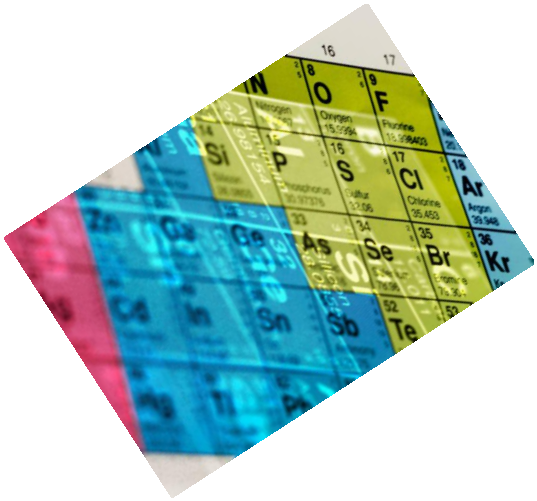
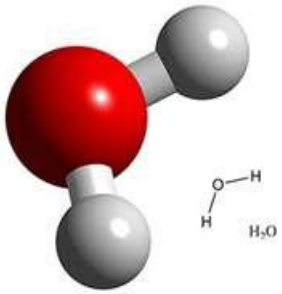
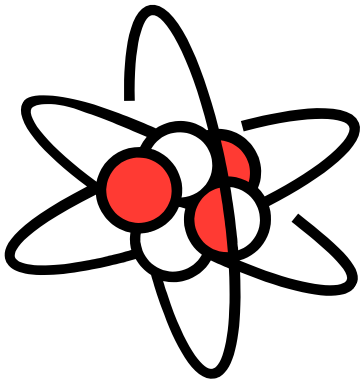
Unit 4:

Matter, the Atomic Structure, and the Periodic Table







Anticipation Guide

True or False (circle the correct answer)

1. **All matter is composed of atoms.** True False

2. **The Isotopes of an element are atoms with the same number of protons and different numbers of neutrons.** True False

3. **Protons have a positive charge.** True False

4. **Compounds have more than one type of atom.** True False

5. **The Periodic Table is a listing of elements by atomic number and other characteristics.** True False

6. **Metals and non-metals have distinct characteristics and are found in separate areas of the Periodic Table.** True False

Read the article about the history of the atom and complete the timeline.

Atomic Theory I

The Early Days

by Anthony Carpi, Ph.D.

Earrings have them. Stereos have them. You have them and they all came from stardust. Matter is composed of atoms that originated either when the Universe began or in stars, often as the dust that exploded out of stars as they ended their life in a super nova. What are those atoms?

Many of the early Greeks believed everything to be made up of air, water, earth and fire or a combination of these. Democritus first suggested the existence of the atom but it took almost two millennia before the atom was placed on a solid foothold as a fundamental chemical object by John Dalton. Although two centuries old, Dalton's Atomic Theory remains valid in modern chemical thought. Dalton's atomic theory states all matter is made of atoms. Atoms are indivisible and indestructible. All atoms of a given element are identical in mass and properties Compounds are formed by a combination of two or more different kinds of atoms and a chemical reaction is a rearrangement of atoms. Until the final years of the nineteenth century, the accepted model of the atom resembled that of a billiard ball - a small, solid sphere.

In 1897, J. J. Thomson dramatically changed the modern view of the atom with his discovery of the electron. Thomson's work suggested that the atom was not an "indivisible" particle as John Dalton had suggested but, a jigsaw puzzle made of smaller pieces.

Thomson's notion of the electron came from his work with a nineteenth century scientific curiosity: the cathode ray tube. For years scientists had known that if an electric current was passed through a vacuum tube, a stream of glowing material could be seen; however, no one could explain why. Thomson found that the mysterious glowing stream would bend toward a positively charged electric plate. Thomson theorized, and was later proven correct, that the stream was in fact made up of small particles, pieces of atoms that carried a negative charge. These particles were later named *electrons*.

After Eugen Goldstein's 1886 discovery that atoms had positive charges, Thomson imagined that atoms looked like pieces of raisin bread, a structure in which clumps of small, negatively charged electrons (the "raisins") were scattered inside a smear of positive charges. This became known as the Plum Pudding model for the

atom. In 1908, Ernest Rutherford, a former student of Thomson's, proved Thomson's raisin bread structure incorrect.

Rutherford performed a series of experiments with radioactive alpha particles. While it was unclear at the time what the alpha particle was, it was known to be very tiny. Rutherford fired tiny alpha particles at solid objects such as gold foil. He found that while most of the alpha particles passed right through the gold foil, a small number of alpha particles passed through at an angle (as if they had bumped up against something) and some bounced straight back like a tennis ball hitting a wall.

Rutherford's experiments suggested that gold foil, and matter in general, had holes in it! These holes allowed most of the alpha particles to pass directly through, while a small number ricocheted off or bounced straight back because they hit a solid object.

In 1911, Rutherford proposed a revolutionary view of the atom. He suggested that the atom consisted of a small, dense core of positively charged particles in the center (or nucleus) of the atom, surrounded by a swirling ring of electrons. The nucleus was so dense that the alpha particles would bounce off of it, but the electrons were so tiny, and spread out at such great distances, that the alpha particles would pass right through this area of the atom.

The positively charged particles in the nucleus of the atom were called protons. Protons carry an equal, but opposite, charge to electrons, but protons are much larger and heavier than electrons.

In 1913, the Danish physicist Niels Bohr proposed yet another modification to the theory of atomic structure based on a curious phenomenon called line spectra. When matter is heated, it gives off light. Bohr depicts the atoms as a small, positively charged nucleus surrounded by electrons that travel in circular orbits or energy levels around the nucleus—similar in structure to the solar system.

Timeline Information

J.J Thomson

Atomic theory

Plum pudding model

Ernest Rutherford

Believed the atom was indivisible.

Atom is mostly empty space.

Discovered the nucleus

Proved atom is divisible.

John Dalton

Niels Bohr

Discovered the electrons.

Placed e- on energy levels.

Solar system model.

Made up of air, water, earth and fire

Came up with the idea of atom

Gold foil experiment

History of the Atom

Early Greeks _____

Democritus _____

Scientist:

Theory/Model:

Contribution:

1.

Scientist:

Theory/Model:

Contribution:

1.

2.

Scientist:

Theory/Model:

Contribution:

1.

2.

Scientist:

Theory/Model:

Contribution:

1.

Bohr & Rutherford

Electron Cloud Model

1. Electrons do not move in definite orbits
2. Electrons based on how much energy it has