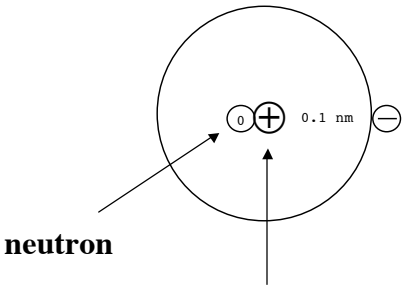
Anatomy of an Atom - DNA is to you as a proton is to an atom

On the following slides, we will describe the experiments which have helped scientists to have this basic view.

Perhaps your basic view of the atom is the following,



electron
chemical reactivity

neutron

proton
physical identity

Where the neutrons and protons are contained in the nucleus.

Now let's go back 2000 years……

supplemental HO 41

Atomic History
Dr. Gergens - SD Mesa College

I. A brief history in the development of atomic structure

A. 400 B.C. The Greeks Substances were made of extremely small invisible and indivisible particles "atomos" atoms meaning invisible
   1. atomos

B. 1627-1691 Robert Boyle
   1. Recognized as one of the first experimentalist
   Science should be grounded in experiment.

C. 1808 John Dalton
   1. Atomic Theory (five postulates)

Memorize and understand all five postulates

1. **Elements are made of tiny particles called atoms**
2. **All atoms of a given element are identical**
3. **The atoms of one element are different from another element**
4. **Atoms combine with other atoms in fixed numbers (ratio)**
5. **Atoms in a chemical reaction are not created nor destroyed, but involve simple rearrangements; AB + CD -> AD + CB**

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Today, 200 years later,
Dalton's postulates for 2 and 5 need to be modified:

1. **Elements are made of tiny particles called atoms**
2. **All atoms of a given element are identical**
3. **The atoms of one element are different from another element**
4. **Atoms combine with other atoms in fixed numbers (ratio)**
5. **Atoms in a chemical reaction are not created nor destroyed, but involve simple rearrangements, AB + CD -> AD + BC**

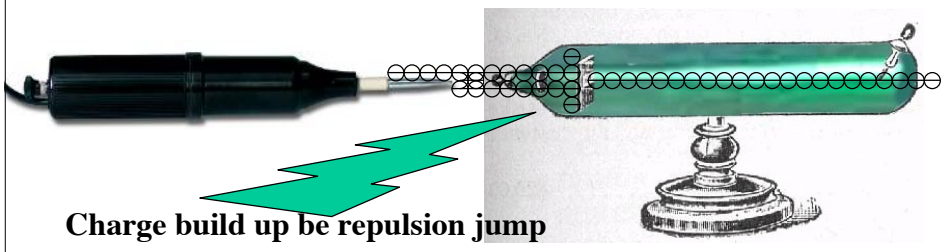
2) All elements consist as a <u>mixture</u> of isotopes; atoms identical in the number of protons but different in the number of neutrons.

5) …..except for nuclear reactions (fusion & fission), where atoms are created (fusion) and destroyed (fission).

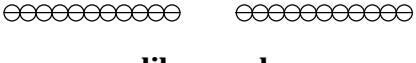
Applying the Law of Electrostatics to make electrons jump to positive

Tesla Coil - Electron Gun

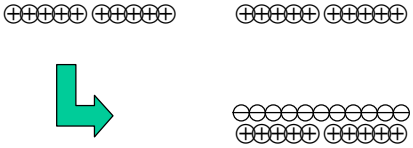
Evacuated Crookes Glass Tube



Charge build up be repulsion jump



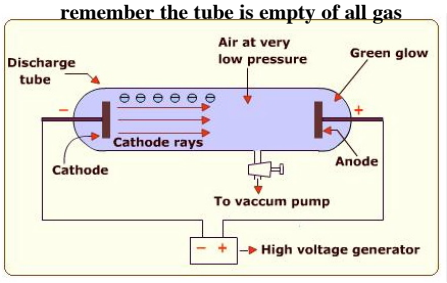
like repel



opposites attract

Schematic of Crookes Tube

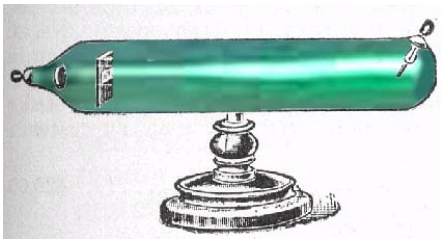
remember the tube is empty of all gas

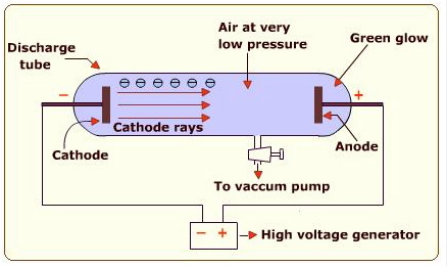


Law of Electrostatics - Opposites Attract, Like Charges Repel

Crooks Tube Demo

1. Studies with electricity and "**Law of Electrostatics**"
2. Cathode Ray Tube or CRT; Crooks Tube
3. A electronically neutral metal plate can be made to discharge a stream of particles.
4. Identify that the stream of particles had mass and negative charge unlike light energy.





Law of Electrostatics - Electrons as Negative Particles

D. 1897 J.J. Thomsom

1. Studies with electricity and "**Law of Electrostatics**"
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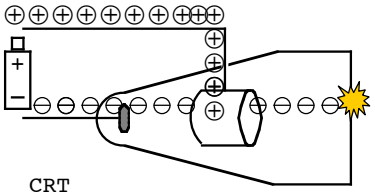
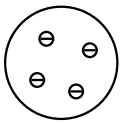


CRT
cathode ray tube



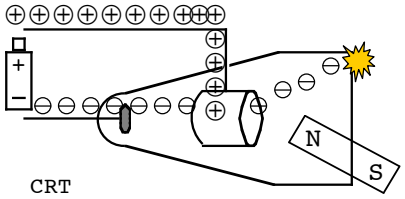
His thoughts about the atom:
electrons embedded in a smear
of positive charge.

opposites attract

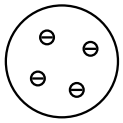
The yellow flash of light is due to a particles striking the screen;

Electrons as Negative Particles supplemental HO 41

Magnetic deflection of electrons using magnets (magnetic fields)



CRT
cathode ray tube



His thoughts about the atom:
electrons embedded in a smear
of positive charge.

The yellow flash of light is due to a particles striking the screen;

J.J. Thomson concluded from his Crookes Tube and CRT experiments:

1) an <u>electron is a particle having mass</u>
2) <u>balance and harmony</u>; every substance has an equal amount of positive charge for the amount of negatively charged particles.
3) negative (-) <u>particles can be deflected by a magnet</u> (magnetic field).

The Application of Electrons as Negative Particles having Mass

Crook's Tube demo, fluorescent lighting, and television

Philo Taylor Farnsworth (1906-1971), born in Beaver Creek, Utah who has been **<u>called the forgotten father of television</u>**, won a prize offered by the Science and Invention magazine for developing a thief proof automobile ignition switch, at the age of thirteen.

The first patents for the Farnsworth television system were filed January 1927. He was 21 years old.

http://www.museum.tv/archives/etv/F/htmlF/farnsworthp/farnsworthp.htm

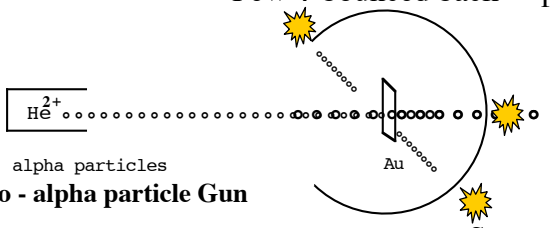
Nucleus as Dense Positive Charge & Atom Mostly Empty Space HO 41

E. 1911 Ernst Rutherford - Nobel Prize in Chemistry 1908

1. Directed heavy positively charged helium nuclei, $^{4}_{2}He^{2+}$, toward a very thin sheet of gold foil.
2. Discovered a majority of helium nuclei, called alpha particles, passed through the foil.
3. A few particles showed small angles of deflection.
4. But one out of 25,000 helium nuclei bounced backwards toward their source.

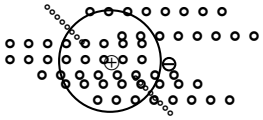
Most positive **+** particles passed through the Au foil

Few **+** bounced back



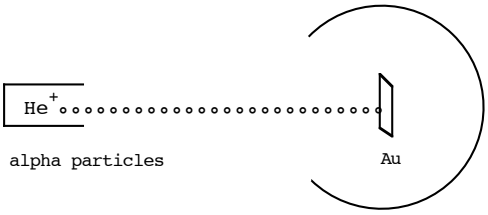
alpha particles

Po - alpha particle Gun

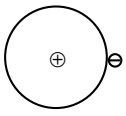


His thoughts about the atom: mostly dead space with a dense positively charged nucleus.

Some positives **+** particles were deflected

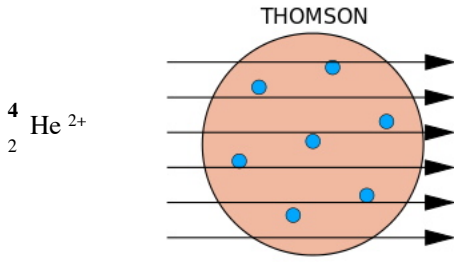


alpha particles



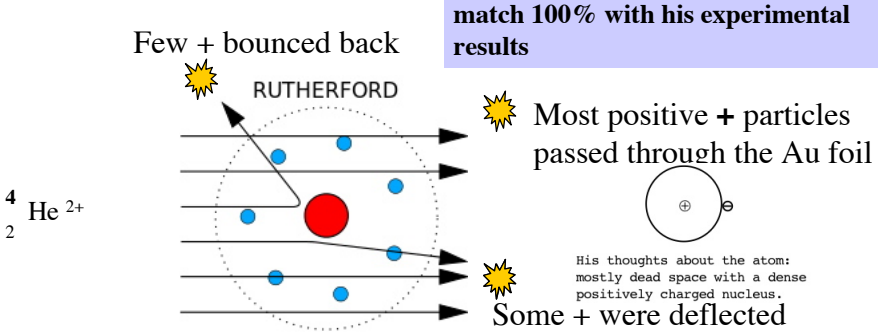
His thoughts about the atom: mostly dead space with a dense positively charged nucleus.

Rutherford Conclusions - Shooting alpha particles at gold foil a million atoms thick



Rutherford predicted on the basis of the Thomson model for the atom all heavy positive alpha particles would pass through the gold foil million of atoms thick

However, the predict outcome did not match 100% with his experimental results

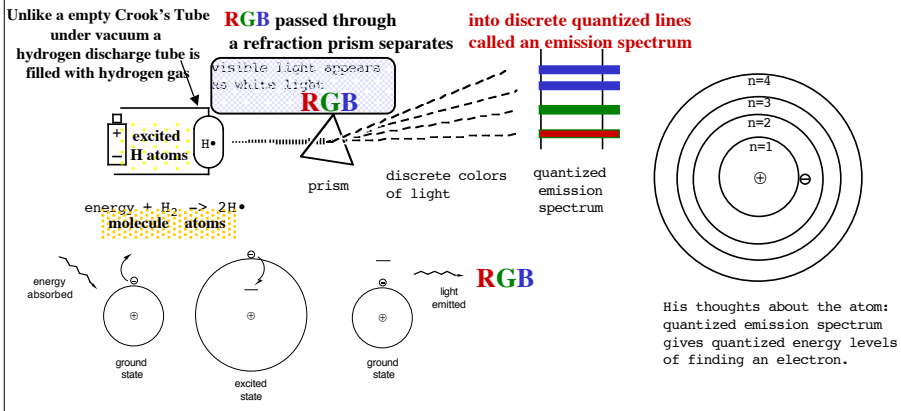


Electron Locations about an Atom

supplemental HO 44

F. 1913 Neils Bohr - Nobel Prize in Physics in 1922

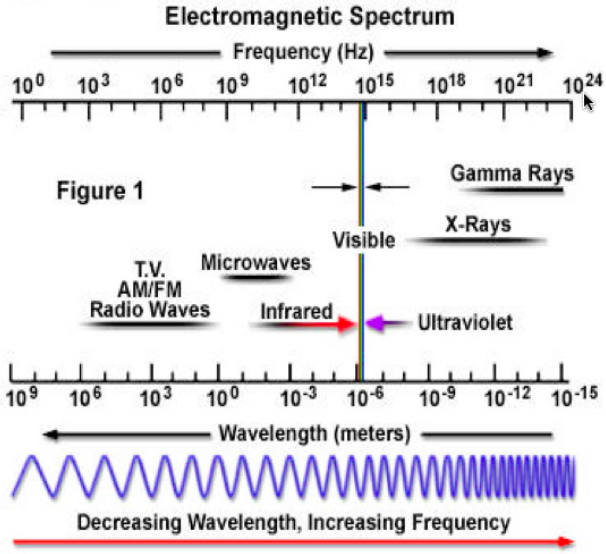
1. The HYDROGEN atom has played a major role in the development of models of electronic structure.
2. In a hydrogen discharge tube, individual atoms of hydrogen emit visible light.
3. When the light is passed through a prism, a quantized emission spectrum appears.



Understanding RGB - Electromagnetic Radiation

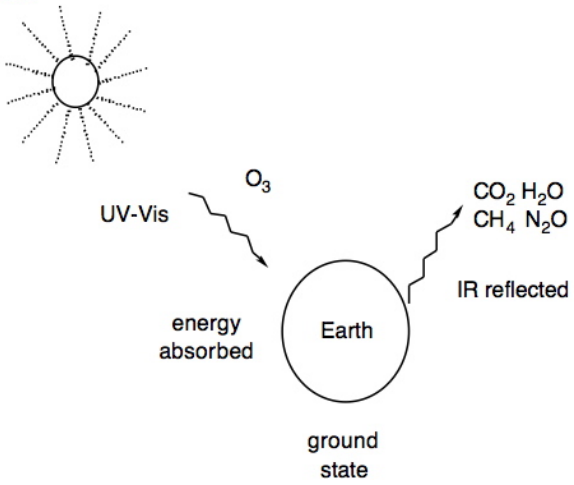
IV. Electromagnetic Radiation (energy in the form of waves)

A. ROY G BIV - Visible Light Rainbow



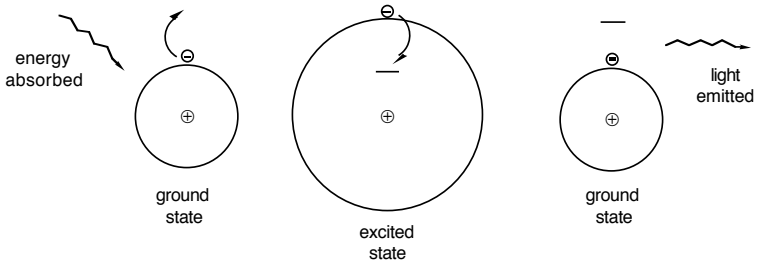
Beginning to Understand the Greenhouse Effect

V. Global Warming and Ozone



The glowing pickle demonstration

Electrons are easily excitable



Handout given in class

It's all about e^-

(if I were an electron, I would be….)

1. **light weight particle; 1/2000th an atomic mass unit (amu)**
2. **(-) negatively charged particle**
3. **loosely bound; American Heritage Dictionary defines loose as**
   - **not fastened; unbound**
4. **attracted to (+) positively charged particles**
5. **repelled by other negatively charged particles**
6. **dynamic <u>not</u> static; I'd would like to move about or jump around**
7. **a traveler and would love to travel but never far from home**
8. **at home within an electron shell shown by Bohr's model**
9. **easily excitable**

Watch the powerpoint it is all about e^-

supplemental HO 42

Dalton's Theory - List the five postulates of Dalton's Atomic Theory

1.
2.
3.
4.
5.

supplemental HO 42

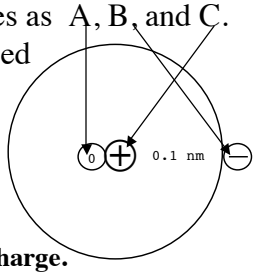
In your own words describe each of the following:

J. J. Thomson "raisin pudding atom" (1897)	Rutherford gold foil experiment (1910)
Rutherford nuclear atom (1911)	Bohr "electron shell" atom (1913)

supplemental HO 41

Atomic Structure:
Identify the subatomic particles in the following logic problem.

1. A, B, and C are three different subatomic particles in the atom for a certain element X.
2. Particles A and B are about 0.1 nm apart.
3. B and C attract each other, while
4. A and C show neither attraction nor repulsion.
   a. Identify the subatomic particles as A, B, and C.
   b. Illustrate what is being observed



ANSWER:
Law of Electrostatics: B & C have + or - charge.
The key to this problem is the 0.1 nm distance between B & C.
- **The 0.1 nm distance is a HUGE separation on the atomic scale.**
- **Imagine a distance of separation from the Sun to Pluto.**

supplemental HO 42

b. Complete the table by filling in the relative masses, and physical characteristic for each of the identified subatomic particles.

c. Briefly state the importance and the physical characteristic of each type of subatomic particle.

Letter	Name	Relative mass	Relative mass	Mass (a.m.u.)	Importance and Physical Characteristics
	proton	**2000**	1	**1.000**	**1.Gives element's identity** **2.Balances electron charge**
	electron	1	**1/2000th**	**1/2000th**	**1.Gives element's reactivity** **2.Balances proton charge**
	neutron	**2000**	**1**	**1.002**	**1.Separate proton charge** **2.Provides for isotopes**