

# Chapter 4

## Atomic Structure

# Warm – Up

We have not yet discussed this material, but what do you know already??

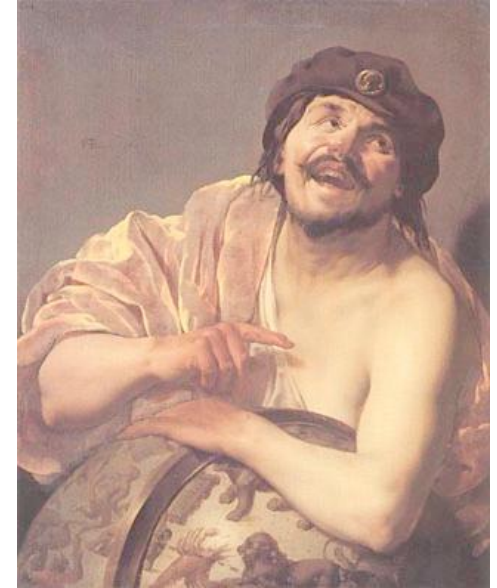
- What is an atom?
- What are electron, neutrons, and protons?
- Draw a picture of an atom from what you know today.

# History of the Atom

- 1. Democritus vs. Aristotle pg. 102-103
- 2. **John Dalton** and conservation of mass pg. 104-105
- 3. Cathode ray tube and Sir William Crookes pg. 107-108
- 4. Mass and charge of electron (J.J. Thompson) and oil drop experiment pg. 108-109
- 5. Plum pudding model vs. Rutherford's experiment pg. 110-112

# Democritus

- Greek philosopher who asked questions about matter.
  - Can you divide matter infinitely?
    - Democritus says no!
  - Tiny particles called atoms, indivisible!
- Matter is composed of atoms, which move through empty space.
- Atoms are solid homogeneous, indestructible, and indivisible.
- Atoms have different sizes and shapes. These properties, and movement determine properties of matter



# John Dalton



- Matter is composed of small particles called atoms that are indivisible and indestructible.
- Atoms of a given element are identical in size, mass, and chemical properties, and are different from those of another element.
- Different atoms combine in simple whole number ratios to form compounds.
- In a chemical reaction, atoms are separated, combined or rearranged.

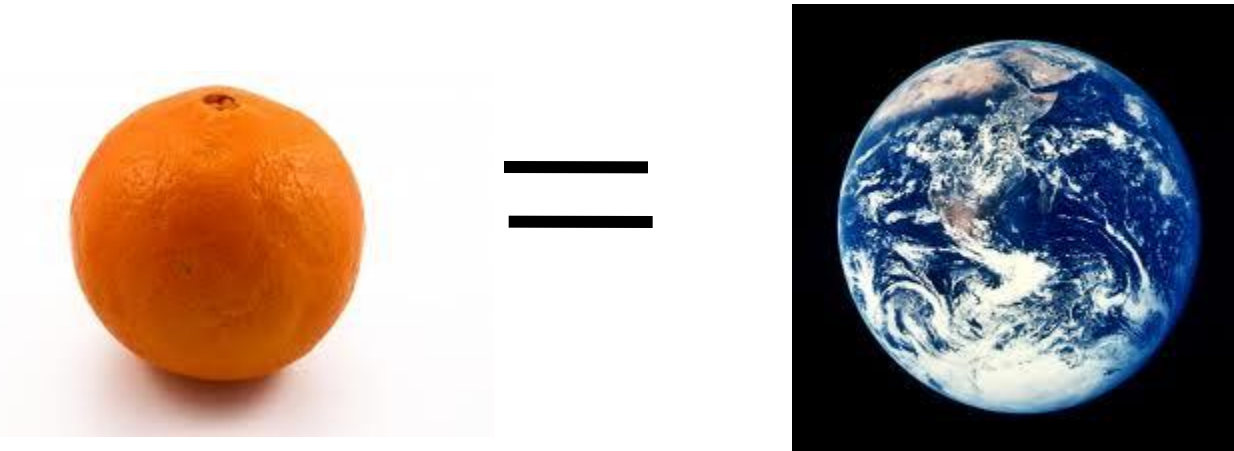
# Dalton's Inaccuracies

- Atoms are not the smallest type of matter!
  - Subatomic particles – **electrons**, **protons**, and **neutrons**
- Atoms of the same element can have slightly different masses! - **isotopes**



# The Atom

- EXTREMELY small particle of an element that retains the properties of that element is an atom.
- If atom is the size of an orange, an orange would be the size of the EARTH

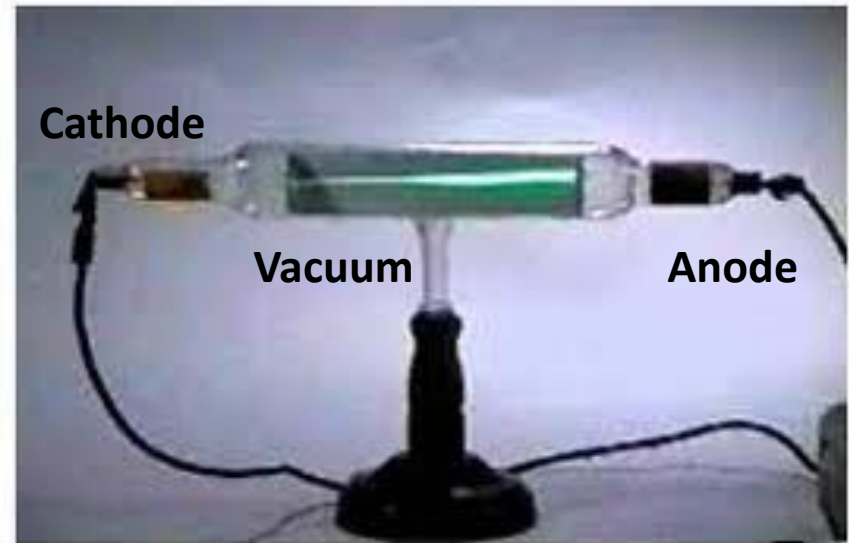


# Subatomic Particles - Electron

- Cathode Ray Tube

Thin beam of electrons travels from cathode to anode!

Cathode rays are a stream of charged particles. Particles carry a negative charge...now called electrons!





# J.J. Thompson

- Determined that the mass of the charged particle (electron) was much less than that of the hydrogen atom.
  - Dalton was **WRONG** about the atom being the smallest particle!

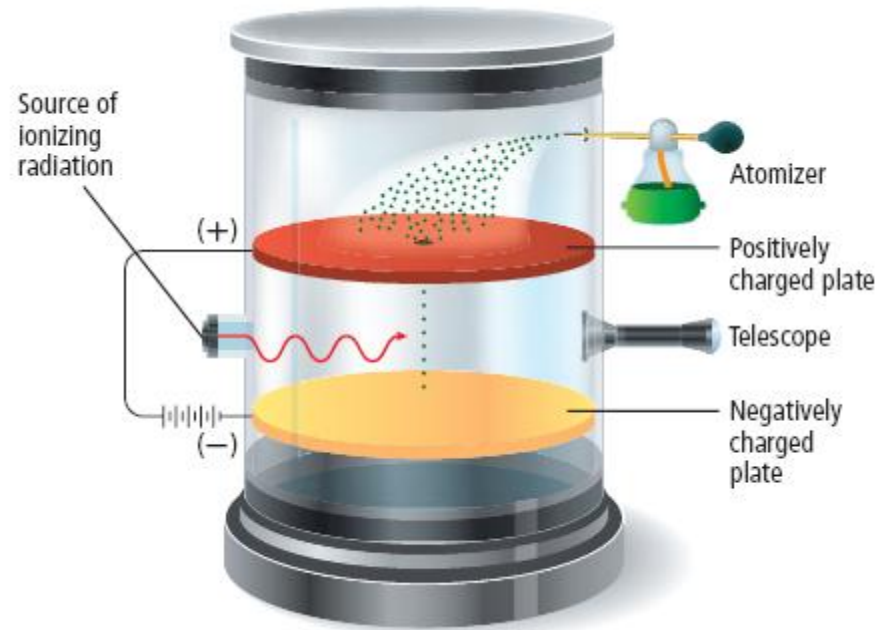


# Millikan Oil-Drop Experiment

- Determined the charge of an electron.

Charge up the oil particles with electrons.

Change the electric field changes the rate of oil droplets!

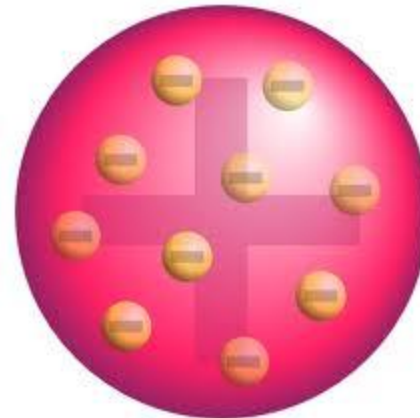


Charge of electron  $1.602 \times 10^{-19}$  coulombs

Mass of electron =  $9.1 \times 10^{-28}$  grams

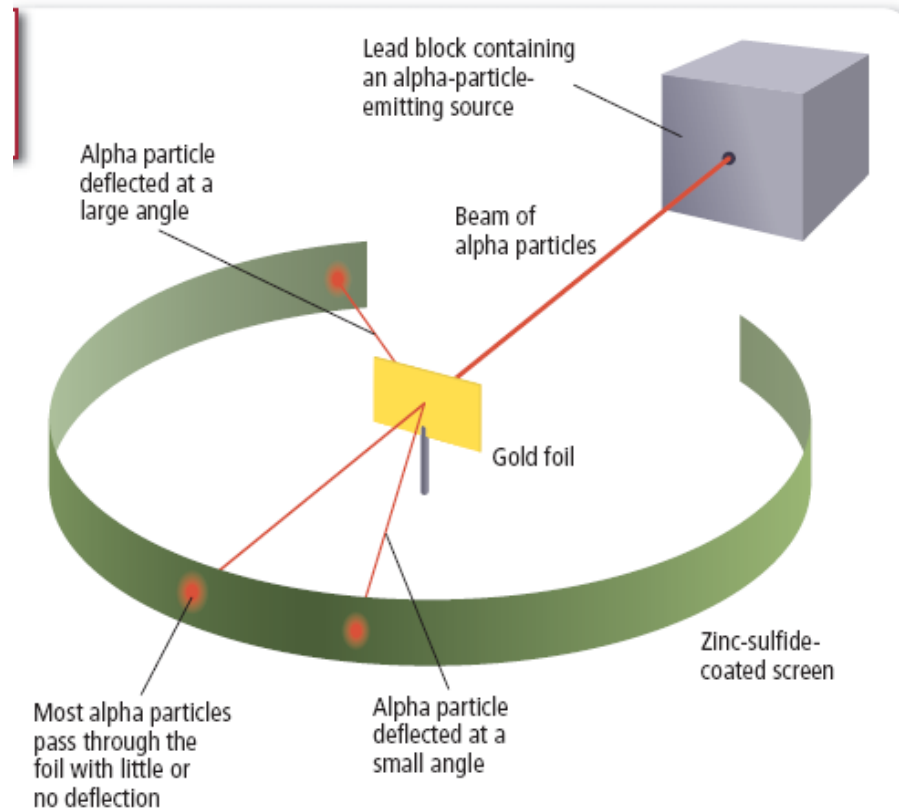
# Plum Pudding Model

- Matter isn't all negatively charged, so how do we have negatively charged subatomic particles without positively charged ones??
- **J.J. Thompson** thought an atom was a positively charged sphere with electrons hanging out within.



# Rutherford and the Nucleus

- Experiment proved that plum pudding model was incorrect!
- Atom is mostly empty space through which  $e^-$  can move. Almost all of the **positive charge** and atomic mass resides in the center – **NUCLEUS!**



Nucleus is positively charged to deflect alpha particles and to balance electron charge.

# Subatomic Particles

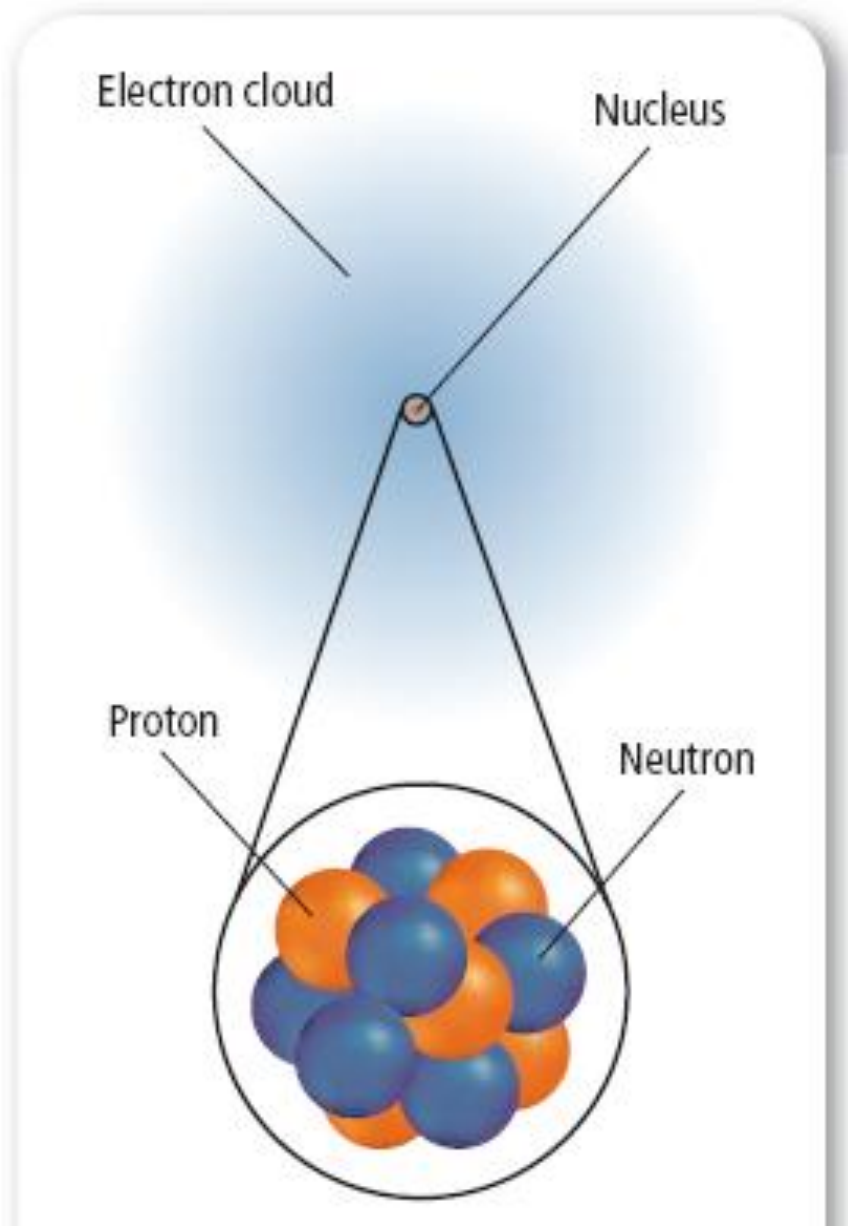
- Electron – VERY tiny, negatively charged
- Proton – located in the nucleus, charge opposite of an electron (positive!)
- Neutron – located in the nucleus, same mass as a proton, neutral!

# Warm – Up!

- What experiment determined the mass and charge of an electron?
- Dalton concluded that the atom was the smallest particle of matter. Was he correct?
- What did the gold foil experiment prove?

# Atomic Theory Today

- Quantum Mechanical Model
- All atoms are made up of electrons, protons, and neutrons. Electrons are located outside of the nucleus, protons and neutrons are located inside the nucleus.
- Electrons exist in a cloud surrounding the nucleus. Attracted to the nucleus so they hang around!
- Nucleus accounts for 99.97% of the atomic mass, and occupies a VERY small volume.
- A neutral atom has the same number of electrons and protons!



# Current Atomic Model

Neutral atom:

# Protons = # Electrons



# Make sure you can answer...

- What are John Dalton's 4 theorems
- How does John Dalton's theory relate to conservation of mass?
- How was the electron discovered?
- Who discovered the mass of an  $e^-$ ? HOW?
- What was Rutherford's contribution?
- Describe the structure of the atom.