ATOMIC HISTORY

How do we know all this stuff anyway?

QUICK REVIEW OF PARTICLES

- Atoms, Molecules, Compounds and Elements
- The Basic Parts of an Atom
- http://www.chem4kids.com/files/matter_intro.html

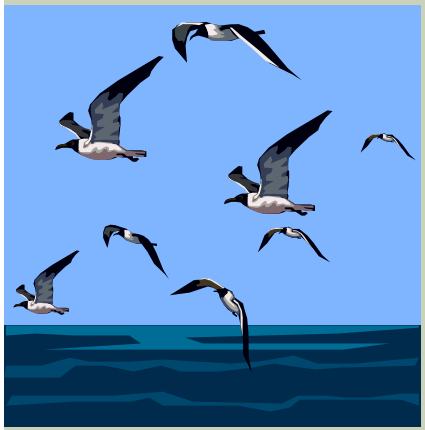
ATOMS ARE TOO SMALL TO SEE.RIGHT?

There are between 100 billion and 400 billion stars in our galaxy.

Size and Scale Link
Universe
Size and Scale Link
Atom

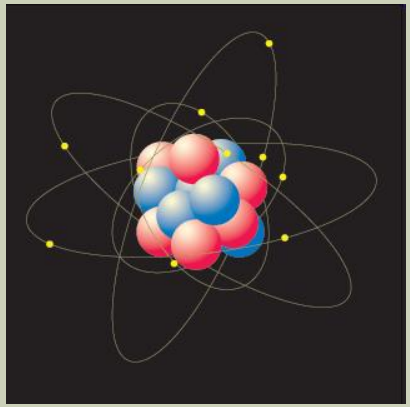
About 6,000,000,000 (6 billion) people live on the earth

About 300,000,000 (300 million) people live in the USA



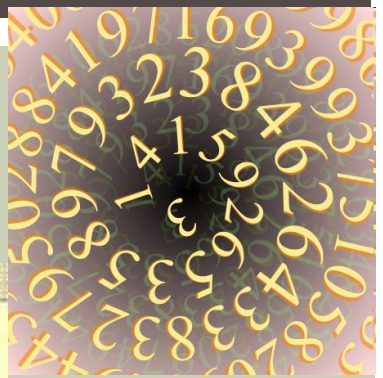
About 2,500,000 (2 .5 million) people live in Utah

The average person is made of around 65,000,000,000,000 to 10 100,000,000,000,000(65 -100 trillion) cells Cells

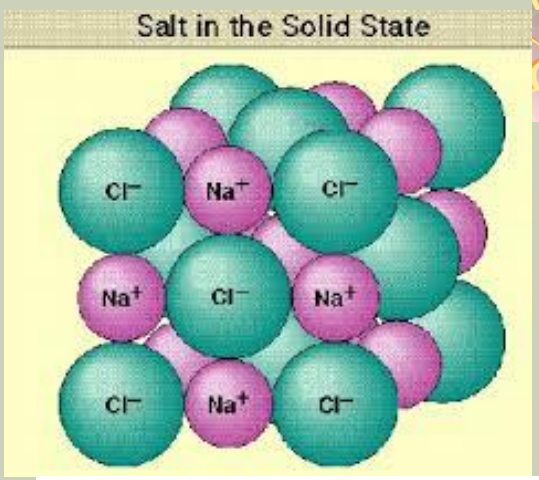


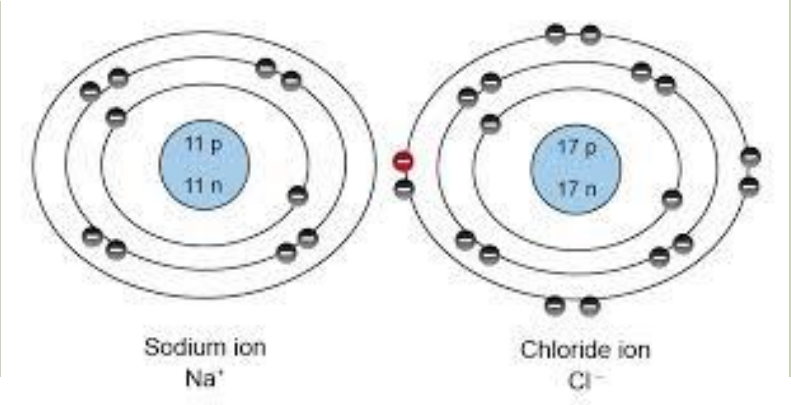
There are about 7,000,000,000,000,000 (7 quadrillion) atoms in one cell.

…HOW COULD WE POSSIBLY KNOW SO MUCH ABOUT THEM?

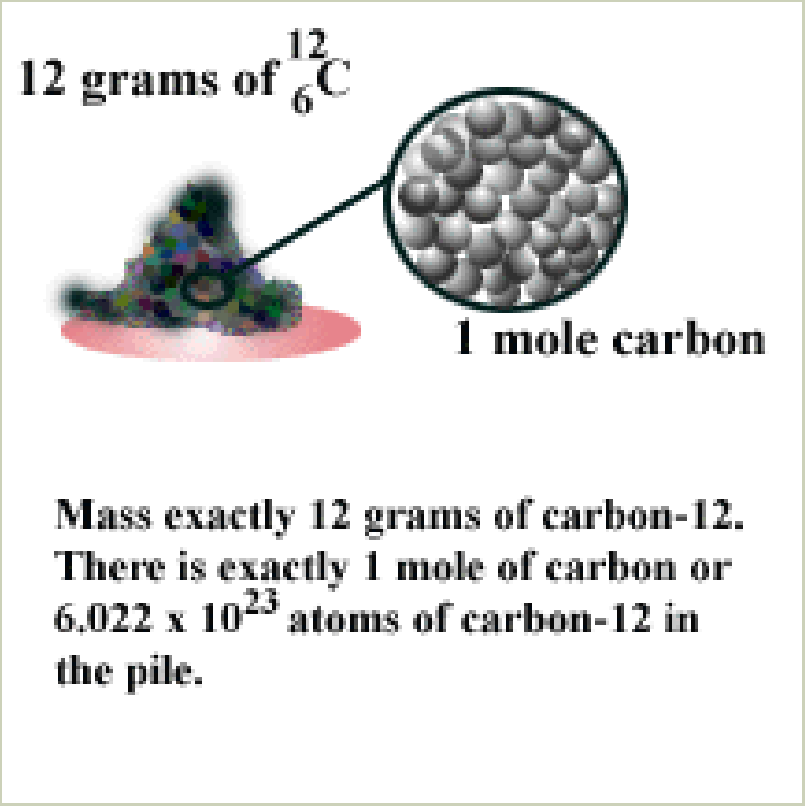


- If you counted one atom per second, it would take you 221,968,544 years to count all of the atoms in one cell!
- Size Scale Example
- Investigate:
  - 1. How many atoms are in a penny?
    - 20 thousand Billion Billion.
    - 20,000,000,000,000,000,000,000
    - 2x10 to 22nd power.
  - 2. How many atoms = the thickness of aluminum foil?
    - 50,000
  - 3. How many atoms are in a grain of salt?
    - **1.2x10^{18} atoms**, half of which are sodium atoms. (The other half is chlorine atoms, of course
    - 12,000,000,000,000,000,000
  - Read page 80.





WHAT THE HECK IS A MOLE?

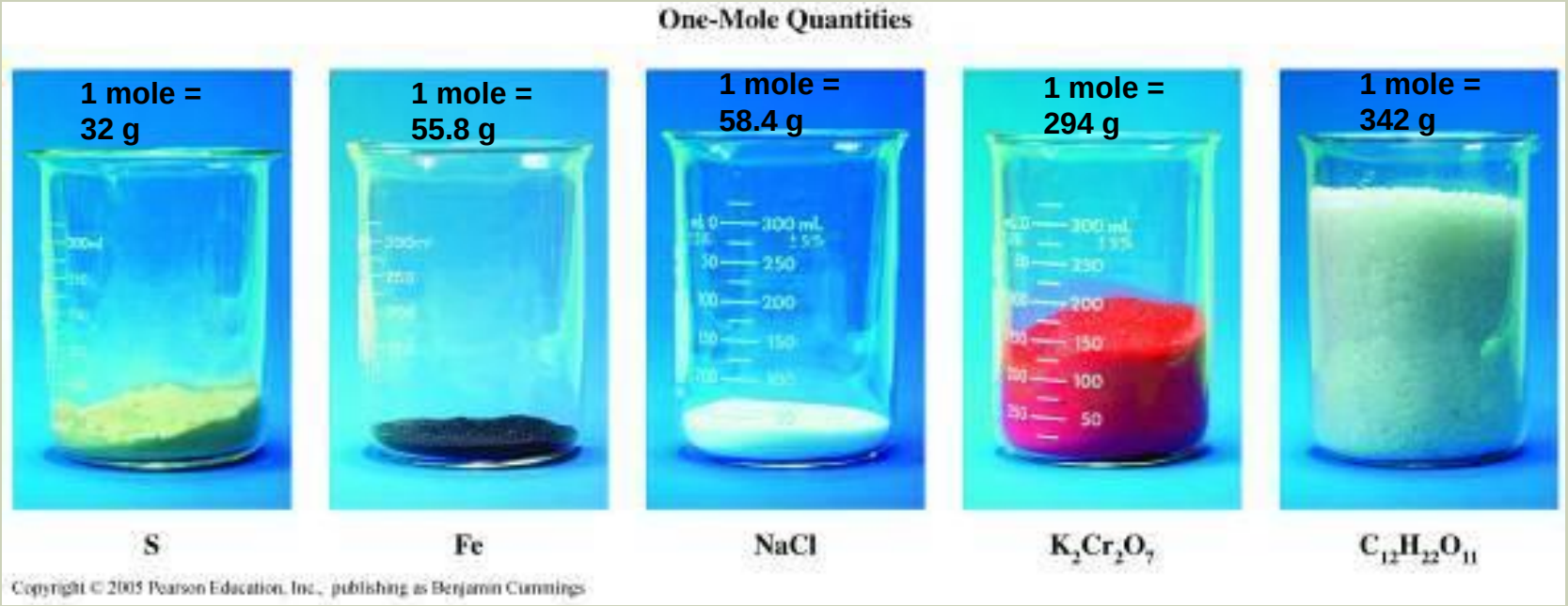


Think of moles as a "chemist's dozen". Just as 12 eggs is a dozen eggs, 6.02×10^{23} eggs is a mole of eggs. 6.02×10^{23} molecules of oxygen is a mole of oxygen. A mole is that number of molecules in a substance.

A MOLE IS A MOLE BUT THE VOLUME AND MASS OF 1 MOLE VARIES FROM 1 ELEMENT TO THE NEXT

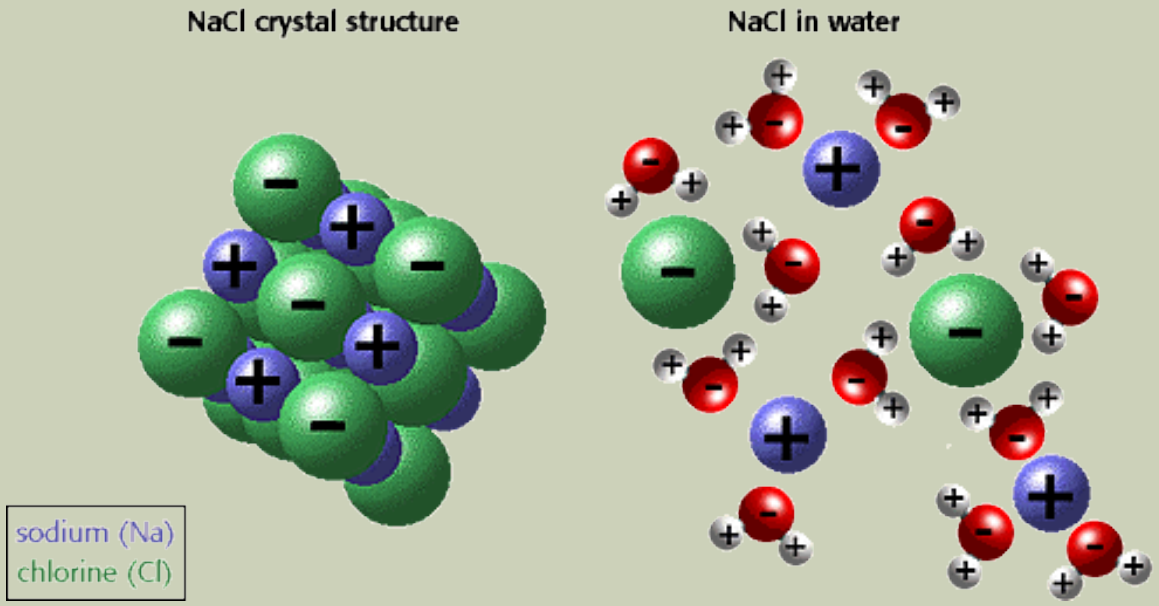
1 Mole of an element or compound is the amount of molecules in that element or compound = to 12 grams of carbon which is

Avogadro's # of 6.022×10^{23}



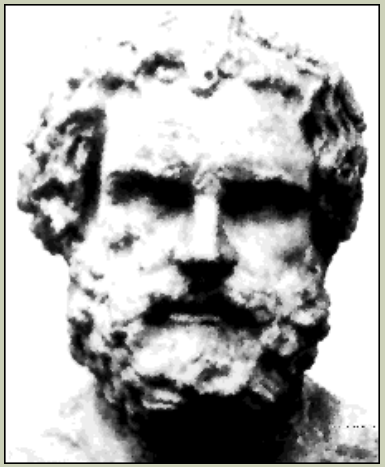
See mole jars of salt and sugar.

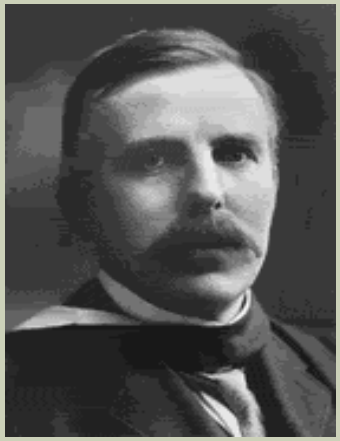
TABLE SALT IN WATER

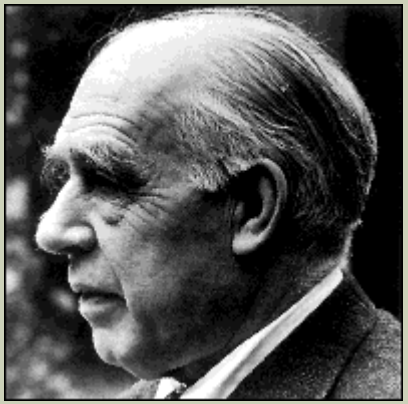


WHO ARE THESE PEOPLE?

In this lesson, we'll learn about the scientists whose quests for knowledge about the fundamental nature of the universe helped define our views about atoms.







Read Text
Page 80.

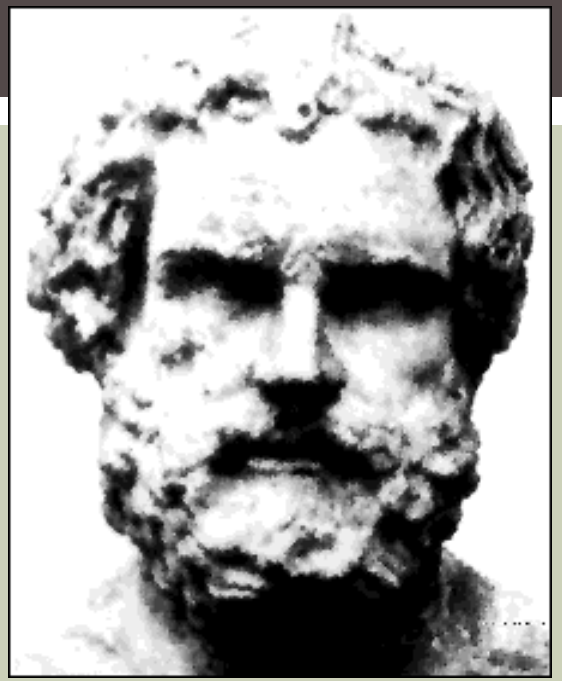
COMPLETE THIS DATA TABLE PLEASE.

The Atomic Theory Development

Scientist Name	Contribution Detail	Year of Contribution
Democritus		
John Dalton		
J.J. Thompson		
Ernest Rutherford		
Niels Bohr		

A GREEK BEGINNING

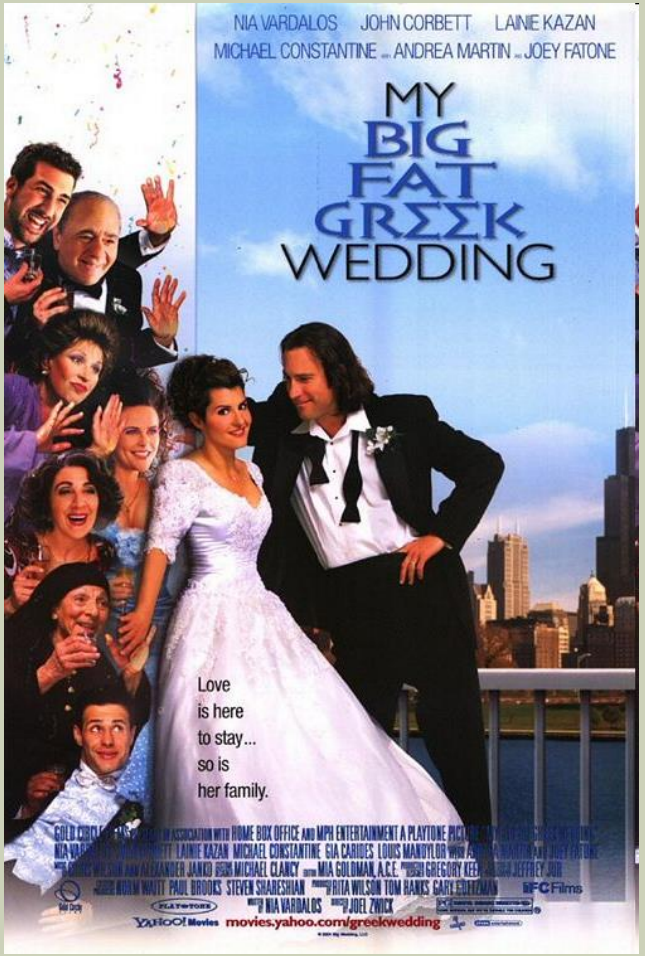
- **Democritus** proposed the atom around **440 BC.** The word "atom" is from the Greek word "atomos" which means "indivisible".
  - He asked: Could matter like the coin below be divided into smaller and smaller pieces forever, or was there a limit to the number of times a piece of matter could be divided?
- He concluded that atoms are.... There are atoms
  - indivisible .
  - too small to see.
  - always moving.



- This is the Greek philosopher Democritus who began the search for a description of matter more than 2400 years ago.
- Scanning Tunneling Microscope 1980's + other 80's technology fun.

AFTER THE GREEKS

- The idea of atoms being the building blocks of matter wasn't seriously looked at for a long time after the Greeks came up with the idea.
- Aristotle who lived from 384-322 BC disagreed about particles being indivisible. Aristotle had a strong influence on what people believed.



ARISTOTLE

- **Aristotle** and **Plato** favored the ***earth, fire, air and water*** approach to the nature of matter.
- Their ideas were persuasive because they were philosophers.
- The idea of atoms was buried for approximately 2000 years.

JOHN DALTON (1803)

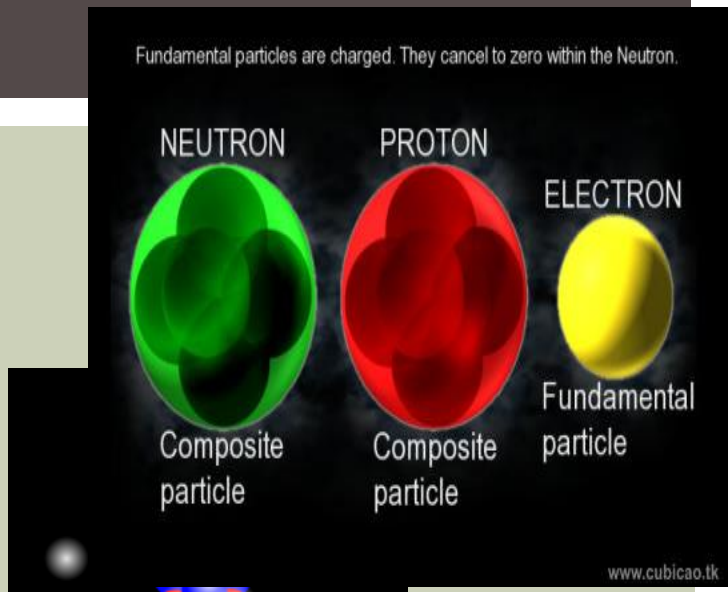
- In 1803, **John Dalton** reintroduced the idea of atoms when he **proposed that all matter is made up of atoms. He created the 1st Atomic Theory.**

JOHN DALTON (1803)

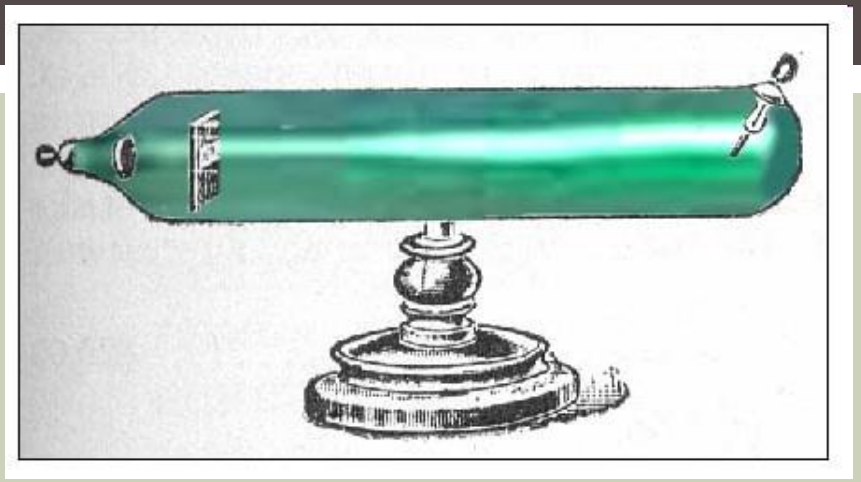
- His Theory Stated
  - 1. All matter is made of atoms. Atoms cannot be created, divided, or destroyed.
  - 2. Atoms of the same element are alike.
  - 3. Atoms of different elements are different.
  - 4. Atoms join with other atoms to make molecules and compounds.
- In the late 1700's scientists noticed that elements combine in specific amounts to make substances.
- Most of his theory ended up being correct.
- However, scientists did later prove that the atom is DIVISIBLE.

AFTER DALTON

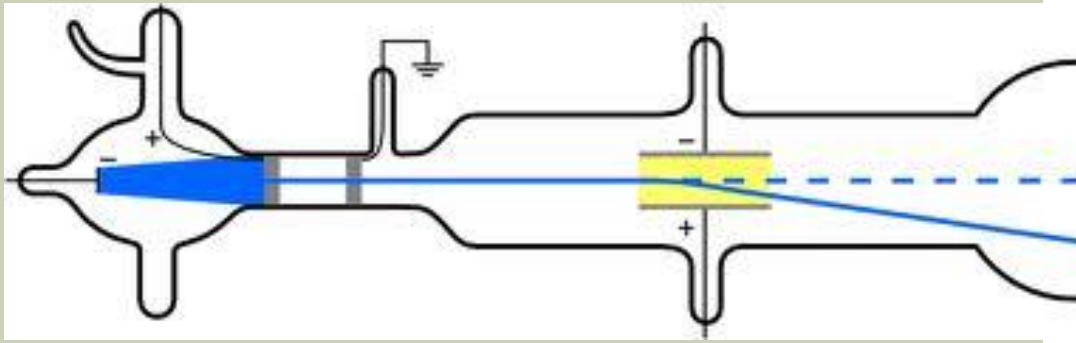
- People began to see clues that atoms might be made up of even smaller particles.
- We now call these particles **protons** (+), **neutrons** (neutral), and **electrons** (-).



J. J. THOMPSON (1897)

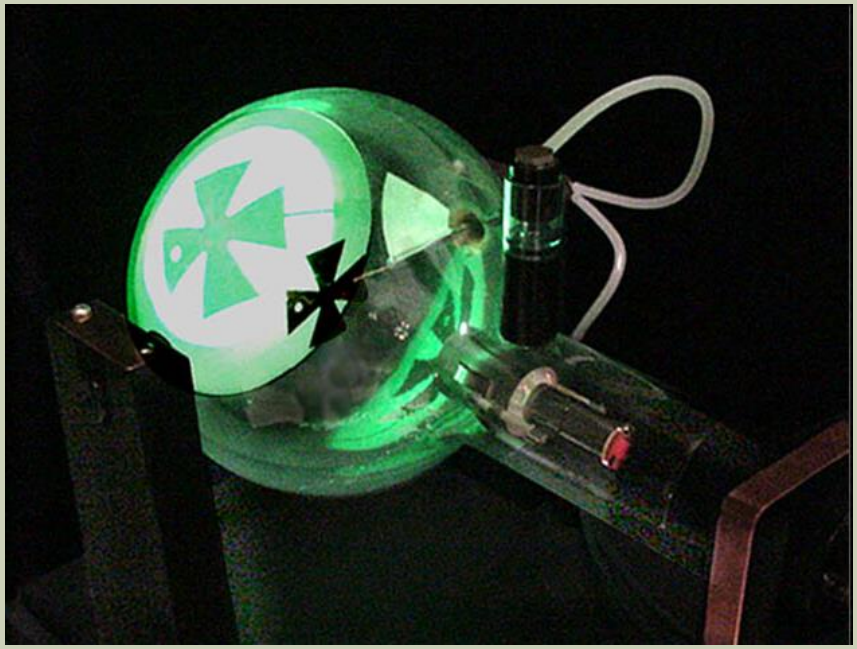


- In 1897, **J.J. Thompson** discovered the negative particles (electrons) of atoms using a glass tube experiment.
- See page 82.
- Try Charging balloon



J. J. THOMPSON (1887)

- By sending an invisible beam of matter through a tube connected to electricity, Thompson did **several experiments** through which he found that:
  - **Electrons are negatively charged particles in an atom.**
  - Electrons are attracted to opposite charges.
  - **Electrons have little mass**

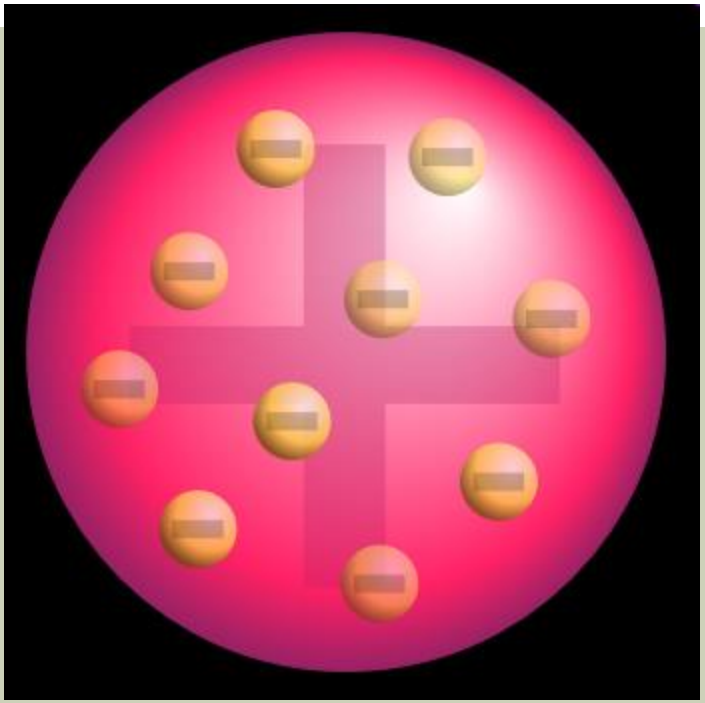


J. J. THOMPSON (1887)

- **In 1897 J.J. Thompson created the plum pudding" model of the atom.**

See pg. 83 plum pudding explanation.

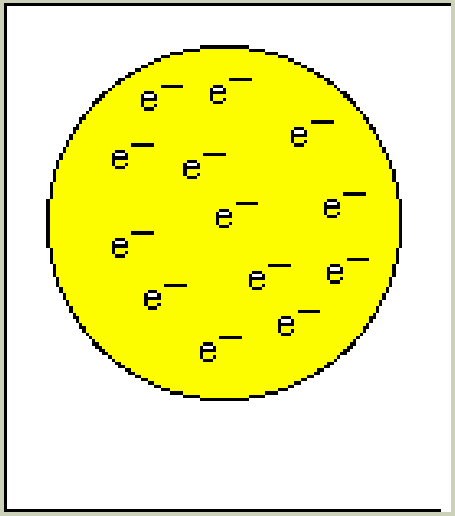
- He thought that negatively charged electrons floated randomly around in a positively charged sphere.



A model is a representation of an object or system. A model is different from a theory in that a model presents a picture of what the theory explains.

THOMPSON'S PLUM PUDDING MODEL OF THE ATOM

- The atom is mostly positive charges material with some small negative particles scattered throughout.



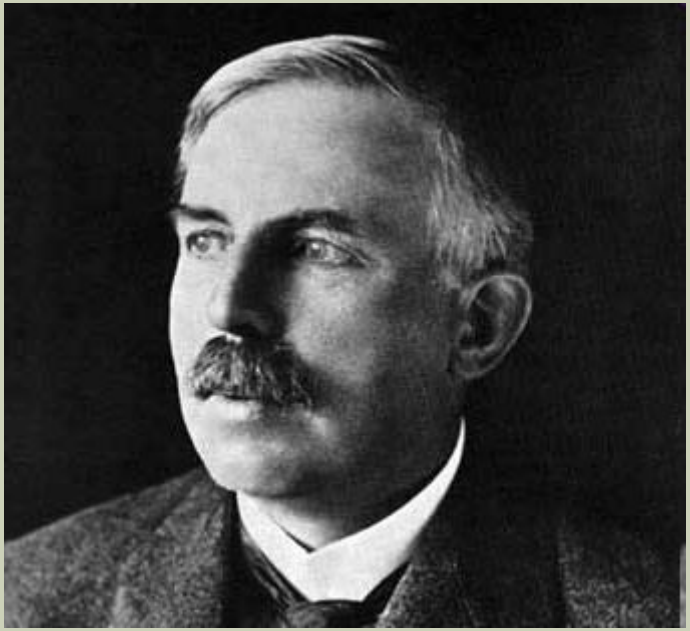
WHAT IS A MODEL IN SCIENCE?

- It is a smaller or **larger** than life representation of an object or system.
- Are there any problems with using models?

- Some models are…
  - The Globe
  - The Atom Model
  - The Cell Model
  - The DNA Model
  - The Earth Model
  - The Eye Model
  - The Skeleton Model

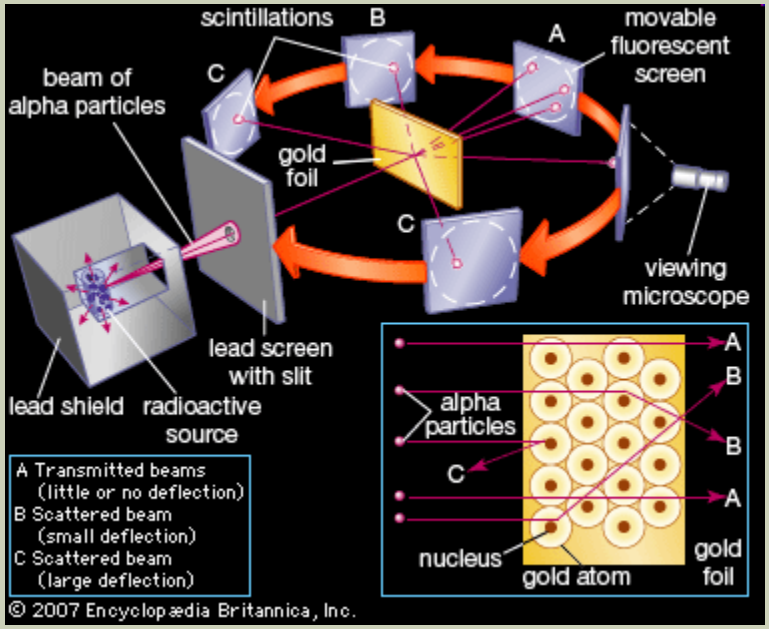
RUTHERFORD (1909)

- In 1909, Ernest Rutherford did an experiment called the "Gold Foil" experiment. **He proved that there is a positive charged nucleus in the atom.**
- See page 84



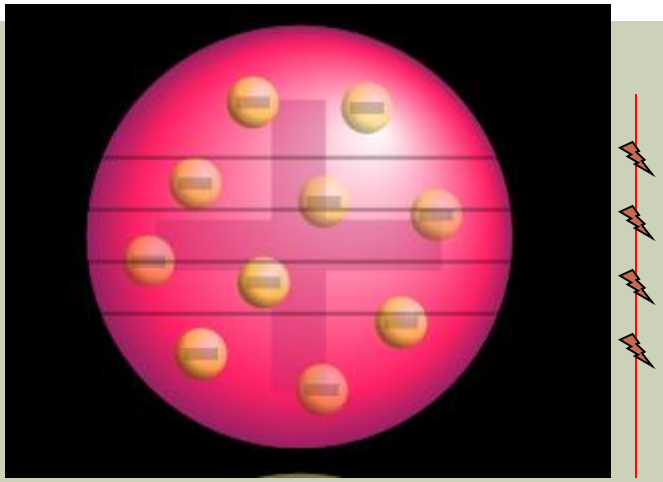
RUTHERFORD (1909 -1911)

- Rutherford shot positive particles of matter at a very thin sheet of metal, and was able to record where they hit on the other side of the metal.



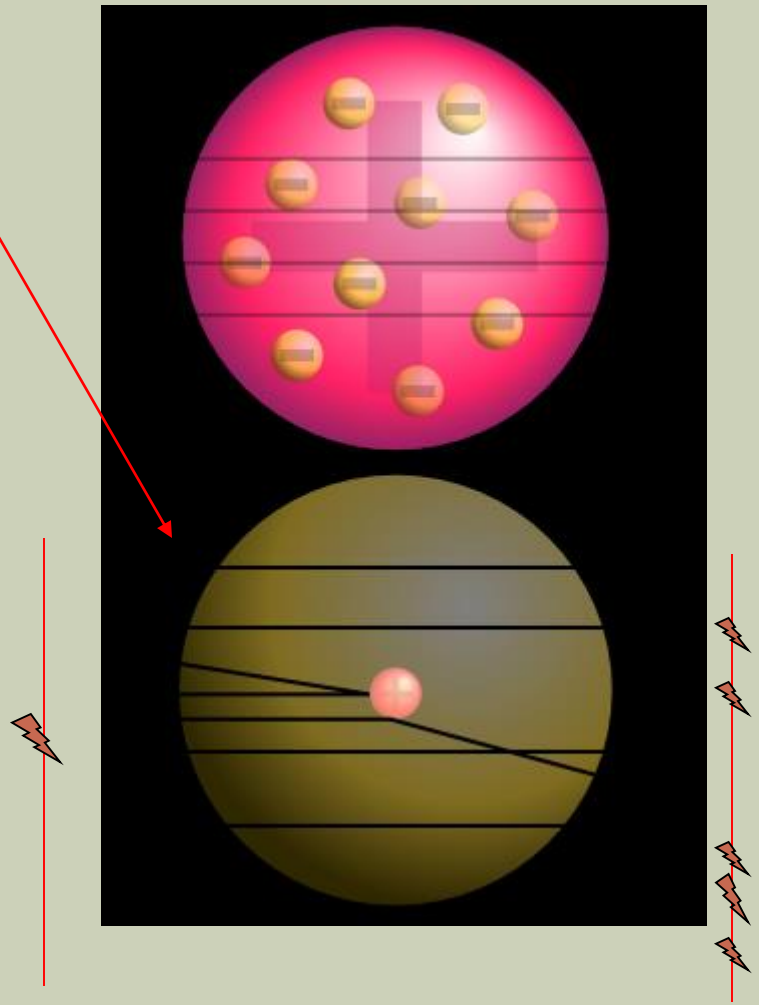
RUTHERFORD (1909 -1911)

- The expected results, using the plum pudding model would look like this.
- The atom has a nucleus. However, this is what Rutherford discovered.



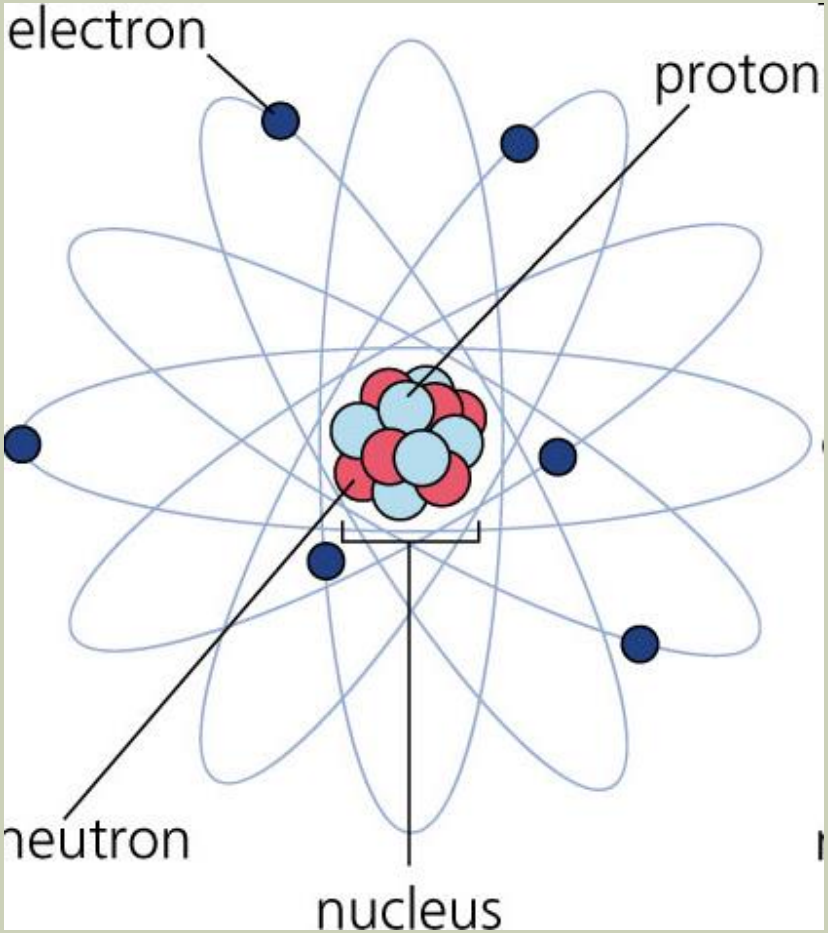
RUTHERFORD (1909 -1911)

- Instead, Rutherford's results looked like this.
- Rutherford's experiment taught us that:
  - **Protons are the positive part of an atom.**
  - Protons are in the center of the nucleus and take up a very small part of the total atom.
  - **However, the nucleus contains most of the mass of the atom.**
  - Most of the atom is empty space.



NIELS BOHR (1913)

- In 1913, **Niels Bohr** said that **electrons orbit the nucleus like planets around the sun** and that you can know their location.
- This is called the Bohr model.

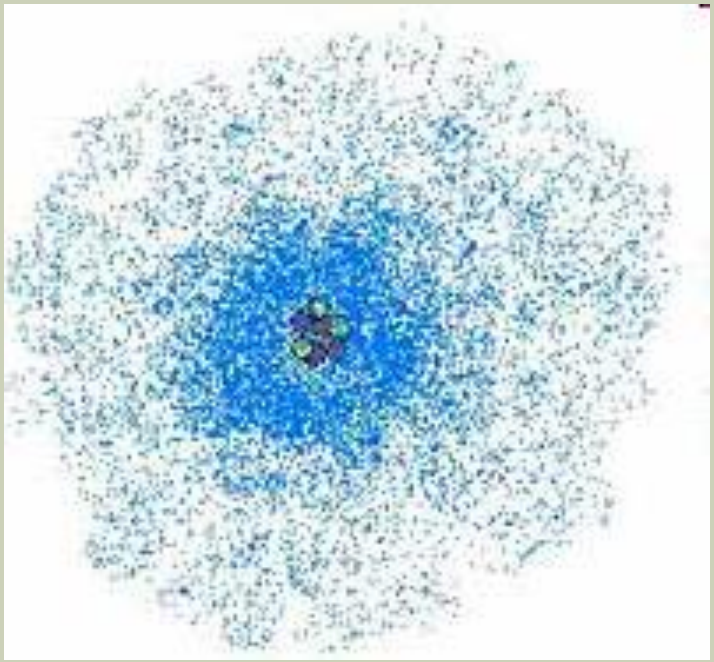


THE DISCOVERY OF THE NEUTRON.

- James Chadwick discovered the neutron in 1932

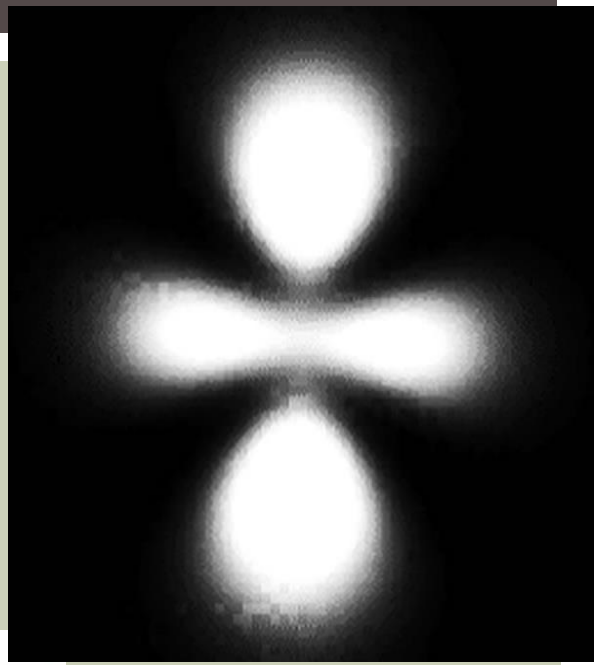
THE MODERN ATOMIC THEORY

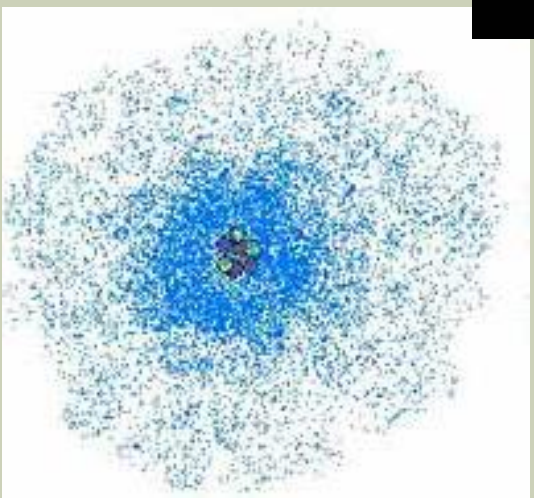
- Erwin Schrodinger
- Werner Heisenberg
  - Helped improve the modern atomic theory.
    - For Example – They determined that **electrons do not orbit the nucleus in defined pathways. They orbit in levels and form clouds.** The exact location of the electron cannot be known.



OUR MODERN MODEL

- Today our model of the atom is one with the nucleus in the center and a "electron cloud" around the nucleus to show the areas where an electron might be found.
- Review Video





PROBLEMS WITH USING A MODEL ATOM

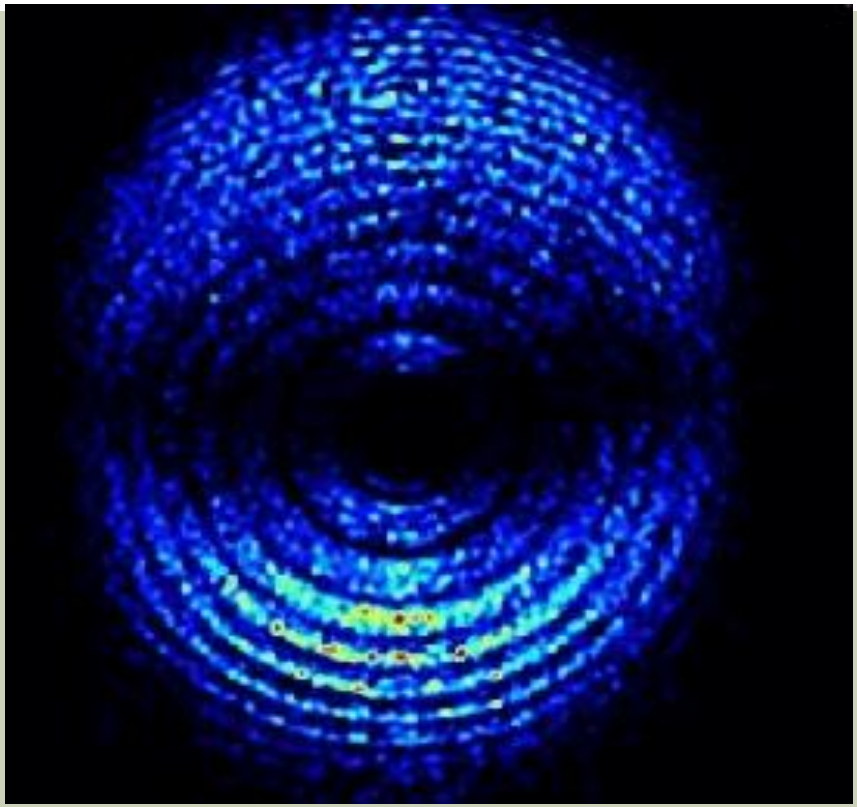
- There are a few limitations (problems) that occur anytime you try to make a model of an atom.

PROBLEMS WITH USING A MODEL ATOM

- 1- You can't accurately show the distance between particles in the atom.
  - If the nucleus were the size of a bean, the atom would be the size of a football stadium.
  - If the nucleus were the size of a tennis ball, the electrons would reach 4 miles out.

PROBLEMS WITH USING A MODEL ATOM

- The motion of electrons cannot be accurately shown in most models.
  - Electrons do not move in nice circular orbits around the nucleus, but that is how most models have to show them, because they can't show the electron movement.



Electron motion video clip

PROBLEMS WITH USING A MODEL ATOM

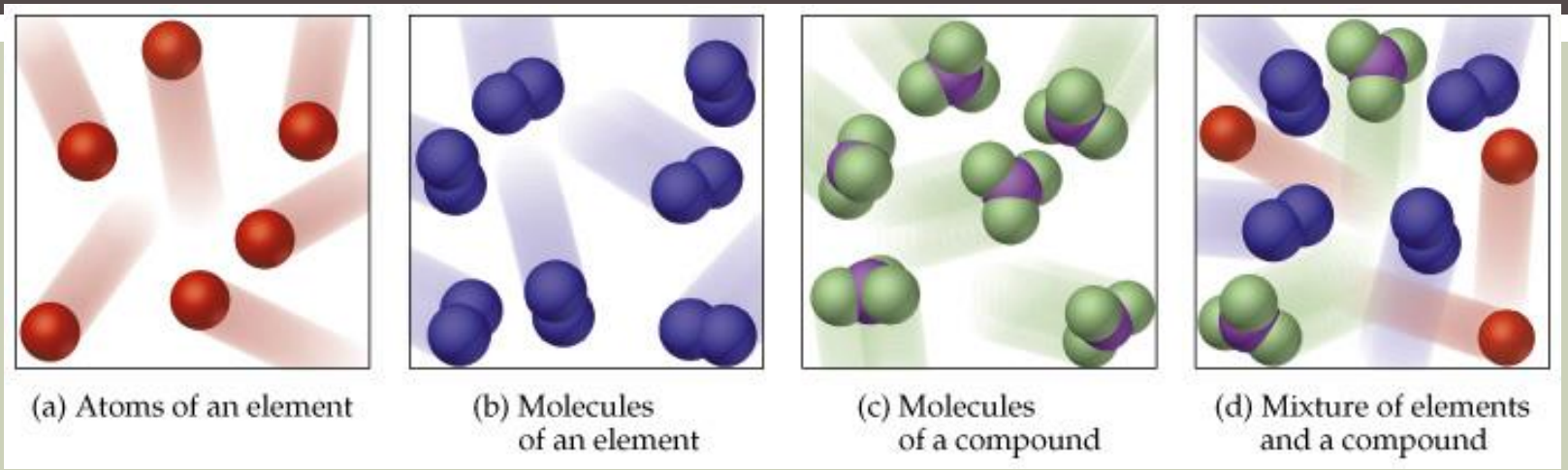
- The size proportion of each atom sub-particle cannot be accurately displayed in models of the atom.

WHY ARE MODELS USEFUL?

FUTURE MODELS

- Our current model of the atom will probably change as we learn more, experiment more, and build on the knowledge of those who came before.

SO HOW DOES IT ALL WORK?



Atoms build molecules. Molecules build compounds.
For example:

•Carbon (C) , Hydrogen (H) and Oxygen (atoms) build sugar molecules ($C_6H_{12}O_6$)

•Oxygen atoms (O) build Oxygen gas molecules (O_2)

•Sodium atoms (Na) and Chlorine atoms (Cl) build salt molecules (NaCl)

SO HOW DOES IT ALL WORK?

- Let's add to our knowledge of the levels of organization.
- Summary:

Protons + Neutrons + Electrons = Atoms