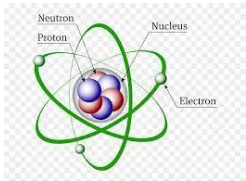




Slide 1

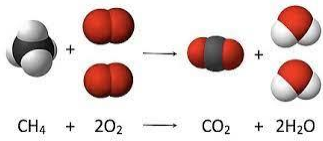
SCIENCE

PARTICLE PHYSICS

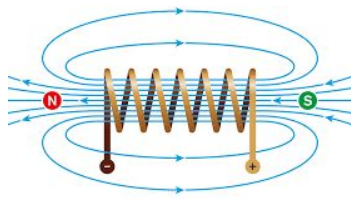
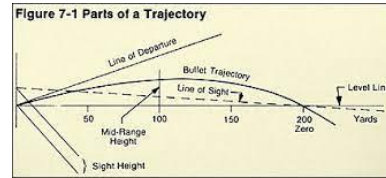


	mass = 1.67 × 10 <sup>-27</sup> kg charge = +1.6 × 10 <sup>-19</sup> C	mass = 1.67 × 10 <sup>-27</sup> kg charge = 0	mass = 9.11 × 10 <sup>-31</sup> kg charge = -1.6 × 10 <sup>-19</sup> C	mass = 1.67 × 10 <sup>-27</sup> kg charge = 0	mass = 1.67 × 10 <sup>-27</sup> kg charge = 0
	<b>u</b> up	<b>c</b> charm	<b>t</b> top	<b>g</b> gluon	<b>H</b> Higgs boson
<b>QUARKS</b>	<b>d</b> down	<b>s</b> strange	<b>b</b> bottom	<b>γ</b> photon	
	mass = 9.11 × 10 <sup>-31</sup> kg charge = -1.6 × 10 <sup>-19</sup> C	mass = 1.88 × 10 <sup>-28</sup> kg charge = -1.6 × 10 <sup>-19</sup> C	mass = 1.77 × 10 <sup>-27</sup> kg charge = -1.6 × 10 <sup>-19</sup> C	mass = 0.125 GeV/c <sup>2</sup> charge = 0	mass = 0.125 GeV/c <sup>2</sup> charge = 0
	<b>e</b> electron	<b>μ</b> muon	<b>τ</b> tau	<b>Z</b> Z boson	
<b>LEPTONS</b>	mass = 9.11 × 10 <sup>-31</sup> kg charge = 0	mass = 1.88 × 10 <sup>-28</sup> kg charge = 0	mass = 1.77 × 10 <sup>-27</sup> kg charge = 0	mass = 80.4 GeV/c <sup>2</sup> charge = 0	mass = 80.4 GeV/c <sup>2</sup> charge = 0
	<b>ν<sub>e</sub></b> electron neutrino	<b>ν<sub>μ</sub></b> muon neutrino	<b>ν<sub>τ</sub></b> tau neutrino	<b>W</b> W boson	
				mass = 80.4 GeV/c <sup>2</sup> charge = ±1.6 × 10 <sup>-19</sup> C	
				<b>Gauge Bosons</b>	

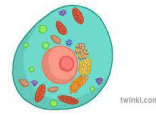
CHEMISTRY



PHYSICS

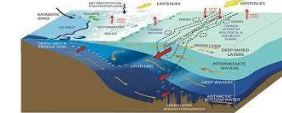
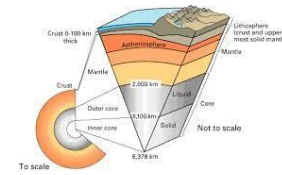


BIOLOGY



GEOLOGY

OCEANOGRAPHY



ASTROPHYSICS

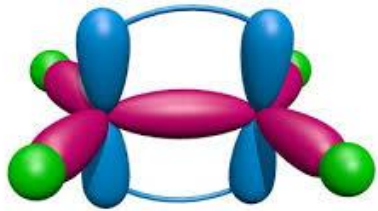


SCIENCE

PHYSICS

CHEMISTRY

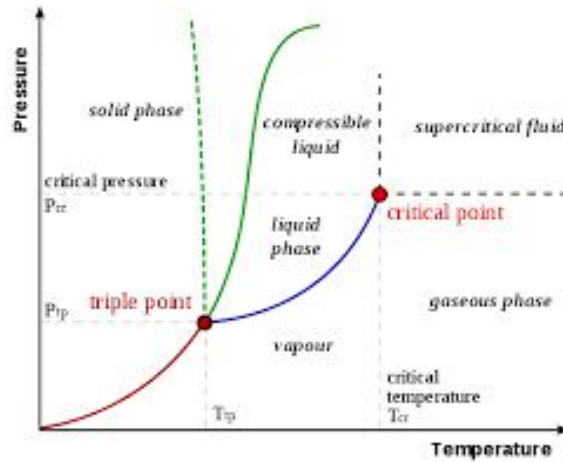
BIOLOGY



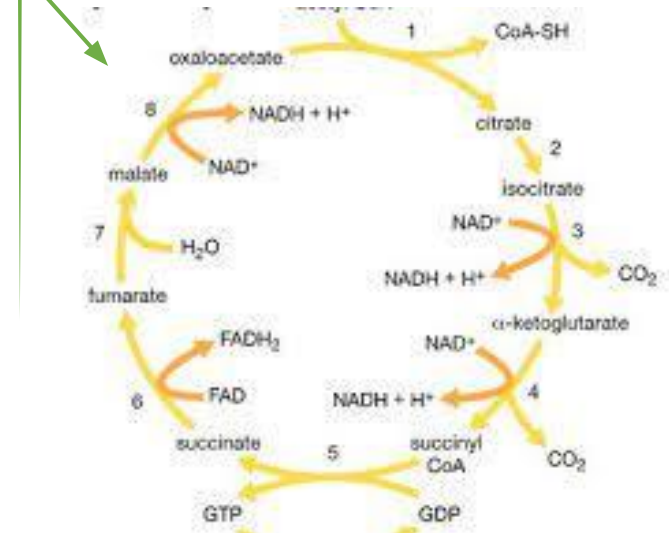
shutterstock.com · 1518457421

PHYSICAL CHEMISTRY

- BONDS
- RXN MECHANISM



THERMODYNAMICS

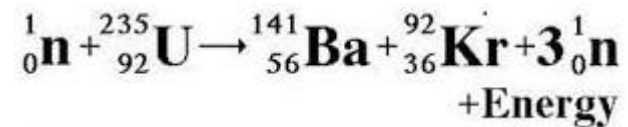


- Study of how new substance(s) is/are formed from old substance(s)
- A substance is something that is made up of two or more atoms.
- A substance is a molecule.

Examples of chemical change:

- Iron rusting
- Wood burning
- Food metabolizing

- Compare to physical change
  - Classical physics
    - Bonds are not being made or broken
    - No new substance is formed
    - Ice  $\Rightarrow$  Water  $\Rightarrow$  Steam
  - Nuclear physics
    - Bonds are not being made or broken
    - New elements are formed



New substances are made by:

- Breaking old bonds
- and/or
- Making bonds

Slide 6

New bonds are made by sharing or exchanging electrons.

Old bonds are broken by separating electrons in a bond.

Therefore:

Making and breaking bonds requires keeping track of electrons.

Chemistry is the science of following **electrons**.

Nuclei are NOT engaged.

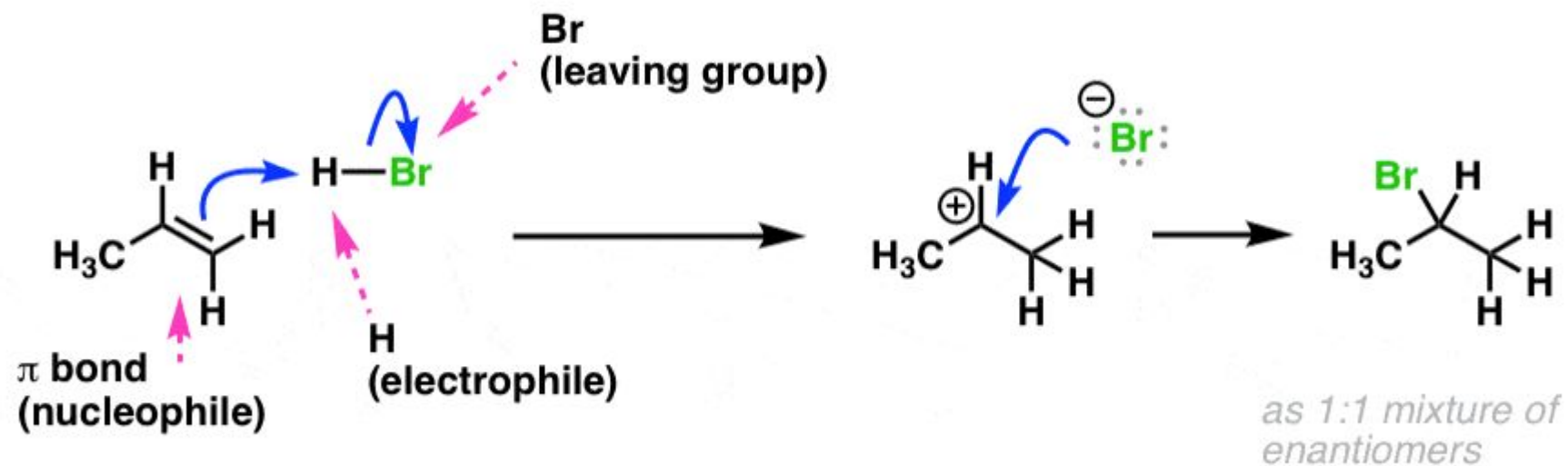
Nuclei consist of protons and neutrons.

**Protons** tell a chemist how many electrons a neutral atom has, and whether the atom has a charge because it is missing electron(s) or has additional electron(s).

**Neutrons** help a chemist calculate the molecular weight of a substance.



In "stepwise" alkene addition mechanisms, the arrows clearly show the role of each component in the reaction



Slide 9

LUMO (Lowest Unoccupied Molecular Orbital)

HOMO (Highest Occupied Molecular Orbital)

