

# Models of the Atom



S1-2-02 Investigate the historical progression of the atomic model.

*Include: Dalton, Thompson, Rutherford, Bohr, quantum model*

# Models of the Atom...

By 1808, it was widely accepted that matter was made up of **ELEMENTS**, which consisted of tiny **PARTICLES** called **ATOMS**. After 2000 years - **DEMOCRITUS** was right all along

## **John Dalton (1766-1844)**

Dalton came up with one of the first models for what atoms look like:

### ***Dalton's Atomic Theory:***

- All elements are made of atoms.
- Atoms are indestructible.
- Atoms of the same element are exactly alike
- Two or more elements combine to form compounds.
- Atoms are not created or destroyed in a chemical reaction.



# Models of the Atom...

## John Dalton (1766-1844)

Dalton's atomic theory is also known as the "BILLIARD BALL MODEL", since he believed that atoms were just tiny SPHERES.

Atoms under Dalton's model would look like this:



# Models of the Atom...

**Joseph John (J.J.) Thompson (1904):**

Thompson was passing **ELECTRICITY** through a **GAS**, when he discovered very **LIGHT, NEGATIVE PARTICLES** that he called **ELECTRONS**

→ **DISPROVING** Dalton's theory that the atom is **INDIVISIBLE**.

Later he also discovered **HEAVIER, POSITIVE PARTICLES** called **PROTONS**.

*Thompson proposed that:*

- Electrons have small mass and a negative charge.
- An atom is a sphere of positive electricity.
- Electrons stuck in the positive sphere.

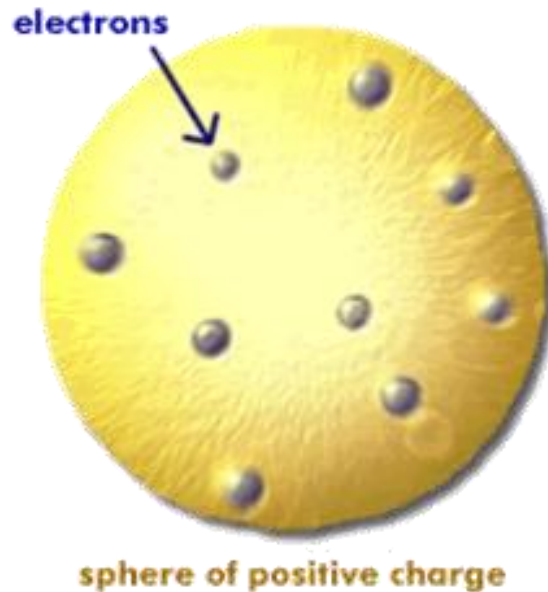


# Models of the Atom...

## Joseph John (J.J.) Thompson (1904):

Thompson's theory is also called the "RAISIN BUN" or "PLUM PUDDING" or "BLUEBERRY MUFFIN" model:

It would look like this:



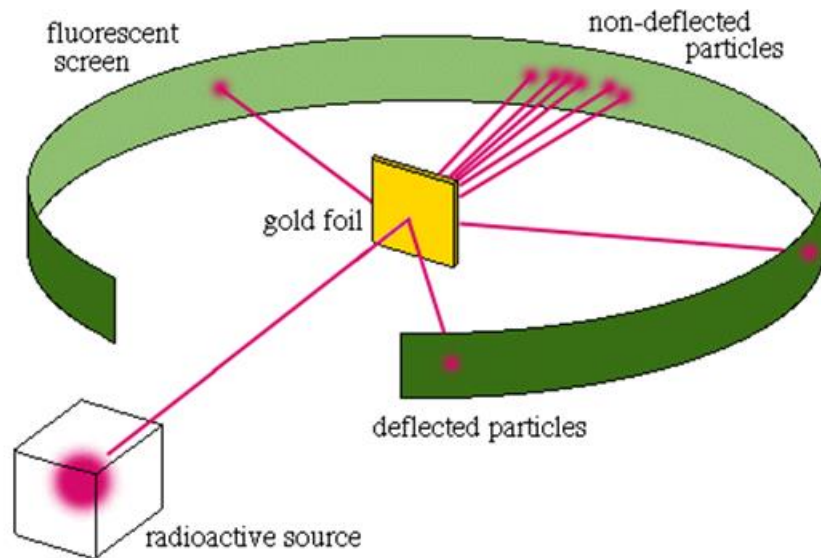
# Models of the Atom...



## Ernest Rutherford (1911):

Performed a famous experiment where “**SHOT**” a beam of **ALPHA PARTICLES** at a sheet of **GOLD FOIL** (the gold foil experiment).

He found that **MOST** of the **PARTICLES** went **THROUGH** the foil, as if it were made of **EMPTY SPACE**, while some **BOUNCED** off.



Through this experiment he discovered a **DENSE, POSITIVELY** charged **NUCLEUS**.

# Models of the Atom...

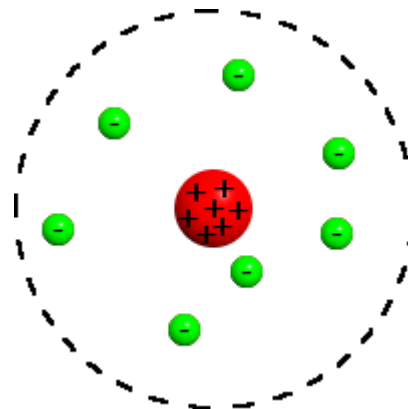
Ernest Rutherford (1911):

*He proposed that:*

- The nucleus is a tiny, dense, positively charged core
- Protons are in the nucleus
- The nucleus is surrounded by mostly empty space.
- Electrons are moving outside the nucleus in an *electron cloud*.

Rutherford developed what we call the NUCLEAR MODEL

His model would look like this:



# Models of the Atom...



## Neils Bohr (1913)

Bohr thought that if RUTHERFORD'S theory were true, the ELECTRONS would just CRASH into the NUCLEUS (since OPPOSITE charges ATTRACT)

He used the idea of planets orbiting the sun to improve upon Rutherford's model of the atom

### *He proposed that:*

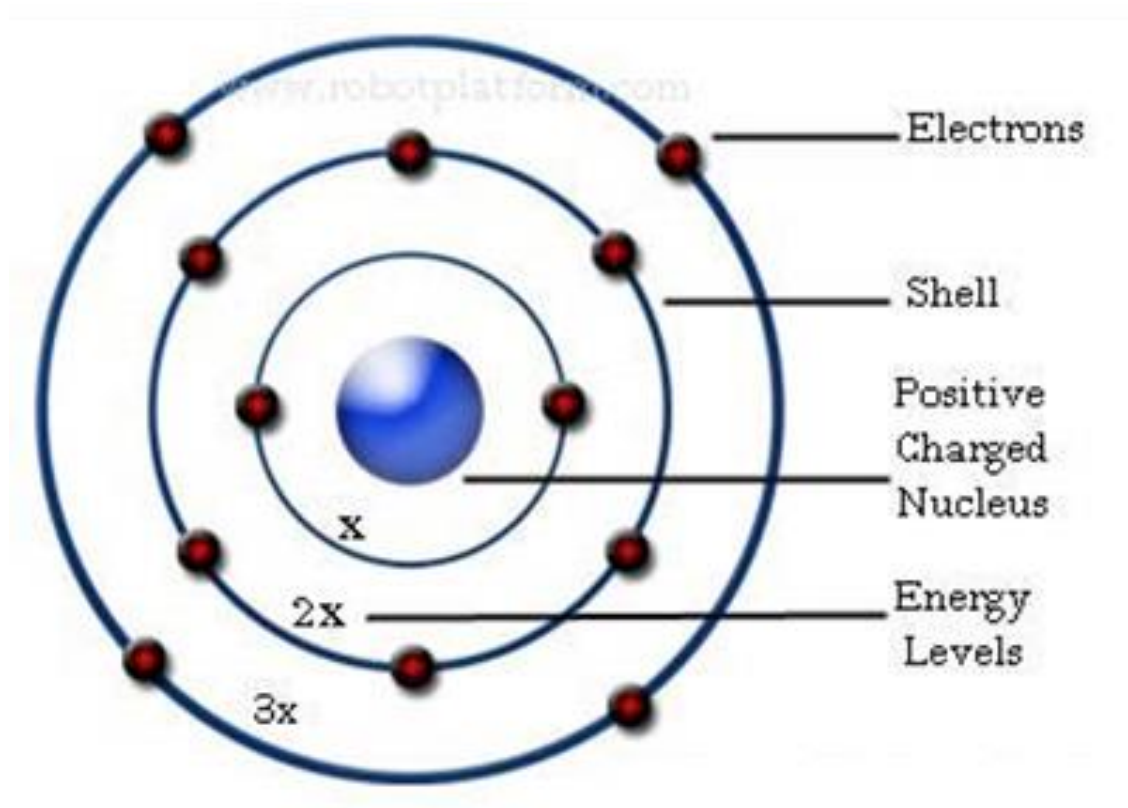
- Electrons move around the nucleus in orbits (like planets around the sun).
- Each orbit is an energy level – Higher orbits have more energy.
- Electrons cannot exist between orbits
- Electrons are more stable at lower energy levels.
- The order of filling electrons is  $2 \rightarrow 8 \rightarrow 8$ .



# Models of the Atom...

His theory is also called the “PLANETARY MODEL”.

It would look like this:

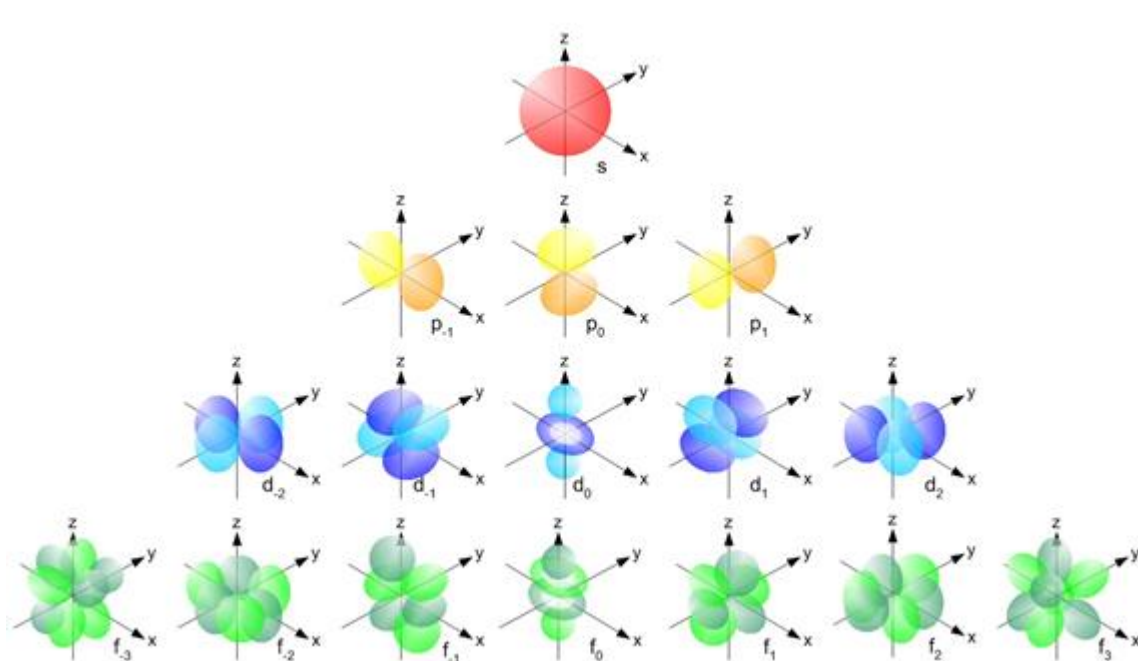


# Models of the Atom...

## Quantum Model of the Atom

Bohr's model works well for **SIMPLE ATOMS** (eg, H), but does not explain more complicated ones.

The quantum model says that instead of circular paths around the nucleus, the orbits are more like "**CLOUDS**" where electrons can be found. (more on this in grade 12)



# Models of the Atom...

## Contents of an Atom:

Today we know that an atom is made up of three major **SUBATOMIC** particles:

- **protons (+ve)**
- **electrons (-ve)**
- **neutrons (neutral)**

The characteristics of these particles are:

<b>Subatomic Particle</b>	<b>Symbol &amp; Charge</b>	<b>Mass</b>	<b>Location</b>
<i>Proton</i>	$p^+$	<i>1 amu</i>	<i>Nucleus</i>
<i>Neutron</i>	$n^0$	<i>1 amu</i>	<i>Nucleus</i>
<i>Electron</i>	$e^-$	<i>1/1837 amu</i>	<i>Electron shell</i>

**amu = atomic mass unit =  $1.66 \times 10^{-27}$  kg**

## **NOTE:**

The mass of an **ELECTRON** is almost **2000X LESS** than a **PROTON** or **NEUTRON**.

# Models of the Atom...

## Analogy of the Size of an Atom:

Atom = TORONTO SKYDOME

Nucleus = BASEBALL

Proton = MARBLES INSIDE BASEBALL

Electrons = MOSQUITOES BUZZING AROUND THE SKYDOME

