Chemistry 1
History of the Atom
Activity – Democritus

Democritus
(460 BC – 370 BC)

In the days before electricity, the internet, cable TV and cell phones, people actually spent a lot of time thinking and philosophizing about the world around them.

While the "ancients" believed everything was made up of earth, wind, fire, or water, Democritus had other ideas. He believed – along with mentor Leucippus - that there had to be a basic building block that made up all other matter. Democritus used the word "atomos" which means indivisible. Around 300 B.C. he proposed a theory which states that all atoms are small, hard, indivisible and indestructible particles made of a single material formed into different shapes and sizes

Democritus believed the atom was it - smallest particle of matter. He was talking about tiny invisible things before there was technology available to see anything this small.

Would it not have been for Aristotle, writing atoms off as nonsense, the idea may have gained traction a lot earlier.

Chemistry 1
History of the Atom
Activity – Dalton

John Dalton
(1766 – 1844)

John's Dalton's theory was based on the premise that atoms of different elements could be distinguished by differences in their weights which he measured in his own experiments. He stated this theory in a lecture to the Royal Institution in 1803. The theory proposed a number of basic ideas:

-all matter is composed of atoms
-atoms cannot be made or destroyed
-different elements have different types of atoms
-chemical reactions occur when atoms are rearranged
-compounds are formed from atoms of the constituent elements

Using his theory, Dalton rationalized the various laws of chemical combination which were in existence at the time. However, he made a mistake in assuming that the simplest compound of two elements must be binary, formed from atoms of each element in a 1:1 ratio, and his system of atomic weights was not very accurate. Despite these errors, Dalton's theory provided a logical explanation of concepts and led the way into a new field of experimentation.

Chemistry 1
History of the Atom
Activity – Thomson

J.J. Thomson
(1856 – 1940)

The **plum pudding model** of the atom by J. J. Thomson, who discovered the electron in 1897, was proposed in 1904 before the discovery of the atomic nucleus in order to add the electron to the atomic model. In this model, the atom is composed of electrons (which Thomson still called "corpuscles", though G. J. Stoney had proposed that atoms of electricity be called *electrons* in 1894) surrounded by a soup of positive charge to balance the electrons' negative charges, like negatively charged "plums" surrounded by positively charged "pudding". The electrons (as we know them today) were thought to be positioned throughout the atom, but with many structures possible for positioning multiple electrons, particularly rotating rings of electrons (see below). Instead of a soup, the atom was also sometimes said to have had a "cloud" of positive charge.

With this model, Thomson abandoned his earlier "nebular atom" hypothesis in which the atom was composed of immaterial vortices. Now, at least part of the atom was to be composed of Thomson's particulate negative corpuscles, although the rest of the positively charged part of the atom remained somewhat nebulous and ill-defined.

Thomson's model was compared to a British dessert called plum pudding, hence the name. Thomson's paper was published in the March 1904 edition of the *Philosophical Magazine*, the leading British science journal of the day.

Chemistry 1
History of the Atom
Activity – Rutherford

Ernest Rutherford
(1871 – 1937)

In 1909, Ernest Rutherford suggested the following characteristics of the atom:

- It consists of a small core, or nucleus, that contains most of the mass of the atom
- This nucleus is made up of particles called protons, which have a positive charge
- The protons are surrounded by negatively charged electrons, but most of the atom is actually empty space

Rutherford came to these conclusions following the results of his famous gold foil experiment. This experiment involved the firing of radioactive particles through minutely thin metal foils (notably gold) and detection of these particles using screens coated with zinc sulfite. Rutherford found that the vast majority of particles passed straight through the foil and approximately 1 in 8000 were deflected. This led him to believe that most of the atom was made of up "empty space."

Chemistry 1
History of the Atom
Activity – Bohr

Niels Bohr
(1885 – 1962)

The discoveries of the electron and radioactivity at the end of the 19th century led to different models for the structure of the atom. In 1913, Niels Bohr proposed a theory for the hydrogen atom based on quantum theory that energy is transferred only in certain well defined quantities. Electrons should move around the nucleus but only in prescribed orbits. When jumping from one orbit to another with lower energy, a light quantum is emitted. Bohr's theory could explain why atoms emitted light in fixed wavelengths.

Chemistry 1
History of the Atom
Activity – Schrodinger

Erwin Schrodinger
(1887-1961)

In 1926 Erwin Schrödinger, an Austrian physicist, took the Bohr atom model one step further. Schrödinger used mathematical equations to describe the likelihood of finding an electron in a certain position. This atomic model is known as the quantum mechanical model of the atom. Unlike the Bohr model, the quantum mechanical model does not define the exact path of an electron, but rather, predicts the odds of the location of the electron. This model can be portrayed as a nucleus surrounded by an electron cloud. Where the cloud is most dense, the probability of finding the electron is greatest, and conversely, the electron is less likely to be in a less dense area of the cloud. Thus, this model introduced the concept of sub-energy levels.
Schrodinger showed that it is more accurate to view the electrons in regions called **electron clouds** (or places where the electrons are likely to be found).

Chemistry 1
History of the Atom
Activity – Chadwick

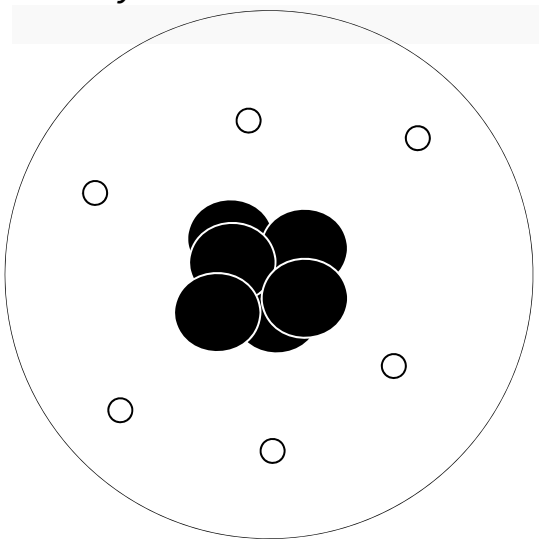
James Chadwick
(1891 – 1974)

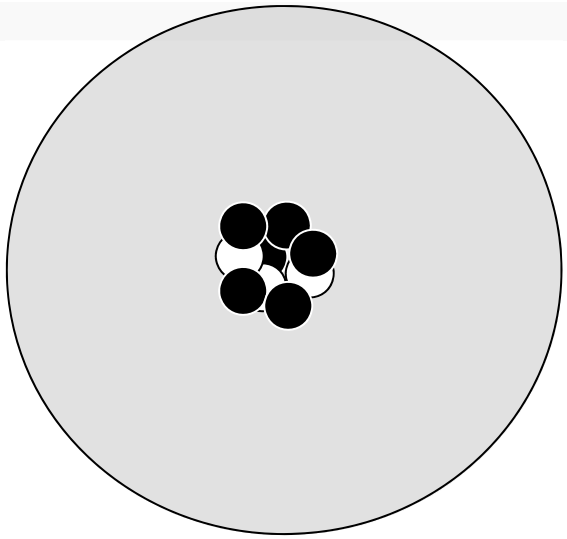
James Chadwick discovered the neutron in 1932using evidence collected by Irene Joliot-Curie, who discovered that when beryllium was bombarded with positively charged alpha particles a beam with a high penetrating power was created. James Chadwick discovered that this beam was not deflected by either electric or magnetic fields, meaning it contained neutral particles- neutrons. Neutrons were found to have the same mass as protons which accounted for more of the mass of the atom and allowed the masses (the known mass of an atom and the known mass of its particles) to match. The common understanding of an atom was now a nucleus containing positively charged protons and neutral neutrons (making up nearly all of the atom's mass) with the rest of the atom (most of it- considering the relative size of the nucleus, which was found to have a radius of 10000 times less than the atom itself) being space in which negatively charged electrons (with a mass so small it is insignificant compared to that of the nucleus) "orbit" the nucleus on energy levels corresponding to the amount of energy the electrons hold.

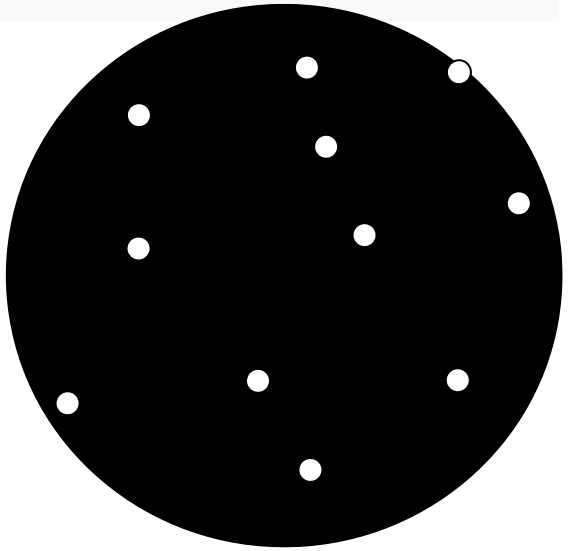
Chemistry 1
History of the Atom
Activity – Summary Chart

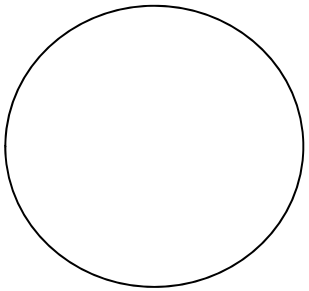
Date	Historical Figure	Experiment/Observation	Implication (Contribution to our understanding of atomic structure)

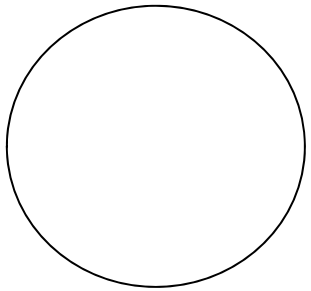
Chemistry 1
History of the Atom
Activity - Atomic Models

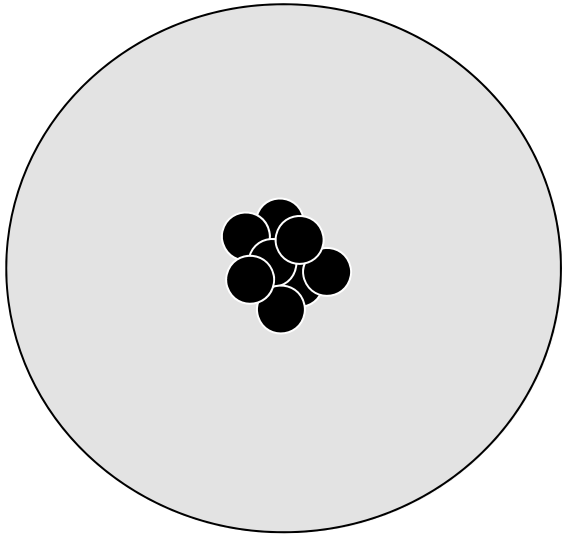


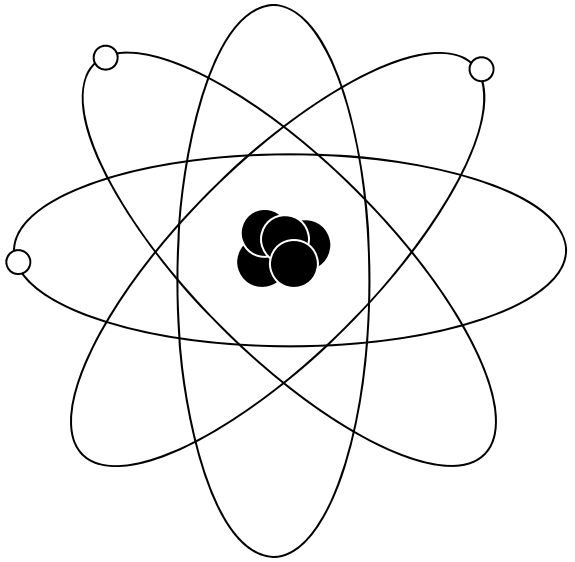












Chemistry 1
History of the Atom
Activity - Conclusion Questions

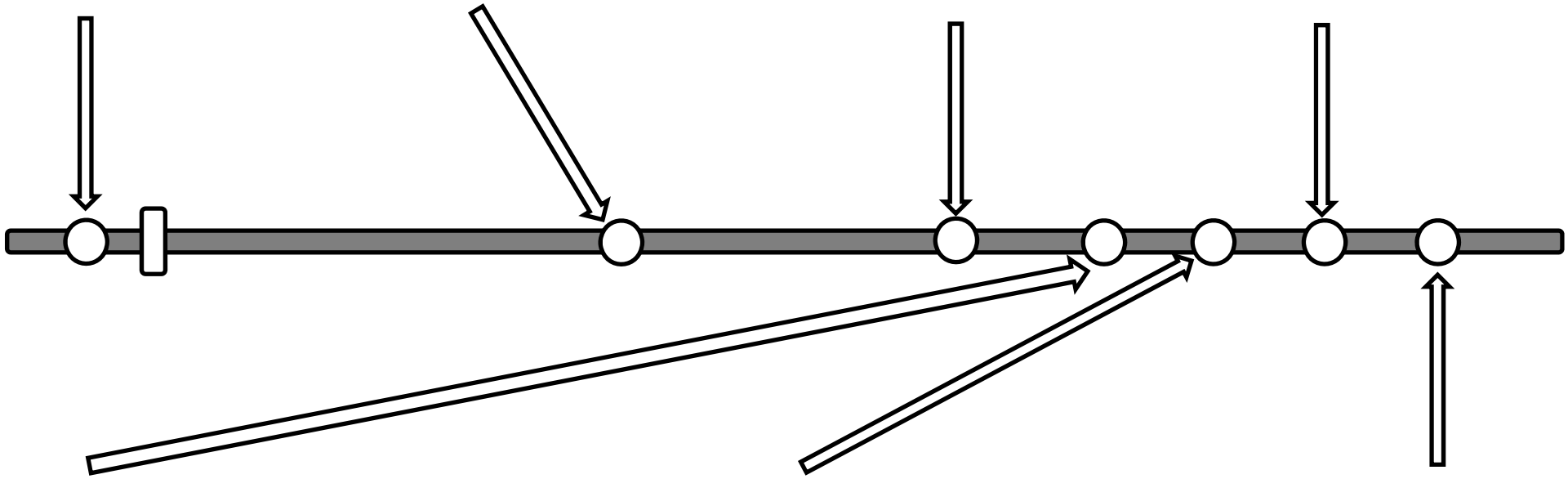
1. Use your book to define the term “atom.”

2. Use your book to define the term “theory.”

3. What happens to a theory when new information is discovered?

4. Describe how the series of discoveries that you have read about in this assignment each built upon the each other to lead to our current understanding of the atom.

Chemistry 1
History of the Atom
Activity - Summary Timeline



INSTRUCTIONS: Cut out each *atomic model* (see other handout) and place it on the timeline in the correct chronological order. Also, label each point on the timeline with the correct date.