Chemistry
Ms. Ye

Name _____
Date _____Block _____

Do Now: Recall

1. What is an atom? What have you learned about the word "atom" so far this semester?

Atoms Video:

1. **Proper Portioned Giant Atom Model of Science:** Structure of an Atom

   i. Nucleus = _____

   Made up of 2 kinds of particles

   a. **Protons:** have a _____ charge

   b. **Neutrons:** have _____ charge

   ii. Electrons=very small particles that surround the nucleus

   have a _____charge

2. If the vibrating buzzing ball as seen in the video is the nucleus of an atom, how far way is the nearest electron?

3. Based on number 2 above, atoms are mostly _____!

4. If atoms are mostly empty space, how come when you jump on a box, your feet doesn't go straight through it?

5. About how many atoms can fit on the head (the sharp tip) of a pin?

6. What makes one atom different from an atom of another element?

The Evolution of the Atomic Model

Since atoms are too small to see even with a very powerful microscope, scientists rely upon indirect evidence and models to help them understand and predict the structure of an atom.

Democritus & Leucippus (~400 BC)

- Greek philosophers: first to propose that matter is made up of _____ _____ particles called *atomos*, the Greek word for atoms

Robert Boyle (1600s)

- Proposed that an _____ is a substance that _____ be broken down _____

Antoine Lavosier (1800s)

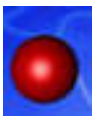
- Law of Conservation of Mass: _____
- Supported Boyle's claim that an <u>element</u> could not be broken down by <u>chemical</u> methods.

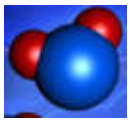
John Dalton (1803)

- Dalton theorized that the _____is a tiny particle called an _____
- Dalton's theory of the atom can be summarized by the following postulates:

1. All _____ are composed of _____
2. All atoms of a given _____
3. Atoms of different elements are _____
4. _____ are formed by the combination of _____

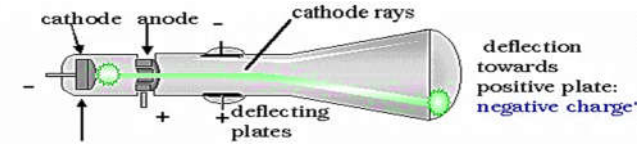
- **Billiard Ball Model:** An atom is represented by a _____



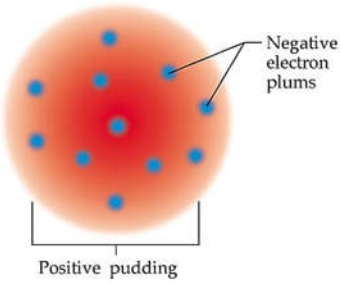


J.J. Thomson (1897)

- Used a _____ to show one of the smaller units that make up an atom
- Because the cathode ray deflected towards the positively charged plate when an electric or magnetic field was applied, Thomson concluded that _____ and the particles were _____

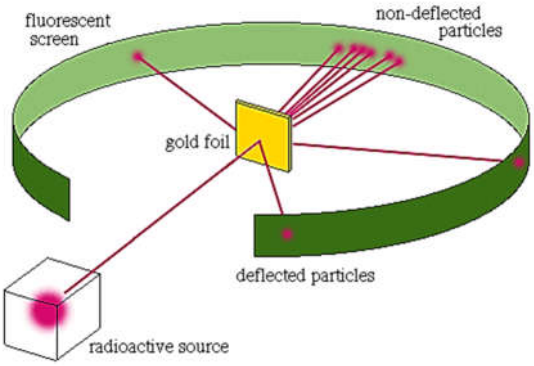


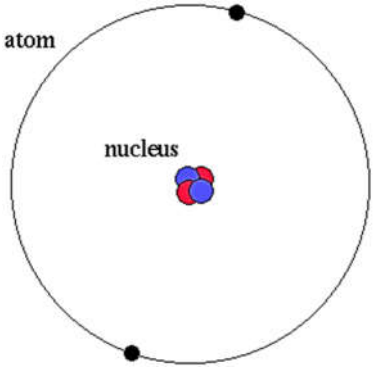
- Thomson discovered that the atom is made up of small, _____ which he called _____
- Developed the _____



Ernest Rutherford (1909)

- Conducted the _____
  - Directed _____, which are positively charged particles much smaller than an atom, at a _____
  - Results: Most of the alpha particles _____ and a few were slightly deflected
  - Some of the alpha particles were _____and _____





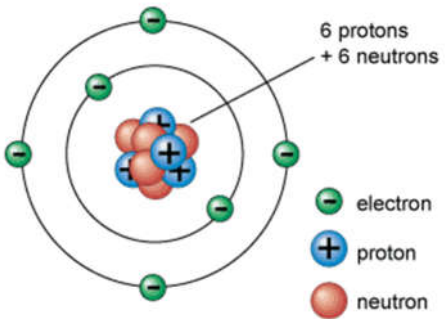
- Rutherford concluded atoms have a _____ called the _____, while the remainder of the atom is essentially _____
- Positively charged particles known as the _____ are found in the nucleus ***provided no information about electrons other than the fact that they were located outside the nucleus

James Chadwick

- First to prove the existence of the _____
- Provided explanation as to why the positively charged protons in the nucleus stayed intact and did not repel each other.

Neils Bohr (1913)

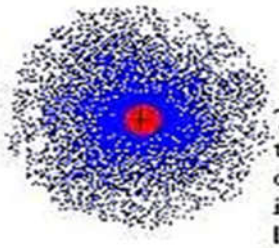
- **Bohr Model of the Atom; a.k.a.** _____
  - The nucleus contained the _____
  - The _____orbited around the nucleus (like planets orbiting the sun)



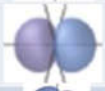
- Electrons are shown in concentric circles or shells around the nucleus
  - The first shell can hold _____
  - The second shell can hold _____
  - The third shell can hold _____
  - Electrons in the outermost shell are called the _____

Wave or Quantum-Mechanical Model a.k.a. Electron-Cloud Model (modern, present-day model)

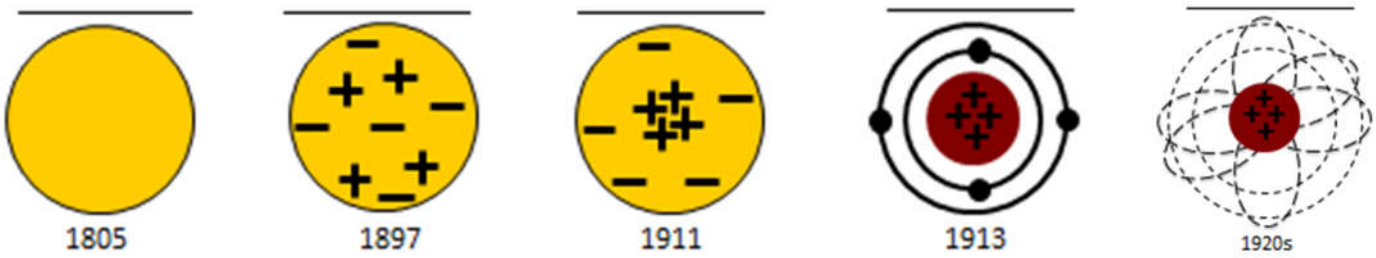
- Developed after the famous discovery that energy can be viewed as both _____
- Like planetary model, atom is pictured as having _____
  The difference in this model is how the electrons are pictured.
  Electrons have distinct _____ and move in areas called _____
- An **orbital** is a region _____



The blue area is the electron cloud. The darker it is, the more likely the electron is there.

Value of *l*	Orbital (subshell)	Orbital Shape	Name*
0	*s*		*sharp*
1	*p*		*principal*
2	*d*		*diffuse*
3	*f*		*fine*

Summary:



1. Which of the following did Rutherford's gold foil experiment prove?
   a. That the atom was a uniformly dense sphere
   b. That the atom is mostly empty space with a dense, positive core
   c. That most of the atom consists of a uniform, positive "pudding" with small negative particles called electrons embedded throughout
   d. That electrons travel around the nucleus in well-defined paths called orbits

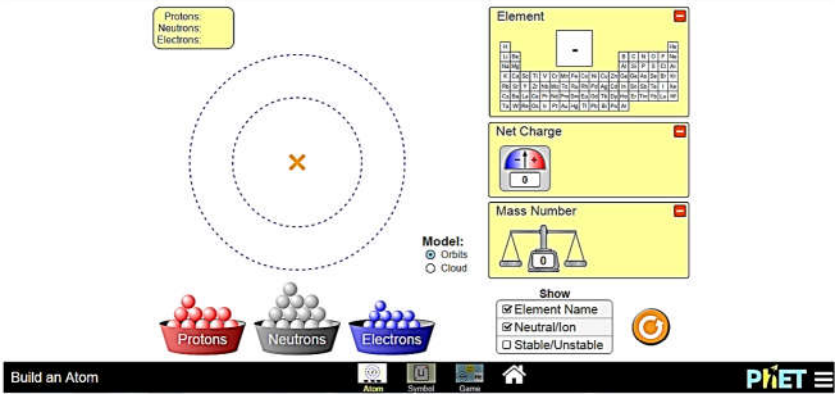
2. J.J. Thomson's cathode ray tube experiment led to the discovery of
   a. The positively charged subatomic particle called the electron
   b. The negatively charged subatomic particle called the proton
   c. The positively charged subatomic particle called the proton
   d. The negatively charged subatomic particle called the electron

3. According to the Bohr Model,
   a. Electrons are found in areas of high probability called orbitals
   b. Electrons travel around the nucleus in circular paths called orbits
   c. Electrons are found in areas of high probability called orbits
   d. Electrons travel around the nucleus in random paths called orbitals

4. According to the Quantum-Mechanical Model,
   a. Electrons are found in areas of high probability called orbitals
   b. Electrons travel around the nucleus in circular paths called orbits
   c. Electrons are found in areas of high probability called orbits
   d. Electrons travel around the nucleus in random paths called orbitals

Structure of an Atom

Go to http://phet.colorado.edu/en/simulation/build-an-atom and click on "run in html5". Click on "Atom" and use the simulation to answer the following questions.



Directions:

1. Place one proton (red) in the atom. Write the charge of one proton in table 1 below.
2. Remove the proton. Now place one neutron (gray) in the atom. Record the charge.
3. Remove the neutron. Now place one electron (blue) in the atom. Record the charge.

Table 1.

	Proton	Neutron	Electron
Charge			

4. Create the atoms on the PhET simulation based on the information given in the first column titled "Atom description;" Complete the rest of the information on table 2 for each atom.

Table 2.

#	Atom description	Name of element	Mass number	Charge of atom
1	1 proton (no neutrons; no electrons)			
2	2 protons (no neutrons; no electrons)			
3	2 protons and 1 neutron (no electrons)			
4	2 protons and 2 neutron (no electrons)			
5	2 protons; 2 neutrons; and 1 electron			
6	2 protons; 2 neutrons; and 2 electron			
7	2 protons; 2 neutrons; and 3 electron			

5. For table 2, you changed the number of protons for #1 and #2. Did the element change? Did the mass or charge change?

6. For #2, #3, and #4, you kept the number of protons the same, but changed the number of neutrons. Did the element change? Did the mass or charge change?

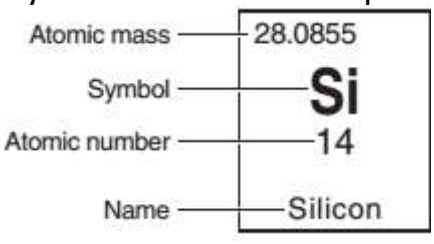
7. For #4, #5, #6, and #7, you kept the number of protons (2) and neutrons (2) the same, but changed the number of electrons. Did the element change? Did the mass or charge change?

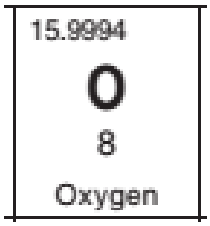
8. Based on your observations above, complete the table below.

Property	Subatomic particle(s) (protons, neutrons, electrons) that determines property
Identity of element (type/name of element)	
The Mass	
Overall positive or negative charge	

<u>What can you determine about the structure of an atom of a specific element based on its information on the Periodic Table?</u>

1. The following key gives you the information a periodic table provides about an atom of a specific element





2. Create an oxygen atom with a mass of 15 and a charge of +1 on your simulation. Determine how the number of protons, neutrons, and electrons relates to the atomic number and atomic mass.

a. **The atomic number equal** to the number of _____

b. **The mass number is equal** to _____ + _____

c. Alter your oxygen atom so that it has a charge of 0 (neutral).

For neutral atoms, the number of electrons is = # of _____

Atomic Structure Practice: Fill in the missing information. The first one has been done for you as an example. Assume these are all **neutral atoms!**

Nuclear Notation	Full Notation	Atomic Number	Mass Number	# Protons	# Neutrons	# Electrons
$^{7}_{3}Li$	**Lithium-7**	**3**	**7**	**3**	**4**	**3**
		15	**31**			
			35	**17**		
		28			**31**	
			39			**19**
		47			**61**	
			1	**1**		
					14	**14**
				74	**110**	
					10	**10**