Name:____Period:_________Date:______
Ms. Randall
Unit 4: Periodic Table Unit Workbook

The **bold, underlined** words are **important vocabulary words** that you should be able to define and use properly in explanations. This is a study guide for what you will be tested on throughout the year. The objectives are divided into categories of "**Knowledge**" (**what you have to *know***) and "**Application**" (**what you have to be able to *do***).

THE PERIODIC TABLE		
	Knowledge	**Application**
1.	o The placement or location of an element on the Periodic Table gives an indication of **physical** and **chemical properties** of that element. o The elements on the Periodic Table are arranged in order of increasing **atomic number**.	o Explain the placement of an unknown element in the periodic table based on its properties
2.	o The number of protons in an atom (**atomic number**) identifies the element. This goes at the bottom left corner of the symbol for that element. o The sum of the protons and neutrons in an atom (**mass number**) identifies an ***isotope***. The mass number is placed at the top left corner of the symbol for an element OR is placed after the element symbol or name and a dash. *Ex: Three different ways to write carbon with a mass number of 14:* *C, carbon-14, or C-14*	o Interpret and write isotopic notations. *Ex:* *C-12, C-13, and C-14 are isotopes of the element carbon*
3.	o Elements are classified by their properties, and located on the periodic table as **metals**, **metalloids**, **nonmetals**, or **noble gases**.	o Identify the properties of metals, metalloids, nonmetals and noble gases o Classify elements as metals, metalloids, nonmetals, or noble gases by their properties o
4.	o An element's **atomic radius**, **first ionization energy**, and **electronegativity** determine its physical and chemical properties	
5.	o **Substances can be differentiated by their physical properties.** o Physical properties of substances include **melting point, boiling point, density**, **conductivity**, **malleability**, **solubility**, and **hardness**.	o Identify and give examples of physical properties o Describe the states of the elements at STP (solid, liquid, or gas). *(Table S)*
6.	o **Substances can be differentiated by chemical properties.** o Chemical properties describe how an element behaves during a chemical reaction and include reactivity, flammability, and toxicity.	o Identify and give examples of chemical properties o Describe the difference between physical and chemical properties of substances
7.	o Some elements exist as two or more forms in the same phase. These forms differ in their molecular or crystal structure and therefore in their properties. The word to describe this phenomenon is **ALLOTROPE**. o Ozone and oxygen gases are allotropes of each other. Ozone is O_3 and it is very dangerous to our health. Oxygen gas is O_2 and we need it to survive.	

	o Diamonds and graphite (better known as pencil lead) are both forms of the element carbon. They have different molecular structures and very different properties.	
8.	o For **<u>Groups</u>** (also called **<u>families</u>**) 1, 2, and 13-18 on the Periodic Table, elements within the same group have the same number of valence electrons (helium is the exception) and therefore similar chemical properties. o Elements in the same **<u>Period</u>** (row) have the same number of **<u>principal energy levels (shells)</u>** which contain electrons.	o Determine the group of an element, given the chemical formula of a compound *Ex: A compound has the formula XCl_2, element X is in Group 2* o Determine the number of energy levels containing electrons given an element's Period and vice versa
9.	o The succession of elements within the same GROUP (top to bottom) demonstrates characteristic **<u>trends</u>**: differences in **<u>atomic radius</u>**, **<u>ionic radius</u>**, **<u>electronegativity</u>**, **<u>first ionization energy</u>**, and **<u>metallic/nonmetallic properties</u>**.	o Compare and contrast properties of elements within a group or a period for groups 1, 2, and 13-18 on the periodic table
10.	o The succession of elements across the same PERIOD (left to right) demonstrates characteristic **<u>trends</u>**: differences in **<u>atomic radius</u>**, **<u>ionic radius</u>**, **<u>electronegativity</u>**, **<u>first ionization energy</u>**, and **<u>metallic/nonmetallic properties</u>**.	o Understand and be able to explain the trends in terms of **nuclear charge and electron shielding**

<u>Goal setting:</u> Based upon your learning style results and the information above list at least two techniques you plan to use to study during this unit.

1.
2.

What grade would you like to achieve on this unit based on your efforts? _______%

<u>Lesson 1:</u> <u>Chapter Diary 5</u>

<u>Objective:</u> To summarize concepts related to the Periodic table of elements

Directions: After reading Chapter diary 5 answer the questions in your workbook.

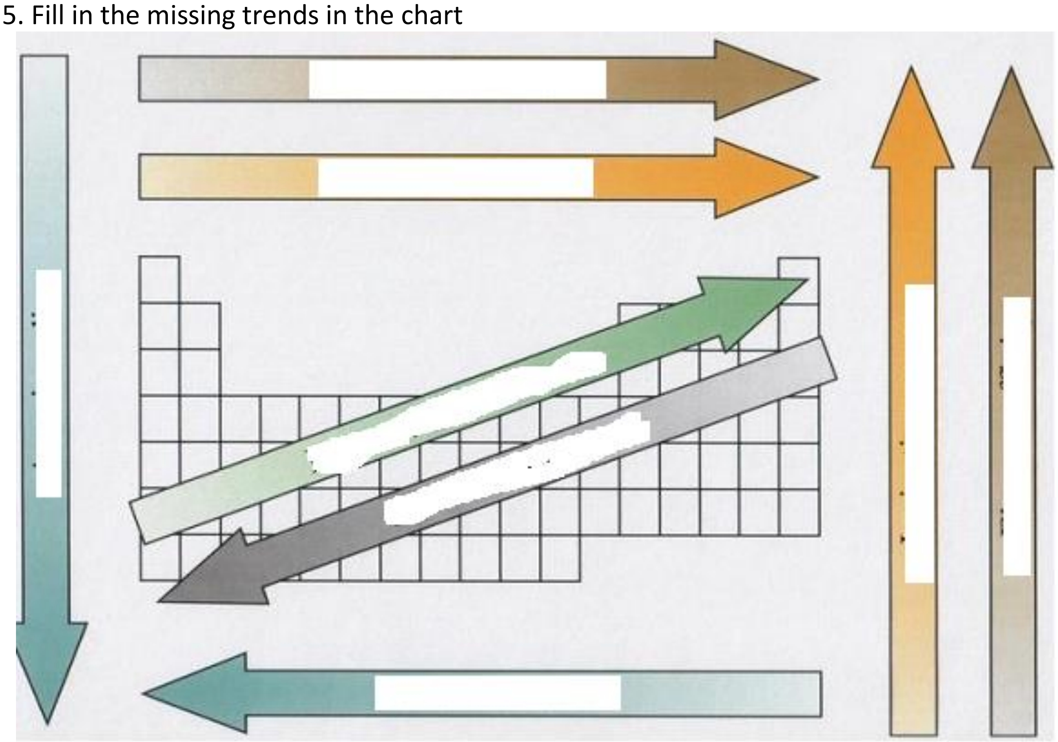
1. How were the periodic table created by Mendeleev and Moseley different?

2. How were they the same?

3. What is a group?

4. What is a period?

5. Fill in the missing trends in the chart



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List 10 facts from the reading

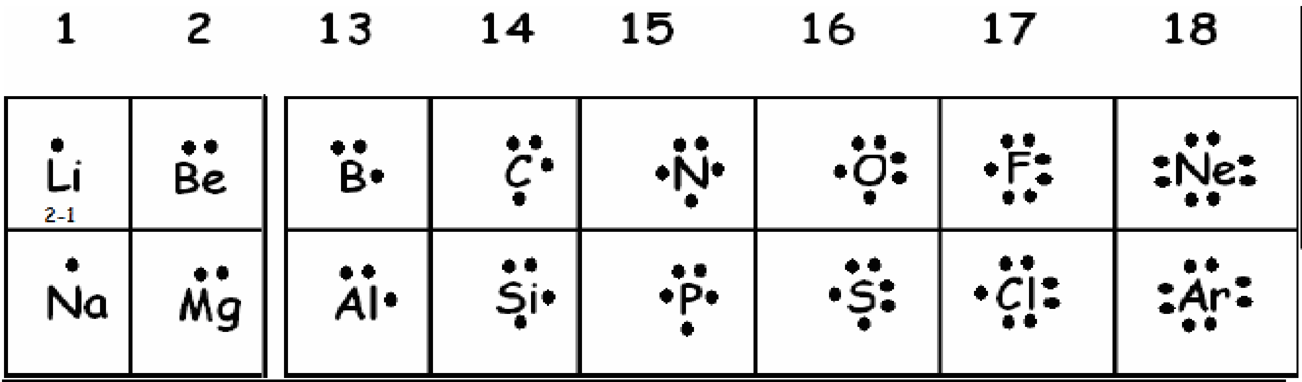
List any questions you may have from your reading:

Lesson 2: The History of the Table & Chemical Periodicity **Date:________________**

Objective: To relate the work of chemists to the modern periodic law and the repeating patterns in the periodic table
Lesson summary:

Check your understanding:

Model: An Electron Dot Diagram of the Elements



Task:
Below the symbol for each element, write an electron configuration for the elements in the model. Lithium has been done for you.

Questions:

1.) How are the members of the same column (group) similar in terms of the number of valence electrons?

2.) Which group contains the least number of valence electrons?

3.) Which group contains the largest number of valence electrons?

4.) Which row (period) contains three occupied shells?

5.) How are the members of the same period similar in terms of the number of energy levels (shells)?

6.) Are atoms with a larger radius more likely to be found at the top or bottom of a group (column)? Explain your answer.

7.) In terms of the number of valence electrons, describe one cyclic property that can be observed in the model.

8.) Which group would be considered non-reactive? Why?

9.)When atoms form ions, the electron configuration of the ion resembles the electron configuration of a CERTAIN noble gas. Which Noble Gas will each of these atom's ions be like?

a. Sr _______	c. Br _______	e. Al ________	g. Li______
b. O _______	d. Si _______	f. P ________	h. Cs_______

Practice: It's Elemental

DIRECTIONS: *Use the reading below to answer the questions that follow.*

We all know by now that the periodic table is arranged according to increasing atomic number. What we're only beginning to learn is the significance of elements within the same column (vertical) and row (horizontal) on the table.

Every element found within a given row, or ***period***, has the same number of electron shells, or ***principle energy levels***. Despite this one common feature, atoms of one element within a given period do not behave similar to atoms of another element in that same period. In fact, the period in which an element is found really tells you nothing about how the atoms of that element will behave. The only additional thing that we can really say about elements of the same period is that they increase by very little in terms of size (or mass) as we go from left to right on the table since the atomic number(number of protons) only goes up by one. Look at the periodic tables that you labeled and color-coordinated. Look at how much the mass increases as you move from left to right in a given period.

Every element found within a given column, or ***group***, has the same number of ***valence electrons***. This is VERY significant because it's the number of valence electrons that determines how atoms of any element are going to "behave." When we say "behave," what we really mean is how they're going to ***react***, or ***bond*** with atoms of other elements. However, not all columns or groups qualify as "families." In fact, the only groups that are considered to be families are Group I (Alkalai Metals), Group II (Alkaline Earth Metals), Group XVII (Halogens), and Group XVIII (Noble Gases). The behaviors of the transition metals are very difficult to predict, and the behavior of the elements within the BCNO group varies greatly from one element to another. *An element's family tells you much more about its properties than its period does*.

All of the elements in the Halogen family have 7 valence electrons. There's an easy way to cheat when it comes to determining the number of valence electrons. Just look at the last digit of the group number above the first element in the family. For the first two families (alkali metals and alkaline earth metals) it's a single digit number, so there's no confusion. Alkali metals are group 1, which means all elements in that family have 1 valence electron. The halogen family, on the other hand, is group 17, which means they have how many electrons in their valence shell? If you said 7, you're right. This trick will help you when it comes to drawing Lewis dot diagrams…

Speaking of the Lewis dot diagram, it's used to show only the ***valence electrons*** in a given atom or compound. After all, the valence electrons are the only electrons involved in ***bonding***. There are four basic spots that an electron can occupy in a Lewis dot diagram because the maximum number of valence electrons that an atom of an element can generally hold is eight. If the element symbol was the face of a clock, the spots would be at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock. The first spot is like a taxi cab that can hold two electrons in its single seat. The remaining three spots are like seats on a bus that can also hold electrons. Just as you would do if you got onto a bus, electrons look for empty seats first. Once the taxi cab is full, the remaining electrons in the valence shell occupy empty "seats." Only after each of the three seats has an electron in it do they begin to pair up. The exceptions to the octet rule are elements that have only one energy level or seek to have one energy level. These elements include hydrogen, helium, lithium, beryllium, and boron. These elements also seek to have a full valence shell, but it will only contain two electrons. Otherwise, there can never be more than 8 valence electrons and, no matter what, there can never be more than 2 electrons in a given "seat."

All atoms seek to have a full valence shell, and the easiest way to do that is to form bonds with other atoms. We mentioned before that atoms in the family of noble gases already have a full valence shell, and that's why they rarely ever seek to bond with other atoms. For all other element families, the atoms seek to form bonds in order to complete their valence shell. As a general rule, the number of ***unpaired*** valence electrons tells you the number of bonds that atoms of a given element "like" to form. Halogens, like chlorine (Cl), have 7 valence electrons and only one unpaired valence electrons. That means that the halogens have two choices: They can either steal an electron, usually from an atom with only 1 valence electron, like sodium (Na), forming what we call an ***ionic bond***. The other choice an atom like chlorine has is to share an electron with an atom that's also one short of having a full valence shell, like another chlorine atom. This ***sharing of electrons*** is an example of a ***covalent bond***. As we said before, carbon has 4 valence electrons, which means that all of them can occupy a seat unpaired for a maximum of 4 unpaired valence electrons. That's why carbon looks to share each of its 4 single valence electrons in order to end up with 4 ***pairs*** instead, giving it the full 8 it needs to fill its valence shell. In other words, carbon will form 4 covalent bonds. A single line is used to illustrate a bond between two atoms, and each single line represents 2 electrons.

1. How is the periodic table arranged?

2. What do we call the horizontal rows of the periodic table? What do all the elements in a given row have in common?

3. What do we call the vertical columns of the periodic table? What do all the elements in a given column have in common?

4. Which tells us more about an element's properties, its row or its column? Why is this?

5. Which of the following elements is chlorine (Cl) most similar to?

   a. fluorine (F)
   b. sulfur (S)
   c. oxygen (O)
   d. argon (Ar)

6. Does mass increase more as we go from left to right or top to bottom on the periodic table?

7. Are atoms of the elements in the family of noble gases reactive (do they readily form bonds with other atoms)? Why is this?

8. How are ionic bonds formed?

9. How are covalent bonds formed?

10. What determines how many bonds an atom will form?

11. What is the easiest way for atoms without a full valence shell to gain a full valence shell?

12. If an atom of an element has four valence electrons, what is the maximum number of unpaired electrons it can have? Draw a Lewis Dot diagram of an element that fits this description.

13. Draw a Lewis Dot diagram of an element with 6 valence electrons. How many bonds can it form?

14. Why do chlorine (Cl) and sodium (Na) bond so easily with one another?

15. Which element, carbon (C) or fluorine (F) would you expect to be more reactive? Explain your answer. (Hint: Think about which element is closer to its goal.)

Lesson 3: Key to the Periodic Table Date:_________________

Objective: To define the location and compare and contrast the properties of metals, nonmetals, and metalloids.

Check your understanding:

Directions: Use the word bank below to fill in the blanks in the passage that follows.

Actinide series	Group	Nonmetal
Alkali metal	Halogen	Period
Alkaline earth metal	Lanthanide series	Periodic law
Atomic mass	Metal	Periodic table
Atomic number	Metalloid	Transition element
Family	Noble gas	

Dmitri Mendeleev developed a chart-like arrangement of the elements called the ________________________. He arranged the elements in order of increasing ________________________, but what he discovered were many gaps. The chart was not that organized and easy to use. The arrangement used today differs from that of Mendeleev in that the elements are arranged in order of increasing _______________. He called this the ___________________of the elements. Each horizontal row of elements is called a(n) _________________. Each vertical column is called a(n) __________________, or because of the resemblance between elements in the same column, a(n) _____________.

In rows 4 through 7, there is a wide central section containing elements, each of which is called a(n) ______________________. Rows 6 and 7 also contain two other sets of elements that are listed below the main chart. These are called the ________________
and the _________________, respectively. Each of these elements, as well as those in the first two columns at the left end of the chart, is classified as a(n) _______________________. Each of the elements at the right side of the chart is classified as a(n) ___________________. Each of the elements between these two main types, having some properties like one type and other properties like the other type, is called a(n) __________________________.

Each of the elements in Group 1 is called a(n) _____________________. Each of the elements in Group 2 is called a(n) _____________________. Each of the elements in Group 17 is called a(n) _____________________. Each of the elements in Group 18 is called a(n) ______________________.

Practice:

1. Write in the space, "Group 1 metals", "Group 2 metals", "transition metals", "halogens", or "noble gases" to indicate which group each statement is describing

a.		Colored solutions
b.		Full valence shell
c.		Most active metals
d.		Most active nonmetals
e.		Monatomic gases
f.		Diatomic elements
g.		Stable and unreactive
h.		7 valence electrons
i.		2 valence electrons
j.		Form ions with a +1 charge

2. Describe *one* chemical property of Group 1 metals that results from the atoms of each metal having only one valence electron.

3. Given: Samples of Na, Ar, As, RB

   a. Which *two* of the given elements have the most similar chemical properties?

   b. Explain your answer in terms of atomic structure.

4. Given: Samples of sulfur, oxygen, and phosphorus

   c. Which *two* of the given elements have the most similar chemical properties?

   d. Explain your answer in terms of atomic structure.

5. Based on the Periodic Table, explain why Na and K have similar chemical properties.

Lesson 4: Periodic Table Trends **Date:_________**

Objective: To describe and explain the reason for periodic trends

Check your understanding:

1. Complete the table below by checking the appropriate boxes.

	Across a Period →		**Down a Group ↓**	
	Increases	Decreases	Increases	Decreases
Atomic radius				
Metallic character				
Ionization energy				
Electronegativity				
Why?	**# of protons** (circle one) Increases or decreases		**# of electron shells** (circle one) Increases or decreases	

2. Complete the statements below by checking the correct ending.

		increases	**decreases**	**remains the same**
a.	**As the elements in a Period are considered from left to right, the number of valence electrons in each successive element…**			
b.	**As the elements in Group 17 are considered from top to bottom, the number of valence electrons in each successive element…**			
c.	**Going left to right across a Period, the number of electron shells…**			
d.	**As the elements in a Group are considered from top to bottom, the number of electron shells…**			
e.	**As the elements in Group 1 are considered from top to bottom, the reactivity of each successive element….**			
f.	**As the elements in Group 17 are considered from top to bottom, the reactivity of each successive element…**			

Practice: Periodic Properties

Certain properties of the elements demonstrate **trends** that repeat in a regular pattern every so many elements. In other words the trends are repeated **periodically.** The periodic trends repeat as a function of the periods of elements on the periodic table.

Within a particular group of elements, the atoms of the elements at the top of the group are smaller in size due to having fewer electron energy levels. This means it is harder to remove a valence electron from atoms that are smaller, as these electrons are closer to the nucleus and more attracted to the nucleus.

So the trend of "**metallic character**" can be thought of this way. Metals tend to want to lose valence electrons to become like noble gases. Atoms that give up their valence electrons more easily have more "metallic character" than those that do not. Therefore, no matter what group we look at, the elements at the bottom are more metallic than those at the top. Simply stated, this means they are more likely to lose valence electrons in bonding. Conversely, the elements at the top of a group are more non-metallic, having a tighter hold on valence electrons. Within periods, the most metallic elements are to the left (Group 1), and the most nonmetallic to the right (Group 17). Said another way, the most metallic element is to the lower left (Fr) and the most nonmetallic to the upper right (F).

Electronegativity is a measure of the ability an atom has to attract electrons to it in a bonding situation. If you understood the paragraph above, then it should be no huge leap in logic to understand that metals have low electronegativity values, and that nonmetals have high values. Noble gases of course have electronegativity values of zero. The highest value belongs to the most nonmetallic element – Fluorine – at 4.0, and the lowest value belongs to the most metallic element – Francium – at 0.7.

First Ionization Energy is a measure of the amount of energy needed in order to rip the most loosely held valence electron away from an atom. If you think about it, the noble gases should have the highest values, since they have a stable octet and do not want to lose electrons. Next, the nonmetals have fairly high values, as they would also rather not lose electrons. Metals have low values (in other words, they do not put up much of a fight when we try to take an electron away… after all they are trying to lose electrons anyways). So atoms to the top of groups and to the right in periods have high values, with the lower values being lower in a group and to the left on the Periodic Table.

Questions:

1. Why is the table of elements called the "Periodic" table?

2. Why is it easier to take a valence electron away from an atom that has that electron in the 5th energy level, versus one that has it in the 1st energy level?

3. What is the most metallic element in each of these Groups?

Group 1: ______

Group 2: ______

Group 14: ______

Group 17: ______

Group 18: ______

4. (T/F) _____ If an element is quite “metallic” then that is a way of saying that it will be quite difficult to remove a valence electron from its atoms.

5. Non-metal atoms tend to ____________ *(gain or lose?)* valence electrons, so they tend to have ______________ *(high or low?)* electronegativity values.

6. Look up the electronegativity values for the noble gases, on Table S.

What do you discover?

Why is this?

7. If you apply “ionization energy” to an atom, what have you done to it?

8. Why are the ionization values for noble gases so high?

Lesson 5: Allotropes **Date:_______**

Objective: To define and recognize an allotrope

Check your understanding:

At STP, solid carbon can exist as graphite or as diamond. These two forms of carbon have

1. the same properties and the same crystal structures
2. the same properties and different crystal structures
3. different properties and the same crystal structures
4. different properties and different crystal structures

Practice:

Read the article “Tantalizing Tubes” from the June 2000 issue of *Scientific American*, and the table from the article “Nanotubes for Electronics” from the December 2000 issue of *Scientific American*. This will give you a good overview of carbon nanotubes, and a little information on their possible applications. When you are finished reading, think about, and then answer, the following questions using complete sentences on a separate piece of paper to be collected.

1. A report for *The Economist* stated, “The only industry the buckyball has really revolutionized is the generation of scientific papers.” What did he mean by this statement?

2. Carbon nanotubes can either behave as metals (and conduct electricity) or as semi-conductors. What causes this difference in electrical conductivity?

3. What are two promising applications for carbon nanotubes that you find most interesting?

4. What are two limitations of the use of carbon nanotubes in technology and industry?

Unit Study Guide

Law, Theories, BIG ideas

Laws:

Theories:

BIG ideas:

Equations, Calculations, Reference Tables

Equation: (When to use & units)

Calculations (When to use)

Reference Table (Hints & tricks)

Helpful tips, sayings, shortcuts

Things I always forget…

Unit Project: Adopt an element **Due date:_____________**

Requirements:

1) Complete an Adopt an Element information sheet. (60% of grade)
You may use a variety of reference sources. Possible ideas are encyclopedias (book or CD Rom), science encyclopedias, science catalogs, magazines, and/or Internet sites*. Information sheets must be neat, written in black ink, and contain all the information requested. You also need to provide a list of your sources on the back of your information sheet. A minimum of three sources are required.

2) Create an advertisement for your element. (40% of grade)
The advertisement must include the element's name, symbol, atomic number, atomic mass, cost, and an advertising slogan that describes one or more of its important uses. Advertisements must be neat, colorful, and contain all the information listed above. You may add pictures that relate to your advertisement theme.

Unit Review:

Periodic Table

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can classify elements as metals, nonmetals, or metalloids based on their placement on the Periodic Table.	Classify each of the following elements as metals (M), nonmetals (NM), or metalloids (MTLD). _______B ________K ________Li ________C _______Ar _______Sb ________H ________Fe ________Au _______S _______F ________Si ________Fr ________He _______Rn _______Ge ________Al ________As ________Bi _______I
_____5. I can state the group names for elements in groups 1, 2, 17, and 18.	Group 1 is called the ______________________________________. Group 2 is called the ______________________________________. Group 17 is called the ______________________________________. Group 18 is called the ______________________________________.
_____6. I can explain why elements in the same group have similar chemical properties.	Elements in the same group have similar chemical properties because
_____7. I can explain why the elements in Group 18 don't usually react with other elements.	Elements in Group 18 don't usually react with other elements because
_____8. I can state the meaning of "STP" and the Reference Table on which it can be found.	STP stands for ____. The values can be found on Reference Table_______________.
_____9. I can state the names/symbols for the two elements on the Periodic Table that are liquids at STP.	The two elements that are liquids at STP are: __________________________ and ____________________

_____10. I can state the names/symbols of the 11 elements that are gases at STP.	The 11 elements that are gases at STP are: ______________________________, ________________________________, ______________________________, ________________________________, ______________________________, ________________________________, ______________________________, ________________________________, ______________________________, ________________________________, and ______________________________
_____11. I can state how the elements on the Periodic Table are arranged.	The elements on the Periodic Table are arranged by increasing ________________ _____________________.
_____12. I can list the 7 diatomic elements.	The seven diatomic elements are:
_____13. I can define electronegativity, first ionization energy, atomic radius, ionic radius, metallic character, and activity/reactivity.	**<u>Definitions:</u>** electronegativity first ionization energy atomic radius ionic radius metallic character activity/reactivity

_____14. I can state the periodic trend for electronegativity and explain why it occurs.	As one reads down a group from top to bottom, electronegativity _______________________ because ___________________________________ ____. As one reads across a period from left to right, electronegativity _______________________ because ___________________________________ ____.
_____17. I can state the periodic trend for first ionization energy and explain why it occurs.	As one reads down a group from top to bottom, first ionization energy _______________________ because ___________________________________ ____. As one reads across a period from left to right, , first ionization energy _______________________ because ___________________________________ ____.
_____15. I can state the periodic trend for atomic radius and explain why it occurs.	As one reads down a group from top to bottom, atomic radius _______________________ because ___________________________________ ____. As one reads across a period from left to right, atomic radius _______________________ because ___________________________________ ____.
_____16. I can state the periodic trend for metallic character and explain why it occurs.	As one reads down a group from top to bottom, metallic character _______________________ because ___________________________________ ____. As one reads across a period from left to right, metallic character _______________________ because ___________________________________ ____.

_____17. I can state the trend for melting points and boiling point for METALS as one reads down a group.	As one reads down a group from top to bottom, the melting points and boiling points for METALS _______________________.
_____18. I can state the trend for melting points and boiling point for NONMETALS as one reads down a group.	As one reads down a group from top to bottom, the melting points and boiling points for NONMETALS _______________________.

_____19. I can state the trend for activity/reactivity for METALS as one reads down a group.	As one reads down a group from top to bottom, the activity/reactivity of METALS _____________________.
_____20. I can state the trend for activity/reactivity for NONMETALS as one reads down a group.	As one reads down a group from top to bottom, the activity/reactivity of NONMETALS _____________________.
_____21. I can explain how loss or gaining of electrons affects the radius of an element.	Metals tend to lose electrons (get oxidized). This loss of electrons causes cations to be ___________________ than the original atom. Nonmetals tend to gain electrons (get reduced). This gain of electrons causes anions to be ___________________ than the original atom.
_____22. I can list the properties of metals.	Properties of metals are:
_____23. I can list the properties of nonmetals.	Properties of nonmetals are: