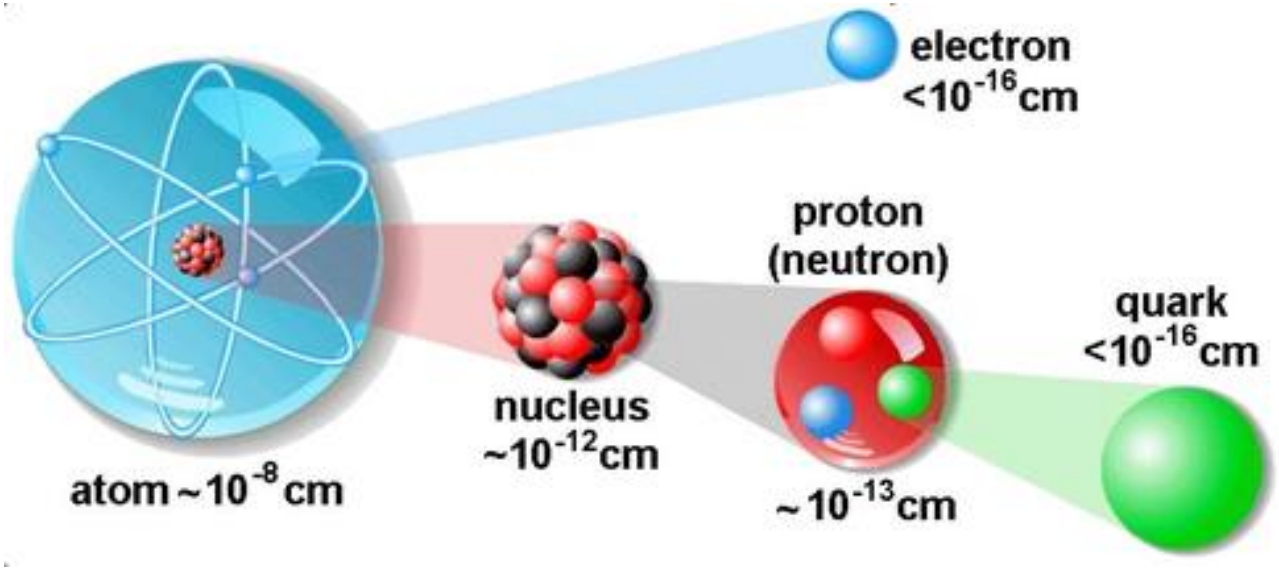
5.1 The Evolution of the Atomic Model

SNC1D

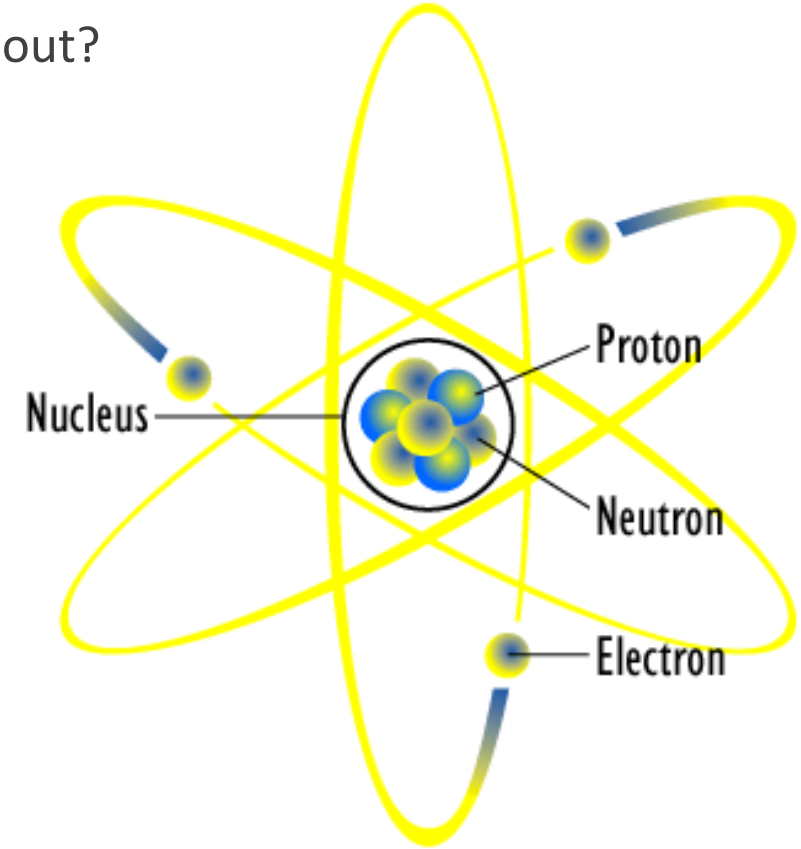
Atoms

Atoms are _____ *to be seen:



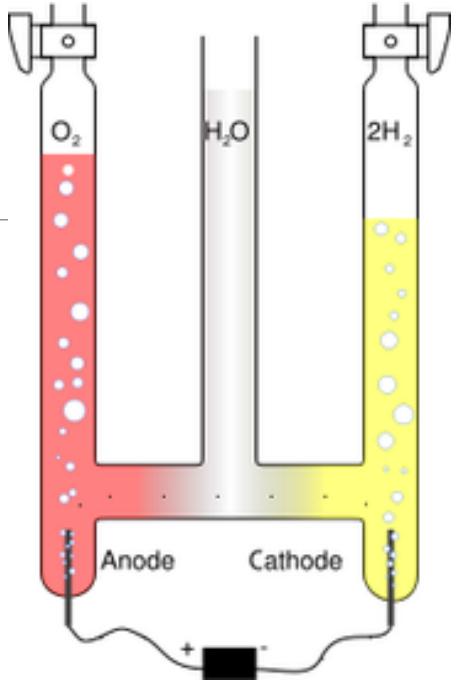
We've seen what we think atoms look like…

…but how did scientists figure this out?



John Dalton, early 1800s

found that running electric current through **water** produced _____ *
and _____ ** gases



expanded on Particle Theory, to describe the behaviour of elements and compounds

Video

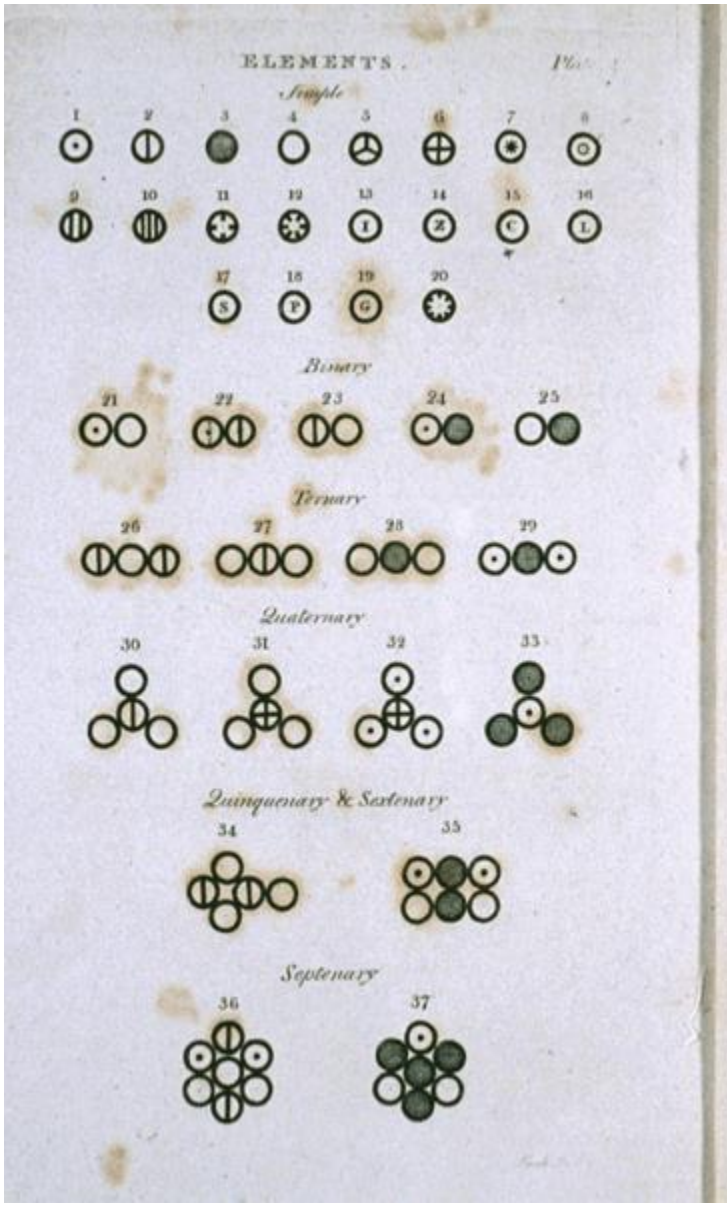
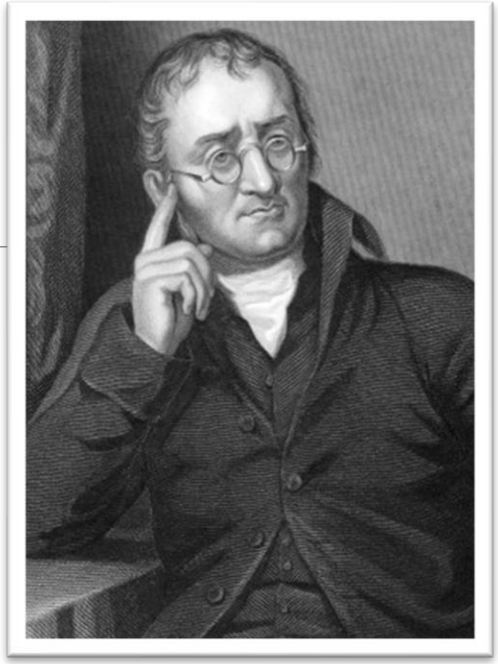


PLATE IV. This plate contains the arbitrary marks or signs chosen to represent the several chemical elements or ultimate particles.

Fig.			Fig.		
1	Hydrog. its rel. weight	1	11	Strontites	46
2	Azote,	5	12	Barytes	68
3	Carbone or charcoal,	5	13	Iron	38
4	Oxygen,	7	14	Zinc	56
5	Phosphorus,	9	15	Copper	56
6	Sulphur,	13	16	Lead	95
7	Magnesia,	20	17	Silver	100
8	Lime,	21	18	Platina	100
9	Soda,	28	19	Gold	140
10	Potash,	42	20	Mercury	167

21. An atom of water or steam, composed of 1 of oxygen and 1 of hydrogen, retained in physical contact by a strong affinity, and supposed to be surrounded by a common atmosphere of heat; its relative weight = 8
22. An atom of ammonia, composed of 1 of azote and 1 of hydrogen 6
23. An atom of nitrous gas, composed of 1 of azote and 1 of oxygen 12
24. An atom of olefiant gas, composed of 1 of carbone and 1 of hydrogen 6
25. An atom of carbonic oxide composed of 1 of carbone and 1 of oxygen 12
26. An atom of nitrous oxide, 2 azote + 1 oxygen 17
27. An atom of nitric acid, 1 azote + 2 oxygen 19
28. An atom of carbonic acid, 1 carbone + 2 oxygen 19
29. An atom of carburetted hydrogen, 1 carbone + 2 hydrogen 7
30. An atom of oxynitric acid, 1 azote + 3 oxygen 26
31. An atom of sulphuric acid, 1 sulphur + 3 oxygen 34
32. An atom of sulphuretted hydrogen, 1 sulphur + 3 hydrogen 16
33. An atom of alcohol, 3 carbone + 1 hydrogen 16
34. An atom of nitrous acid, 1 nitric acid + 1 nitrous gas 31
35. An atom of acetous acid, 2 carbone + 2 water 26
36. An atom of nitrate of ammonia, 1 nitric acid + 1 ammonia + 1 water 33
37. An atom of sugar, 1 alcohol + 1 carbonic acid 35

Dalton's Atomic Theory



- All matter is made of small particles called **atoms**.
- Atoms cannot be **created**, _____*, or **divided**.
- All atoms of the same element are identical in _____ ** and **size**. The atoms of one element are different from the atoms of other elements.
- _____ *** are created when atoms of different elements link together in fixed proportions.

Dalton's Model of the Atom

The "**billiard ball**" model: Dalton envisioned atoms are small, indestructible particles.

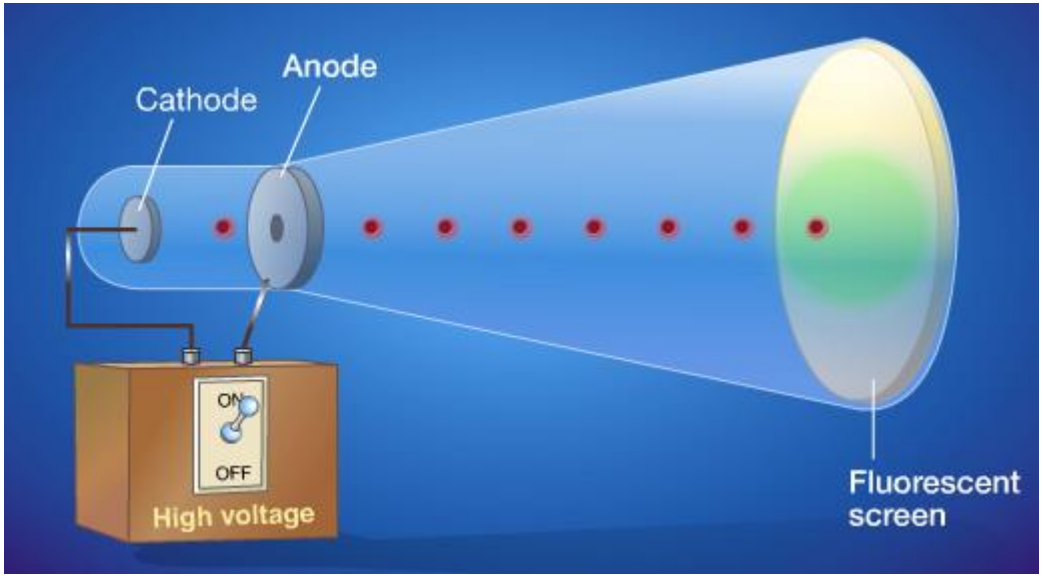
Oxygen atom

Hydrogen atom

Joseph John Thomson, 1897

Discovered the existence of **negatively-charged particles** in atoms

Made his discovery by performing experiments with evacuated gas tubes, called cathode ray tubes



Video:
Discovery of the Electron

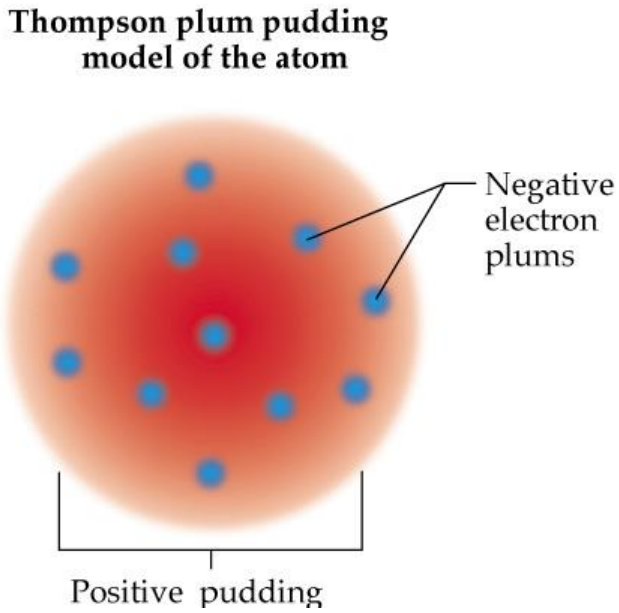
Thomson's Observation	His Inference
Particles emitted from the cathode are **attracted to positive** charges	The cathode ray particles must be **negatively-charged**
The cathode ray particles have a much **lower mass than hydrogen** atoms	Cathode particles are much **smaller than hydrogen** atoms
All metals that he tested emit **identical** cathode rays	All atoms contain the **same negatively-charged particles**
Atoms are electrically **neutral**	Atoms must therefore contain **positively-charged particles** to balance the negative ones

Thomson's Model of the Atom

Negatively-charged particles (_____*) are embedded in a positively-charged mass

Called the "plum pudding" model

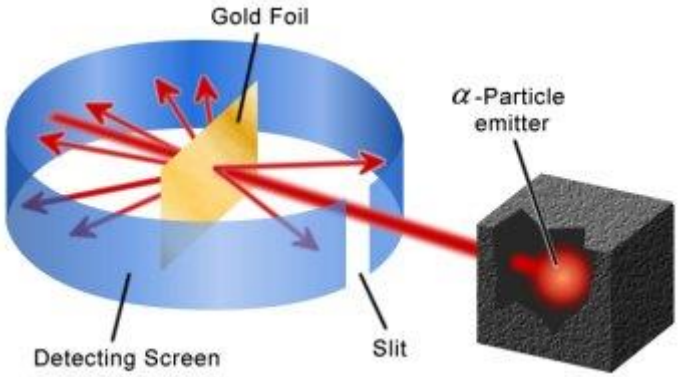
- think *chocolate chip muffin*



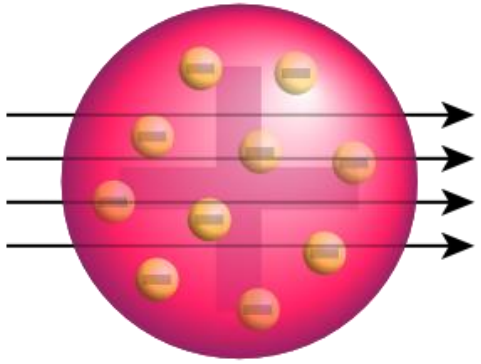
Ernest Rutherford, 1911

Famous “gold foil experiment”

Aimed ***positively-charged alpha particles*** at thin sheets of gold foil



Prediction: If the atom was composed of evenly-distributed positive and negative charges, the alpha particles ***should pass right through***



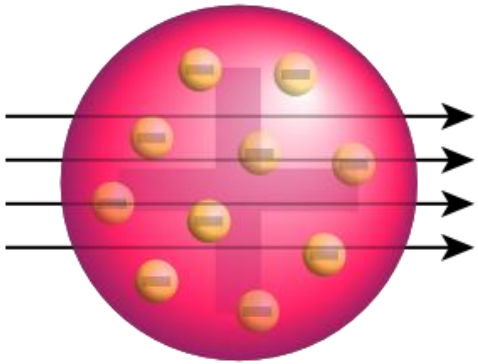
Video:
Discovery of the nucleus

Observation: Most of the particles passed through, but a very small number of them ***bounced backwards***

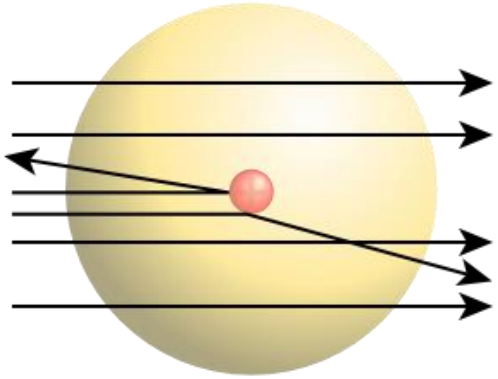
Inferences:

- The alpha particles bounced backwards because they hit a region of _____ *
- The majority of the atom's volume is empty space.

Expected outcome



Observed outcome

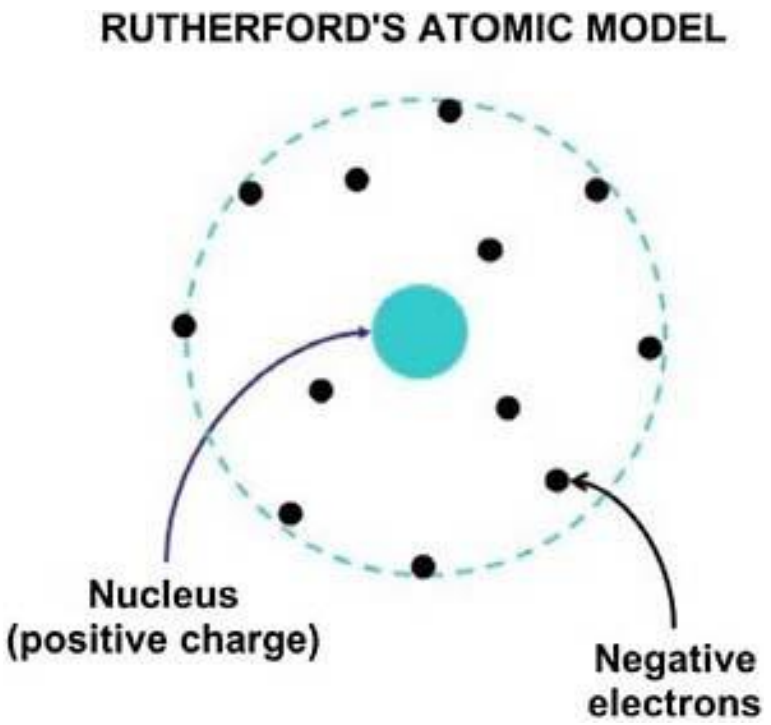


Rutherford's Model of the Atom

The beehive model:

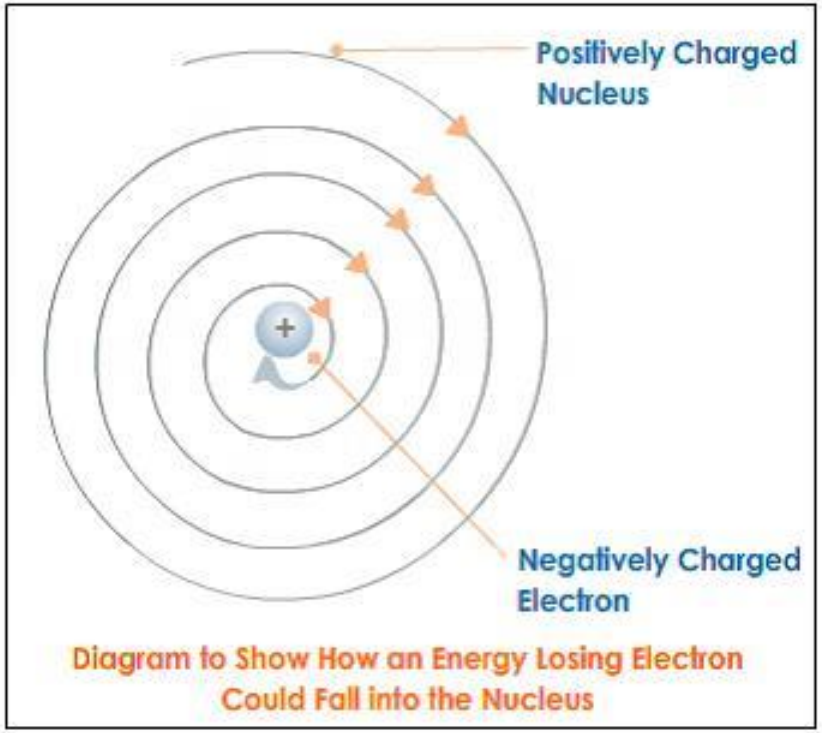
The positive charges are contained in a small dense centre called the nucleus.

The electrons revolve around the nucleus.



Opposition to Rutherford's model:

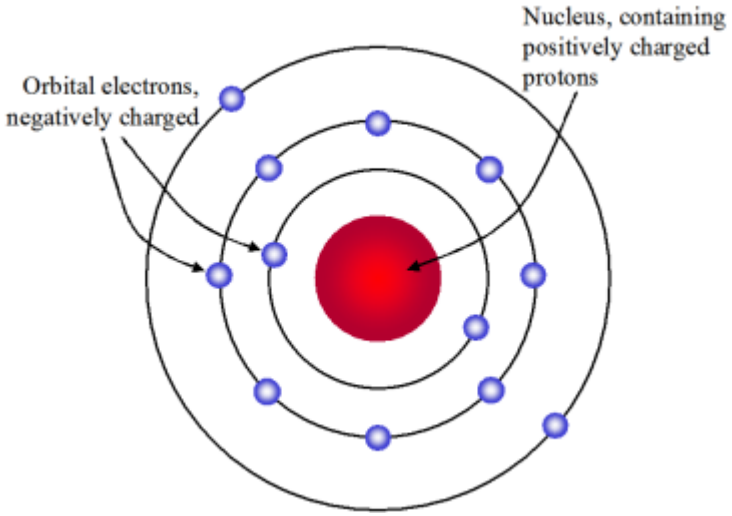
Why don't the negative electrons fall into the positive nucleus?



Neils Bohr, 1922

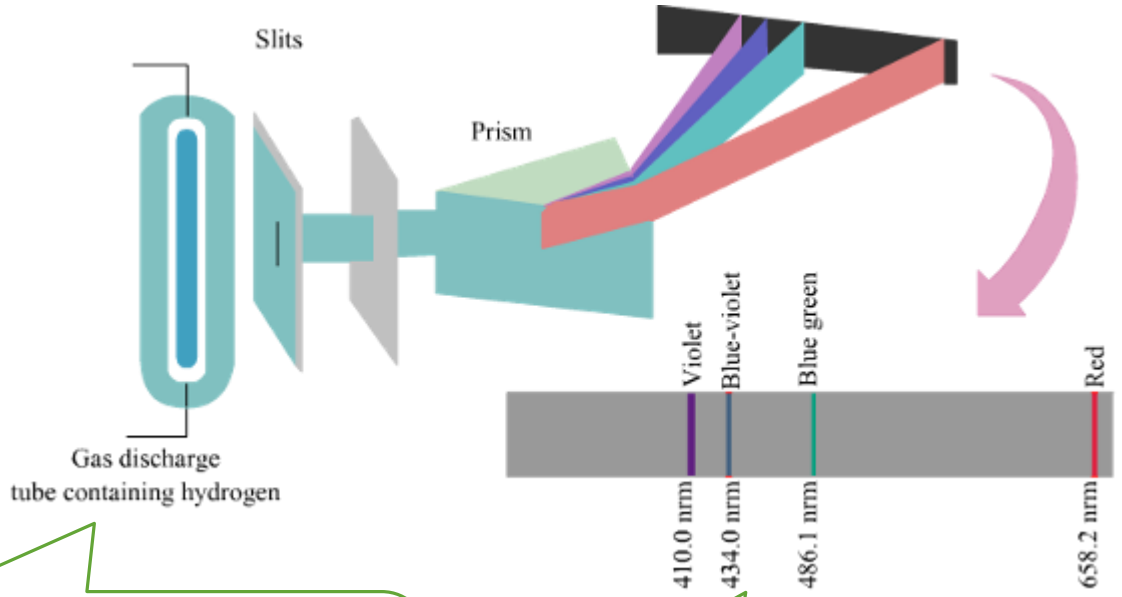
Proposed that electrons were restricted to _____ *.

Each orbit represents an **energy level**, and has a different distance from the nucleus.



Each electron shell represents an energy level.

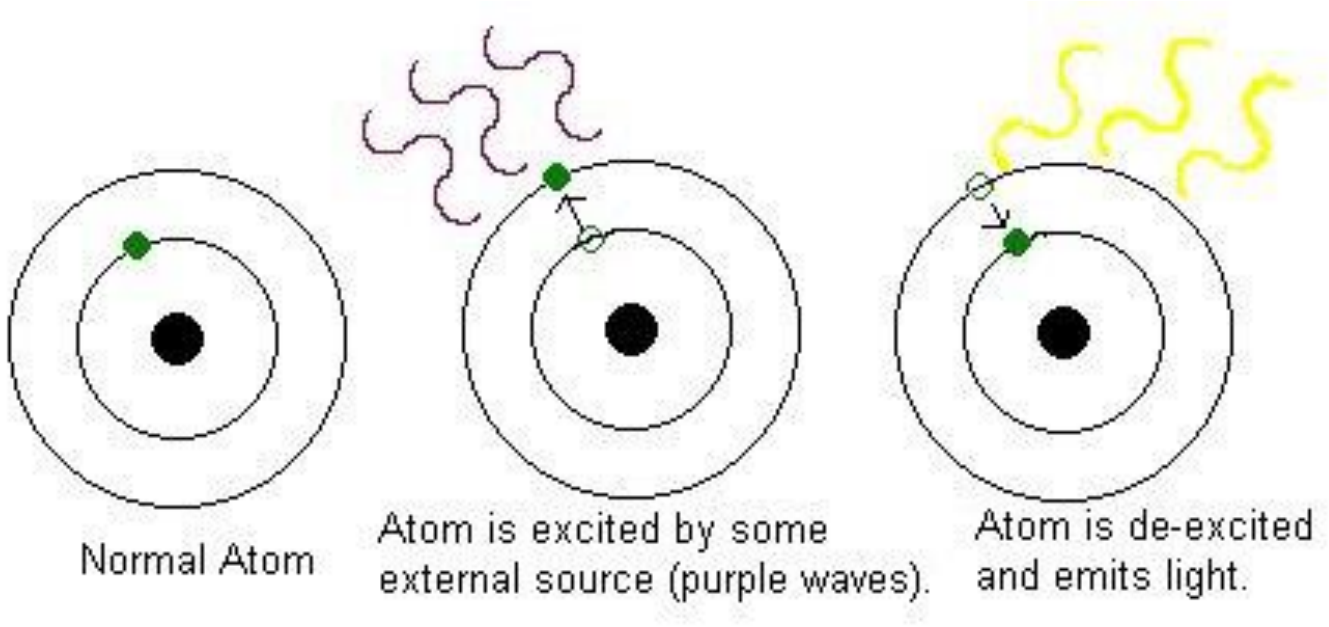
Bohr developed this model by observing the **emission spectrum** of hydrogen.



Run electric current through tube of hydrogen, to make it produce light

Use a prism to split up the light produced by hydrogen gas

Light is emitted when an electron **absorbs energy** (is "_____"), and then **releases it** as it falls down to its original energy state.



Continuous Spectrum

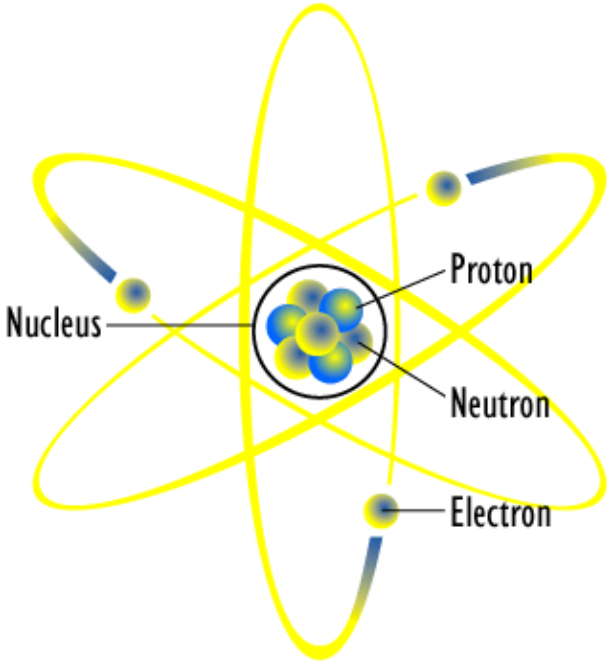
If the electrons could absorb any quantity of energy, a continuous spectrum would be produced.

Emission Lines

Since a non-continuous line spectrum is observed, this means electrons can only absorb **fixed** packets of energy (**quanta**, *sing.* **quantum**).

James Chadwick, 1932

Showed experimentally that neutral particles exist in the nucleus, along with the protons.



Homework

- Read Ch 5.1 p. 179- 185
- pg. 186 Q # 1, 2, 5, 6, 8
- Complete handout: Evolution of the Atomic Model