Chemistry: Hood River Valley High School Name:___________________________________
Unit 3 Note Packet and Goals Period:__________

Unit 3 – Atomic Structure and Periodic Table

Unit Goals- As you work through this unit, you should be able to:

1. describe previous atomic theories and compare to our modern understanding of the atom (4.1)
2. distinguish among protons, electrons, and neutrons in terms of mass and charge. (4.2)
3. describe the structure of the atom. (4.2)
4. explain why isotopes differ and why atomic masses are not whole numbers. (4.3)
5. understand how atomic mass is calculated. (4.3)
6. describe the different electron orbitals. (5.1)
7. understand how to write electron configurations and orbital diagrams for atoms using the periodic table. (5.2)
8. understand the difference between an atom and an ion and be able to write electron configurations of various ions using the periodic table. (5.2)
9. describe quantum mechanical model and how we discovered this phenomenon using light. (5.3)
10. identify the position of groups, periods, and different chemical families on the periodic table and understand how the periodic table is organized using periodic law. (6.1)
11. explain why elements in the same family have similar properties and relate this to electron configuration. (6.2)
12. describe the trends on the periodic table of atomic size, and electronegativity and how they relate to atomic structure. (6.3)

Read: Chapters 4, 5 & 6

Assignments:

	Description	5	4	0
A1	Atomic Structure WS (goals 1-3), Chapter 4			
A2	Isotopes WS (goals 4-5) Chapter 4			
A3	Atomic Theory and Orbitals (g 6-9) Ch. 5			
A4	Elect Configs and orbital diagrams w/ Shorthand(g 6-9) Chapter 5			
A5	Period Table: Organizing the Elements(g 10-12) Chapter 6			
A6	Periodic Table and Trends(g 10-12) Chapter 6			

Activities, Labs & Test

Marble Lab
Nailon Isotope Lab
Flame Test Lab
Chapter 4 & 5 test

Late Lab Stamp (this stamp means you are not qualified to do lab and test corrections)

Key Terms: atom, electrons, neutrons, nucleus, protons, atomic number, mass number, atomic mass, atomic mass unit, isotope, Dalton's atomic theory, ground state, excited state, quantum, quantum mechanical model, orbitals, Pauli's Exclusion Principle, Hund's Rule, Aufbau Principle, electron configuration, orbital diagrams, electron configuration, periodic table, periodic law, representative elements, period, group, metals, non-metals, alkali metals, alkaline earth metals, transition metals, halogens, noble gases, metalloids, atomic size, electronegativity,

Demo's: Vandegraff machine, Cathode Ray Tubes, Spectrophotometers, Activity Series (Na, Li, K), Outside Atom model, Pennies in HNO_3, Zinc/Copper/Mg/Lead,

4.1 Atoms: Smallest particle of matter that retains it's identity in a _______________

A. _____________ **Atomic Theory.**

1. All ________________ are composed of _____ ____________________

particles called __________

2. Atoms of the same element are _________________. Atoms of any one element are _________________ from atoms of _____________elements

3. Atoms of different elements _____________ mix together, or can chemically combine in __________ _______________ratios to form ________________.

4. Chemical reactions occur when atoms are _____________, _____________, or _____________. Atoms of one element, however, are _____________changed into atoms of _____________element as a result of a chemical reaction.

4.2 Subatomic Particles: Actually means _____________ atom.

A. Electrons: This is what makes elements___________________________.

a. Located ____.

b. Charge is ___________________________.

c. Electrons ______________________so they can__________________________.

d. Have no _______________________

e. Exist at different_____________. The number of _____________can be found by looking at ___________________________the element

f. The only electrons that can bond with other atoms are the ________________ _____________. Called ___________________________.

Thompson's Experiment

B. Protons: Protons give ____________________________ b/c their positive charge controls the _______________ attractions of an atom, thus controlling it's ____________________________

6 **C** **Carbon** **12.01**

a. Located in the _______________.

b. Charge is _______________.

c. Found on periodic table by looking at the ____________________of an element.

d. Has a mass of ____

Example: Potassium has how many protons? ____________
Potassium (K) has how many electrons? _______________
Potassium has how many energy levels? ______________

Diagram here:

K has how many outer electrons for bonding? ______________

C. Neutrons: This is what adds to the _______________of an atom. 1 Neutron = ____________.

a. Located in the _______________

b. Charge is _______________

c. Total mass of an atom from the ________________ and the _________________

Rutherford's Experiment

Fill in the grid below for each subatomic particle.

	Location in atom	Charge	Weight
Protons			
Nuetrons			
Elctrons			

4.3 Distinguishing Between Atoms = The Periodic Table

A. Atomic Number: This is the _______________ number for each element on the periodic table. It tells us how many ______________ there are for that element. Remember, the protons are positive, so they control the _____________________ of each element.

1. Atomic # of carbon =
2. Atomic # of potassium =

B. Mass Number: The number of ________________ plus _________________. Remember, the mass is not affected by _____________ because they are so ___________.

a. The number of neutrons can be found by: ___________________________________

1. Oxygen with a mass number of 16 has:
2. Sodium with a mass number of 23 has:
3. How many neutrons are in carbon 14?
4. How many neutrons are in boron 11?

b. Isotopic Symbol for any element is the _______________ & _________________

ie

$^{197}_{79}\textbf{Au}$

C. Isotopes: All atoms of an element have same number of_______________ . But, in nature, some atoms of the same element have different numbers of_______________, they are called different_______________. This causes their masses to be different, but their ______________ stays the same b/c the neutrons are ________________ so they don't change the _____________

Copy the three neon isotopes on page 113 below.

Problem: An atom is identified as platinum-195.

a. What does the number represent?____________________

b. How many protons? _______________

c. How many neutrons?________________________

d. How many electrons?_______________________

D. Atomic Mass

a. Individual atoms are _________________________________.

b. We measure the mass of atoms using _______________________________________.

i. This standard unit was set using carbon-12 which has ________________ protons and ____________________ neutrons.

ii. Carbon-12 was given a mass of ______________________________

iii. One atomic mass unit is ________________________ of carbons mass.

iv. Each proton and neutron has a mass of about _____________________________.

v. The _______________________________ of an element is the ________________ mass of all the isotopes of an element in nature_____________________________ This is only useful for ______________________ in the ___________________.

Copy Figure 4.10, pg. 115 (calculating weighted averages)

Practice Isotope Problem 1. Magnesium has three naturally occuring isotopes. 78.70% of Magnesium atoms exist as Magnesium-24 (23.9850 g/mol), 10.03% exist as Magnesium-25 (24.9858 g/mol) and 11.17% exist as Magnesium-26 (25.9826 g/mol). What is the average atomic mass of Magnesium?

Practice Isotope Problem 1. Neon has two major isotopes, Neon-20 and Neon-22. Out of every 250 neon atoms, 225 will be Neon-20 (19.992 g/mol), and 25 will be Neon-22 (21.991 g/mol). What is the average atomic mass of Neon?

5.1 Applying the Periodic table to useful models of atoms

A. Bohr Model: Uses _______________to show the energy levels. The number of rings should match the _______________of that element. This model is ________________________.

1. The protons in the nucleus are found by looking at the_______________.
2. The neutrons plus the protons must add up to_______________.
3. The electrons fill the shells from _______________until they match the number of _______________. They fill in the following order _______________
4. Each energy level is called a _________________
   - **a.** You can check you outer electrons to make sure they match the ______________
   - **b.** This model can only be used for the first ***20*** atoms. After that it _____________

i.e. Calcium 44 **i.e. lithium 7**

Draw Bohr Models for the following Isotopes. Include…

- # of Electrons in correct orbitals
- # of Protons in nucleus
- # of Neutrons in nucleus

Sulfur 34	**Boron 10**	**Helium 3**
Sulfur 32	**Boron 14**	**Helium 4**

Directions: Complete the table for the following isotopes of each element:

Element	Symbol	Number of Protons	Number of Electrons	Number of Neutrons	Atomic Number	Mass Number	Valence Electrons
Sodium				**13**			
Mercury				**120**			
			4	**5**			
	F					**19**	

A. **In 1926**, the Austrian physicist **Erwin Schrodinger** took atomic models one step further. He has given us the modern description of the electrons in atoms, called the ____________________ ___________________ __________.

<u>Atomic Orbitals – Page 131</u>

a. What is a principal energy level?

b. What are sublevels?

c. What are orbitals?

d. What are the four "letters" used to denote the energy sublevels?

e. What shape do the first 3 atomic orbitals take? Remember, they are "clouds" of probability. (draw them below)

S shape

P shape

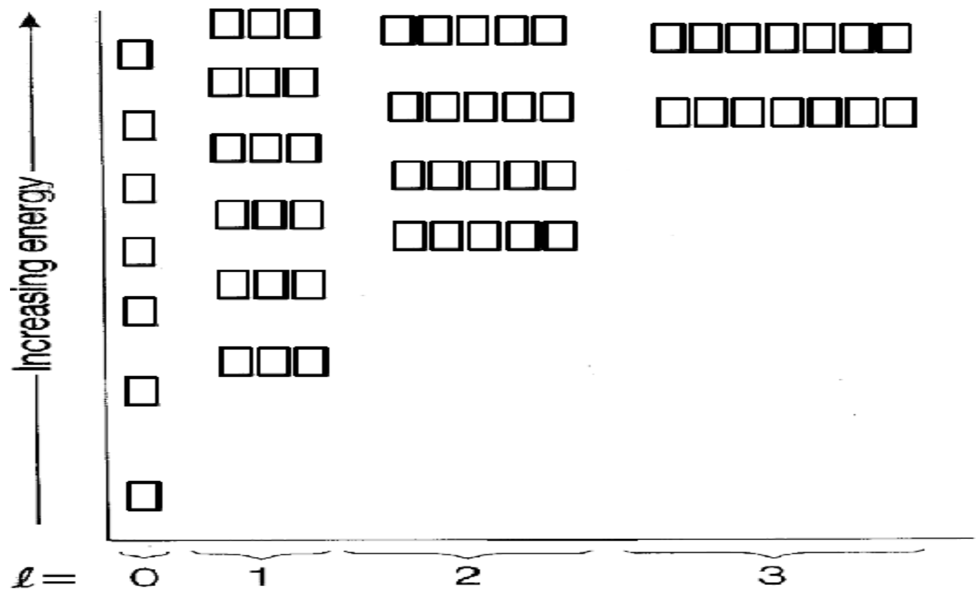
D shape

(f shape clouds are too complicated to draw…)

The S sublevel has __________ orbital , therefore can hold _____________ electrons.
The P sublevel has __________ orbitals, therefore can hold _________ electrons.
The D sublevel has___________ orbitals, therefore can hold ________ electrons.
The F sublevel has _________ orbitals, therefore can hold __________ electrons.

f. Three different views of the Quantum Mechanical Model.

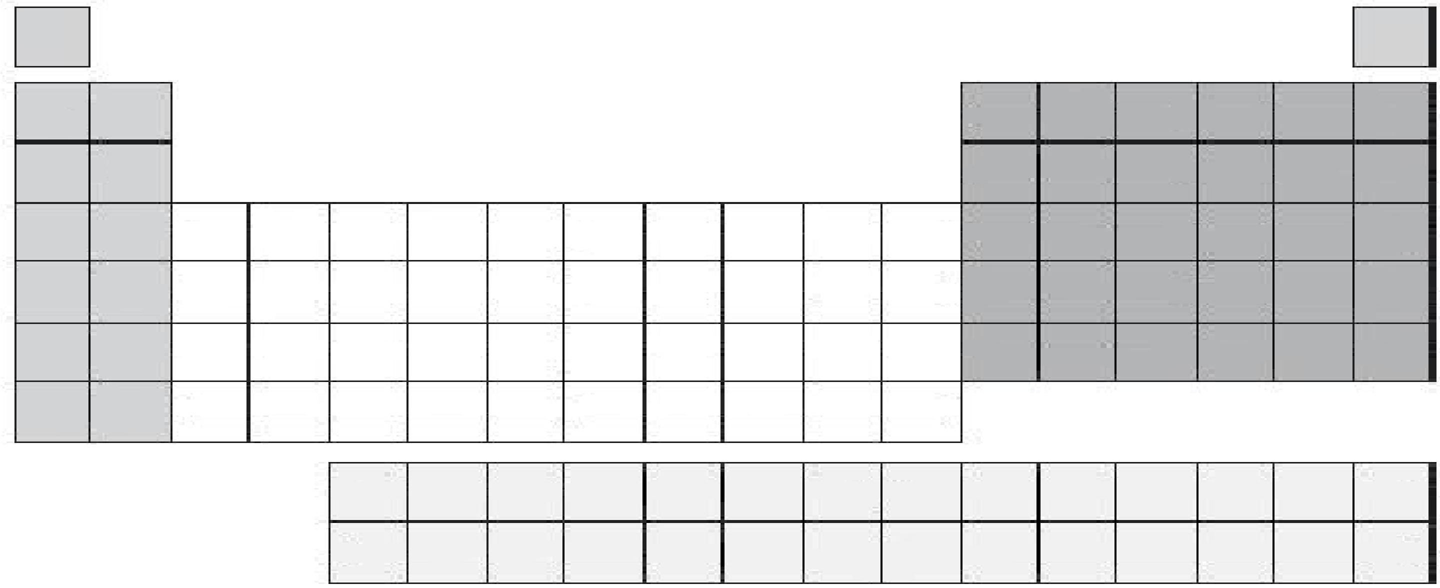
1. Aufbau Diagram: Try Chromium



2. Electron Configuration Pyramid" (see poster in room):

1**s**
2**s** 2**p**
3**s** 3**p** 3**d**
4**s** 4**p** 4**d** 4**f**
5**s** 5**p** 5**d** 5**f**
6**s** 6**p** 6**d**
7**s** 7**p** 7**d**

3. Block Diagram,



g. There are 3 general rules that guide us when writing electron configurations. They are:

1. Aufbau principle: Electrons occupy _____________energy level first

2. Pauli Exclusion Principle: Only ______ electrons per orbital, each with _____________ spin.

3. Hund's Rule: When electrons occupy _____________orbitals of the _____________ energy, _______ electron enters each orbital with the ___________spin until each orbital in that level has one electron. _____________electrons then occupy each orbital so they __________with opposite spins.

Problem: Use these rules to write electron configurations and orbital diagrams for the following atoms:

a. Lithium

b. Fluorine

c. Rubidium

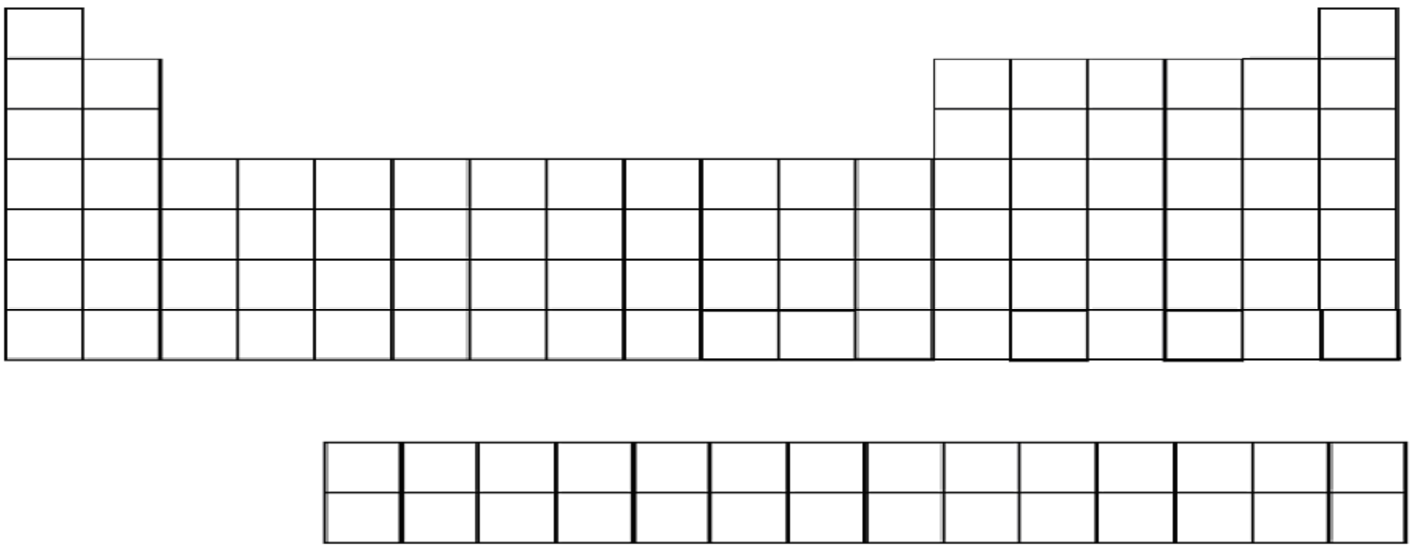
d. Nickel

- **Ions?** Atoms that have ________________ or __________electrons.

Li^{+1}, lithium that has __________one electron.

F^{-1}, fluorine that has __________ one electron

A. Shorthand Method: We can use the____________ __________ Electron configurations from now on. Let's try a few. Write down the ________ noble gas that was filled on the way to finding your element. Then only do the electron configuration for the ________________ electrons.



Phosphorus

Germanium

Argon

Calcium ion, Ca^{+2}

Oxygen ion, O^{-2}

5.3 Physics and the Quantum Mechanical Model

A. Light has behavior like a particle and behavior like a wave.

Sunlight is the full electromagnetic spectrum of wavelengths. We only see a small sliver called visible light which ranges between ___________________________________.

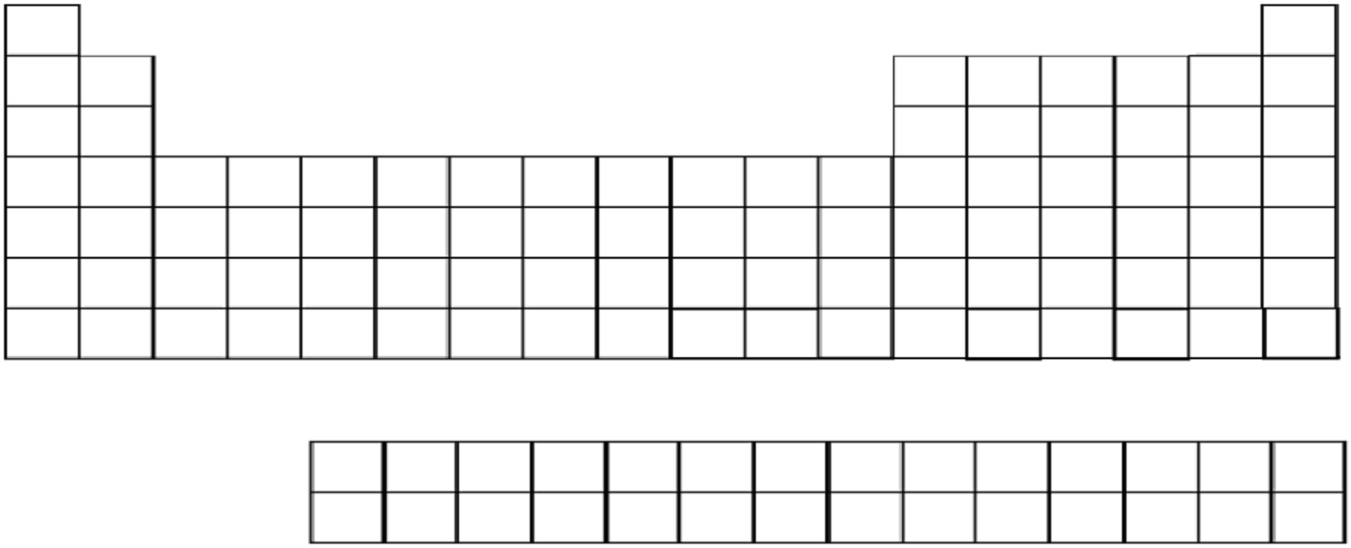
Copy the full electromagnetic spectrum below.

A. Atomic Spectra

1. When atoms ____________energy, electrons move into ____________energy levels. These electrons then lose energy by ____________light when they return to ____________energy levels.
2. Each element will emit it's own unique _________________ ________________ ___________________when energy is added. Each discrete line, or color represents one exact ________________ or _______________ released as electrons return to ____________states, or resting energy levels.

Diagram Hydrogen below

6.1 Organizing Elements



A. Metals, Non-Metals, & Metalloids

a. _____________: ___________ of the ladder(exception is_____________)

i. Conduct________________: means they can pass________________

ii. ______________: Means they can be pounded_____________

iii. ____________: Means they can be draw into thin ______________

iv. ___________at room temp except______________

b. _________________:_______________of the ladder

i. Do not ______________ _________________(exception_______________ vs. ______________)

ii. _______________: ______________when hit with hammer

iii. Many are ______________ at room temp

iv. ____, _____,_____,______,______ are solids at room temp

v. ____, is a liquid at room temp

c. _______________:_______________two sides of the ladder

i. These have ______________ properties of ____________ and __________________

d. The ________________groups are called ________________________. This is b/c the group number tells you __________________ for that group of elements. Each group has the exact same _____________________or _______________________________

i. Group 1A metals are called _______________.
-Their valence electrons follow what pattern?

ii. Group 2A metals are called ____________
-Their valence electrons follow what pattern?

iii. Group 7A are called ___________
-Their valence electrons follow what pattern?

iv. Group 8A are called ___________
-Think
-Their valence electrons follow what pattern?

e. The ________________groups are called __________________________ because metals with _______ energy sublevels in their _______________ shell can ________________________ their valence electrons. There are of course three exceptions(_______, _______, ________)

v. _____________________ metals have valence electrons that occupy an _____energy sublevel and the nearest _____energy sublevel

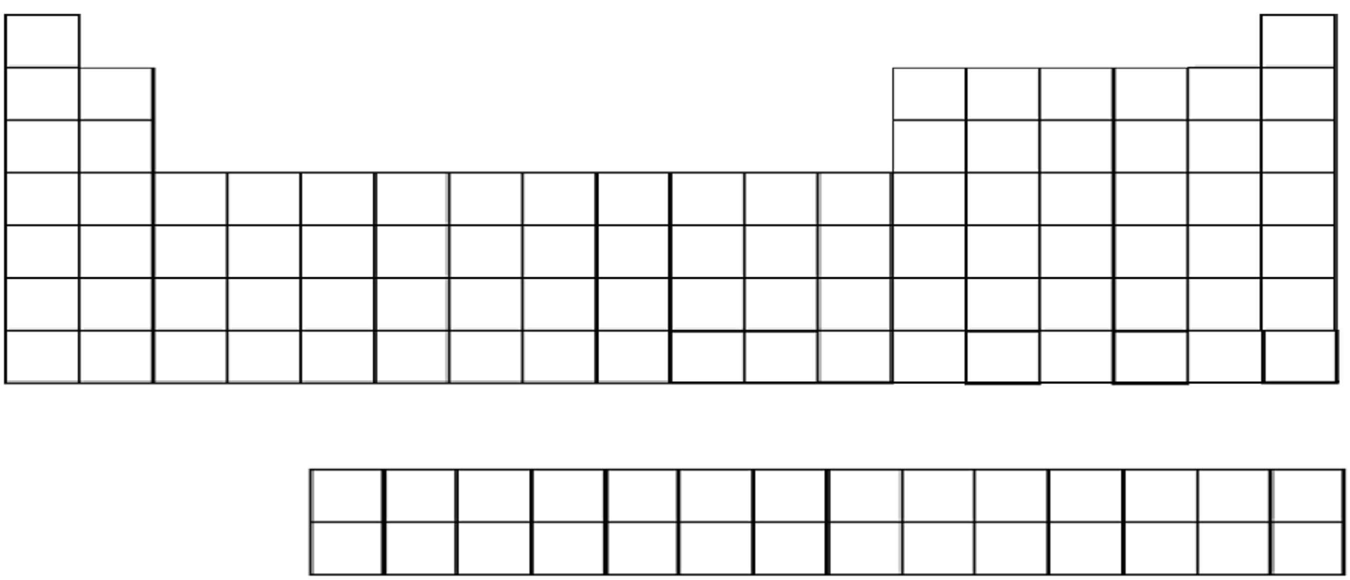
vi. _______________ transition metals have valence electrons that occupy an _____ energy sublevel and the nearest _____energy sublevel. These are found ____________ the periodic table.

6.2 Periodic Trends

A. Atomic Size is measured as the atomic _____________ of an atom by taking _________ the distance between two atoms of the same ___________. See diagram below of Florine and Iodine

a. Trends in Group Size: As you go ___________ a group, size _________________ because ______________ levels are increasing, cause valence electrons to fly _____________ away from the _________________.

b. Trends in Period Size: As you go across a period, to the ______________, the valence electrons occupy the ______________________level, but the additional ______________ in the nucleus cause greater _______, resulting in ____________ atomic radius.



B. Electronegativity: The ability of an atom to attract electrons when the atom is in a compound.

a. Electronegativity ____________________as you go down a group because the ____________________nucleus becomes ____________________from the valence electrons, thus ____________________it's influence.

b. Electronegativity ____________________as you move ____________________across the periodic table because the proton influence ____________________along the same principal energy level.

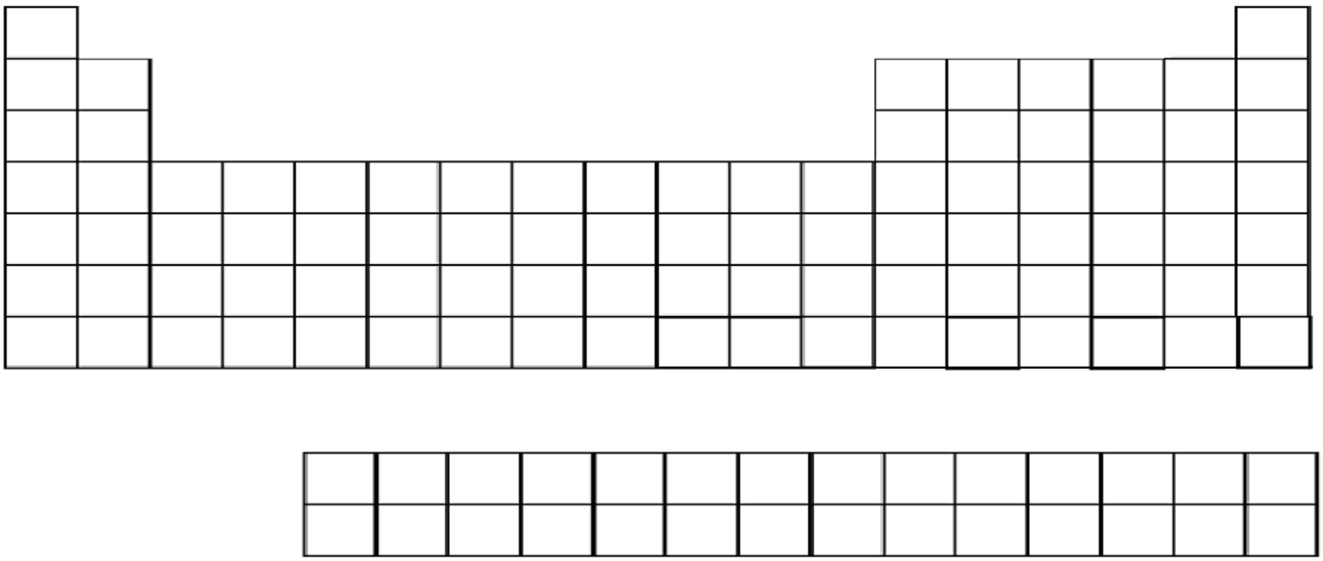


Diagram how electronegativity affects ion formation below between fluorine and cesium. Include relative sizes of atoms to help illustrate why they are so different.