

Unit 3

- **Law of conservation of mass**
- **Law of definite proportion**
- **Atomic Structure**
- **Isotopes**

Competencies

The student will be able to:

- write the name of an element up to atomic number 36, given the correct symbol or vice versa
- state the number of atoms of each element in a molecule of a compound, given its formula.
- **state Dalton's Atomic Theory; describe the ways in which it is supported and rejected by modern models; state Thomson's, Rutherford-Bohr atomic model**
- describe the structure of an atom and name the three major subatomic particles in an atom, and give their charges and relative masses.
- define atomic number and mass number.
- identify the element and state the number of electrons, protons and neutrons in an atom of the element, given its atomic number and mass number.
- define the terms ion, anion, and cation.
- **state the number of electrons, protons, and neutrons in an ion, given the charge on an ion and its mass number.**
- **explain how two isotopes of a single element differ in their structure.**
- compute the average atomic mass given the percentage and the mass of constituent stable isotopes.

Laws

Law of conservation of mass:

Mass is neither created nor destroyed in a chemical reaction.

Law of definite proportion:

A specific compound always contains the same proportion of elements by mass.

Tools:

2 2

N

4 6

H

1 N₂ + 2 H₂ → 2 NH₃

Make Ammonia Separate Water Combust Methane

Balancing Chemical Equations

Phet Simulation: http://phet.colorado.edu/sims/html/balancing-chemical-equations/latest/balancing-chemical-equations_en.html

Elements

Element: One type of atom that can not be broken down by chemical means.

Name: Planets, mythological figures, colours, scientists ...

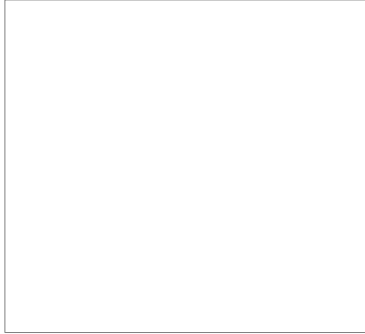
Symbol: Consists of 1 or 2 letter. Starts with capital letter.

Examples:

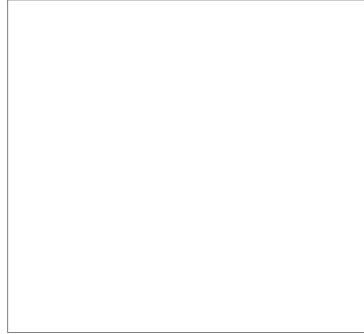
→ Memorize the names and symbols of the first 36 elements in the periodic table

Atomic Models

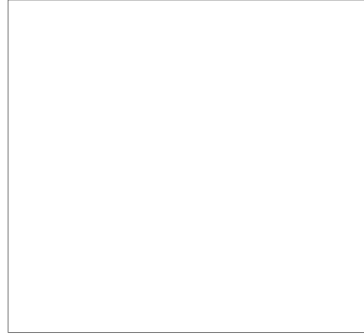
Dalton:



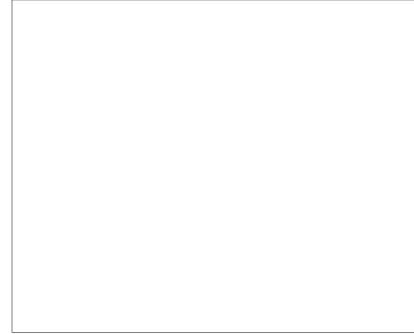
Thomson:



Rutherford:



Rutherford-Bohr-Chadwick :



The screenshot shows the Phet Simulation 'Hydrogen Atom' interface. On the left, a vertical menu lists atomic models: Billiard Ball, Plum Pudding, Classical Solar System, Bohr, deBroglie, and Schrödinger. The Bohr model is currently selected. A central window displays a Bohr model of a hydrogen atom with a central nucleus (red and blue spheres) and concentric electron shells (dotted lines). A legend identifies the particles: electron (blue dot), proton (red dot), and neutron (grey dot). Below the Bohr model, a 'Spectrometer' window shows a line spectrum with discrete colored lines (violet, blue, green, yellow, red) against a dark background. The x-axis is labeled 'nm' and ranges from 92 to 7500. At the bottom, there are controls for 'Light controls' (White and Monochromatic) and a speed slider (slow to fast) with play/pause buttons.

Phet Simulation: <https://phet.colorado.edu/en/simulation/hydrogen-atom>

Atomic Models

Simplified model used in this class :



Nucleus: Protons p^+ (+, 1u)
 Neutrons n^0 (no charge, 1u)

Electrons e^- (-, 0.0006 u):
 Lowest shell: 2
 2nd shell : 8
 3rd shell: 16*

Shells fill up from lowest to highest. However, when the 3rd shell contains 8 electrons, the 4th shell starts filling up before completing the 3rd.

Information from the periodic table:

Period (Line):	Number of electron shells
Atomic number (on top):	Number of protons and electrons
Group (Column):	Number of Valence electrons (electrons in the outermost shell)

Atomic Models

Protons: ●●
Neutrons: ●●
Electrons: ●●

Neutral Atom

Helium

Model:
● Orbits
○ Cloud

Protons Neutrons Electrons

Element

H	He																	Ne
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	
Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At						

Net Charge

Mass Number

4

Show

Element Name
 Neutral/Ion
 Stable/Unstable

Build an Atom

Atom Symbol Game

PhET

Phet Simulation : <https://phet.colorado.edu/en/simulation/build-an-atom>

Information from the periodic table:

Period (Line):

Number of electron shells

Atomic number (on top):

Number of protons and electrons

Group (Column):

Number of Valence electrons (electrons in the outermost shell)

→ Do Unit III – Problem 7-8

Isotopes

Isotopes: Atoms of the same element with different mass. (Different number of neutrons)

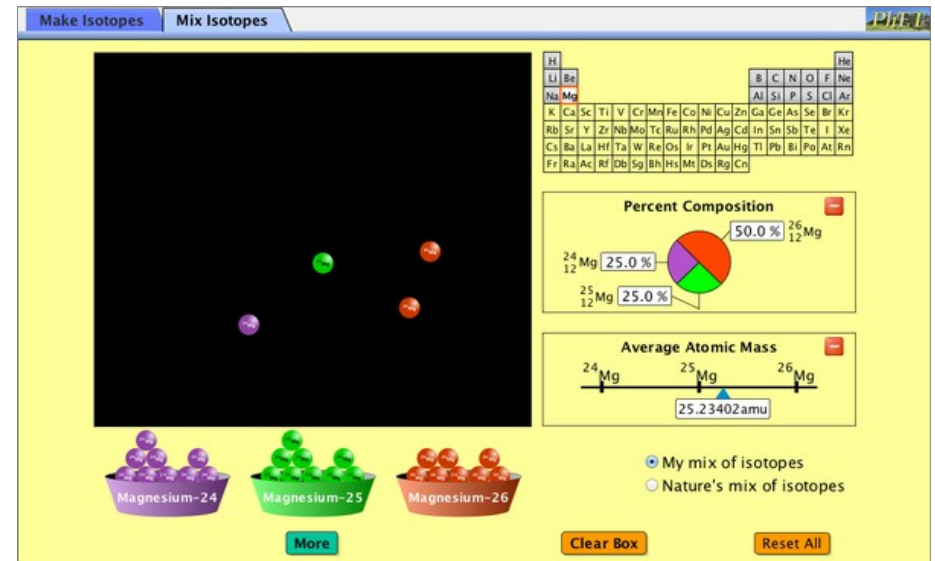


X : Symbol of the element

A : Atomic Number = Number of protons

M : Mass number = Protons + Neutrons

Examples:



Phet Simulation: <https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass>

→ Do Unit III – Problem 8-13

Charge

Net Charge : Number of protons – Number of electrons

Ion: Atom (or compound) with a net charge $\neq 0$

Anion: Negative net charge

Cation: Positive net charge

Review

Clicker Review Activity : Sec 4 – Atoms

<http://b.socrative.com>



STUDENT	TEACHER
<input type="text" value="Room Name"/>	<input type="text" value="Email Address"/>
<input type="button" value="JOIN ROOM"/>	<input type="text" value="Password"/>
	<input type="button" value="SIGN IN"/>
	<p>or</p>
	<input type="button" value="g+ Sign in with Google"/>
	<p>Forgot your password? • Get a FREE account</p>

Additional Resources

- Atoms, Molecules and Ions in „College Chemistry“
<http://cnx.org/contents/havxkyvS@9.110:zjMNbCdh@4/Introduction>