

# Biochemistry Lecture 1 notes

What is biochemistry?

Biochemistry = Understanding life.

Studying Biochemistry is about understanding three things :

- Chemical structure of biological molecules. Why? Because these biological molecules have function that we should understand and functions are coming from the structure of molecules (Structure fits function)

If we wanna study our body we should study the molecules forming it (their chemical structure and function and reactions) The first thing we need to know about these molecules is the atoms that are forming them.

And this leads us to a question :

What are the atoms that are forming our bodies?

Primary : Oxygen, Carbon, 96.0%

of our body mass.

Major: Only cool hip nerds can party  
*Oxygen Hydrogen Carbon Nitrogen Calcium Phosphorus*

Lesser: Some kings need clean mighty food  
*K: Potassium Na: Sodium Chloride Mg Fe: Iron*

Trace: 3 groups

→ Crazy cool cup  
*Cr Co Cu*

→ Funny Intelligent men  
*F Mo I Se Si Sn Mn*

→ Most Sexy Scientists

+ V + Zn

TABLE 2.1

Elements of the Human Body

Name		Symbol	Percentage of Body Weight
Major Elements (Total 98.5%)			
Oxygen		O	65.0
Carbon		C	18.0
Hydrogen		H	10.0
Nitrogen		N	3.0
Calcium	} → 2.5%	Ca	1.5
Phosphorus		P	1.0
Lesser Elements (Total 0.8%)			
Sulfur		S	0.25
Potassium		K	0.20
Sodium		Na	0.15
Chlorine		Cl	0.15
Magnesium		Mg	0.05
Iron		Fe	0.006
Trace Elements (Total 0.7%)			
Chromium	Cr	Molybdenum	Mo
Cobalt	Co	Selenium	Se
Copper	Cu	Silicon	Si
Fluorine	F	Tin	Sn
Iodine	I	Vanadium	V
Manganese	Mn	Zinc	Zn

The doctor didn't say any things about this soooo (طنش)

Legend:

- Bulk biological elements
- Trace elements believed to be essential for bacteria, plants or animals
- Possibly essential trace elements for some species

The 2nd and 3rd thing that we need to study in biochemsitry are :

- Interactions (reactions) between molecules and the organization of biological molecules withot invidual cell or the whole biological system. And this is very logical because in order to under stand our body we mention that we need to know biological molecules and also above that we. need to know the reactions of these molecules, because these molecules are not standing in there place doing nothing, they are interacting and reacting with other molecules.

We all know that chemical reactions always have a transfer of energy from one molecules to other or the release of this energy to be used, so this lead us to the 3rd point which is :

- Understand Bioenergetics (the flow of energy in cells).

Is biochemistry important?

It is not important to be a normal doctor(مسخمط) But it is impotant for elite ones. elite one يعني ودك تدرسها يحبي عشك

Biochemistry in medicine:

explains all disciplines diagnose and monitor diseases.  
design drugs (new antibiotics, chemotherapy agents).  
understand the molecular bases of diseases.

When we want to study biological molecules (molecules found inside organisms and since we are dealing with medical biochemistry we are going to study specifically the ones that are inside human bodies) what is the first molecule we are going to start our studying with? **of course it is water (H<sub>2</sub>O) because it is the most abundant and forms most of our body mass and from that information you can also know that Oxygen is**

Note: You may be thinking that H is the most abundant atom in our body and not oxygen and that's right it is the most abundant in terms of quantity, number, moles. but since Oxygen molecular weight is more than molecular weight of 2 Hydrogen atoms it is consisting more of our body mass.

In order to study Biochemistry we need to be familiar with some

- **Covalent bond : a bond formed between two atoms** (Non-metal with non metal or non-metal with metalloid). **including the sharing electrons between the 2 atoms.**

You may think are the two electrons that are shared between the two atoms (covalent electrons) exactly in the middle distance between them? **Well that a very nice question that opens a new concept which is :**

- **Electronegativity : The atoms ability to pull (withdraw) covalent bond's electrons toward it self.**

Since there is a sharing of electrons between two atoms, there can be two cases which are:

- There is a difference in electronegativity. Polar covalent bond.

- \* The electrons are more closer to the more electronegative atom, this gives it a partial negative charge.
- \* The electrons are more away from the less electronegative atom, this gives it a partial positive charge.

There isn't a difference in electronegativity. Non-Polar covalent bond.

The electrons are exactly in the middle of the distance between the 2 nuclei of the atoms. -not really :) -

- some books consider if the difference in electronegativity is less than 0.4 it is not electronegative (Extra information)

When the electrons are more close toward one atom than the other, there will be a partial charges on the atoms (positive for lower electronegativity / negative for higher electronegativity).

These partial charges can interact with each other and with

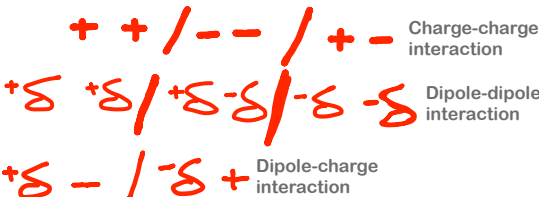
- Intramolecular Interactions: **Interaction (attraction) between molecules.**

## Intramolecular Interactions

### Electrostatic interactions

An interaction between charges (real,real)/(real,partial)/(partial,partial)

Could be attracting or repulsion.



### Hydrogen bond

An interaction ( its called bond but it not like that) between hydrogen atom on a molecules (donor) and a high electronegative atom on other molecule (N/O/F)

### Hydrophobic interactions

Interaction between non-polar molecules (hydrophobic molecules) when they are present in an aqueous medium. It is not a real bond and not a real interaction.. its simply that water molecules prefer interacting with hydrophilic substance rather than hydrophobic ones because the interaction between hydrophobic and hydrophilic is nonenergy favorable.

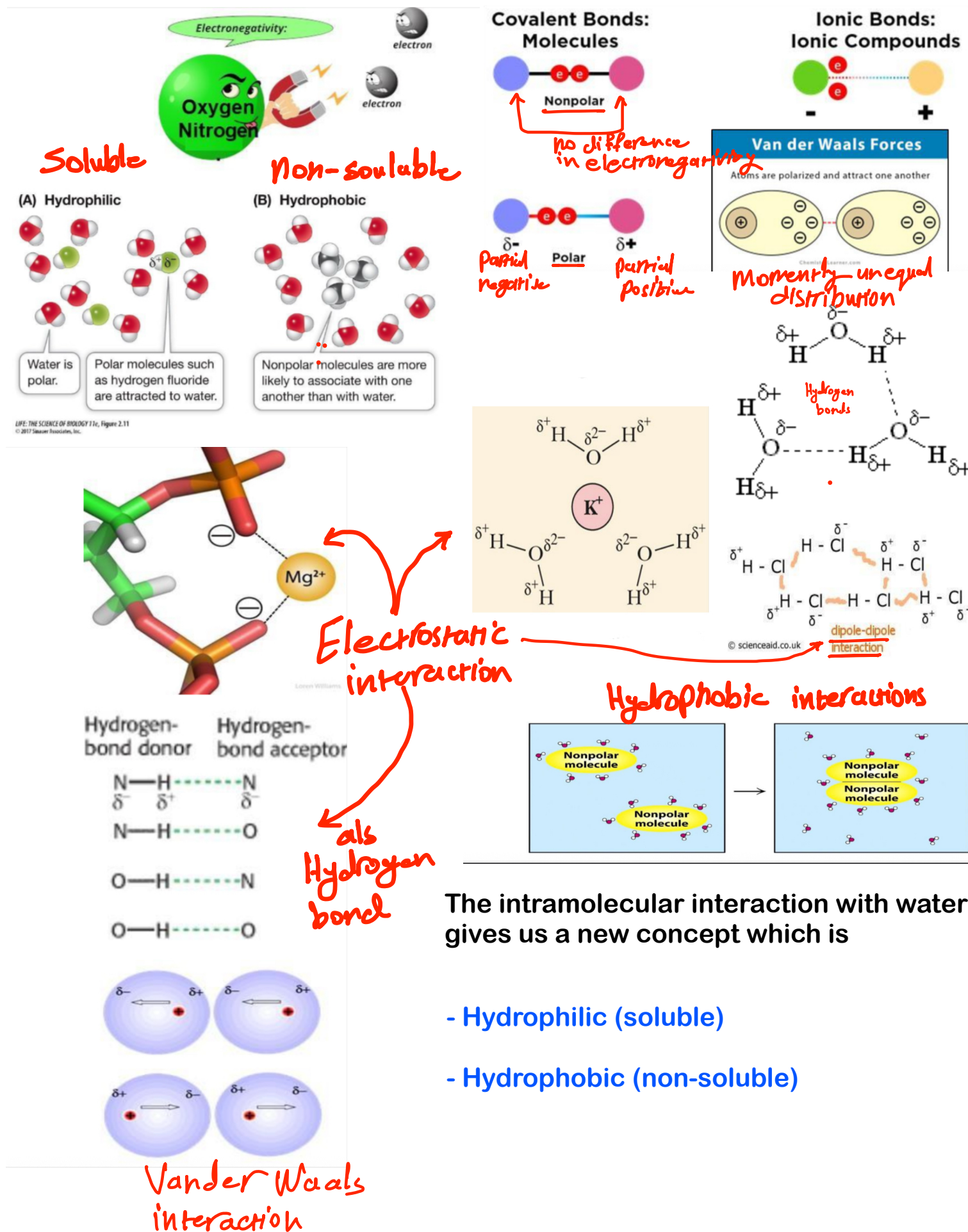
So hydrophobic molecules attract to each other (by excluding them from water molecules) to form a mass where they decrease the area of interacting with water molecules

### Van der Waals Interactions

Weak interaction between nonpolar molecules due to the momentary change in the distribution of bond's electrons around atoms (which makes momentary partial positive and negative charge)

It is a very weak interaction but collectively it can stabilize the structure.

The strength of any attraction is affected by distance.





# Properties of non-covalent interactions :

- They are reversible and relatively weak.

- Electrostatic interactions (charge-charge interactions):

Quite strong in the absence of water.

- Hydrogen bonds:

Shared between a donor and an acceptor

- Van der Waals interactions

Unequal distribution of electronic charge around an atom changes with time.

- The strength of the attraction is affected by distance.

## Water (Most abundant molecules in human body).

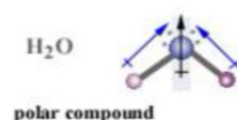
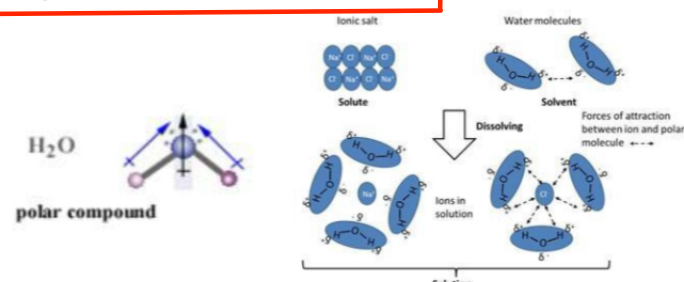
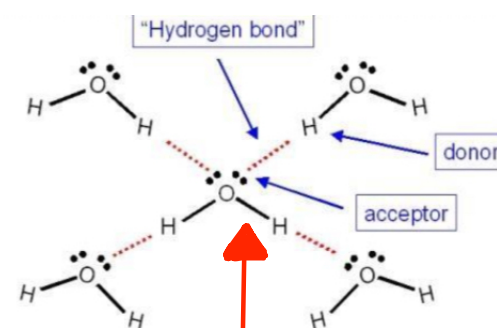
- Polar  $\rightarrow$  it has a polar bonds.  
 $\rightarrow$  it is angular.

$\rightarrow$  **Angular** (Asymmetrical) we can detect if its angular or not by drawing a line that separates partial positive charges on one side while partial negative charges on the other side, if we can do that then it is angular.

- Dipole-dipole interaction and Dipole charge interaction

- Highly cohesive  
It can form up to 4 Hydrogen bond.

- Form a network  
Since each molecules can form 4 hydrogen bonds with the surrounding water molecules.



- excellent solvent Why?

Cuz its polar? Ok but thats not the thing that distinguishes water as a solevent than other solevents, **the thing that makes water the best solevent (the solevent of life) is it's SMALL size.** And whats special about small size?

~> It can present in larg numbers.

~> Its small size makes it able to disturb the ionic bonds between atoms by making interaction with ions that form that bond, and standing between these atoms to disturb the interaction (bond) between them.

## Water can be ionized :

Water is reactive since it is a Nucleophile. **what is neucleophile?**  
Nucleophile is electron-rich molecule that is attracted to positively charged or electron-deficient species (electrophiles).



# Carbon

- It can form four bonds  
Single, double, or triple bonds.
- Bonds are very stable
- They link C atoms together in chains and rings
- They serve as backbones  
It forms the basis of the molecular backbones in your
- Three-dimensional structures (angles).
- Rotation (molecules of different shapes).
- Electronegativity (between others):

