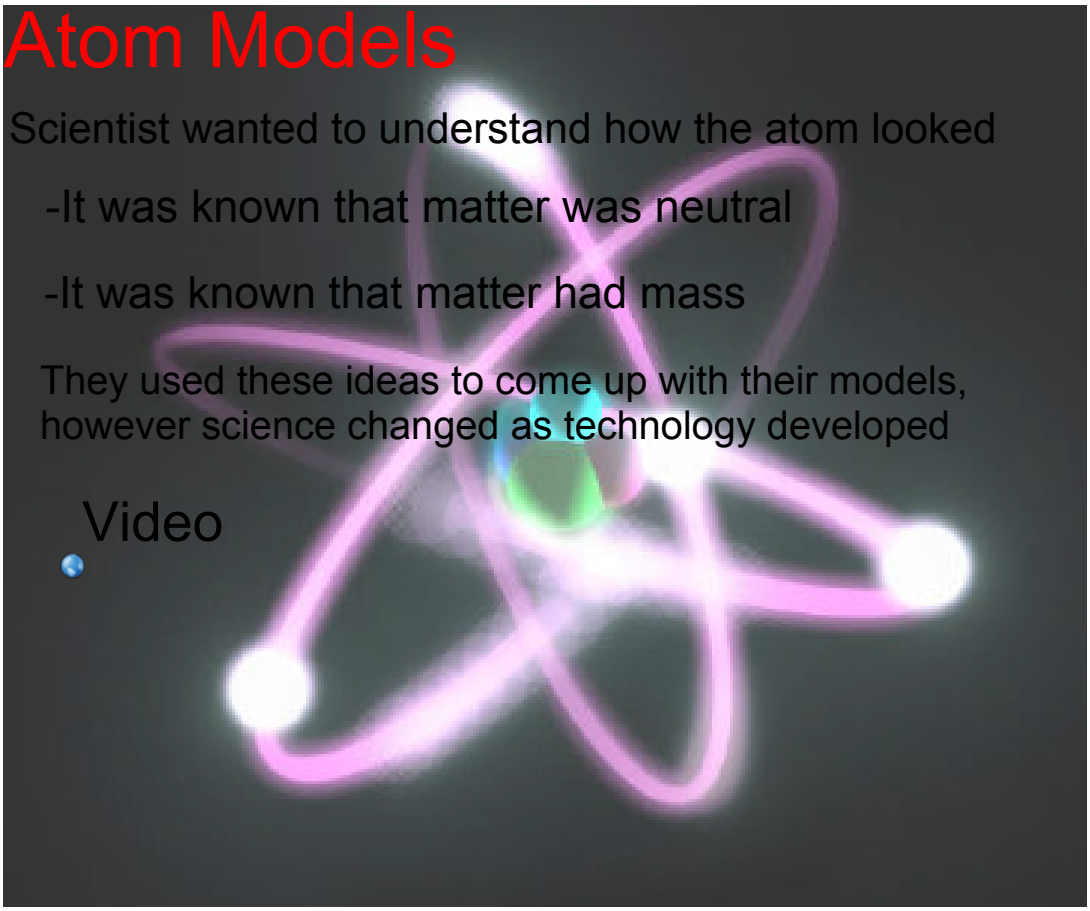


History of Atomic Theory

ΕΡΛΨ ΓΡΣΣΚ ΘΟΤ

Democritus and Leucippus- Greek philosophers who came up with the concept of an "atom" from the Greek word *atomos* which means indivisible.

OR

Aristotle - Famous philosopher who believed that all substances were made of 4 elements: Fire – Hot, Air – light, Earth - cool, heavy, and Water – wet. Blend these in different proportions to get all substances

Medieval Times

In medieval times, alchemists began experimentation. They are known for trying to change lead to gold. Out of this practice emerged the modern chemists, the first being Sir Robert Boyle in the 1600s.

Late 1700's - **John Dalton**, an English school teacher, summarized results of his experiments and those of other scientists.

His conclusions led to the **first scientific theory** of the **atom**

Dalton's Atomic Theory

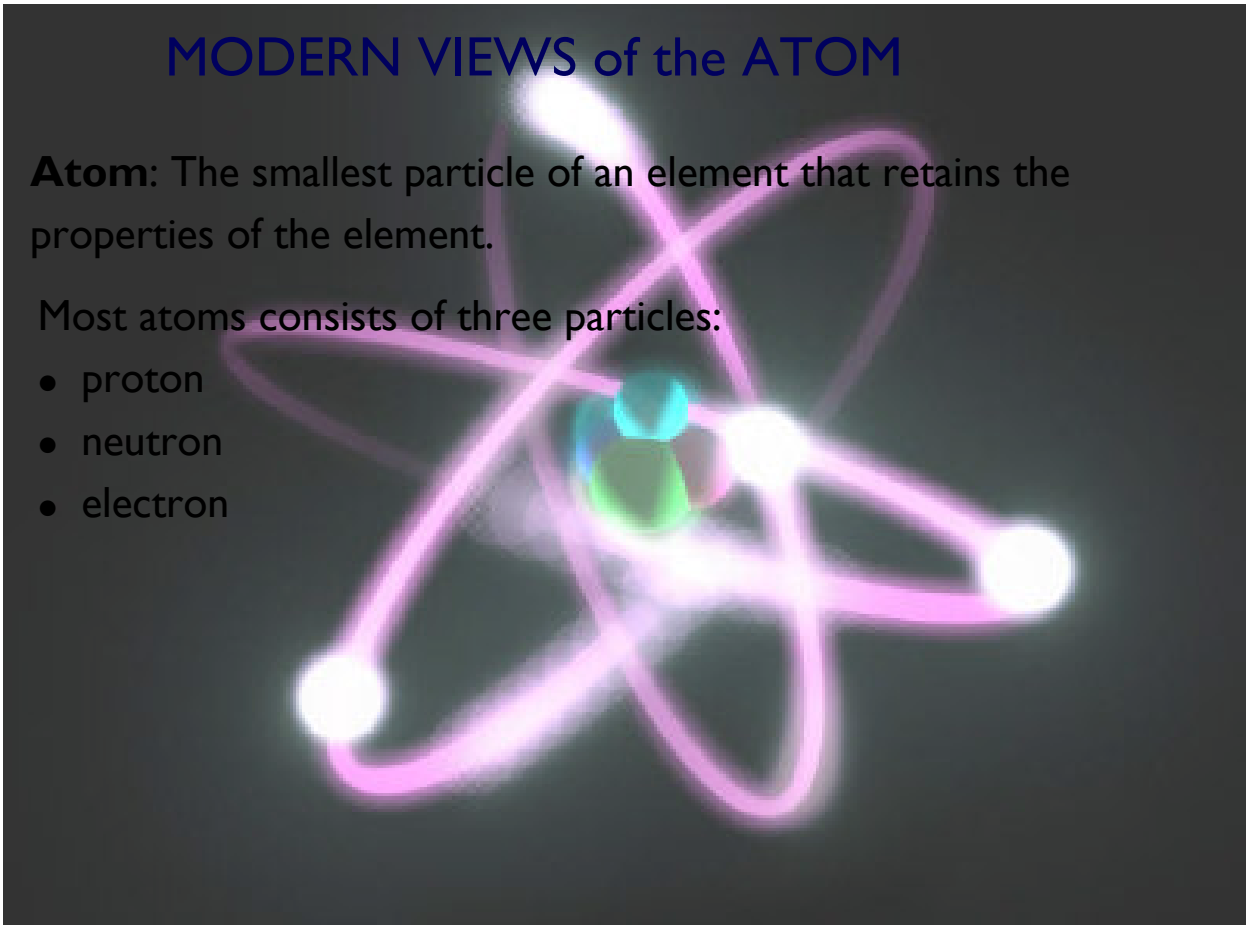
1. All matter is made of tiny ***indivisible*** particles called atoms.
2. Atoms of the same element are ***identical***, those of different atoms are different.
3. Atoms of different elements combine in **whole number ratios** to form compounds.
4. Chemical reactions involve the **rearrangement** of atoms. No new atoms are created nor destroyed.

MODERN VIEWS of the ATOM

Atom: The smallest particle of an element that retains the properties of the element.

Most atoms consists of three particles:

- proton
- neutron
- electron



Who? what? where? when? why? and how?

SCAVENGER HUNT

For each particle answer the following questions:

Who discovered this particle?

What experiment was conducted that led to its discovery?

Where is the particle found?

When was it discovered?

Why does is behave like it does? (what properties does it have?)

How do we use it in technology or science?

History of the Atom

Plum Pudding model:

(J. J. Thomson in 1897)

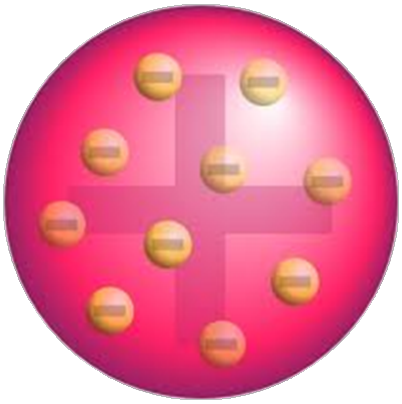
-Spherically shaped

-Electrons (negatively charged) positioned throughout it like chocolate chips in a cookie

-The sphere was a positively charged mass, like the cookie dough

-Idea did not last long

Video



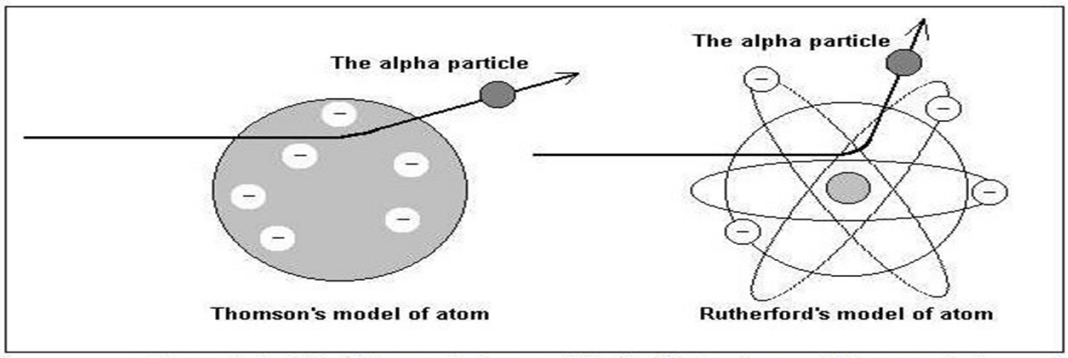
History of the Atom

Ernest Rutherford (1911)

-Shot a beam of radiation particles at a thin sheet of gold

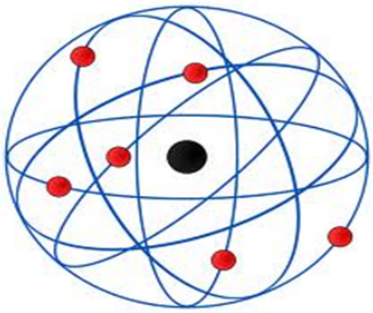
-He expected the particles to go straight through if the atom was based off the Plum Pudding Model.

-Particles should only alter course if they hit an electron in the atom



The models of the Thomson's atom and Rurtherford's atom; and the expected aberrations of alpha particle in both cases.

History of the Atom



Ernest Rutherford (1911)

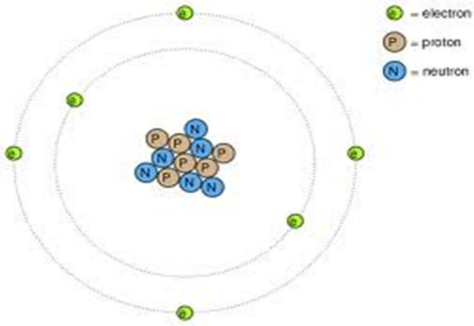
-The atom was made up of mostly empty space where the electrons moved

-The positive charge of the atom was within the center of the atom: **The nucleus**--a small dense positively charged space at the center of an atom

-Electrons are held within the atom due to the attraction of the nucleus

-The diameter of the atom was calculated to be 10,000 times the diameter of the nucleus (*comparison: if the diameter of the nucleus was a centimeter, how big would the diameter of the atom be?*)

History of the Atom



Ernest Rutherford (1920)

-The Nucleus contains protons and neutrons, containing 99.97% of the atoms mass

-Protons are a positively charged subatomic particle
-Neutrons are neutrally charged subatomic particle
-Nucleus is surrounded by negatively charged electrons, with negligible mass

-Protons and electrons are attracted to each other

-Atoms are mostly empty space

Video

History of the Atom

Modern Atomic Theory (Present)

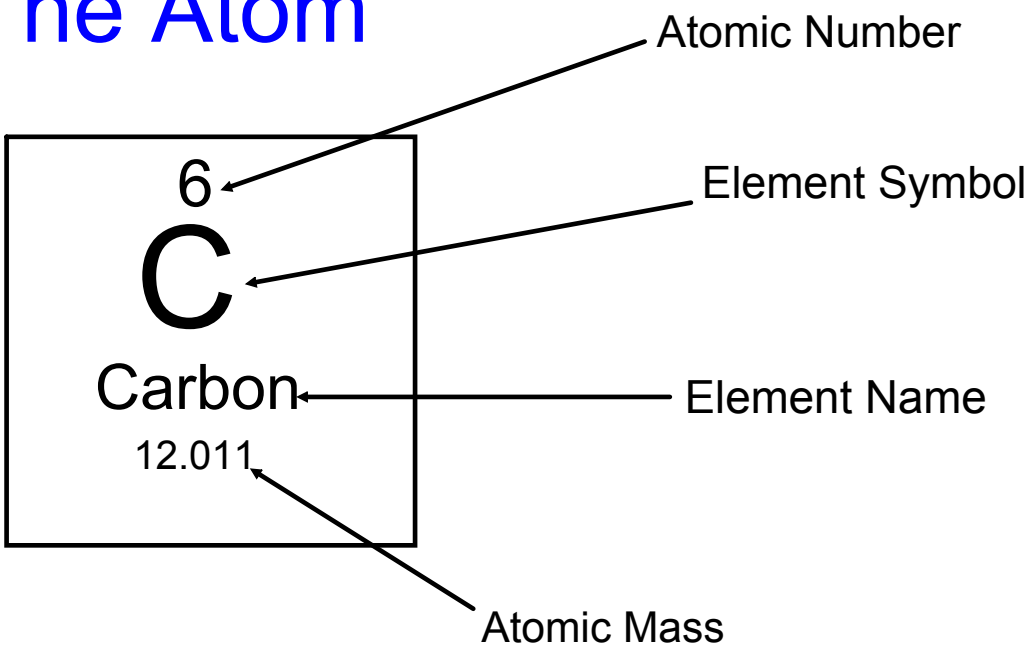
Follows Rutherford's Ideas and Design from 1920

-Protons and neutrons are divisible into smaller particles called Quarks

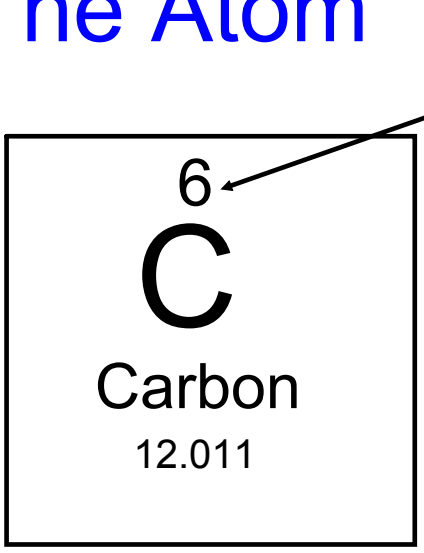
-Quarks are a relatively new discovery and are still being figured ou

Video

The Atom



The Atom

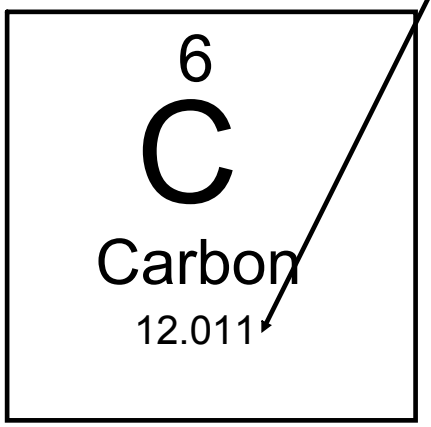


-This tells you how many protons are in the atom (ALWAYS!!!)

-The # of protons is the DNA of the atom, it makes it that element

-This also tells you how many electrons there are in a neutral atom (remember protons are positive and electrons are negative

The Atom



Atomic Mass

-Measured in Atomic Mass Units (AMUs)

Atomic mass number of any one atom = # Protons + # Neutrons

-Remember Electrons mass is Negligible

12 amu - 6 protons = 6 neutrons

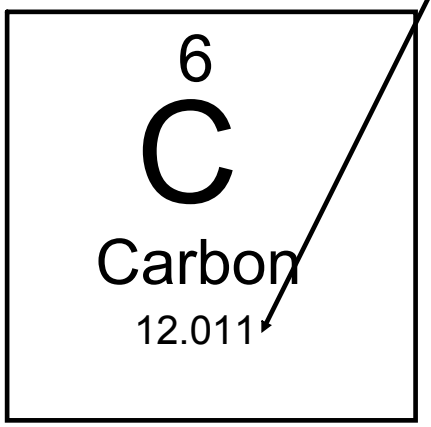
Round the mass to a whole number

The Atom

Practice finding protons, electrons, and neutrons

	amu	P?	N?	e-?
Oxygen	17	8	9	8
Strontium	88	38	50	38
Iron	56	26	30	26
Arsenic	75	33	42	33
Gold	197	79	118	79

The Atom



Average Atomic Mass
(Why is this number not a whole number?)

-This is the weighted sum of all the atomic masses possible for this element

-Since protons do not **EVER** change, and electrons mass is negligible, the only thing that can change the mass is a change in Neutrons

-Isotopes: Atoms with the same number of protons but different number of Neutrons

Writing isotopes

Uranium 238

-atomic mass

$^{238}_{92}U$

atomic #

Isotopes

	amu	p	n	e^-
oxygen 18				
$^{9}_{3}$Li				
Bromine 80				
$^{136}_{56}$Ba				
$^{198}_{79}$Au				

The Atom

Atomic Mass Calculation

[% of Mass 1 x (Mass 1)] + [% of Mass 2 x (Mass 2)] +...

Copper has two isotopes: 69.2% of all copper has a mass of 63 amus and 30.8% of all copper has a mass of 65 amus. What is copper's atomic mass?

(.692(63)) + (.308(65))

63.616

Splitting the Atom

Radioactive decay occurs when an atom undergoes a **nuclear reaction**. The nucleus breaks apart into a more stable structure. When this happens particles and energy are released. These particles and energy are called **radiation**.

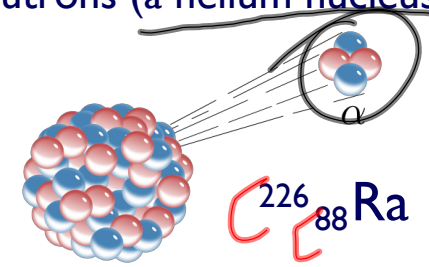
Three types of radiation:

- **alpha** α
- **beta** β
- **gamma** γ

Fission
Fusion

Alpha Radiation

Alpha radiation is a very weak form of radiation. It can easily be stopped by human skin or paper. In alpha radiation, **alpha particles** are given off.
An **alpha particle** contains two protons and two neutrons (a helium nucleus). It carries a +2 charge.



$^{226}_{88}Ra \Rightarrow {}^{222}_{86}Rn + {}^{4}_{2}\alpha$

$^{4}_{2}He$

$^{237}_{93}Np \rightarrow {}^{4}_{2}He + {}^{233}_{91}Pa$

Beta Radiation

Beta radiation is a stronger form of radiation. It can be stopped by aluminum foil or an inch of acrylic. In beta radiation, **beta particles** are given off.

A **beta particle** is a particle with a -1 charge

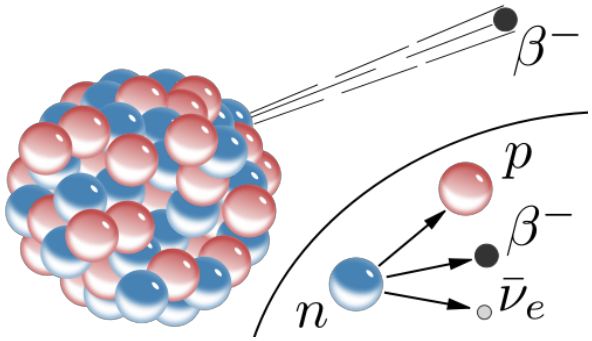
$^{14}_{6}C \Rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta^-$ $\quad {}^{0}_{-1}e$

How does this happen?

${}^{247}_{96}Cm \rightarrow {}^{0}_{-1}e + {}^{247}_{97}Bk$

Beta radiation (cont.)

A neutron decomposes into a positive proton and releases the negative portion as a negatively charged particle and the extra energy as a neutrino



$^{14}_{6}C \Rightarrow {}^{14}_{7}N + \beta^- +$ *neutrino*

Gamma radiation

Gamma radiation is the strongest form of radiation. It is deadly to life. It can be stopped by an inch of lead or a meter of concrete.

It will not turn you into the Hulk.

In gamma radiation, a very unstable nucleus has *too much* energy. To become stable, the nucleus releases the energy in the form of **gamma rays** and also other particles (beta, alpha, and/or neutrons)