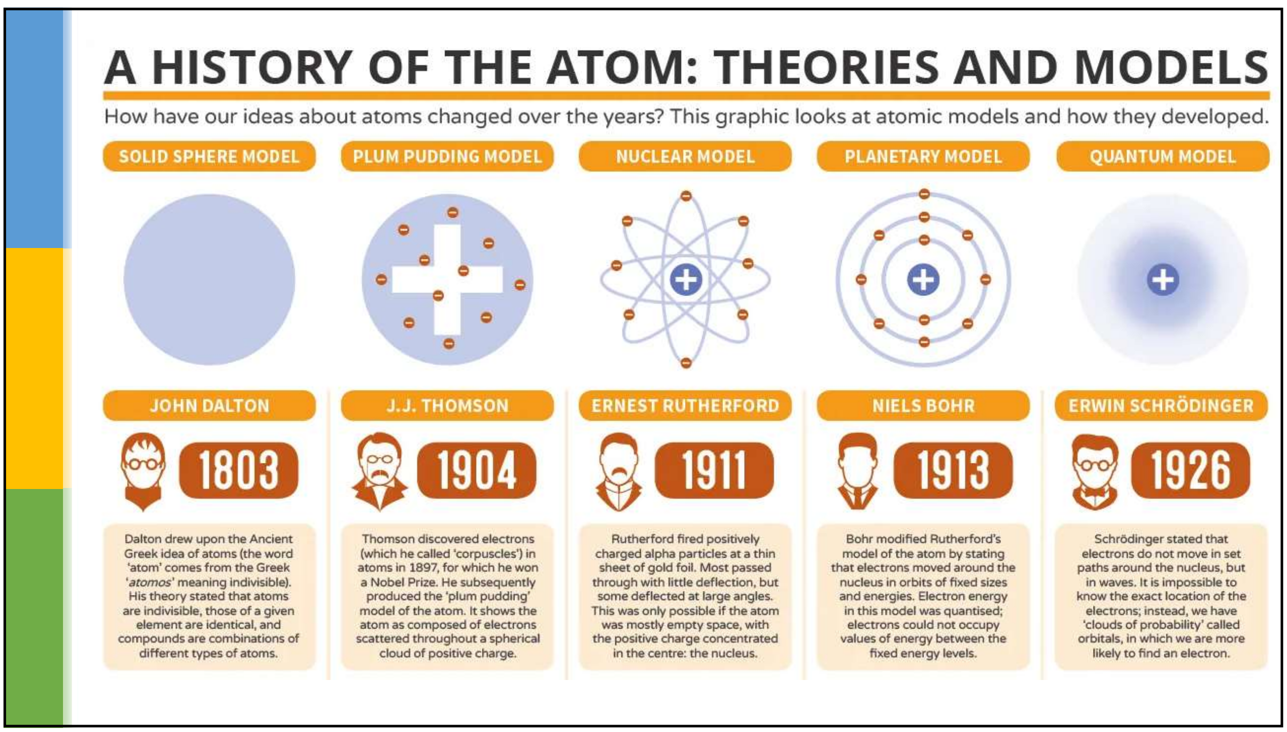
4. ATOMIC STRUCTURE

CH30S UNIT 1 – ELEMENTS & COMPOUNDS

1



2

THE ATOMIC MODEL

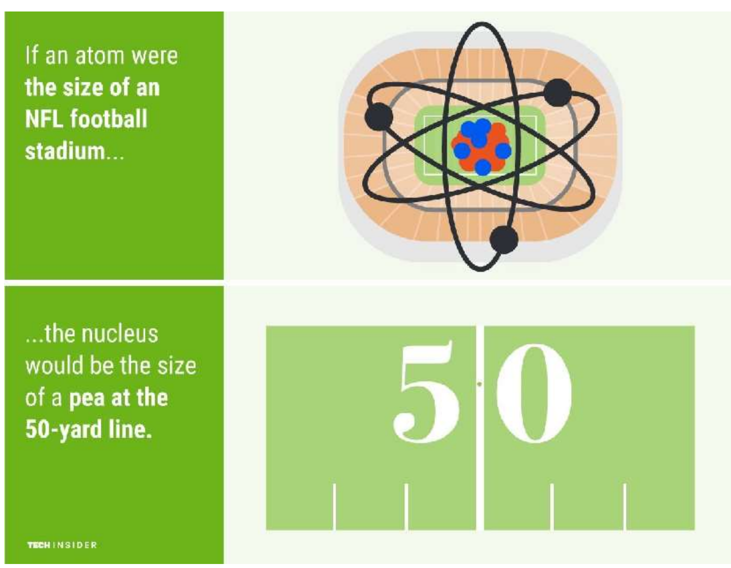
The most common model of the atom is like a mini solar system. While this is not truly accurate, it works for now!

THE <u>MASS</u> OF THE ATOM IS DUE TO THE SIZE OF THE NUCLEUS.

THE <u>SIZE</u> OF THE ATOM IS DUE TO THE NUMBER OF ELECTRONS.

3

PUTTING IN TO PERSPECTIVE



4

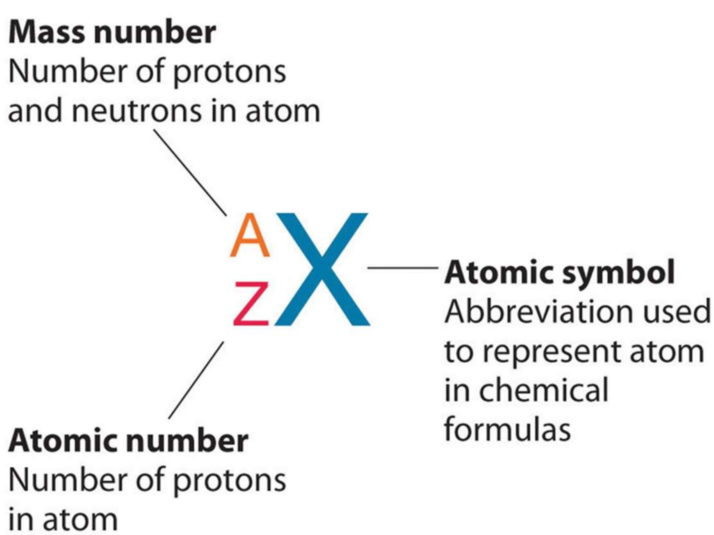
WHAT MAKES UP AN ATOM?

Most people already know that the atom is made up of three main parts, the protons and neutrons in the **nucleus** and the electrons somewhere outside of the **nucleus**.

	PROTONS	NEUTRONS	ELECTRONS
SYMBOL			
CHARGE			
LOCATION			

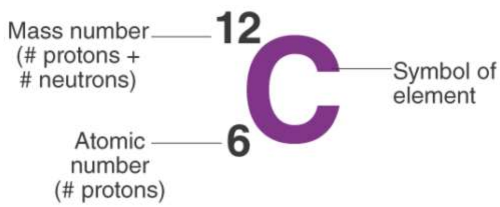
5

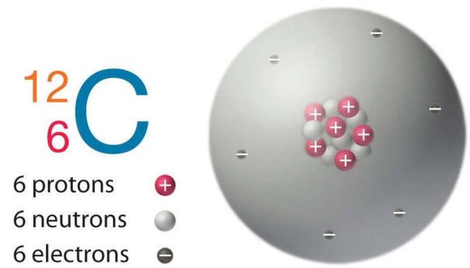
ATOMIC NOTATION



6

ATOMIC NOTATION





CARBON - 12

7

ATOMIC NUMBER (Z)

The proton is the particle that determines the identity of the element.

The atomic number of an element is the number of protons found in the nucleus of the atom.

ATOMIC NUMBER (Z)	NUMBER OF PROTONS	IDENTITY OF ELEMENT
23		
92		
		Chlorine
		Magnesium

8

ATOMIC NUMBER (Z)

Atoms (as opposed to ions) are electrically neutral, meaning they have one electron for every proton.

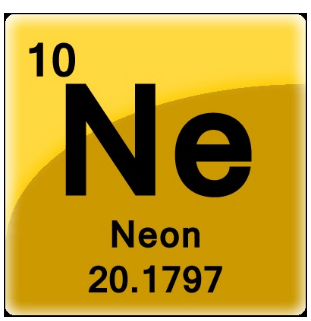
ELEMENT	NUMBER OF PROTONS	NUMBER OF ELECTRONS
sodium		
potassium		
sulphur		
bromine		

9

MASS NUMBER (A)

The mass of an atom is found in its nucleus.

The mass number of an atom is the sum of its protons and neutrons.



Determining Neutrons:

10

EXAMPLE #1

Determine the number of protons, electrons, and neutrons in:

a) ^{210}Pb

b) ^{34}S

11

IONS

Chemical changes involve the gaining or losing of electrons only.

Ions are atoms (or groups of atoms) that have gained or lost electrons during a reaction to become electrically charged.

$^{24}_{12}Mg^{2+}$

Magnesium Cation
Lost 2 electrons

$^{31}_{15}P^{3-}$

Phosphide Anion
Gained 3 electrons

12

EXAMPLE #2

Determine the number of protons, neutrons, and electrons present in the following substances:

$^{207}_{82}Pb$ $^{209}_{82}Pb$ $^{207}_{82}Pb^{2+}$

13

YOUR TURN!

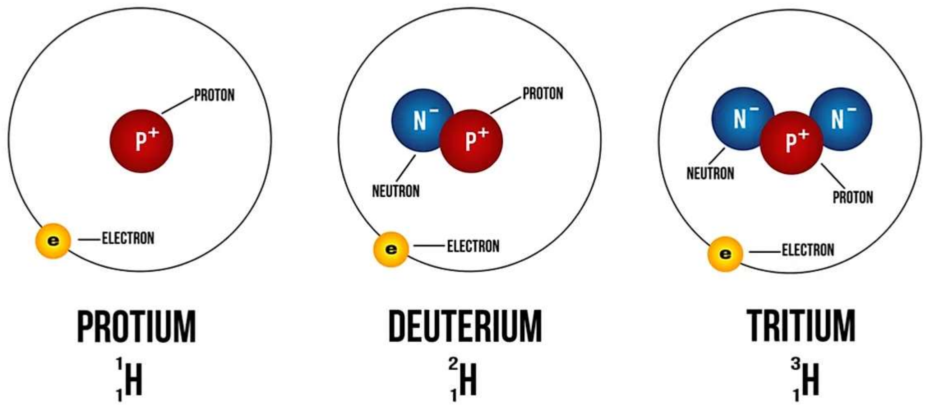
NASA has just discovered a delicious new element on Mars that smells and tastes like lunch meat. The have called it Bolognium (Bo). Determine the number of protons (p^+), neutrons (n^0) and electrons (e^-) in the following atomic notation of Bolognium.

$^{293}_{115}Bo$ $^{296}_{115}Bo$ $^{294}_{115}Bo^{2-}$

14

ISOTOPES

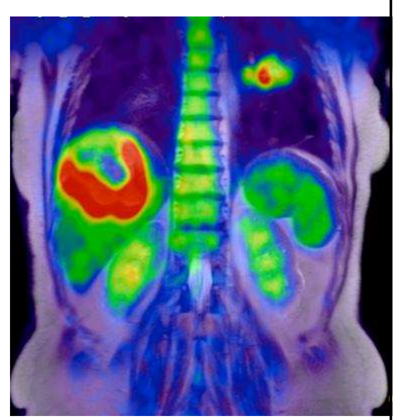
Isotopes are atoms of the same element having different masses due to **varying numbers of neutrons.**



15

COMMON MEDICAL ISOTOPES

Radioactive Isotope	Applications in Medicine
Cobalt-60	Radiation therapy to prevent cancer
Iodine-131	Locate brain tumors, monitor cardiac, liver and thyroid activity
Carbon-14	Study metabolism changes for patients with diabetes, gout and anemia
Carbon-11	Tagged onto glucose to monitor organs during a PET scan
Sodium-24	Study blood circulation
Thallium-201	Determine damage in heart tissue, detection of tumors



17

AVERAGE ATOMIC MASS

- The average mass of all the naturally occurring isotopes of that element.
- This explains why atomic masses on your periodic table are decimals and not whole numbers, as you might expect.

Isotope	Symbol	Composition of the nucleus	% in nature
Carbon-12	^{12}C	6 protons 6 neutrons	98.89%
Carbon-13	^{13}C	6 protons 7 neutrons	1.11%
Carbon-14	^{14}C	6 protons 8 neutrons	<0.01%

19

19

EXAMPLE # 3

Use the mass spectrometry data below to calculate the average atomic mass of iron.

Table 2. Stable Isotopes of Iron

Isotope	Mass (amu)	% Abundance
^{54}Fe	53.94	5.845
^{56}Fe	55.93	91.75
^{57}Fe	56.94	2.119

20

YOUR TURN

Use the mass spectrometry data below to calculate the average atomic mass of neon.

Strontium		
Isotope	Mass (amu)	Abundance
Sr-84	83.913428	0.56%
Sr-86	85.909273	9.86%
Sr-87	86.908902	7.00%
Sr-88	87.905625	82.58%

21