.

9. The elements in groups 3 through 12 are called the transition metals.

10. The elements in group 1 are called the alkali metals.

11. The elements in group 2 are called the alkaline earth metals.

12. The elements in group 18 are called the noble gases.

13. The elements in group 17 are called the halogens.

14. The elements in group 1 are the most reactive metals.

15. The elements in group 17 are the most reactive nonmetals.

16. The elements in group 18 are very unreactive.

17. The elements in group 1 react very violently with water.

18. Complete the following atomic chart.

ISOTOPE	# OF PROTONS	# OF NEUTRONS	# OF ELECTRONS	ATOMIC NUMBER	MASS NUMBER
Ca-42	20	22	20	20	42
Ni-54	28	26	28	28	54
Al-28	13	15	13		
S-31	16	15	16	16	31
F-18	9	9	9	9	18
Ge-61	32	29	32	32	61
Li-7	3	4	3	3	7
Mg-25	12	13	12	12	25

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Periodic Trends

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Can the properties of an element be predicted using the Periodic Table?

WHY?

The Periodic Table is often considered to be the "best friend" of chemists and students alike. It includes information about atomic masses and element symbols, but it can also be used to make predictions about atomic size, electronegativity, ionization energies, bonding, and reactivity. In this activity you will look at a few periodic trends that can help you make those predictions. Like most trends, they are not perfect but useful just the same.

1. Consider the data in Model 1 on the following page.

   a. Each element has three numbers listed under it. Which value represents the atomic radius?

      the first one

   b. Write a description that conveys your understanding of the radius of a circle.

      the length from the center of the circle to the outside

   c. How does the term radius apply to the atom?

      the length from the nucleus to the outermost electron shell

2. In general, what is the trend in atomic radius as you go down a group (from top to bottom) in Model 1?

   it increases

   a. As the number of electrons increase, new energy levels or shells must be added further away from the nucleus.

   b. The size of the atoms will grow as you go from the top to the bottom of a group on the periodic table.

READ THIS!

- Opposite charges attract.
- Protons in the nucleus are positively-charged.
- Electrons in the shells or energy levels are negatively-charged.
- Each period or row on the Periodic Table corresponds to a major shell or energy level

3. Use your knowledge of the forces of attraction and the structure of the atom to explain the trend in atomic radius you identified in question #2. *Hint:* You should discuss either the change in distance between the nucleus and the outer shell of electrons or the change in the number of protons in the nucleus.

   as you go down the group more energy levels have been added on, making the size of the atom larger

4. In general, what is the trend in atomic radius as you go across a period (left to right) in Model 1?

   atomic radius decreases

5. Using your knowledge of attractive forces and the structure of the atom, explain the trend in atomic radius that you identified in Question #4.

   as you go across the periodic table the # of protons increases creating a stronger positive charge for the electrons to attract to

   The strong attractive force of the nucleus pulls the electrons in the same energy level closer to the nucleus.

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6. Locate the numbers in Model 1 that represent the ionization energy. The ionization energy is the amount of energy needed to remove the outermost electron from an atom. It is measured in kilojoules/mole.

a. Using your knowledge of attractive forces, explain why ionization—removing an electron from an atom—takes energy.

electrons are held onto the nucleus b/c it is positive and electrons are negative creating an attractive force

b. 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? Explain.

tight hold b/c you have to break the attractive force between the nucleus and the electron

7. Using Model 1, what is the general trend in ionization energy as you go down a group? Support your answer using hydrogen and sodium as an example of this trend.

Ionization ~~increase~~ energy decreases as you go down a group

H - 1312 kJ/mol Na - 496 kJ/mol

8. Using your knowledge of attractive forces and the structure of the atom, explain the trend in ionization energy you identified in Question #7.

Since ~~the~~ the outer most electrons are further from the nucleus for sodium the hold on to the electrons wasn't as much, require less energy to remove one

a. Elements with a larger radius will hold their outer electrons less tightly.

b. The ionization energy is less for bromine than it is for chlorine.

9. In general, what is the trend in ionization energy as you go across a period? Support youranswer by comparing argon and phosphorus.

Ionization energy Increases as you go across the periodic table

P - 1011 kJ/mol Ar - 1521 kJ/mol

10. Recall that the force of attraction between the proton pulls the negatively-charged electrons.

a. In a period, each successive element has one more proton and one more electron in the same energy level.

b. Atoms will a smaller radium require more energy to remove the outermost electron.

11. Atoms with loosely held electrons are usually classified as metals. They will exhibit good conductivity, ductility, and malleability because of their atomic structure. Would you expect metals to have high or low ionization energies? Explain.

low ionization energies b/c their electrons are loosely held so it won't require a lot of energy to remove them

a. As radius increases, the ionization energy decreases.

b. As radius decreases, the ionization energy increases.

c. Radius and ionization energy vary inversely.

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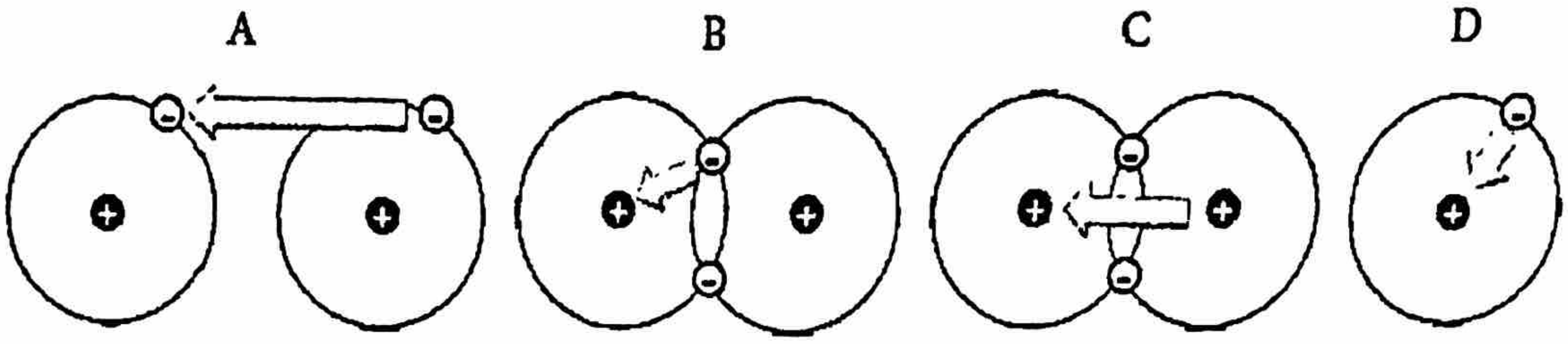
Read This!

Electronegativity is a measure of the ability of an atom's nucleus to attract electrons from a different atom within a covalent bond. A higher electronegativity value correlates to a stronger pull on the electrons in a bond. This value is only theoretical. It cannot be directly measured in the lab.

12. Using the definition stated in the *Read This!* box above, select the best visual representation for electronegativity. Explain your reasoning.



13. Locate the electronegativity values in Model 1.

a. What is the trend in electronegativity going down a group in Model 1?

decreases

b. Explain the existence of the trend described in part a in terms of atomic structure and atomic radius.

the smaller the atom, the more pull the nucleus has to pull electrons towards it, and vice versa

c. What is the trend in electronegativity going across a period in Model 1?

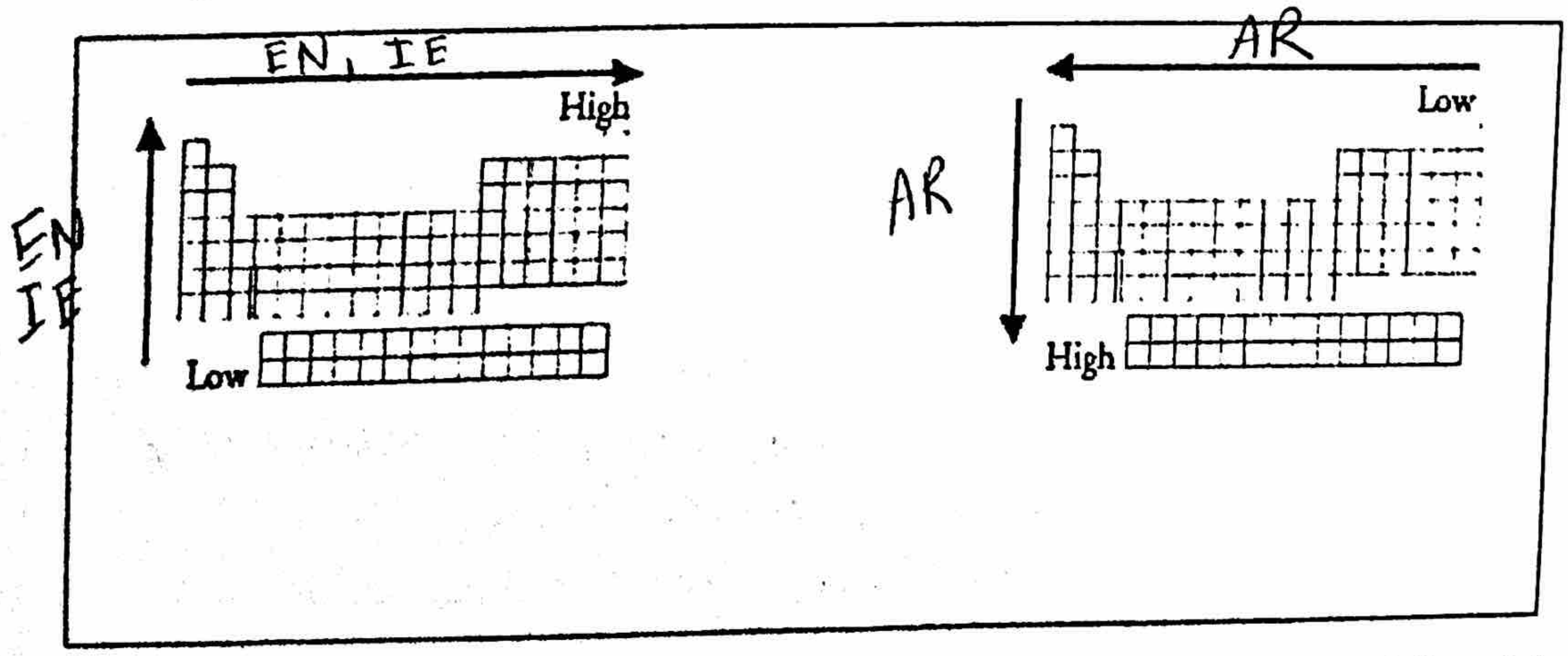
increases

d. Explain the existence of the trend from part c in terms of atomic structure and atomic radius.

Since the radius is smaller the nucleus has more positive attraction, allowing it to pull electrons in

14. The two diagrams shown below can summarize one of the three trends discussed in this activity. Write "atomic radius", or "ionization energy" or "electronegativity" under the appropriate diagram.

NOTE: the arrows point in the direction of the greater or larger values, ie. toward the increasing trend.



15. During this activity you may have noticed that not all of the data provided in Model 1 followed the trends. Circle two exceptions to the trends on Model 1.

a. Identify two places in Model 1 where the property listed does not fit the trend identified in this activity.

Noble gases → EN   F → Atomic Radius

b. Rank the following elements from smallest to largest electronegativity. Fe, Ca, Br

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Chemistry
Periodicity #1

CLASSWORK: Circle the correct answer:

1.	Lowest EN	Be	Ca	Sr	Ra
2.	Highest IE	Cs	W	Pb	At
3.	Highest AR	Na	Al	P	Cl
4.	Lowest IR	Br	Br^{-1}		
5.	Highest IE	Be	Mg	Sr	Ba
6.	Highest EN	O	S	Se	Te
7.	Highest AR	Nb	Al	Cl	Fr
8.	Lowest IE	O	Al	Mn	Cs
9.	Highest AR	K	V	Ga	Br
10.	Lowest IE	Li	K	Cs	Fr
11.	Highest EN	Cl	K	Te	Cs
12.	Highest AR	Rb	Ag	Sn	Xe
13.	Highest IR	Be	Be^{+2}		
14.	Highest AR	Ne	Si	Fe	Rb
15.	Lowest EN	O	Ge	Mo	Ba
16.	Highest IR	N^{-3}	N		
17.	Lowest IR	Na	Na^{+1}		
18.	Lowest IE	N	P	Sb	Bi

Periodicity #2

CLASSWORK: Circle the correct answer:

1.	Highest IR	Ca^{+2}	Ca		
2.	Lowest AR	Cs	W	Pb	At
3.	Highest EN	Na	Al	P	Cl
4.	Lowest IE	V	Ga	Se	Br
5.	Highest AR	Be	Mg	Sr	Ba
6.	Highest IR	O^{-2}	O		
7.	Highest IE	Nb	Al	Cl	Fr
8.	Lowest IE	O	Al	Mn	Cs
9.	Highest IR	K^{+1}	K		
10.	Lowest AR	Li	K	Cs	Fr
11.	Highest EN	Cl	K	Te	Cs
12.	Highest IE	Rb	Ag	Sn	Xe
13.	Highest EN	Be	Mg	Sr	Ba
14.	Highest AR	Ne	Si	Fe	Rb
15.	Lowest IR	S^{-2}	S		
16.	Highest IE	F	Cl	I	At
17.	Lowest AR	N	As	Sb	Bi
18.	Lowest IE	N	P	Sb	Bi

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Periodic Trends Worksheet

***Directions:* Use your notes to answer the following questions.**

1. Rank the following elements by increasing atomic radius: carbon, aluminum, oxygen, potassium.

   small → big

   Oxygen, carbon, aluminum, potassium

2. Rank the following elements by increasing electronegativity: sulfur, oxygen, neon, aluminum.

   small → big

   Neon, aluminum, sulfur, oxygen

3. Why does fluorine have a higher ionization energy than iodine?

   Fluorine has less energy shells blocking the positive attraction between the protons and electrons, so the electrons are held on more tightly.

4. Why do elements in the same family generally have similar properties?

   same # of valence electrons

5. Indicate whether the following properties increase or decrease from left to right across the periodic table.
   a. atomic radius decrease
   b. first ionization energy increase
   c. electronegativity (excluding noble gases) increase

6. What trend in atomic radius occurs across the periodic table? What causes this trend?

   atomic radius decreases because the additional protons in the nucleus pulls the valence electrons closer to the center

7. What trend in ionization energy occurs across a period on the periodic table? What causes this trend?

   Ionization energy increases because the valence electrons are held more tightly due to decreased size of atom, making it more difficult to remove a valence electron

8. Circle the atom in each pair that has the largest radius.
   a. Al or B
   b. Na or Al
   c. S or O
   d. O or F
   e. Br or Cl
   f. Mg or Ca
   G. Na or Na^{+1}
   H. K^{+1} or Mg^{+2}
   I. O or O^{-2}
   J. Cl^{-1} or Br^{-1}

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9. Circle the atom in each pair that has the greater ionization energy.
   a. Li or Be
   b. Ca or Ba
   c. Na or K
   d. P or Ar
   e. Cl or Si
   f. Li or K

10. Define electronegativity.

the ability to gain an electron from another atom

11. Circle the atom in each pair that has the greater electronegativity.
   a. Ca or Ga
   b. Br or As
   c. Li or O
   d. Ba or Sr
   e. Cl or S
   f. O or S

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