

### Atomic Theory Notes

1. **The Greeks:** Democritus and Aristotle      No experiments!
2. **Dalton**      Observations and Research  
The Atom
3. **Thomson**      Cathode Ray Tube  
Electrons
4. **Becquerel and Curies**      Radioactivity
5. **Rutherford**      Types of Radiation  
Gold Foil Experiment  
Nucleus
6. **Bohr**      Flame tests  
Energy Levels  
Bright Line Spectra

### The Greeks: (350 BCE)

#### Democritus

- matter is **dis**continuous
- it is made up of separate particles called atoms
- matter can only be divided so far until you divide down to the final piece called the atom

#### Aristotle

- Democritus was wrong
- matter is continuous
- matter can be divided forever
- matter is made up of 4 elements: earth, wind, fire and water

### Dalton

- **around 1803 CE**
- Democritus was right
- elements consist of tiny particles called atoms
- **atoms are small hard indivisible spheres**
- all atoms of an element are identical i.e. they have the same mass
- the atoms of different elements are different i.e. they have different masses
- compounds consist of atoms of different elements bonded together
- compounds have constant composition because they contain a fixed ratio of atoms
- chemical reactions involved the rearrangement of combinations of those atoms
- doesn't explain static electricity

### Roentgen

- **1895 CE**
- experimenting with cathode ray tubes (CRTs) and discovers "**X**" rays
- called X rays because he didn't know what they were
- CRT give off rays that can make object light up with phosphorescence

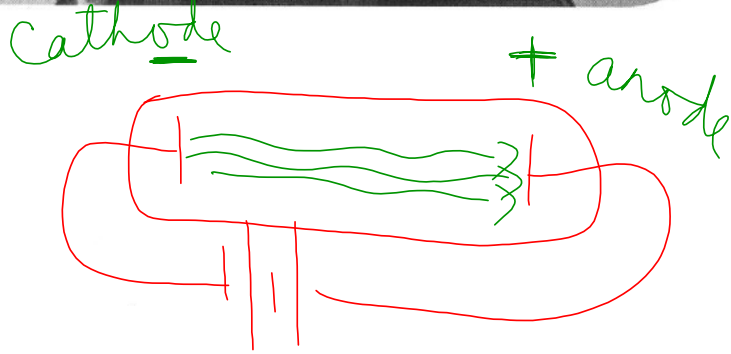
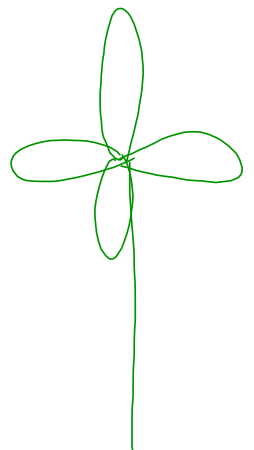
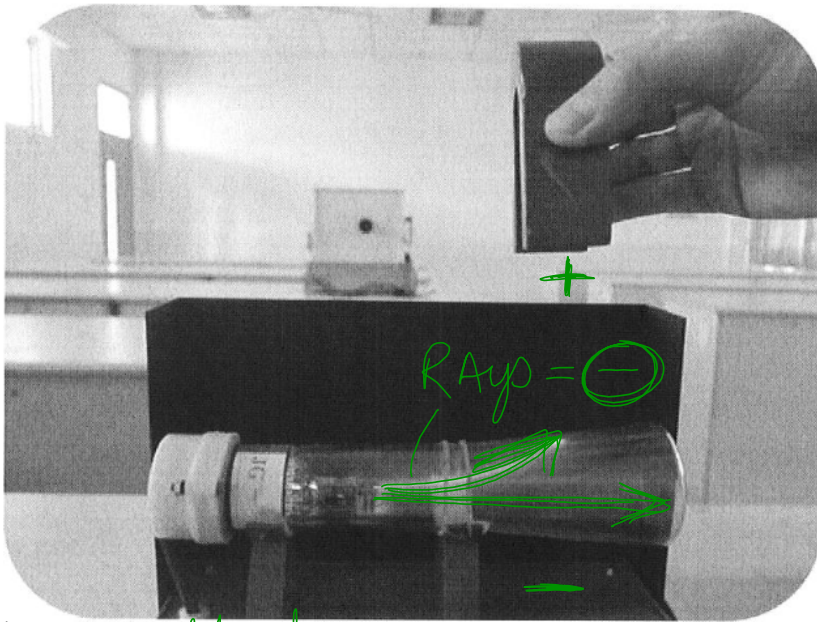
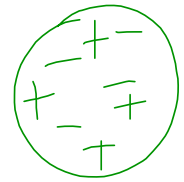
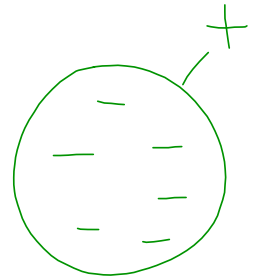
### J.J. Thomson

- **1897 CE**
- discovers the electron
- experiments with CRTs
- **CRT** is a glass tube containing a vacuum (no air)
- when an electric charge is passed through the tube a green glowing line appears = **cathode rays**
- it doesn't matter which gas you start with and pump out of the tube the same green glowing line appears

green

- the "line" is made up of negative particles called electrons
- the line moves towards a positive electrode placed ~~(negative)~~ <sup>near</sup> it = which means the "lines" are NEG.
- the negative particles have mass (move a pinwheel)
- the electrons are deflected by a magnet (are charged)
- the electrons shining on a cross cast a shadow (travel in straight lines)
- \* therefore the atom is NOT a hard indivisible sphere
- the atom is made up of smaller pieces
- **plum pudding model/raisin pudding or chocolate chip cookie!**
- the atom consists of negative electrons embedded in a positive sphere
- explains static electricity

which means the "lines" are NEG.

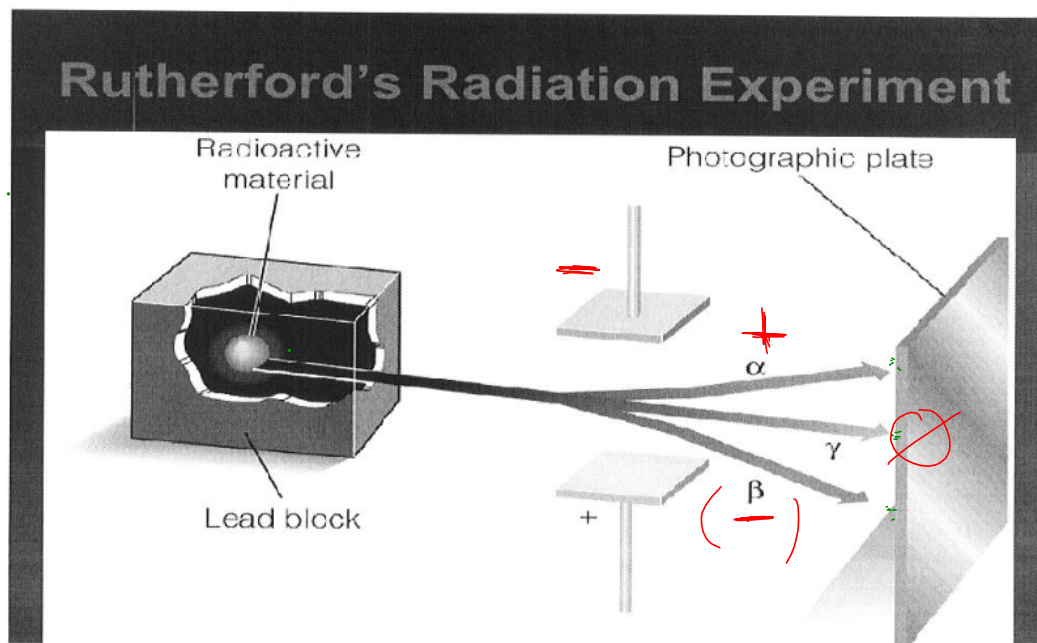


### Becquerel and the Curies

- around the same time as everybody else!
- experimenting with the uranium ore
- thinks sunlight shining on uranium ore causes it to give off rays = **radiation/radioactivity**
- puts ore in a drawer on top of film and comes back to find film has been exposed as if light had been shining on it
- therefore the ore itself was giving off rays on its own
- Marie purifies uranium and finds 2 new elements: polonium and radium and wins 2 Nobel prizes and becomes the first woman to teach at the Sorbonne in 650 years

### Ernest Rutherford

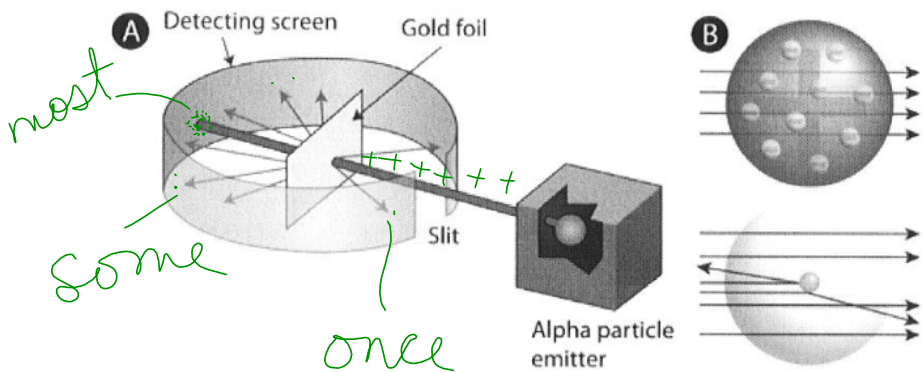
- 1898 CE
- did a lot of his work at McGill
- experiments with radioactivity
- finds radiation is really 3 types: alpha, beta and gamma radiation



Radiation	Charge	Size	Symbol
Alpha particles	+2	He nucleus	$\alpha$
Beta particles	-1	$e^-$	$\beta$
Gamma rays	$\phi$	none	$\gamma$

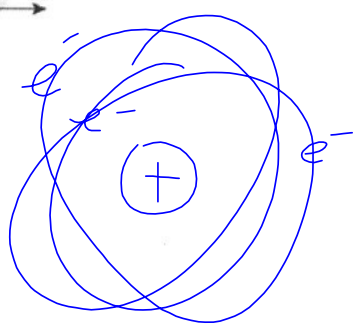
2<sup>nd</sup> Experiment Gold Foil

- uses positive alpha particles to shoot at a thin piece of gold foil *(+)* *very very*
- most of particles go right through *∴ The atom is mainly empty space*
- some particles are slightly deflected *= they came close to a (+)*
- a very few particles ricochet backwards *hit the + massive NUCLEUS*
- he discovers the NUCLEUS
- planetary model of the atom -- the electrons spin around the nucleus like the planets around the sun



*most*  
*some*

*once in a blue moon*



Olympic Stadium = 1 atom  
1 marble = 1 nucleus

Niels Bohr

- 1913 CE
- says electrons cannot be spinning around the nucleus just anywhere
- elements give off light when you excite them with heat, electrical or light energy
- when excited the atoms give off light
- they give off light because the electrons jump up to further distances from the nucleus and then fall back down
- the electrons must be on very specific **energy levels** with respect to the nucleus

