Chapter 4

Lesson 2

Welcome To 8th grade Physical Science!

Mrs. Winters

Materials Needed Today

Please take these materials out of your backpack.

- Pencil
- Blank sheet of paper for notes.

Hot Sync

Friday 1/10/14

Answer the following questions in ***complete sentences*** on the hot sync worksheet.

1) In your own words, what is meant by the law of definite proportions? (2 sentences)
2) What did you learn from the burning of the steel wool? (2 sentences)

4.2 Discovering Parts of the Atom

LESSON Vocabulary

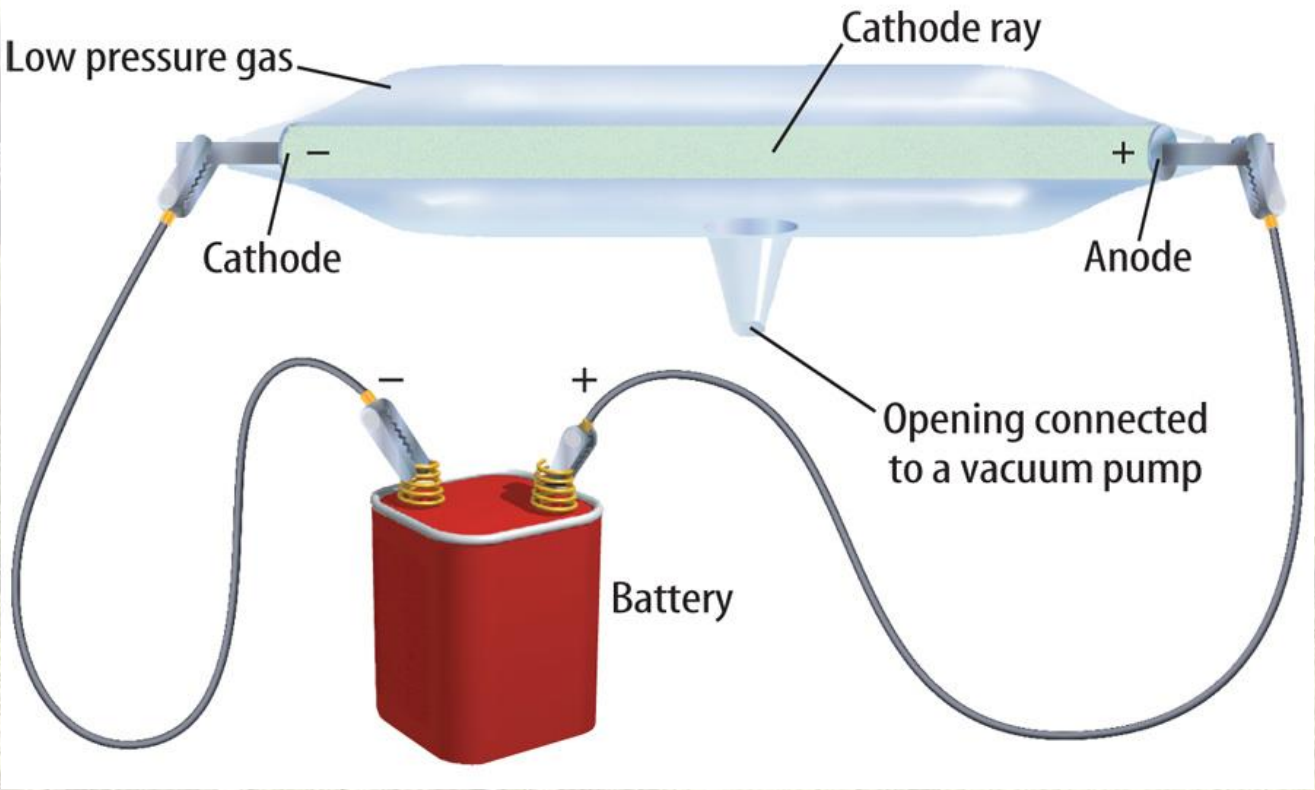
- spectral lines
- energy level
- electron cloud

How were electrons discovered?

- Scientists have put together a detailed model of atoms and their parts. Here is the journey of atom parts….

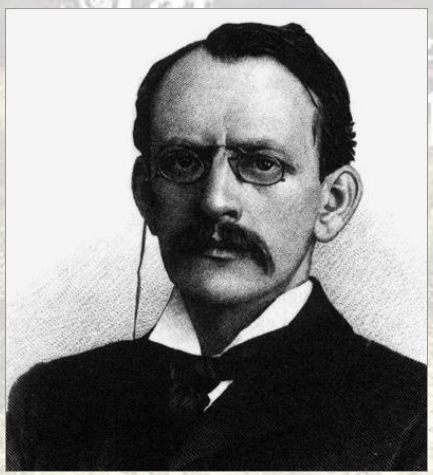
How were electrons discovered? (cont.)

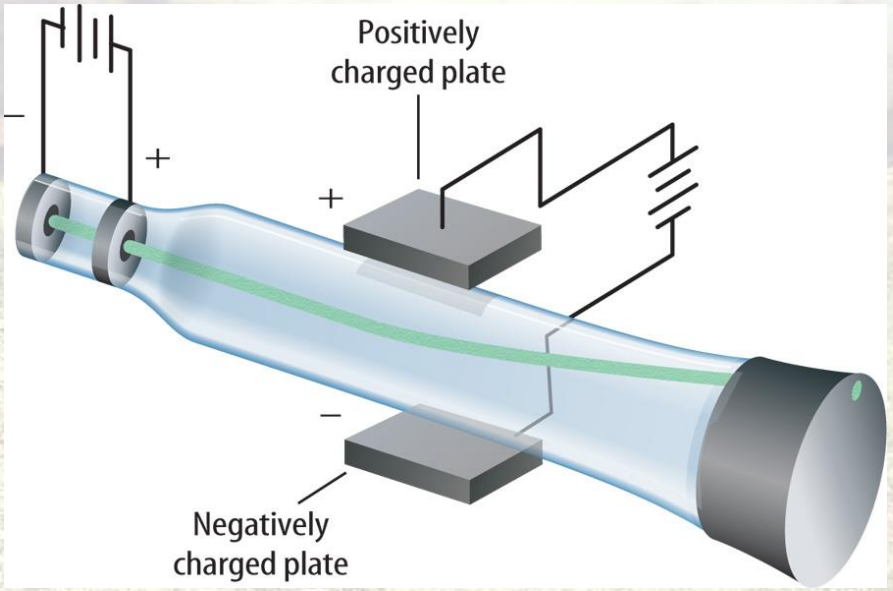
- Cathode Ray Tube



Thomson's Experiments

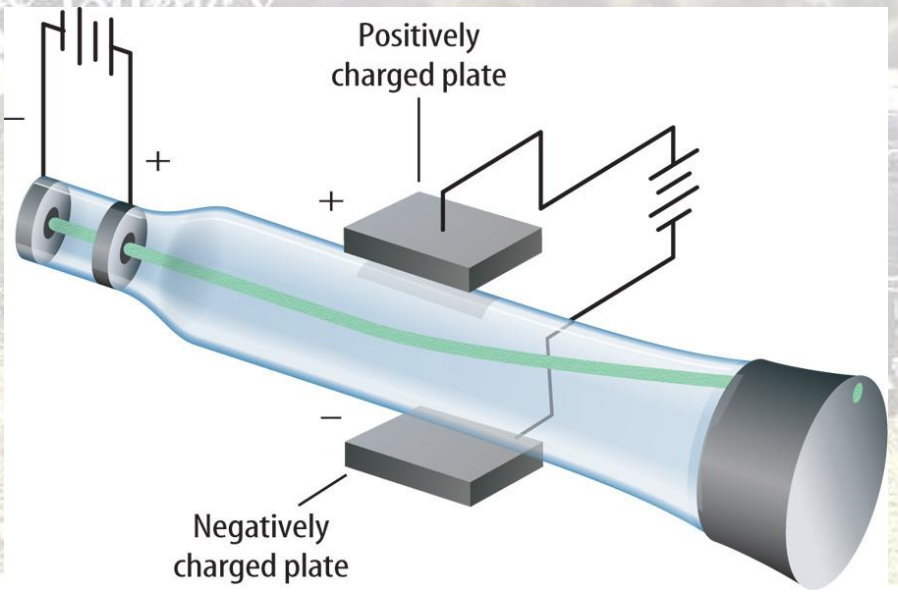
- Thomson discovered the cathode rays did not travel in a straight line, but bent towards the positively charged plate.





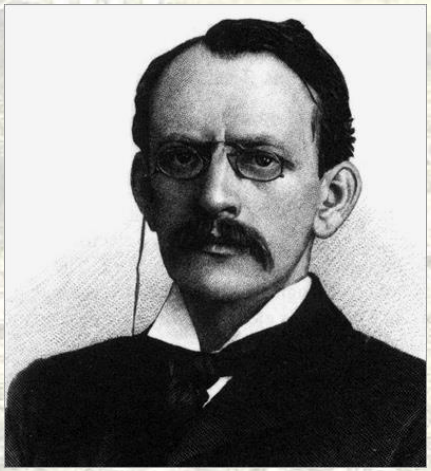
Thomson's Experiments (cont.)

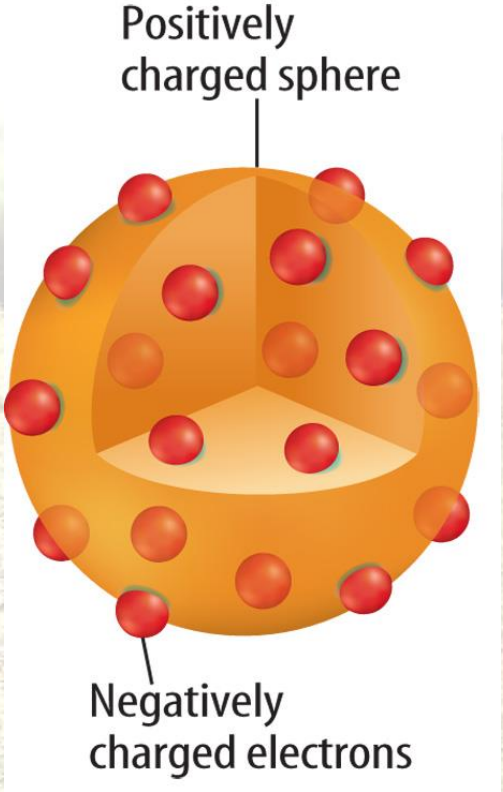
- Opposite charges attract each other.
- Thomson concluded the cathode ray must have a negative charge and named the particles *electrons*.



Thomson's Atomic Model

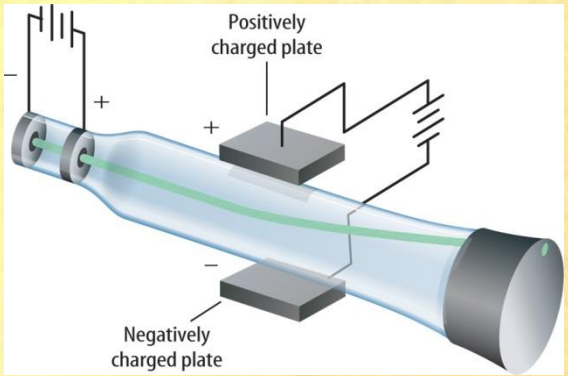
- Thomson proposed that an atom was a positively charged sphere.
- Electrons mixed in to balance the charge.





J.J. THOMSAN 1897

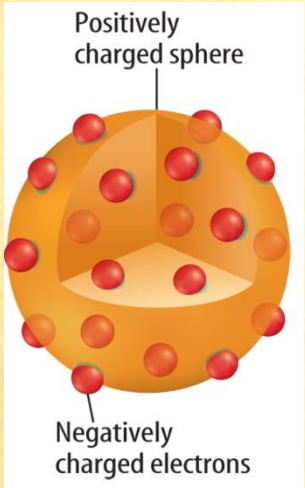
USING A CATHODE RAY TUBE, FOUND AN ATOM HAS A NEGATIVE CHARGE



THEORY:

AN ATOM IS A POSITIVELY CHARGED SPHERE

WITH NEGATIVELY CHARGED ELECTRONS MIXED EVENLY THROUGHOUT THE SOLID SPHERE.

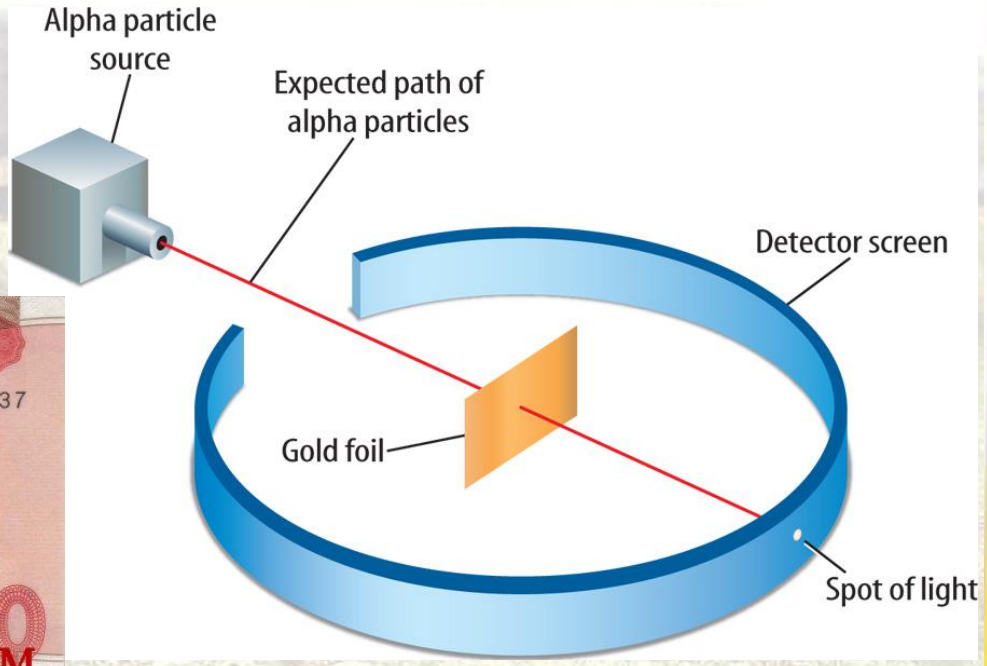


How were electrons discovered?

Continue…

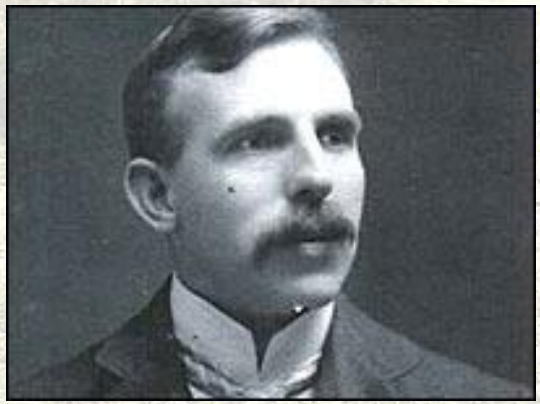
Discovering the Nucleus

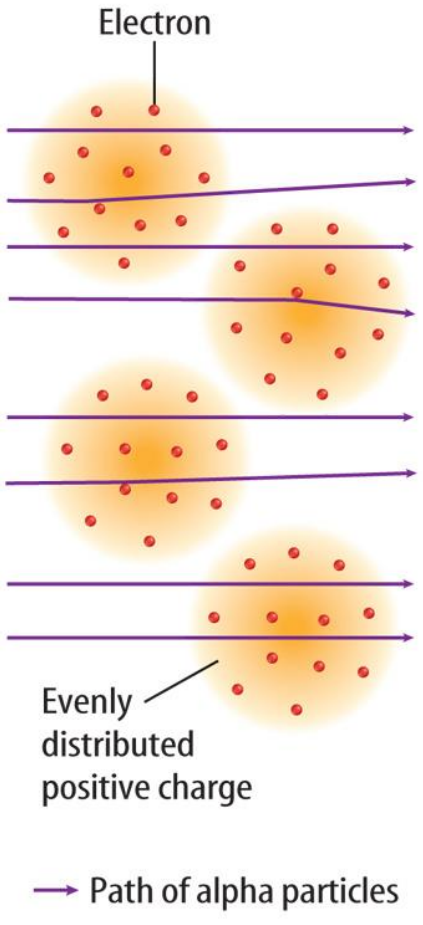
- In Rutherford's gold foil experiment, particles were shot through a thin sheet of gold into a detector behind the foil.

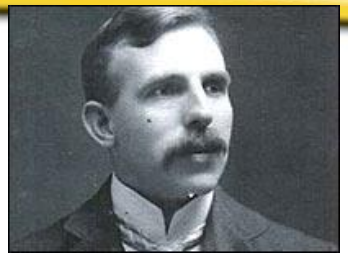


Discovering the Nucleus (cont.)

- Rutherford predicted the path of the particles would bend only slightly because the particles would not come upon a charge large enough to strongly repel them.

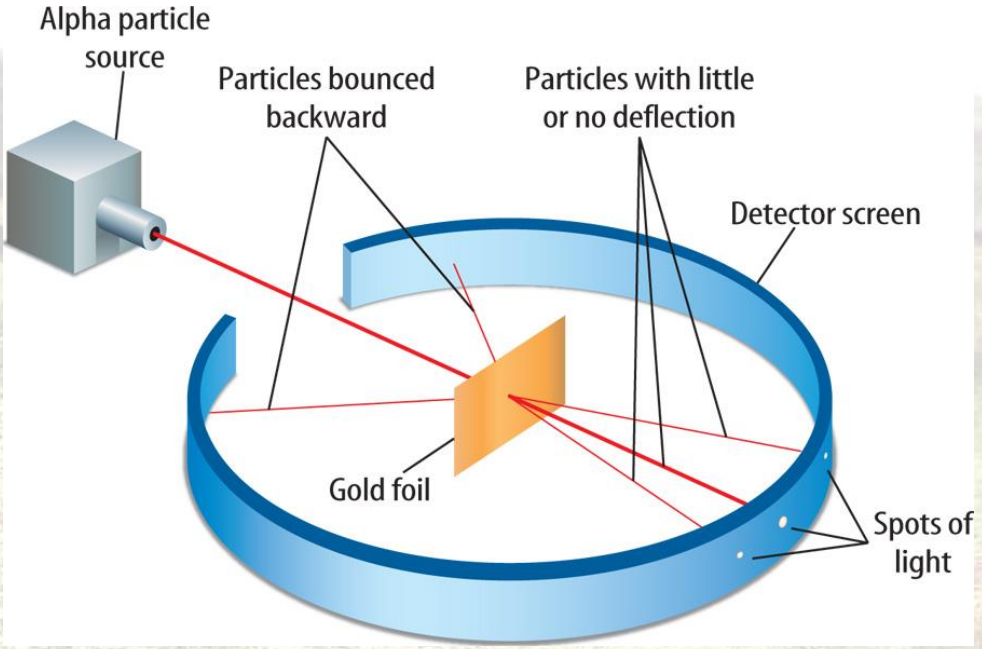


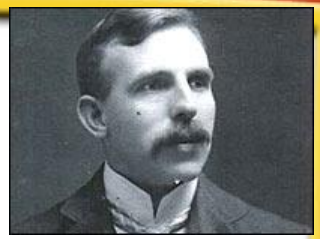




Discovering the Nucleus (cont.)

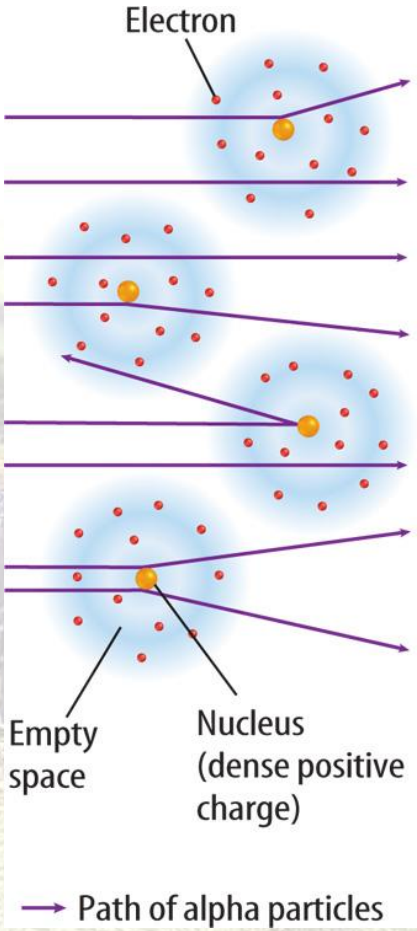
- Most of the particles did pass straight though.
- Some particles were strongly bounced to the side.
- One in about 8000 bounced completely backwards.





Discovering the Nucleus (cont.)

- If the positive charge was spread evenly, all the particles would have passed through the foil with only a small direction change.
- Only something with a larger mass and positive charge could cause some of the particles to bounce backwards.



Rutherford's Atomic Model

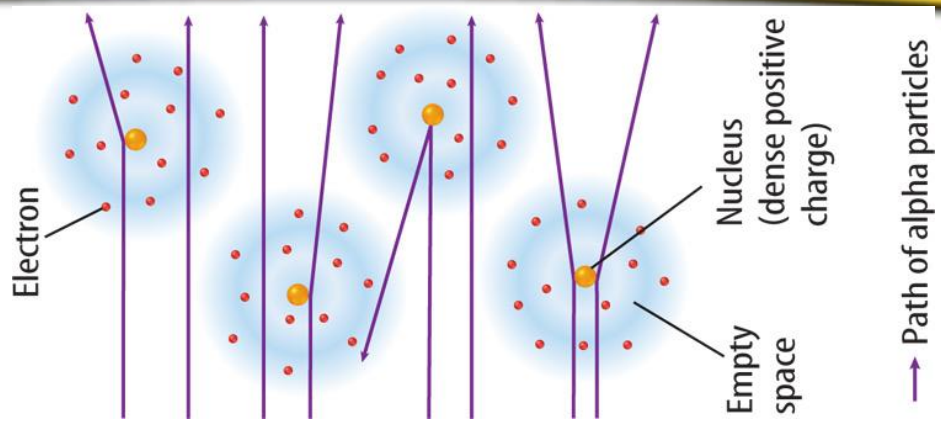
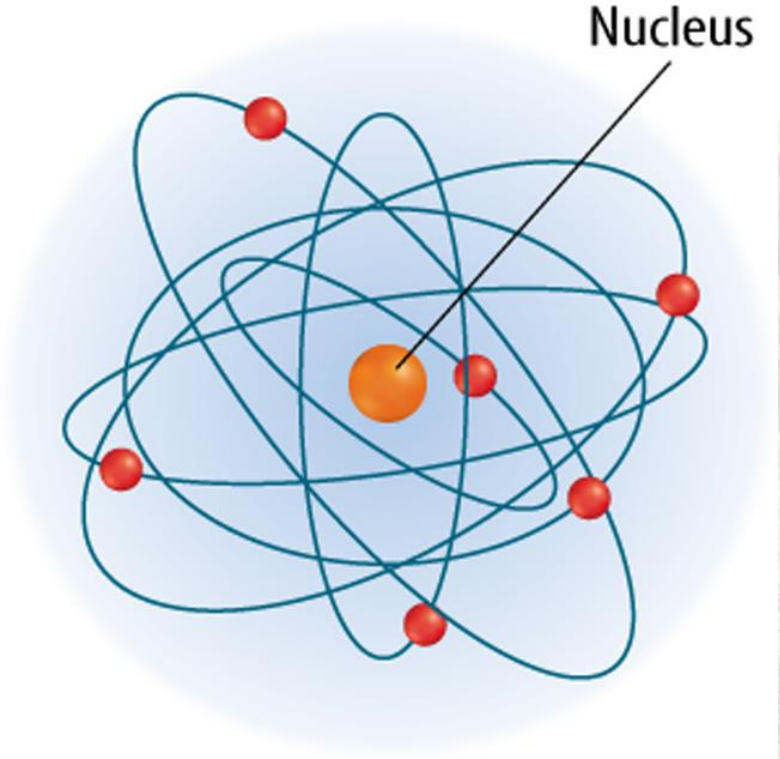


Table 2 Summary of Rutherford's Conclusions

Evidence	Conclusion
Most of the alpha particles passed right through the gold foil.	An atom is mostly empty space.
The charged particles that bounced back could not have been knocked off course unless they had hit a mass much larger than their own.	Most of the mass of an atom is concentrated in a small space within the atom.
A few of the alpha particles bounced directly back.	The positive charge is concentrated in a small space within an atom.

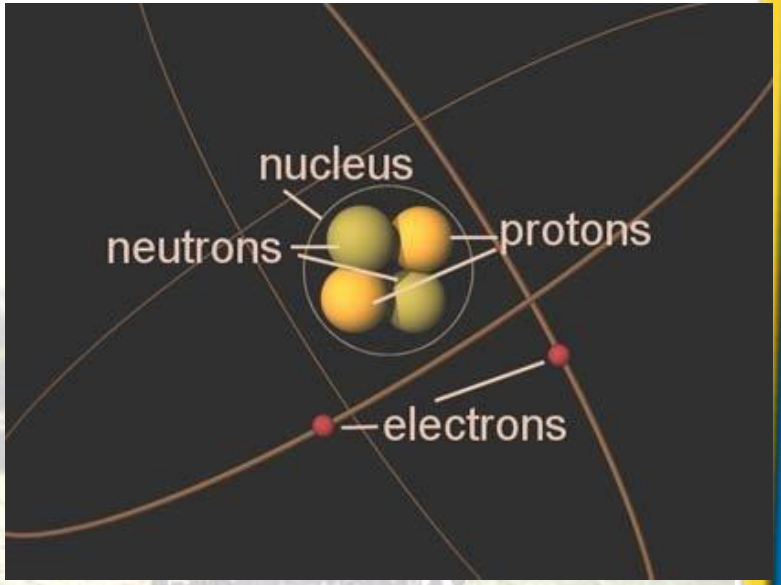
Rutherford's Atomic Model (cont.)

- The positively charged nucleus is in the center of an atom.
- Electrons with a negative charge travel around empty space surrounding the nucleus.



Completing Rutherford's Model

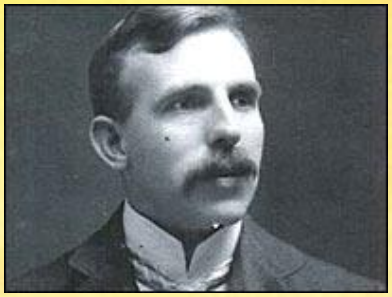
- Rutherford also discovered the proton, a particle with a positive charge.



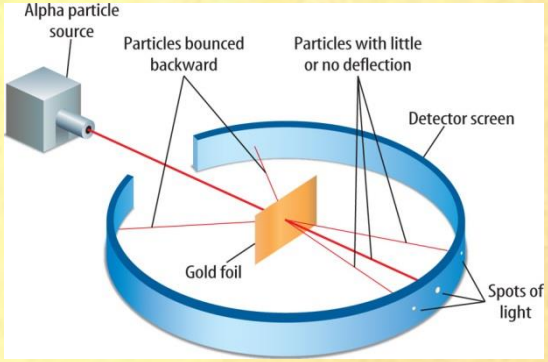
- Rutherford knew the mass of a proton, but could not account for the total mass of an atom.

- Rutherford's theory was later confirmed when the existence of the neutron—a neutral atomic particle with a mass similar to a proton but without a charge—was proved.

Ernest Rutherford 1911



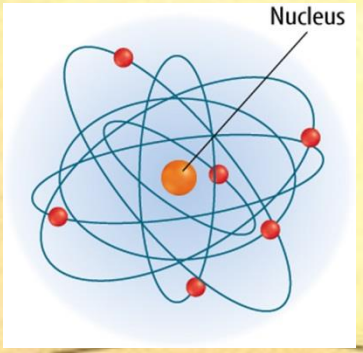
Gold foil experiment showed alpha particles rarely ran into heavy particles but mostly went completely through.



Theory:

An atom has a dense ***nucleus*** at the center which carries <u>most of the mass</u> and a positive charge (proton)and a neutral particle (neutron).

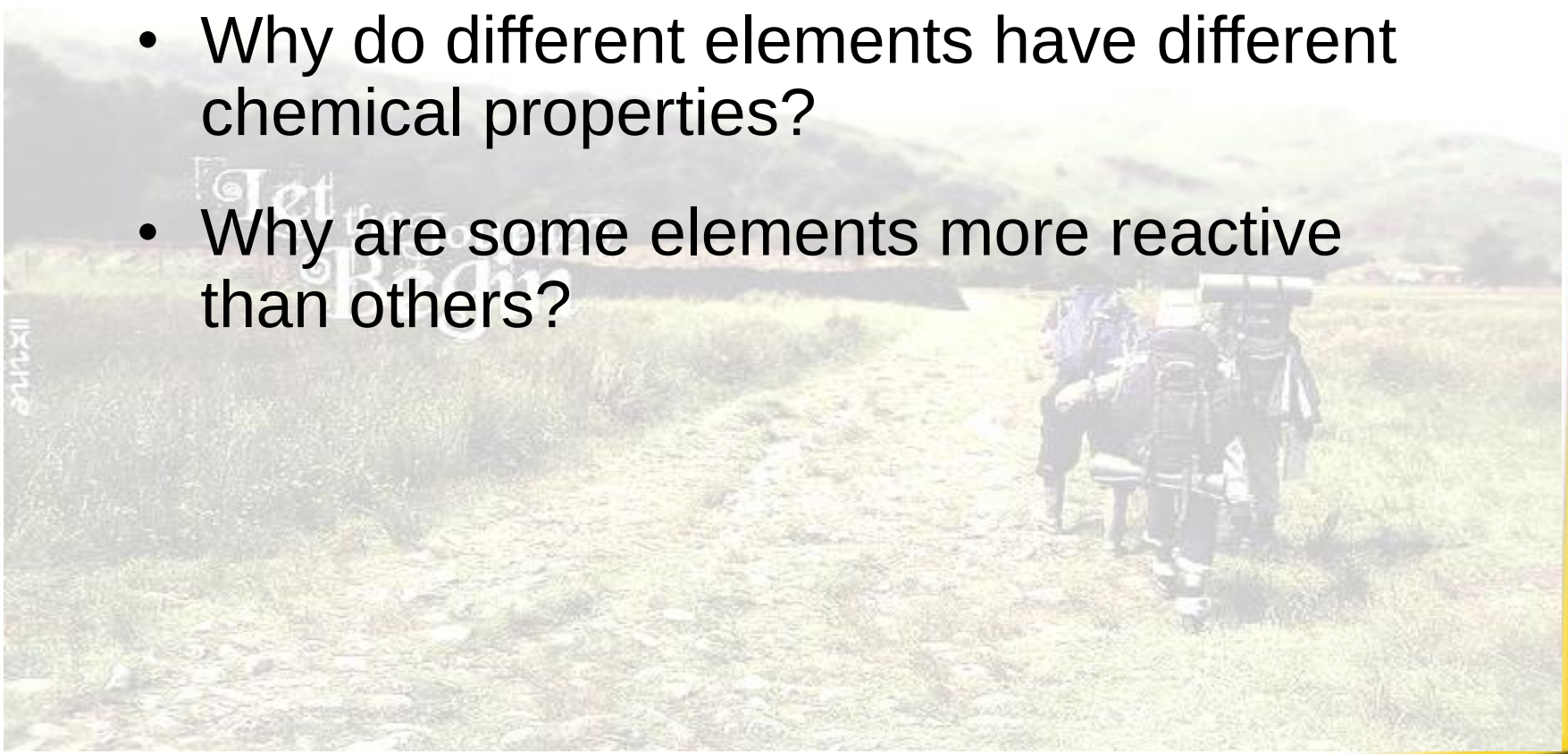
An atom is mostly empty space *with free floating* electrons



How were electrons discovered?

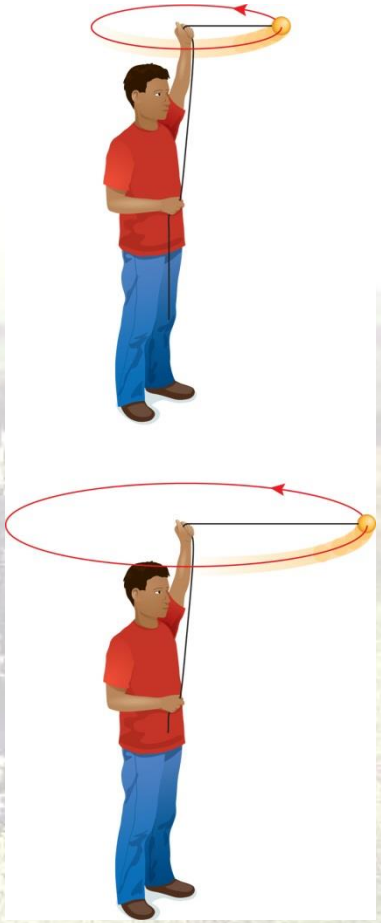
Weakness in the Rutherford Model

- How are electrons arranged?
- Why do different elements have different chemical properties?
- Why are some elements more reactive than others?



Bohr and the Hydrogen Atom

- Rutherford thought the electrons moved around the nucleus like a ball swinging on a rope at any distance.
- Bohr thought electrons traveled in circles with a certain diameter.



Bohr and the Hydrogen Atom (cont.)

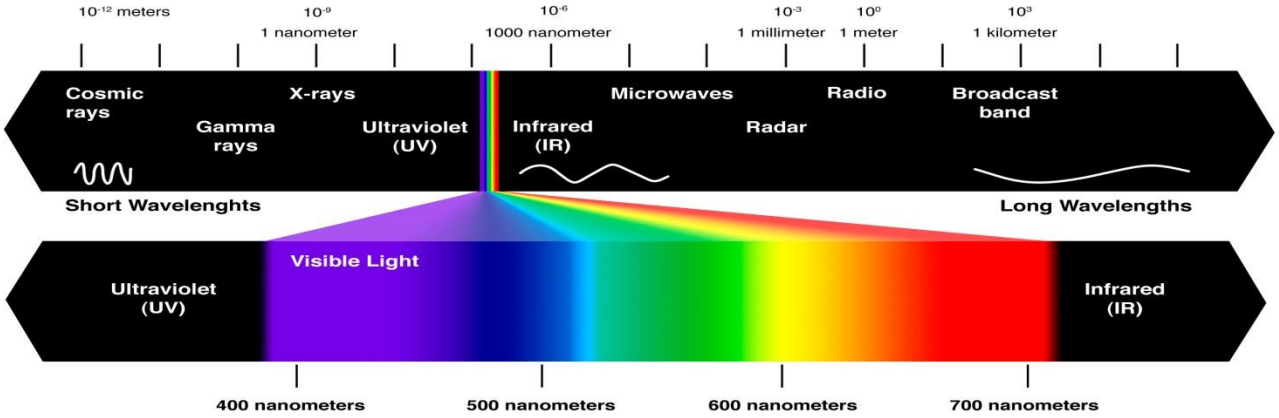
- Bohr studied hydrogen because it has only one electron.
- When atoms are excited, they absorb and release energy as light.

Reviewing the Light spectrum…

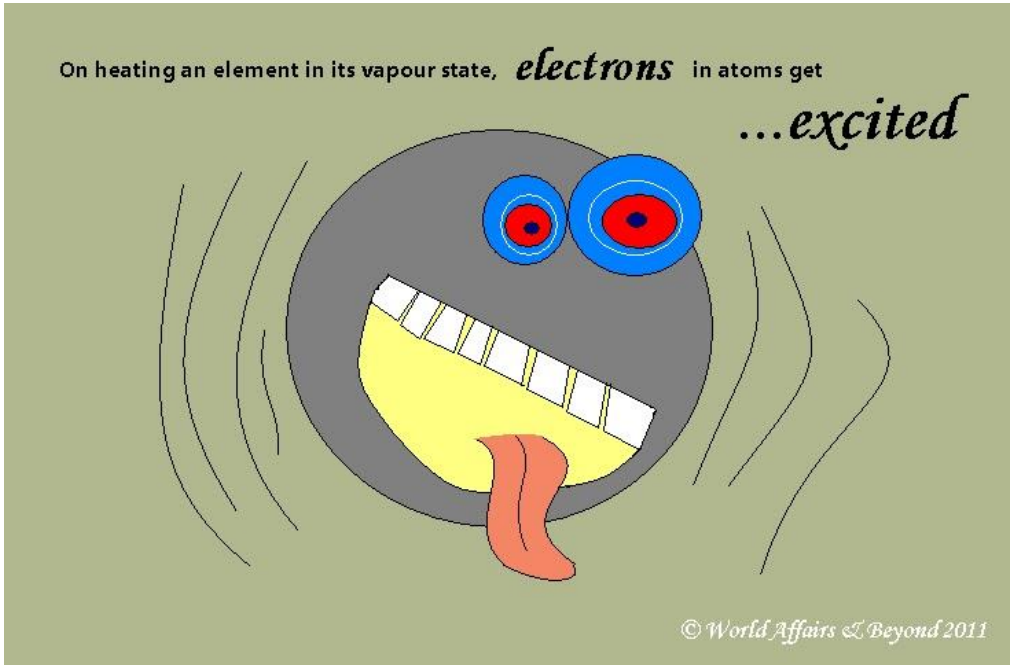
- Light passing through a prism is broken into a continuous spectrum of light—red, orange, yellow, green, blue, and violet blend into each other.

The Spectrum of Hydrogen (cont.)

- Ultraviolet rays have shorter wavelengths and higher energies than visible light.
- Infrared light has longer wavelengths and lower energies than visible light.



What Happens when and electron is excited!



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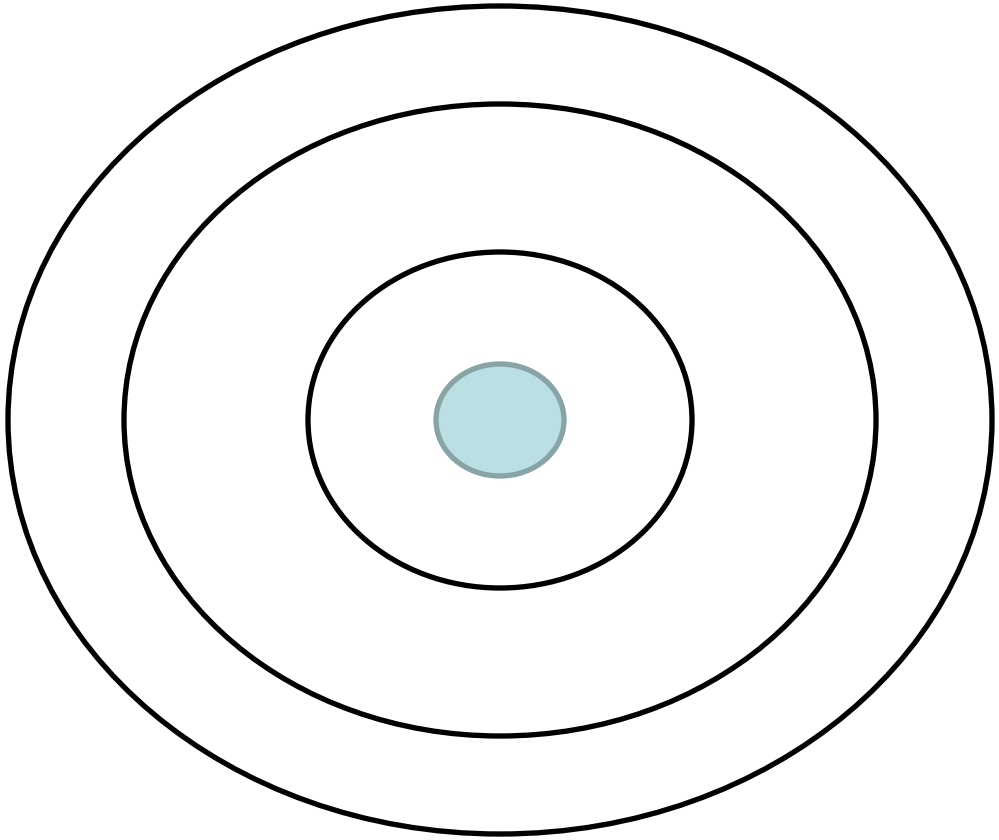
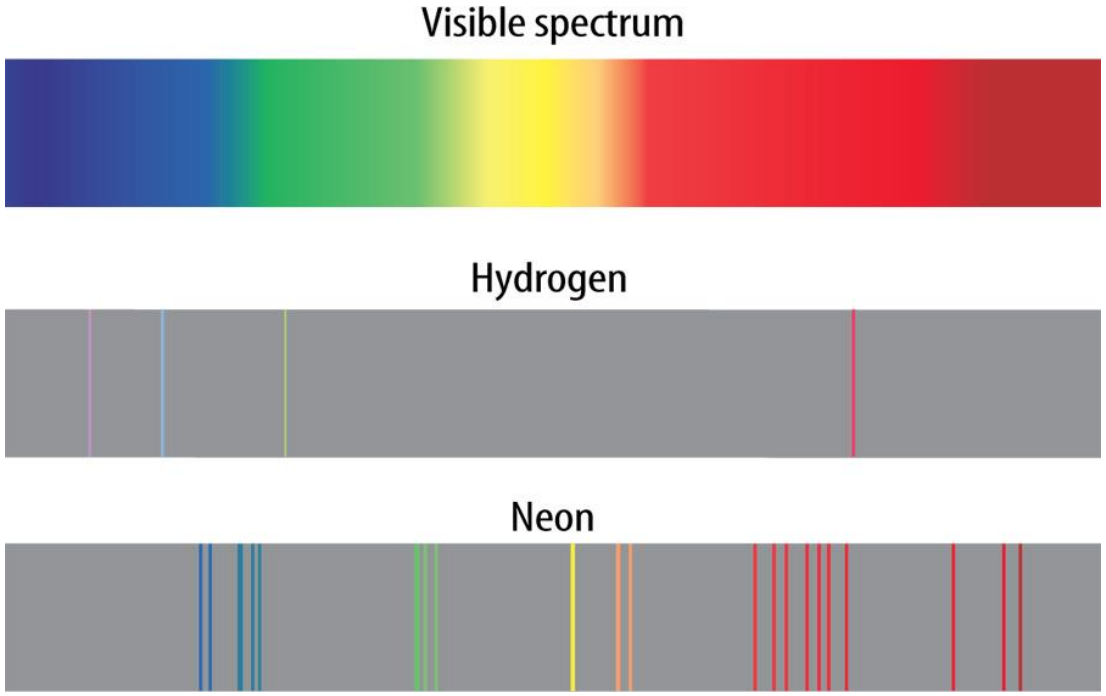


The Spectrum of Hydrogen (cont.)

- When excited, hydrogen and neon give off unique narrow bands of light on the spectrum that are called **spectral lines.**

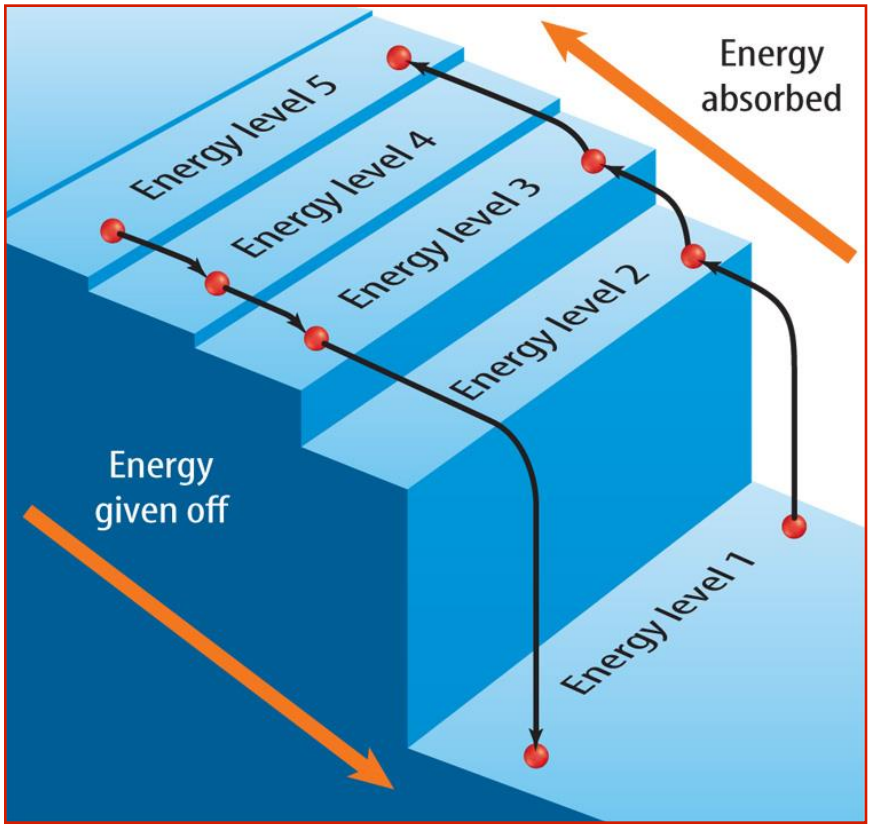


Spectral Lines and Energy Levels

- Each color in a spectral line is a different wavelength and different energy.
- Electrons can have only certain amounts of energy.
- Electrons can only move at a certain distance from the nucleus that corresponds to that amount of energy.

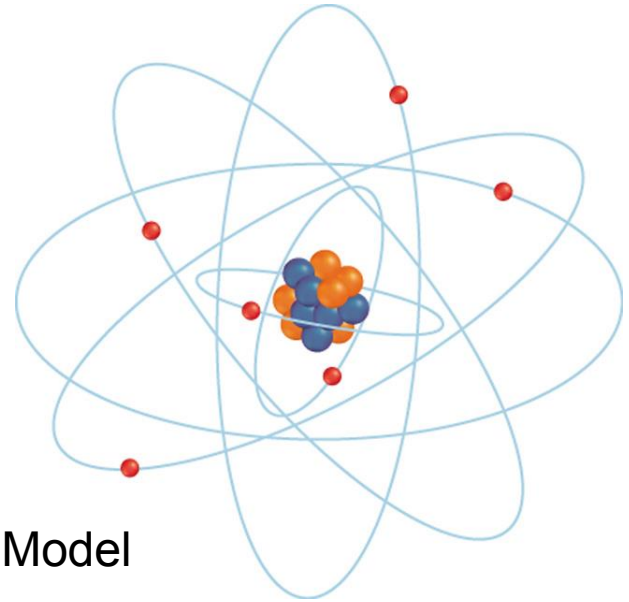
Spectral Lines and Energy Levels (cont.)

- The region in space that an electron can move about the nucleus is called the **energy level.**



Electrons in the Bohr Atom

- The electrons can move only in an orbit that is a set distance from the nucleus.
- Each energy level can hold a certain number of electrons.



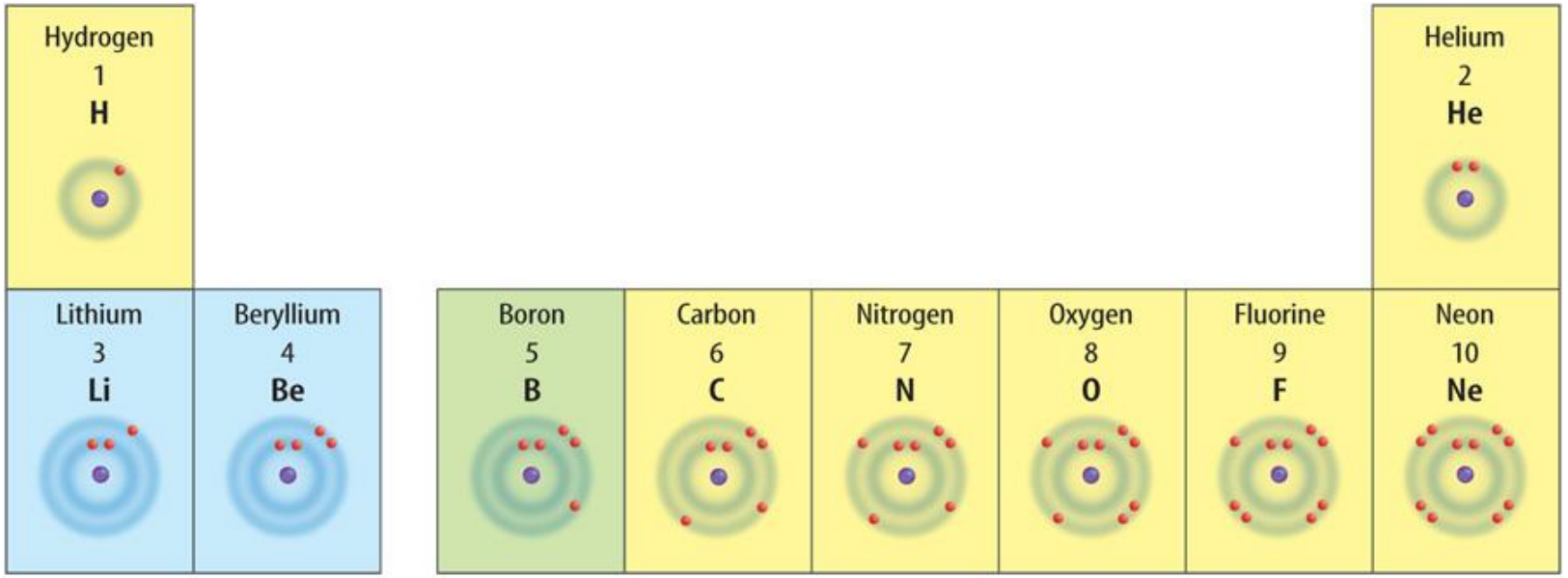
Bohr's Model

Electrons in the Bohr Atom (cont.)

- Electrons fill the energy levels in order.
  - The lowest level is filled first.
  - The second level has no electrons until the first level is full.
  - The first level holds 2 electrons, the second level holds 8 electrons.
  - The last energy level may or may not be filled.

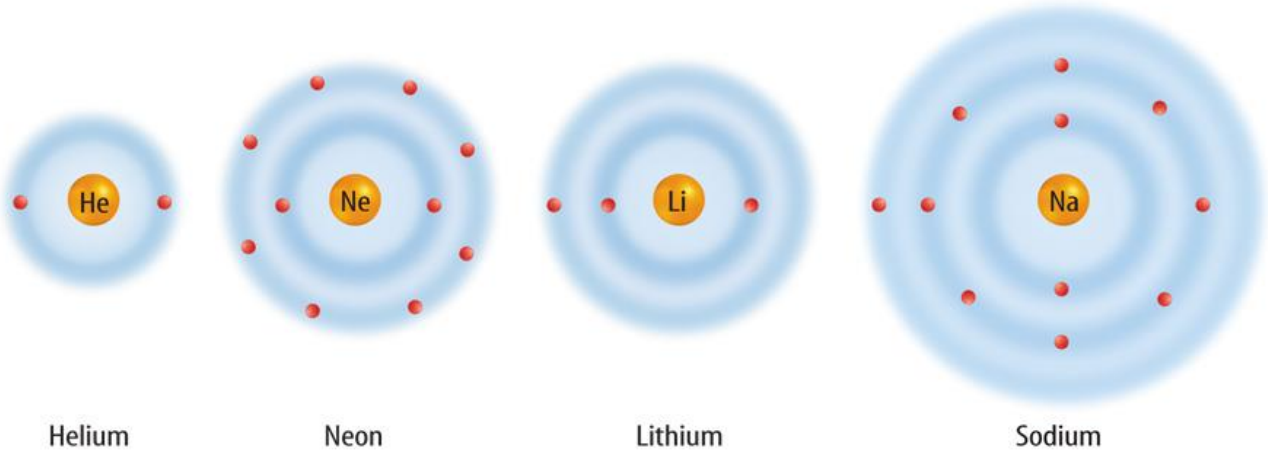
Electrons in the Bohr Atom (cont.)

- This diagram shows how electrons are placed in the elements with atomic numbers 1–10.



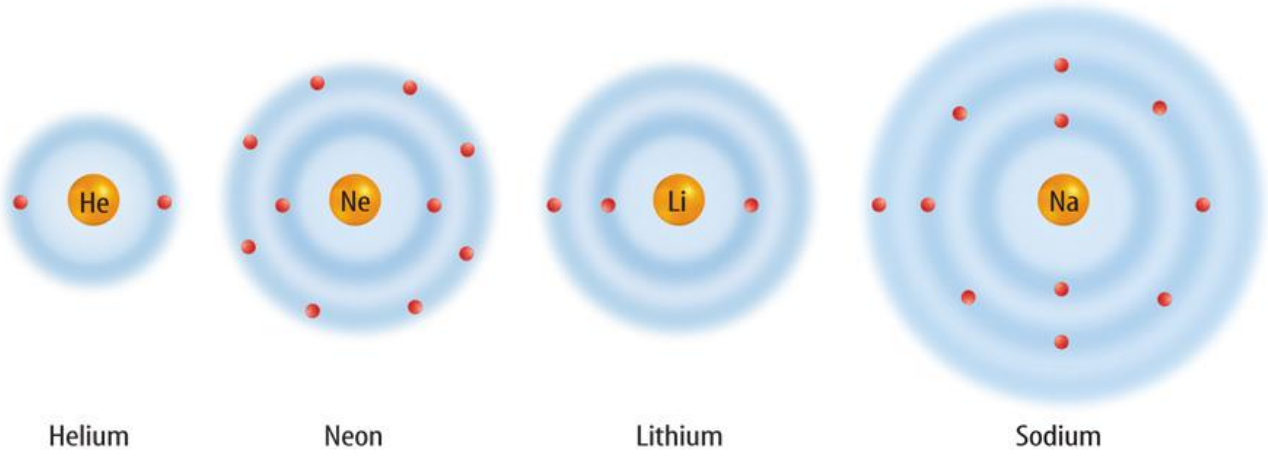
Bohr's Model and Chemical Properties

- Elements have different chemical properties because they have different numbers of electrons in their outer energy level.



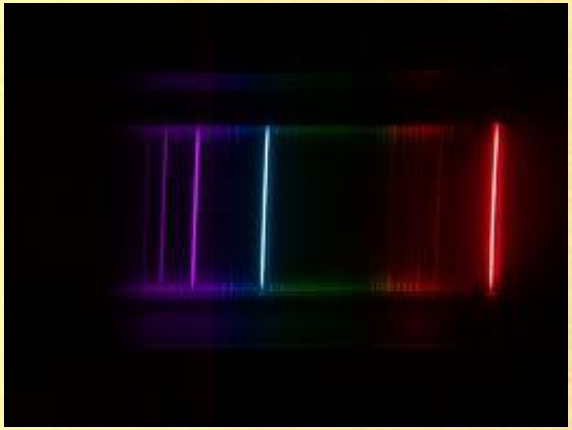
Bohr's Model and Chemical Properties (cont.)

- Unreactive elements have the exact number of electrons needed to fill their outer energy level.
- Elements with incomplete outer energy levels are likely to form compounds.



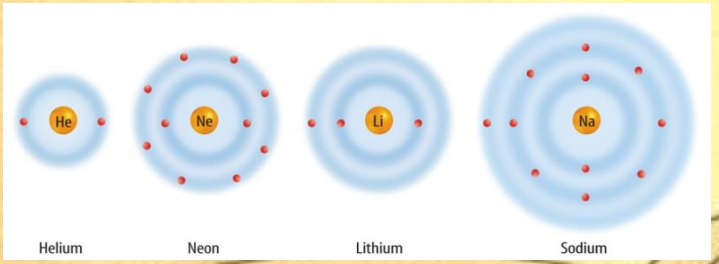
NIELS BOHR
1918

EXCITED THE HYDROGEN ATOM AND FOUND JUST A FEW SPECTRAL LINES



THEORY:

* AN ATOM CONTAINS A NUCLEUS
* ELECTRONS CAN ONLY MOVE IN CIRCLES WITH CERTAIN DIAMETERS
- EACH CIRCLE, CALLED ENERGY LEVEL HAS ITS OWN ENERGY LEVEL WITH SPECIFIC ENERGY
- CHEMICAL REACTIONS DEPEND ON HOW MANY ELECTRONS ARE IN THE OUTER ORBITAL
- SHELLS FILL FROM THE INSIDE OUT.



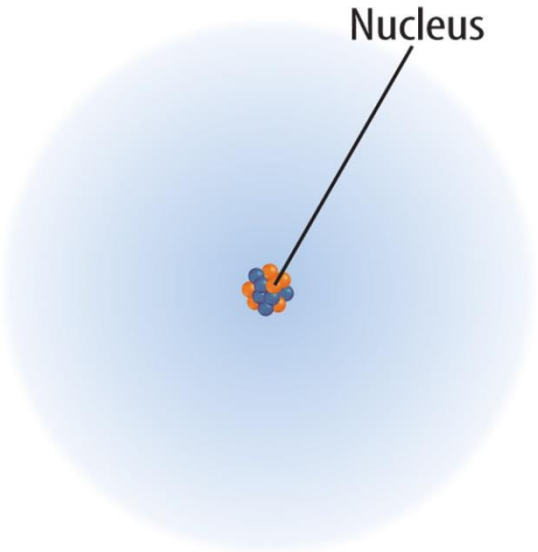
Limitations of Bohr's Model

- Energy levels were like circular orbits.
- Bohr's theory works for the simple hydrogen atom, but not for more complex elements.

The end of a journey
Is the beginning of another

The Electron Cloud Model

- The **electron cloud** is the region surrounding an atomic nucleus where an electron is most likely to be found.
- Electrons are more likely to be near the nucleus because they are attracted to the positive charge of the protons.



Electron Cloud Model

LESSON 2 Review

CheckPoint

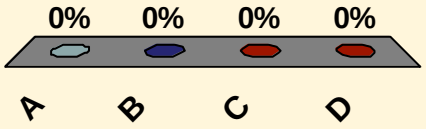
An excited hydrogen atom emits narrow bands of light called _____.

A energy lines

B wave lines

C spectral lines

D wavelengths



LESSON 2 Review

CheckPoint

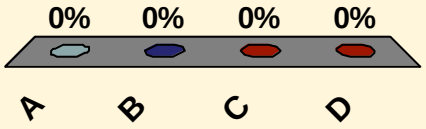
Elements that do not react with other elements must have _____.

A completely filled energy levels

B excited electrons

C empty energy levels

D the same number of protons and neutrons



LESSON 2 Review

CheckPoint

In the gold foil experiment, why did some particles pass straight through the foil?

A because they were repelled by the protons in the foil

B because they were attracted by the protons in the foil

C because atoms have no effect on charged particles

D because atoms are mostly empty spaces