Name:________________Period:_________Date:______
Ms. Randall
Unit 3: Atomic Theory 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***).

1.) ATOMIC CONCEPTS		
	Knowledge	**Application**
1.	o **Atoms** are the basic unit (building block) of **matter**. o Atoms of the same kind are called **elements**. o The modern model of the atom has developed over a long period of time through the work of many scientists.	o Explain what happened during the **gold-foil experiment** and what it showed. *Gold foil was bombarded (hit) with positively charged alpha particles. Most alpha particles passed through the gold foil, but some were deflected. This showed that:* *1. the atom is mostly empty space* *2. the nucleus is small, positively charged, and located in the center of the atom*
2.	o The three **subatomic particles** that make up an **atom** are **protons, neutrons, and electrons**. o The proton is positively charged, the neutron has no charge, and the electron is negatively charged. (This is also referenced on Table O. Check it out!)	
3.	o Each atom has a **nucleus** with an overall positive charge, made up of protons and neutrons. o The nucleus is surrounded by negatively charged **electrons**.	o Determine the **nuclear charge** of an atom. (equal to the number of protons in the nucleus)
4.	o Atoms are electrically neutral, which means that they have no charge (# protons = # electrons) o **Ions** are atoms that have either lost or gained electrons and are either positively or negatively charged o When an atom gains one or more electrons, it becomes a negative ion and its radius increases. o When an atom loses one or more electrons, it becomes a positive ion and its radius decreases.	o Determine the number of protons or electrons in an atom or ion when given one of these values. (Periodic Table) o Compare the **atomic radius** and **ionic radius** of any given element *Ex: A chloride ion has a larger radius than a chlorine atom because the ion has an extra electron. A sodium ion has a smaller radius than a sodium atom because the ion has lost an electron.*
5.	o The mass of each proton and each neutron is approximately equal to one **atomic mass unit (AMU)**. o An electron is much less massive (has almost no mass) compared to a proton or neutron.	o Calculate the mass of an atom given the number of protons and neutrons o Calculate the number of neutrons or protons, given the other value

6.	○ In the <u>modern model of the atom</u>, the **<u>WAVE-MECHANICAL MODEL (electron cloud)</u>**, the electrons are in **<u>orbitals (clouds)</u>**, which are defined as regions of most probable electron location.	
7.	○ Each electron in an atom has a specific amount of energy. ○ Electrons closest to the nucleus have the lowest energy. As an electron moves away from the nucleus, it has higher energy.	
8.	○ **<u>Electron configurations</u>** show how many electrons are in each orbital. ○ When all of an atom's electrons are in the orbitals closest to the nucleus, the electrons are in their lowest possible energy states. This is called the **<u>ground state</u>**. ○ When an electron in an atom gains a specific amount of energy, the electron is at a higher energy state (**<u>excited state</u>**)	○ Distinguish between **<u>ground state</u>** and **<u>excited state electron configurations</u>**. (Be careful to keep the same number of electrons when writing the excited state.)
9.	○ When an electron returns from a higher energy (excited) state to a lower energy (ground) state, a specific amount of energy is emitted. This emitted energy can be used to identify an element. ○ The **<u>flame test</u>** is an example of the **<u>bright-line spectrum</u>** visible to the naked eye. The color can determine the identity of a positive ion in a compound.	○ Identify an element by comparing its bright-line spectrum to given spectra
10.	○ The outermost electrons in an atom are called the **<u>valence electrons</u>**. In general, the number of valence electrons affects the chemical properties of an element.	○ Draw a Lewis electron-dot structure of an atom. ○ Distinguish between valence and non-valence electrons, given an electron configuration
11.	○ Atoms of an element that contain the same number of protons but a different number of neutrons are called **<u>isotopes</u>** of that element.	○ Calculate the number of neutrons in an isotope of an element given the isotope's mass
12.	○ The **<u>average atomic mass</u>** of an element is the weighted average of the masses of its naturally occurring isotopes.	○ Given an atomic mass, determine the most abundant isotope ○ Calculate the atomic mass of an element, given the masses and abundance of naturally occurring isotopes

<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 3</u>

<u>Objective</u>: To summarize unit concepts

Directions: After reading the Chapter diary answer the following questions.

1. Explain the contribution to the scientific community made by each of the individuals listed:

- ***Democritus***

- ***Dalton***

- ***JJ Thompson***

- ***Rutherford***

- ***Bohr***

2. Describe the structure of the atom

3. Compare a ground state and an excited state electron

List 10 facts from the reading

List any questions you may have from your reading:

Lesson 2: Concept of an Atom **Date:______________**

Objective: To compare and contrast the development of the models of the atom.

Lesson summary:

Check your understanding:

1. Draw below the model of the atom proposed be the following individuals

Dalton (1800) Thompson (1897) Bohr (1913)

2. How did Thompson's model differ from Dalton's model?

3. The gold foil experiment resulted in two major discoveries which were made about the structure of the atom. What were they?

a.

b.

4. How does the Bohr model represent electrons around the central nucleus? Why (think of spectra)?

Practice:

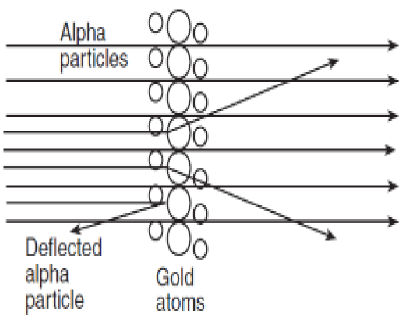
1.) J.J. Thomson's Cathode Ray Tube experiment led to the discovery of
1. the positively charged subatomic particle called the electron
2. the positively charged subatomic particle called the proton
3. the positively charged subatomic particle called the electron
4. the negatively charged subatomic particle called the electron

2.) According to the Bohr Model,
1. electrons are found in areas of high probability called orbitals
2. electrons travel around the nucleus in circular paths called orbits
3. electrons are found in areas of high probability called orbits
4. electrons travel around the nucleus in random paths called orbitals

3.) According to the Wave-Mechanical Model,
1. electrons are found in areas of high probability called orbitals
2. electrons travel around the nucleus in circular paths called orbits
3. electrons are found in areas of high probability called orbits
4. electrons travel around the nucleus in random paths called orbitals

4.) In Thomson's cathode-ray experiment, what evidence led him to believe that the ray consisted of particles, and why did he conclude that the ray was negatively charged?

5.) *One model of the atom states that atoms are tiny particles composed of a uniform mixture of positive and negative charges. Scientists conducted an experiment where alpha particles were aimed at a thin layer of gold atoms. Most of the alpha particles passed directly through the gold atoms. A few alpha particles were deflected from their straight-line paths. An illustration of the experiment is shown below.*



a. Most of the alpha particles passed directly through the gold atoms undisturbed. What does this evidence suggest about the structure of the gold atoms?

b. A few of the alpha particles were deflected. What does this evidence suggest about the structure of the gold atoms

c. How should the original model be revised based on the results of this experiment?

6) Explain the current model of the atom.

Lesson 3: Subatomic Particles & Their Properties **Date:________________**

Objective: To define the parts of an atom

Check your understanding:

1. Fill in the blanks

The modern model of the atom has evolved over a long period of time through the work of many scientists.
Each atom has a nucleus, with an overall positive charge, surrounded by one or more negatively charged ________________. Subatomic particles contained in the nucleus include ____________________ and _____________________. The proton is positively charged, and the neutron has no charge. The electron is __________________ charged. Protons and electrons have equal but opposite charges. The number of protons _____________ the number of electrons in an atom. The mass of each proton and each neutron is approximately ________________ atomic mass unit. An electron is much _______________ massive than a proton or a neutron. The number of protons in an atom (_________________) identifies the element.

2. Fill in the following table:

Particle	Charge	Mass	Location
neutron			
	+1	1	
electron			

Practice:

1.) In the modern model of the atom, each atom is composed of three major subatomic particles.

a) Name the subatomic particles contained in the nucleus of the atom.

b) State the charge associated with each type of subatomic particle contained in the nucleus of the atom.

c) What is the net charge of the nucleus? ____________________

2.) Give the names and chemical symbols for the elements that correspond to these atomic numbers:

a. 10 b. 18 c. 36 d. 51

3.) What is the charge on the nucleus of…

a) a Cr atom? _______
b) a Ni atom? _______
c) a sodium atom?______

4.) Which statement best describes electrons?

(1) They are positive subatomic particles and are found in the nucleus.
(2) They are positive subatomic particles and are found surrounding the nucleus.
(3) They are negative subatomic particles and are found in the nucleus.
(4) They are negative subatomic particles and are found surrounding the nucleus.

5.) The atomic number of an atom is always equal to the number of its

(1) protons, only
(2) neutrons, only
(3) protons plus neutrons
(4) protons plus electrons

6.) Which particles are found in the nucleus of an atom?

(1) electrons, only
(2) protons and electrons
(3) neutrons, only
(4) protons and neutrons

7.) A neutral atom contains 12 neutrons and 11 electrons. The number of protons in this atom is

(1) 1 (2) 11 (3) 12 (4) 23

8.) Which statement is true about the charges assigned to an electron and a proton?

(1) Both an electron and a proton are positive.
(2) An electron is negative and a proton is positive.
(3) An electron is positive and a proton is negative.
(4) Both an electron and a proton are negative.

9.) What is the charge of the nucleus in an atom of oxygen-17?
(1) 0 (2) -2 (3) +8 (4) +17

10. Using the definitions provided above please fill in the following chart.

Symbol	# Protons	# Neutrons	# Electrons	Atomic Number	Mass Number	Nuclear Symbol
						$^{35}_{17}Cl$
	15	16				
C-14		8				

Lesson 4 : Subatomic Particles & Ions **Date:______________**

Objective: To compare and contrast the subatomic particles of atoms and ions.

Check your understanding:

1.) In terms of subatomic particles, what is the difference between an atom and an ion?

2.) How can you determine the electrical charge on an ion?

3.) When an atom becomes an ion, does the element's nucleus change?

Practice: For the following atoms/ions determine the number of protons, neutrons, electrons, mass number, and nuclear charge.

	ATOM or ION?	PROTONS	NEUTRONS	ELECTRONS	MASS NUMBER	NUCLEAR CHARGE
^{15}N						
Cu^{+2}						
$^{8}B^{+3}$						
^{17}O						
F^{-1}						
^{206}Pb						
^{208}Pb						
Ag^{+1}						
Zn^{+2}						
Mg						
S^{-2}						

Challenge:

Directions: Answer the following questions on a separate sheet of paper for extra credit. You must answer ALL questions for credit!

1.) Iron loses 3 electrons to form an ion, what is the electrical charge of the ion?
2.) Oxygen gains 2 electrons to form an ion, what is the electrical charge of the ion?
3.) What number is the Lowest Common Multiple of the numbers 3 and 2?
4.) Iron reacts with oxygen in the air to form the electrically neutral compound, iron (III) oxide, known as rust. How many of each type of ion would be needed to form an electrically neutral compound?
5.) Write the chemical formula for iron (III) oxide.

Lesson 5: Subatomic Particles & Isotopes Date:______________________

Objective: To differentiate between isotopic forms of atoms based on number of neutrons

Check your understanding:

1. What information is provided by the atomic number, Z?

2. What information is provided by the mass number, A?

3. Calculate the atomic mass of each of the following isotopes. SHOW ALL WORK.

Element	**Mass**	**Percent Abundance**
copper-63	62.9396 amu	69.17%
copper-65	64.9278 amu	30.83%

4. Describe the similarities between $^{35}_{17}Cl$ and $^{37}_{17}Cl$.

5. Describe the differences between $^{35}_{17}Cl$ and $^{37}_{17}Cl$.

Practice:

1. Use a periodic table to fill in the missing information in the following table.

Name	Symbol	Atomic Number Z	Mass Number A	Number of Neutrons	Number of Electrons
oxygen	$^{16}_{8}O$	8	16	8	8
		7		7	
	$^{34}_{16}S$			18	
		1		1	
		1	3		
		12	24		
		12	25		
			238		92
	$^{84}_{36}Kr$		84		36

Which elements listed in the table are isotopes?

2. A mystery element occurs in nature as two isotopes. Isotope A has a mass of 10.0130 amu and its abundance is 19.9%; Isotope B has a mass of 11.0093 amu and its abundance is 80.1%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

<u>Lesson 6: Bohr Diagrams</u> **Date:________**

<u>Objective</u>: To represent the atom using the model defined by Bohr.

<u>Check your understanding:</u>

1. What subatomic particle is most important in determining the properties of atoms? Why?

2. Give the electron configurations for the following:
   a. Carbon ____________
   b. Strontium ____________
   c. Fluorine ____________
   d. Argon ____________
   e. Sodium ____________
   f. Lithium_____________

<u>Practice:</u> Construct Bohr diagrams for the following.

Carbon	Fluorine	Beryllium	Br
Li	Ca^{2+}	Na^{+}	S^{2-}

Argon	Phosphorus	Oxygen	O^{2-}
Aluminum	Sodium	N^{3-}	He

Lesson 7: Electrons and Energy **Date:____________________**

Objective: **To relate energy state to electron location**

Check your Understanding:

1. What is the relationship between the distance an electron is from the nucleus, and its energy?

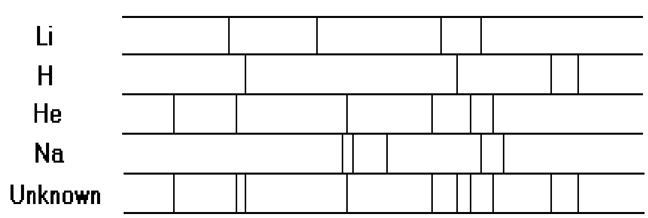
2. How does an atom enter the "excited state?"

3. What does an atom in the excited state do as its electron(s) return to the ground state?

4. (T/F) ____ When an atom becomes excited it loses electrons.

5. What is a "Bright line spectrum?"

6. Why do you think that the bright line spectrum of an element can be thought of as a "fingerprint" for that element?



7.

The diagram shows the characteristic spectral line patterns of four elements. Also shown are spectral lines produced by an unknown substance. Which pair of elements is present in the unknown?

1. lithium and sodium
2. sodium and hydrogen
3. lithium and helium
4. helium and hydrogen

Practice:

Distinguish between ground state and excited state electron configurations below:

Bohr Electron Configuration	Ground (G) or Excited (E) state?
2-1	
2-0-1	
1-1-1	
2-7-3	
2-8-2	
2-8-8-2	
2-8-17-6	
2-8-18-8	
2-6-18-1	
2-5-18-32	

1. Compared to a sodium atom in the ground state, a sodium atom in the excited state must have

    1. a greater number of electrons
    2. a smaller number of electrons
    3. an electron with greater energy
    4. an electron with less energy

2. Which principal energy level change by the electron of a hydrogen atom will cause the greatest amount of energy to be absorbed?

    1. $n = 2$ to $n = 4$
    2. $n = 2$ to $n = 5$
    3. $n = 4$ to $n = 2$
    4. $n = 5$ to $n = 2$

3. Spectral lines produced from the radiant energy emitted from excited atoms are thought to be due to the movements of electrons

    1. from lower to higher energy levels
    2. from higher to lower energy levels
    3. within their orbitals
    4. out of the nucleus

4. What is the electron configuration of a sulfur atom in the excited state?

    1. 2–4
    2. 2–6
    3. 2–8–6
    4. 2–8–5-1

5. Electron *X* can change to a higher energy level or a lower energy level. Which statement is true of electron *X*?

    1. Electron *X* emits energy when it changes to a higher energy level.
    2. Electron *X* absorbs energy when it changes to a higher energy level.
    3. Electron *X* absorbs energy when it changes to a lower energy level.
    4. Electron *X* neither emits nor absorbs energy when it changes energy level.

Choose from the following set of answers for questions 10-12:

1. 2–7
2. 2–8
3. 2–8–1
4. 2–7-1-1

6. Represents the electron configuration of an atom of sodium in the ground state. _______

7. Represents the electron configuration of the Na^{+1} ion. ________

8. Represents an excited state electron configuration for an atom of sodium. ________

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9. The characteristic bright-line spectrum of an element is produced when its electrons

    1. form a covalent bond
    2. form an ionic bond
    3. move to a higher energy state
    4. return to a lower energy state

Lesson 8: Lewis Dot Diagrams **Date:________**

Objective: To represent the atom using the model defined by Lewis.

Check your Understanding:

1. **Give the number of valence electrons for the following.**

    a. Carbon ____________
    b. Strontium ____________
    c. Fluorine ____________
    d. Argon ____________
    e. Sodium ____________
    f. Lithium_____________

2. Why are the valence electrons the most important electrons?

Practice: Construct Lewis Dot diagrams for the following.

Carbon	Fluorine	Beryllium	Br
Li	Ca^{2+}	Na^{+}	S^{2-}

Argon	Phosphorus	Oxygen	O^{2-}
Aluminum	Sodium	N^{3-}	He

Lesson 9 : Article Analysis ***Date:_______***

Objective: To relate the nature of science to historical influences.

Reading:Niels Bohr and Ernst Rutherford:The Life of a Scientist.

Scientists are people too and can lead very interesting lives. Just as our childhood and environment mold us into who we are, the life experiences of a scientist mold their character and ability to achieve greatness. Read the attached two passages about two scientists that were instrumental in defining the structure of the atom. Answer the following questions on a separate piece of paper to be collected upon completion of your reading.

1. What type of education did both scientists receive in their youth and how did it influence their careers? Do they have anything in common?

2. The work of one scientist can very much influence the work of another scientist. How does this statement apply to Bohr and Rutherford? Support your answer with examples from the passage.

3. Both scientists lived and worked during Hitler's reign. How did this influence their ability to complete their work? Support your answer with examples from the passage.

4. If Rutherford were still alive, what do you think his reaction would be to the creation of the atomic bomb and Bohr's role in its creation?

Niels Bohr
1885 - 1962

Niels Bohr was born and educated in Copenhagen, Denmark. He lived, worked, and died there, too. But his mark on science and history was worldwide. His professional work and personal convictions were part of the larger stories of the century.

At the University of Copenhagen, he studied physics and played soccer (though not as well as his brother, who helped the 1908 Danish soccer team win an Olympic silver medal). After receiving his doctorate in 1911, Bohr traveled to England on a study grant and worked under J.J. Thomson, who had discovered the electron 15 years earlier.

Bohr began to work on the problem of the atom's structure. Ernest Rutherford had recently suggested the atom had a miniature, dense nucleus surrounded by a cloud of nearly weightless electrons. There were a few problems with the model, however. For example, according to classical physics, the electrons orbiting the nucleus should lose energy until they spiral down into the center, collapsing the atom. Bohr proposed adding to the model the new idea of quanta put forth by Max Planck in 1901. That way, electrons existed at set levels of energy, that is, at fixed distances from the nucleus. If the atom absorbed energy, the electron jumped to a level further from the nucleus; if it radiated energy, it fell to a level closer to the nucleus. His model was a huge leap forward in making theory fit the experimental evidence that other physicists had found over the years. A few inaccuracies remained to be ironed out by others over the next few years, but his essential idea was proved correct. He received the Nobel Prize for this work in 1922, and it's what he's most famous for. But he was only 37 at the time, and he didn't stop there. Among other things, he put forth the theory of the nucleus as a liquid drop, and the idea of "complementarity" -- that things may have a dual nature (as the electron is both particle and wave) but we can only experience one aspect at a time.

In 1912 Bohr married Margrethe Nørlund. They had six sons, one of whom, Aage, followed his father into physics -- and into the ranks of Nobel Prize-winners. Bohr returned to Denmark as a professor at the University of Copenhagen, and in 1920 founded the Institute for Theoretical Physics -- sponsored by the Carlsberg brewery! Bohr remained director of the institute for the rest of his life, except for his absence during World War II. Bohr's personal warmth, good humor ("Never express yourself more clearly than you can think," he once said), and hospitality combined with world events to make Copenhagen a refuge for many of the century's greatest physicists.

After Hitler took power in Germany, Bohr was deeply concerned for his colleagues there, and offered a place for many escaping Jewish scientists to live and work. He later donated his gold Nobel medal to the Finnish war effort. In 1939 Bohr visited the United States with the news from Lise Meitner (who had escaped German-occupied Austria) that German scientists were working on splitting the atom. This spurred the United States to launch the Manhattan Project to develop the atomic bomb. Shortly after Bohr's return home, the German army occupied Denmark. Three years later Bohr's family fled to Sweden in a fishing boat. Then Bohr and his son Aage left Sweden traveling in the empty bomb rack of a British military plane. They ultimately went to the United States, where both joined the government's team of physicists working on atomic bomb at Los Alamos. Bohr had qualms about the consequences of the bomb. He angered Winston Churchill by wanting to share information with the Soviet Union and supporting postwar arms control. Bohr went on to organize the Atoms for Peace Conference in Geneva in 1955.

In addition to his major contributions to theoretical physics, Bohr was an excellent administrator. The institute he headed is now named for him, and he helped found CERN, Europe's great particle accelerator and research station. He died at home in 1962, following a stroke.

"An expert is a man who has made all the mistakes which can be made, in a very narrow field."

Ernest Rutherford
1871 - 1937

Ernest Rutherford's family emigrated from England to New Zealand before he was born. They ran a successful farm near Nelson, where Ernest was born. One of 12 children, he liked the hard work and open air of farming, but was a good student and won a university scholarship. After college, he won another scholarship to study at Cambridge University in England -- a turning point in his life. There he met J.J. Thomson (who would soon discover the electron), and Thomson encouraged him to study recently-discovered x-rays.

This was the start of a long, productive, and influential career in atomic physics. Rutherford eventually coined the terms for some of the most basic principles in the field: alpha, beta, and gamma rays, the proton, the neutron, half-life, and daughter atoms. Several of the century's giants in physics studied under him, including Niels Bohr, James Chadwick, and Robert Oppenheimer.

Early on he found that all known radioactive elements emit two kinds of radiation: positively and negatively charged, or alpha and beta. He showed that every radioactive element decreases in radioactivity over a unique and regular time, or half-life, ultimately becoming stable. In 1901 and 1902 he worked with Frederick Soddy to prove that atoms of one radioactive element would spontaneously turn into another, by expelling a piece of the atom at high velocity. Many scientists of the day scorned the idea as alchemy. They stuck with the age-old belief that the atom is indivisible and unchangeable. But by 1904 Rutherford's publications and achievements gained recognition. He was an extremely energetic researcher: in the span of seven years, he published 80 papers.

In 1907 he went to the University of Manchester and with Hans Geiger (of the Geiger counter) set up a center to study radiation. In 1909 he began experiments that were to change the face of physics. He discovered the atomic nucleus and developed a model of the atom that was similar to the solar system. Like planets, electrons orbited a central, sun-like nucleus. Acceptance of this model grew after it was modified with quantum theory by Niels Bohr. For his work with radiation and the atomic nucleus, Rutherford received the 1908 Nobel Prize in chemistry. He was slightly put out, since he was a physicist and felt a bit superior to chemistry! In 1914 Rutherford was knighted.

During World War I, he left his research to help the British Admiralty with problems of submarine detection, but was soon back in the lab. He managed to produce the disintegration of a non-radioactive atom, dislodging a single particle. The particle had a positive charge, so it must have come from nucleus: he called this new particle a proton. With this experiment, he was the first human to create a "nuclear reaction," though a weak one. In 1919 he took over as director of the Cavendish Laboratory. His warm, outgoing personality made him an outstanding mentor to researchers attracted there by his scientific achievements.

He took on more supervision and less direct research as years went by. In 1931 he was made the first Baron Rutherford of Nelson, allowing him to join the House of Lords. He was fiercely anti-Nazi, and in 1933 he served as president of the Academic Assistance Council, established to help German refugees. He would not personally help chemist Fritz Haber, however, who had been instrumental in creating chemical weapons in World War I. Rutherford died two years before the discovery of atomic fission.

"All science is either physics or stamp collecting."

Unit Study Guide

Law, Theories, BIG ideas	**Equations, Calculations, Reference Tables**	
Laws:	Equation:	(When to use & units)
Theories:	Calculations	(When to use)
BIG ideas:	Reference Table	(Hints & tricks)

Helpful tips, sayings, shortcuts

Things I always forget…

Unit Project: Inside an atom **Due date:_____**

Around 460 BC Democritus, a Greek Philosopher, proposed that all matter is composed of particles he called atoms (Greek for particle). His ideas were not popular.
They did not fit the observations at that time. The idea of atoms did not take hold for over another 2,000 years. In 1803, John Dalton, an English scientist, made some observations about the relative masses of elements in a compound. He explained his observations by postulating that all matter is made of small particles called atoms. Dalton said all atoms are indestructible, and that they cannot be created or destroyed during chemical or physical changes. He also said all atoms of an element are identical and have the same mass, an idea later disproved. By 1911, Ernest Rutherford found evidence that atoms have a dense, positive core or nucleus with electrons orbiting the nucleus at relatively great distances. This idea, called the nuclear atom or solar system model, with some refinements, is the basic model of the atom that chemists use today.

Assignment: **Imagine you awake one morning and discover that you shrank to an incredibly small size and are trapped inside a carbon atom in your pillow case. What would you see?**

• Write a story, poem, song, comic strip, or do some other creative project based on this scenario.

• Be sure to include all the relevant facts about atomic structure in your work.

• Use reference books for information and add additional sheets if needed.

Unit Review:

Atomic Theory

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 describe John Dalton's contribution to our understanding of the atom.	Dalton's Model: What it looked like:
_____4. I can describe JJ Thomson's contribution to our understanding of the atom.	Thomson's Experiment: Thomson's Model: What it looked like:
_____5. I can describe Ernest Rutherford's contribution to our understanding of the atom.	Rutherford's Experiment: Rutherford's Model: What it looked like:
_____6. I can describe Niels Bohr's contribution to our understanding of the atom.	Bohr's Model: What it looked like:

<table>
<tr><td>_____7. I can state the chronological order of atomic models.</td><td>From oldest to newest, list the models that we have used to describe an atom.</td></tr>
<tr><td>_____8. I can state the three subatomic particles, their location in an atom, their charges, and their masses (in amu).</td><td><table>
<tr><th></th><th>Particle #1</th><th>Particle #2</th><th>Particle #3</th></tr>
<tr><td>Name</td><td></td><td></td><td></td></tr>
<tr><td>Charge</td><td></td><td></td><td></td></tr>
<tr><td>Mass</td><td></td><td></td><td></td></tr>
<tr><td>Location in Atom</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>_____9. I can explain why atoms are electrically neutral.</td><td>Atoms are electrically neutral because the number of __________________ is

equal to the number of ________________________.</td></tr>
<tr><td>_____10. I can define mass number and atomic number.</td><td><u>Definitions:</u>
mass number

atomic number</td></tr>
<tr><td>_____11. Given the mass number,
I can determine the number of protons, neutron, and electrons in an atom.</td><td>In an atom of $^{212}_{84}\text{Po}$, how many protons are present?

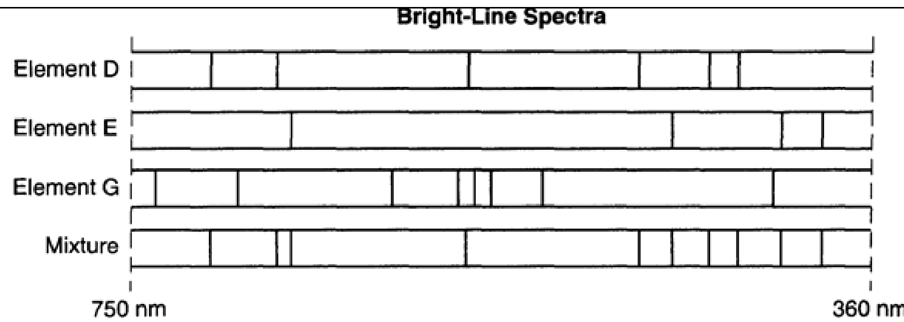
In an atom of $^{212}_{84}\text{Po}$, how many electrons are present?

In an atom of $^{212}_{84}\text{Po}$, how many neutrons are present?</td></tr>
<tr><td>_____12. I can use the Periodic Table to determine the atomic number of an element.</td><td>How many protons are in an atom of selenium?

How many protons are in an atom of silicon?</td></tr>
</table>

_____13. I can define isotope.	**<u>Definition:</u>** isotope
_____14. I can represent an atom in any of the two methods of isotopic notation.	Write the four different methods of isotopic notation for an atom of bromine that has 45 neutrons. Method 1 Method 2
_____15. I can calculate average atomic mass given the masses of the naturally occurring isotopes and the percent abundances.	Element Q has two isotopes. If 77% of the element has an isotopic mass of 83.7 amu and 23% of the element has an isotopic mass of 89.3 amu, what is the average atomic mass of the element?
_____16. I can define ion, cation, and anion.	**<u>Definitions:</u>** ion cation anion
_____17. Given the mass number and the charge, I can determine the number of protons, neutrons, and electrons in an ion.	How many protons are in $^{19}_{9}F^{1-}$? How many neutrons are in $^{19}_{9}F^{1-}$? How many electrons are in $^{19}_{9}F^{1-}$?

_____18. I can define orbital, ground state, excited state, electron configuration, and bright line spectrum.	**<u>Definitions:</u>** orbital ground state excited state electron configuration bright line spectrum
_____19. I determine the number of valence electrons for an atom and an ion.	How many electrons does Na have? How many electrons does Na^+ have?
_____20. I can state the relationship between distance from the nucleus and energy of an electron.	As the distance between the nucleus and the electron increases, the energy of the electron ___________________.
_____21. I can state the relationship between the number of the principal energy level and the distance to the atom's nucleus.	As the number of the PEL increases, the distance to the nucleus ____________

_____22. I can explain, in terms of subatomic particles and energy states, how a bright line spectrum is created.	A bright line spectrum is created when
_____23. I can identify the elements shown in a bright line spectrum.	 Which element(s) is/are present in the mixture?
_____24. I can define valence electrons.	**<u>Definition:</u>** valence electron
_____25. I can locate and interpret an element's electron configuration on the Periodic Table.	How many valence electrons does an atom of rubidium have in the ground state? How many energy levels does an atom of iodine have in the ground state?
_____26. I can identify an electron configuration that shows an atom in the excited state.	Which electron configuration represents an atom of potassium in the excited state? A) 2-8-7-1 B) 2-8-8-1 C) 2-8-7-2 D) 2-8-8-2
_____27. I can draw Lewis electron dot diagrams for a given element.	Draw the Lewis electron dot diagram for the following atoms: Li Be B C N O F Ne

_____28. I can define and state the importance of "octet of valence electrons."	**<u>Definition:</u>** octet of valence electrons The importance of having a complete"octet of valence electrons" is