

# What in the world isn't Chemistry??



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**Chemistry** is the branch of science that studies the composition and properties of matter and the changes that matter undergoes



# Elements are the fundamental substances of chemistry and are composed of atoms.

~118 different elements have been identified, eg. hydrogen, phosphorus, oxygen, nitrogen, sulfur, helium, carbon, calcium, iron, sodium, chlorine.

Elements cannot be decomposed or converted to simpler substances or other elements by any common form of energy, eg. heat, light, electricity, sound, magnetism.

Only neutron bombardment can induce fission of some nuclei (ie  $^{236}\text{U}$ ) causing decay to other elements and release of energy.

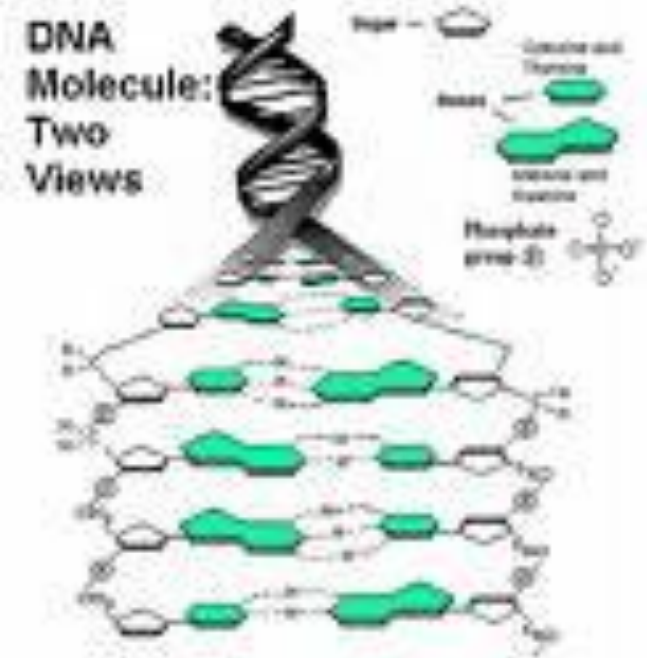
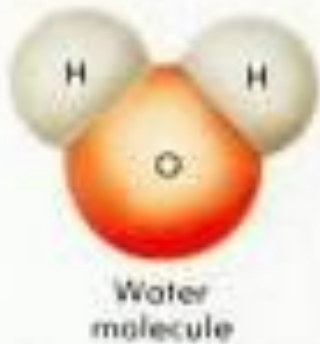
**An atom is the smallest particle of an element that can be identified as that element.**

Atoms, once thought to be the ultimate indivisible particles that make up all matter, are among the fundamental particles of the science of chemistry

John Dalton (1776-1844) (UK) proposed that all matter was composed of atoms-he was correct!



A **compound** is a pure substance formed by the chemical combination of two or more different elements in a specific ratio.



**Molecules** are groups of two or more atoms held together by the forces of chemical bonds.  $H_2$  and  $O_2$  are molecules but not compounds.

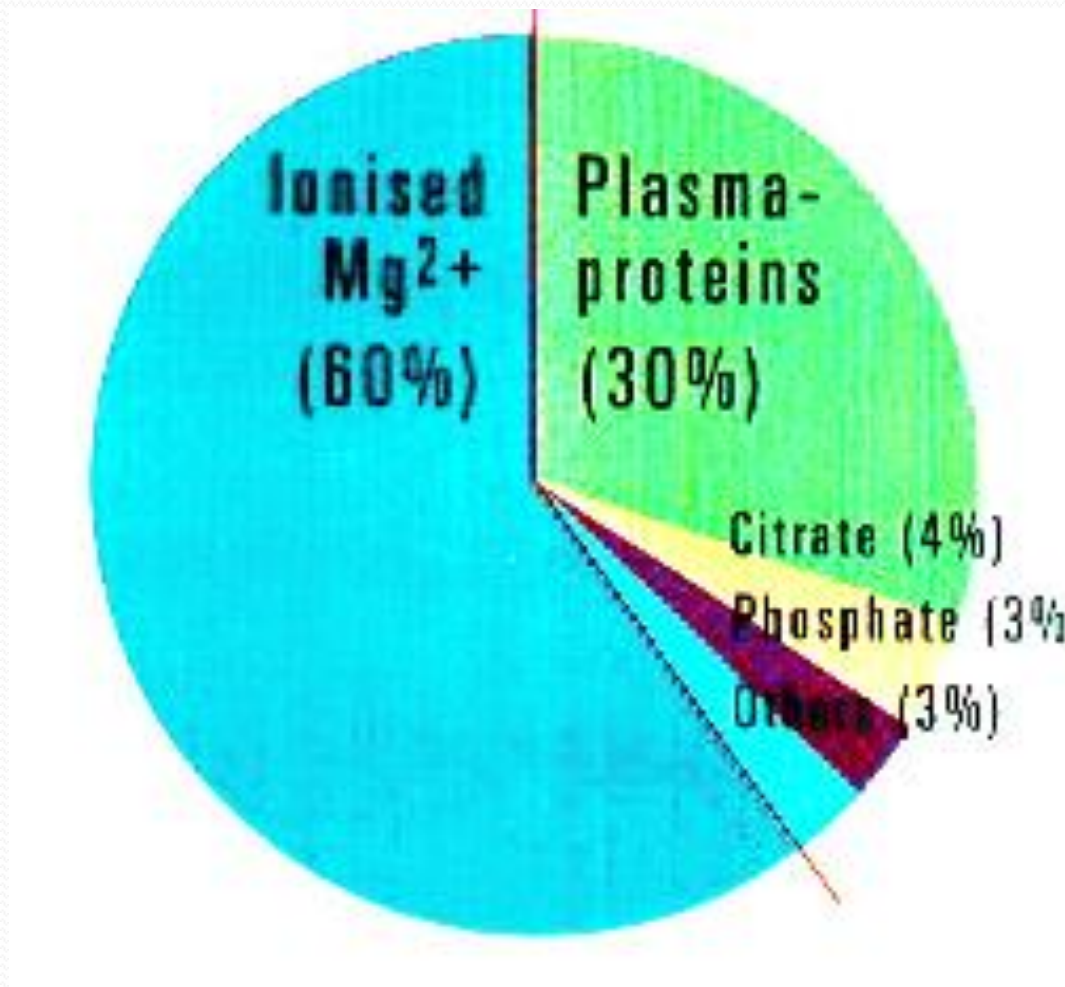
An **ion** is an atom or group of atoms that carries an electrical charge.

An **anion** is a negatively charged ion.

A **cation** is a positively charged ion.

**Electrolytes are substances that conduct electricity when dissolved in water, or when melted if they don't dissolve. Those that don't are nonelectrolytes.**

# Electrolytes in Human Cells



## What are we made of?

- On average, about 60% Water by weight, hence O and H are major components
- Muscles and fat also contain C and N
- Thus H, O, C and N make up over 95% of our weight!
- In terms of # of atoms, much higher % H
- As we age, we lose water



# Other Elements in the Human Body

<u>Element</u>	<u>~gms/ 70kg</u>	<u>Where</u>	<u>Dietary Source</u>
Calcium	1500	bones & teeth	milk products
Chlorine	105	all cells& stomach	table salt
Cobalt	trace	vitamin B <sub>12</sub>	meat, fish, milk
Copper	trace	in many enzymes	nuts, shellfish
Iodine	trace	thyroid	seafood
Iron	2	hemoglobin	beef, fruits
Magnesium	22	in all cells + bones	green veggies
Phosphorus	800	in ATP & bones	meat, eggs
Potassium	220	intracellular cation	'everywhere'
Sodium	70	extracellular cation	table salt
Zinc	trace	many enzymes	seafood, meat

## Nature of these elements

- Many present as ions or in combination with others.
- Chlorine is present as  $\text{Cl}^-$  (chloride ion).
- Phosphorus is in phosphate ion  $(\text{PO}_4)^{-3}$ .
- Sodium & Potassium present as  $\text{Na}^+$  and  $\text{K}^+$ .
- 2009 “sodium kills” campaign-  $\text{NaCl}$  and blood pressure
- Iodine present as  $\text{I}^-$  (iodide ion).
- Calcium present as  $\text{Ca}^{+2}$ , often in  $\text{Ca}_3(\text{PO}_4)_2$ . Calcium phosphate in teeth and bones.

## Trace Elements in the Body (a few of many)

- Selenium : Se-in selenoproteins, acts as a peroxide scavenger. Hence “anti-aging” effects (at the proper level). Toxic at higher levels
- Manganese: Mn-in metalloenzymes such as pyruvate carboxylase
- Molybdenum: Mo-in xanthine oxidase, also a metalloenzyme
- “ase” suffix denotes an enzyme-physiological catalyst

# So we are full of Chemicals!!

- The 10 most abundant elements in the Earth's crust are:
  - Oxygen 65
  - Carbon 18
  - Hydrogen 10
  - Nitrogen 3
  - Calcium 1.5
  - Phosphorus 1.0
  - Potassium .25
  - Sulfur .25
  - Chlorine .15
  - Sodium .15
  - and 37 others (of known function)





THANKYOU