Radioactivity

- One of the pieces of evidence for the fact that atoms are made of smaller particles came from the work of Marie Curie (1876-1934).
- She discovered radioactivity, the spontaneous disintegration of some elements into smaller pieces.

Atomic Composition

- **Protons**
  - + electrical charge
  - mass \( \approx 1.672623 \times 10^{-24} \) g
  - relative mass = 1.007 atomic mass units (amu)

- **Electrons**
  - negative electrical charge
  - relative mass = 0.0005 amu

- **Neutrons**
  - no electrical charge
  - mass = 1.009 amu

ATOM COMPOSITION

The atom is mostly empty space
- protons and neutrons in the nucleus.
- the number of electrons is equal to the number of protons.
- electrons in space around the nucleus.
- extremely small. One teaspoon of water has 3 times as many atoms as the Atlantic Ocean has teaspoons of water.

The modern view of the atom was developed by Ernest Rutherford (1871-1937).

Ernest Rutherford

Canterbury University in Christchurch, NZ

Rutherford birthplace, Nelson, NZ
The modern view of the atom was developed by Ernest Rutherford (1871-1937).

**Atomic Number, Z**

All atoms of the same element have the same number of protons in the nucleus, Z.

**Mass Number, A**
- C atom with 6 protons and 6 neutrons is the mass standard
- A = 12 atomic mass units
- Mass Number = # protons + # neutrons
- A boron atom can have
  - \(A = 5\) p + 5 n = 10 amu

**Isotopes**
- Atoms of the same element (same Z) but different mass number (A).
- Boron-10 (\(^{10}\text{B}\)) has 5 p and 5 n
- Boron-11 (\(^{11}\text{B}\)) has 5 p and 6 n

**Boron in Death Valley**

\[\begin{array}{c}
A = 10 \\
Z = 5 \\
\text{B}
\end{array}\]
Because of the existence of isotopes, the mass of a collection of atoms has an average value. Average mass = ATOMIC WEIGHT

Boron is 20% $^{10}\text{B}$ and 80% $^{11}\text{B}$. That is, $^{11}\text{B}$ is 80 percent abundant on earth.

For boron atomic weight

\[ 0.20 \times (10 \text{ amu}) + 0.80 \times (11 \text{ amu}) = 10.8 \text{ amu} \]

Dmitri Mendeleev developed the modern periodic table. Argued that element properties are periodic functions of their atomic weights.

We now know that element properties are periodic functions of their ATOMIC NUMBERS.

See CD-ROM, Screen 2.16.
Group 2A: Alkaline Earth Metals
Mg, MgO

Group 3A: B, Al, Ga, In, Tl
Al, BF₃ & BL₃

Group 4A: C, Si, Ge, Sn, Pb
Diamond, SiO₂

Group 5A: N, P, As, Sb, Bi
Ammonia, NH₃

White and red phosphorus

From the Comic Book Periodic Table
from http://cnst.rice.edu/images
Group 6A: O, S, Se, Te, Po
Shuttle main engines use H₂ and O₂
Sulfur

Group 7A: F, Cl, Br, I, At

Group 8A: He, Ne, Ar, Kr, Xe, Rn
• Lighter than air balloons
• “Neon” signs

Transition Elements
Lanthanides and actinides
Iron in air gives iron(III) oxide

From the Comic Book Periodic Table