

# AMINO ACIDS

❖ **Color Index:**

- **Very important**
- Extra information

“IF YOU CAN DREAM IT YOU CAN DO IT”

# OBJECTIVES:

- What are the amino acids?
- General structure.
- Classification of amino acids.
- Optical properties.
- Amino acid configuration.
- Non-standard amino acids.
- Derivatives of amino acids.

# extra information that might help you

---

- *Acids* are proton donors.
- *Bases*: proton acceptors.
- PH is a numeric scale used to specify the acidity or alkalinity of an aqueous solution.
  - Low PH → acidic solution → high protons concentration
  - High PH → basic solution → low protons concentration
- Buffer: solution that resists change in PH following the addition of an acid or base.
- A buffer can be created by mixing a weak acid with its conjugate base.

# What are amino acids ?

a type of organic acid that contain both a carboxyl group(COOH) and an amino group(NH<sub>2</sub>).

the chemical units that combine to form proteins .

## #Importance:

- the building blocks of proteins .
- they play an intermediates role in metabolism.

There are 20 amino acids .

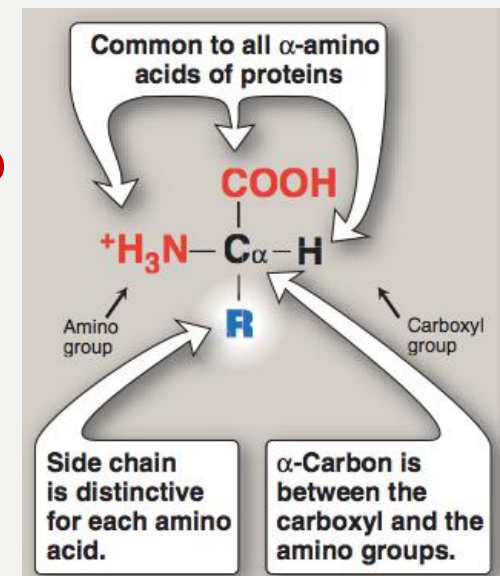
- humans can produce about half of amino acids .
- The others must be supplied in the food.

# General structure of Amino acids

Alpha Carbon that is attached to:

- 1- Hydrogen atom \*H\*.
- 2- side chain \*R\* ( **which is distinctive for each amino acid and gives the amino acid a unique set of characteristics** ).
- 3- two functional Groups :
  - Carboxylic acid Group \*COOH\*.
  - Primary Amino acid group \*NH<sub>2</sub>\* ( **except for Proline which has a secondary amino group** ) .

- **Alpha carbon : is between the carboxyl and the amino groups.**



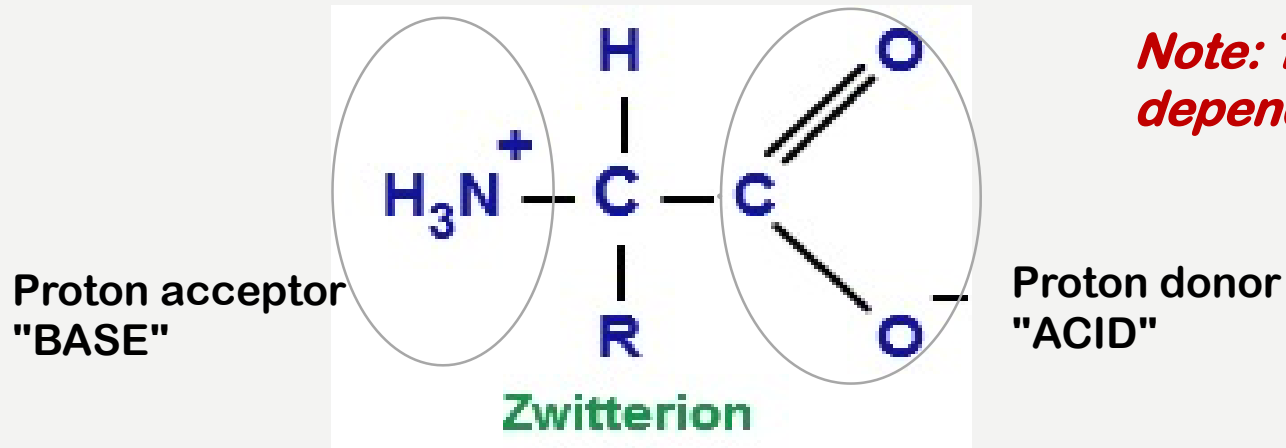
# #ISOELECTRIC POINT (PI):

- Is the pH at which an Amino Acid is electrically neutral (That is, the sum of the positive charges equal to the sum of negative charge) .

هو الرقم الهيدروجيني PH الذي يصبح الامينو اسيد عنده في حاله Zwitterion

# #ZWITTERION:

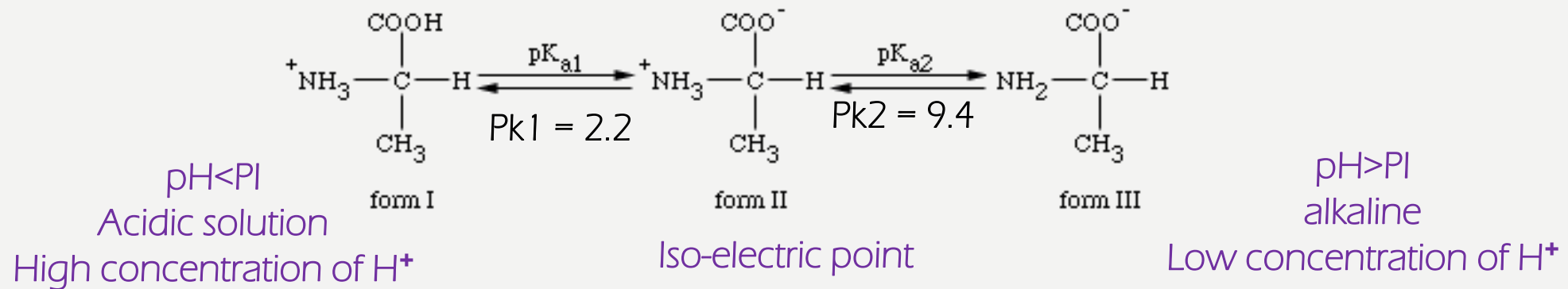
- . Amino acid that carries no net charge!



**Note: The charge of Amino Acid depend on pH**

# Ionic Forms of Amino Acids

Cationic	Zwitterion	Anionic
Low PH	PH=PI	High PH
Positively charged	No net charge	Negatively Charged
Acidic Solution	-	Alkaline Solution
$\text{H}_3\text{N}^+ - \text{CH}(\text{R}) - \text{C}(=\text{O})\text{OH}$	$\text{H}_3\text{N}^+ - \text{CH}(\text{R}) - \text{C}(=\text{O})\text{O}^-$	$\text{H}_2\text{N} - \text{CH}(\text{R}) - \text{C}(=\text{O})\text{O}^-$



# PK VALUE

- **What is it?**

It is the ability of an acid to donate a proton (dissociate).

- **Known As:**

Acid dissociation constant or PKa value .

- **PK value and PH :**

1) If the pH of a solution is one unit or more below pK value → the protons are on (attached)

$pH < pK$  (protonation)

2) If the pH of a solution is one unit or more above pK value → the protons are off (removed )

$PH > pK$  ( deprotonation )

باختصار:  
الازم يكون pH أعلى من pK علشان تقدر تتخلص من بروتوناتها الجميله ☺



# PK VALUE

## ▪ PK and acidity:

Inverse relationship .

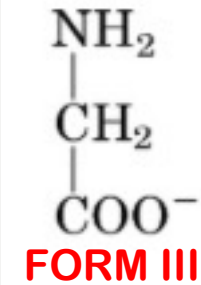
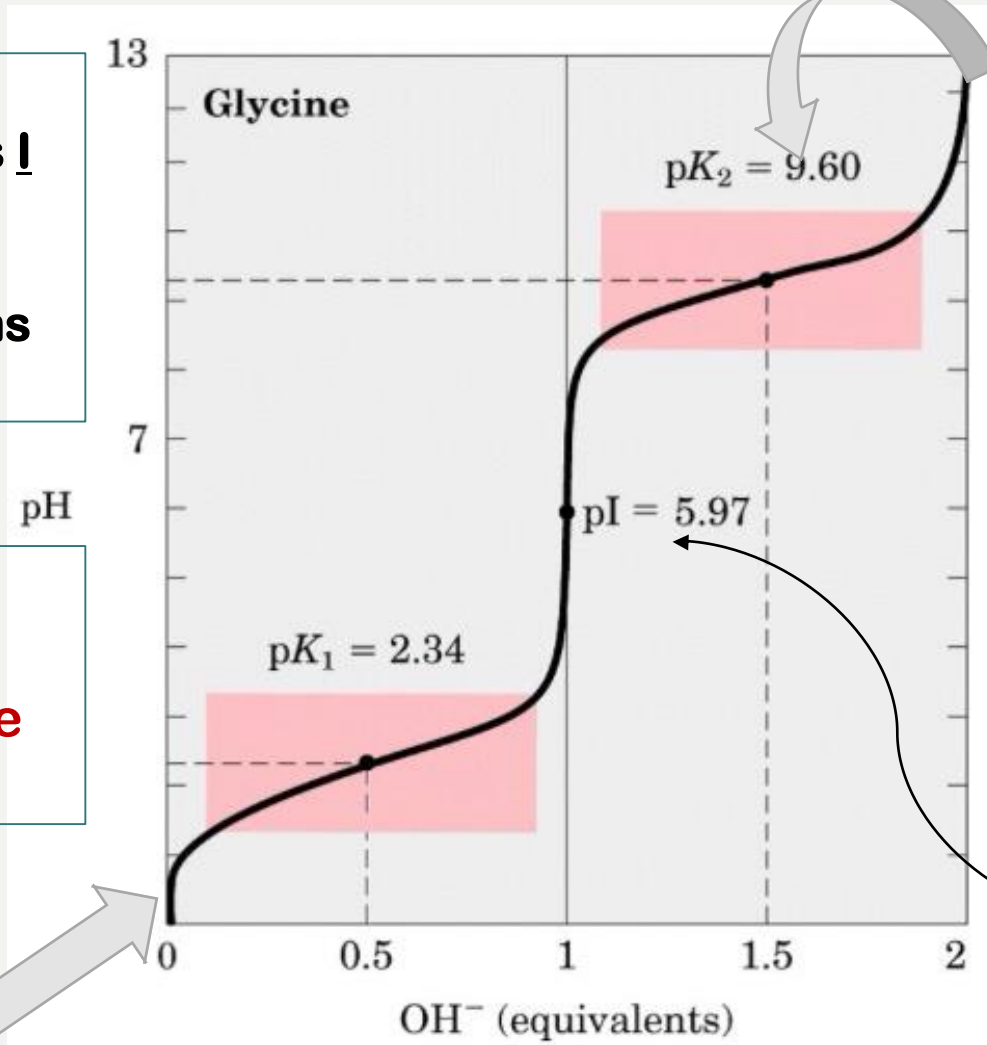
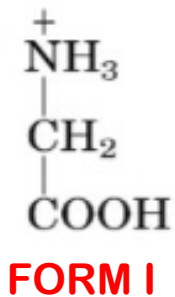
- The PK values of alpha-carboxylic group is in the range of 2.2
- The PK values of alpha-amino group is in the range of 9.4

we can conclude that the carboxylic group are more acidic than the amino group .. Since the PK value of COOH is lower than NH<sub>3</sub> Group!

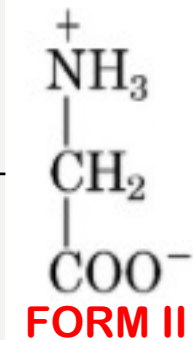
# TITRATION CURVE OF GLYCINE

\*When  $\text{pH} = \text{pK}_1$  (2.3) equal amount of Forms I and II exist in solution  
 \*When  $\text{pH} = \text{pK}_2$  (9.6) equal amounts of Forms II and III

Buffer is a solution resists change in pH when an acid or base is added into it



Buffering action is maximum around pK values and minimum at PI



Adding OH<sup>-</sup> to rise the pH

# TITRATION CURVE OF GLYCINE EXPLANATION

هذي الشريحه اضافيه فقط لشرح الكيرف والبروسس اللي يصير - تقدرن تتركونها اذا كنتو فاهمين 😊

**Consider alanine, for example, which contains an ionizable -COOH group and +NH<sub>3</sub> Group (note that its R group is nonionizable )**

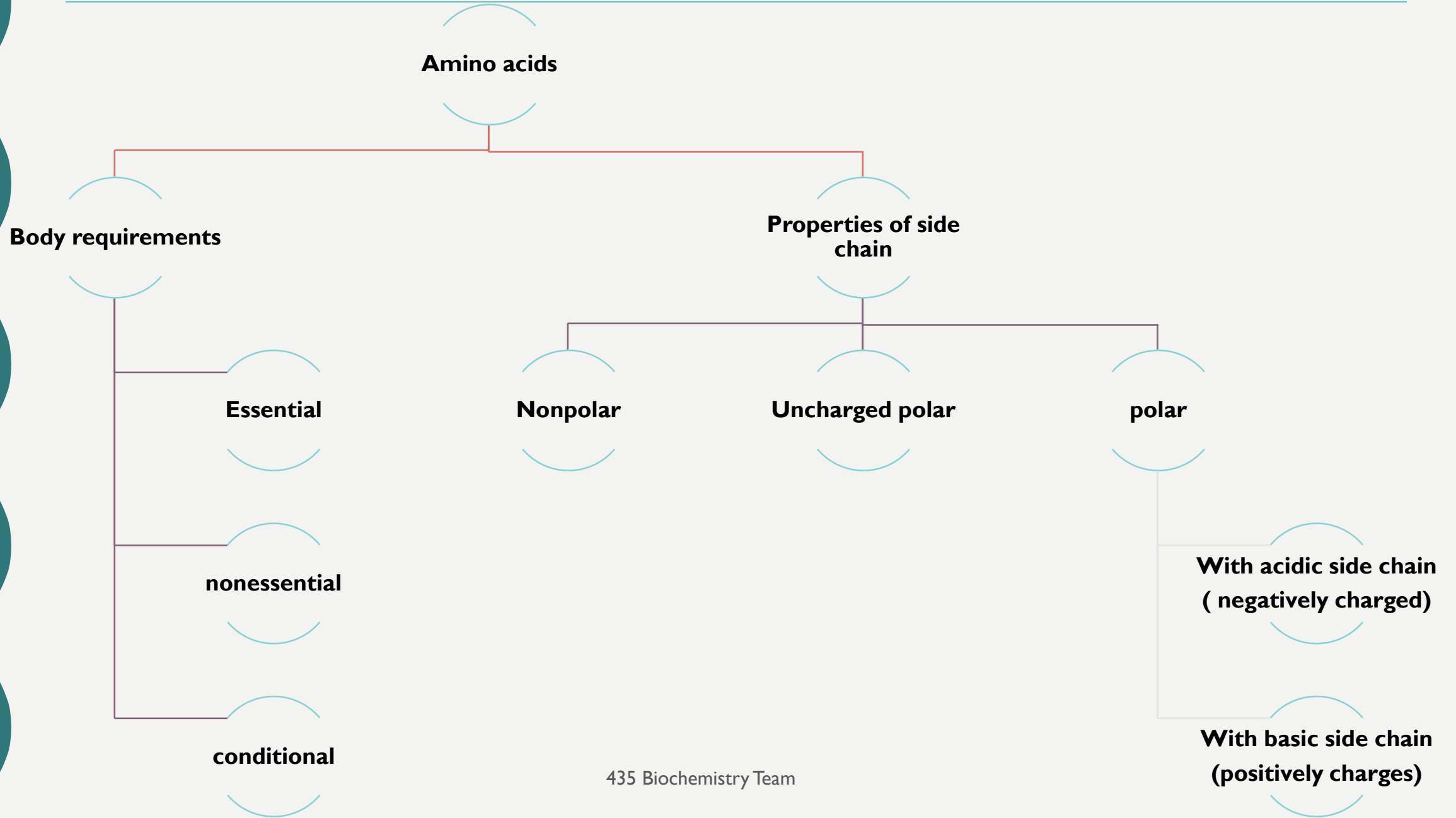
- At low PH (acidic) -→ both of these groups are protonated.
- As the pH is raised -→ the -COOH of form I dissociate by donating a proton to the medium.

The release of a proton results in the formation of the carboxylate group -COO. Structure is known as Zwitterion.

نزيد بالرقم الهيدروجيني لحد ماتفقد مجموعه الكربوكسيل بروتونها ويصير الامينو اسيد بفورم تو او بمعنى zwitterion.

- Release of a proton from the protonated amino group of form II → results in fully deprotonated form of alanine, form III.

# CLASSIFICATIONS OF AMINO ACIDS



# CLASSIFICATIONS OF AMINO ACIDS

Based on the body requirement, amino acids can be classified into three groups:

**Conditional amino acids:**

not essential,  
except in time of  
illness or stress.

**Nonessential amino acids:**

produced by the  
body.

**Essential amino acids:**

cannot be made  
by the body.

# CLASSIFICATIONS OF AMINO ACIDS

Groups and EX	Essential amino acids	Nonessential amino acids	Conditional amino acids
1	histidine	alanine	arginine
2	isoleucine	asparagine	cysteine
3	leucine	aspartic acid	glutamine
4	lysine	glutamic acid	tyrosine
5	methionine		glycine
6	phenylalanine		proline
7-8-9	threonine, tryptophan, and valine.		serine

# CLASSIFICATIONS OF AMINO ACIDS

- **based on the side chain**

In an amino acid the  $-NH_2$  and  $-COOH$  group on an alpha carbon atom can neutralize each other, so we look at the side chain that will determine the attitude of the molecule.

**We can classify amino acids into three categories based on the properties of their side chain :**

- 1- Nonpolar Amino Acids.
- 2- Uncharged polar amino acids
- 3- polar amino acids.

# #NONPOLAR AMINO ACIDS

## ▪ What is it?

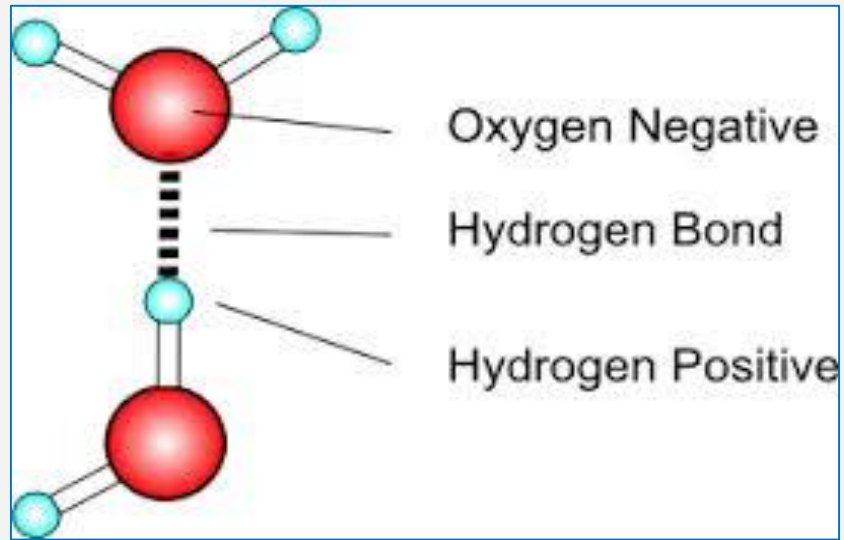
- the amino acid has no charge on the side chain \*non polar R group\*.
- The amino acid that doesn't bind or gain or give off proton or participate in a hydrogen or ionic bonds.

## ▪ Location of nonpolar amino acids in proteins:

- In protein found in **aqueous solution** (polar environment) → **interior** of that soluble protein → gives the protein its three-dimensional shape  
لمن تكون في \*البروتينات التي تتواجد بوسط مائي\* رح تكون خايفه من الماء لانها هي الوحيده النون بولر في ذاك المكان .. فنتجمع مع اخواتها النون بولر امينو اسيدز الباقيين ويتخبون ببيتهم البروتين .. فيعطون البيت هيبتة وشكله الثلاثي الابعاد.. فهو بالنسبه للماء بيت اشباح
- In protein located in **hydrophobic region** (non polar environment) \*e.g. :membrane protein\* → **outside** surface of that protein → stabilize protein shape  
اذا كانت في وسط هايدروفوبيك فرح تحس بالامان لان كل الاشياء اللي حولها مثلها كلهم نون بولر .. بتطلع للمسطح وللعالم الخارجي ورح تشارك في تثبيت تركيب البروتين .. لانها ماتبي ترجع للعالم المائي ..

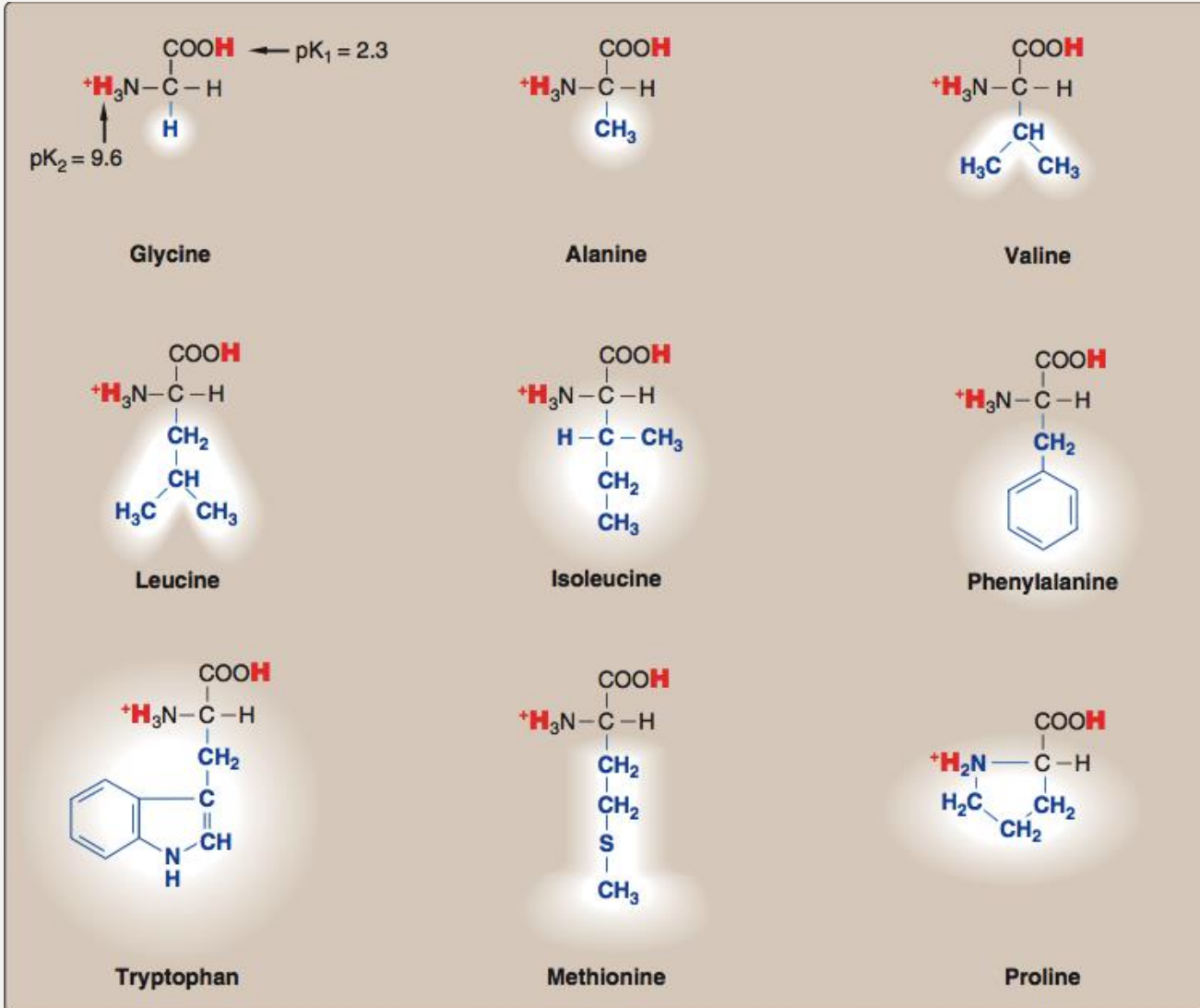
ملاحظة : التشبيهات من وحي الخيال فقط لتسهيل الفهم ! 😊





***“An example of polar molecule that forms hydrogen bonds is water”***





## NONPOLAR AMINO ACIDS:

مهم جدا معرفة اسماء البروتينات ال ٢٠ مع  
معرفة الى أي نوع ينتمون!

# #POLAR AMINO ACIDS

## A)Uncharged:

- In a neutral pH this amino acid has zero net charge.
- In an alkaline pH → **cysteine and tyrosine** can lose a proton.
- They can participate in : hydrogen bond formation.
- The amino acids in this group are: **serine, threonine, tyrosine, cysteine, glutamine and asparagine**.

## B)charged:

### B.1) Charged with a positive charge: (+, acceptors)

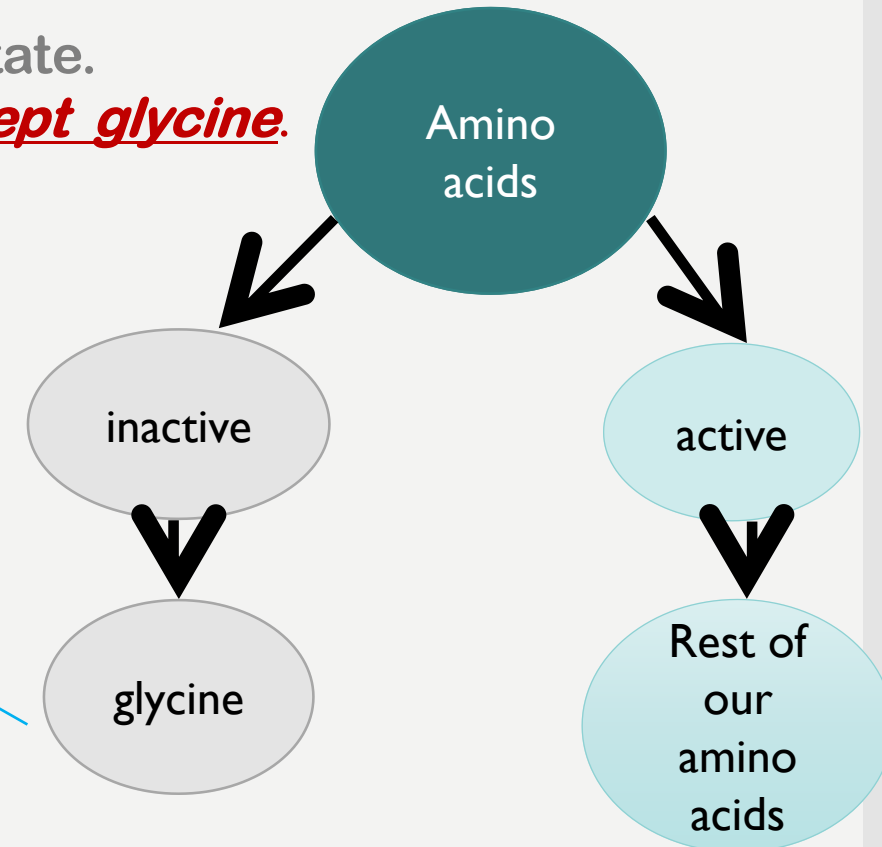
- These amino acids have basic side chains.
- In neutral pH they are proton acceptors so in a neutral pH they are fully ionized with a positive charge.
- The amino acids in this group are **histidine, lysine and arginine**.

### B.2) Charged with a negative charge(- , donators):

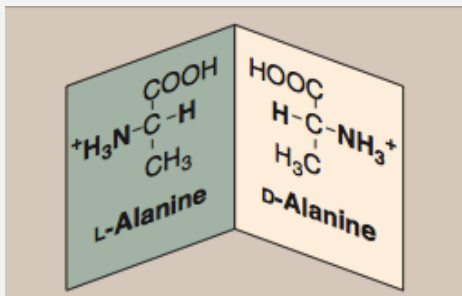
- These amino acids have acidic side chains.
- they are proton donors so in a neutral pH they are fully ionized with a negative charge.
- The amino acids in this group are **aspartic and glutamic acids**. When they are ionized we call them aspartate and glutamate.

# OPTICAL PROPERTIES:

- When  $\alpha$  Carbon is attached to 4 different groups we call it asymmetric.
- symmetric amino acids = inactive.
- asymmetric amino acid = active.
- active amino acids cause the plane of the light to rotate.
- All our amino acids are ACTIVE=ASYMMETRIC , *except glycine*.

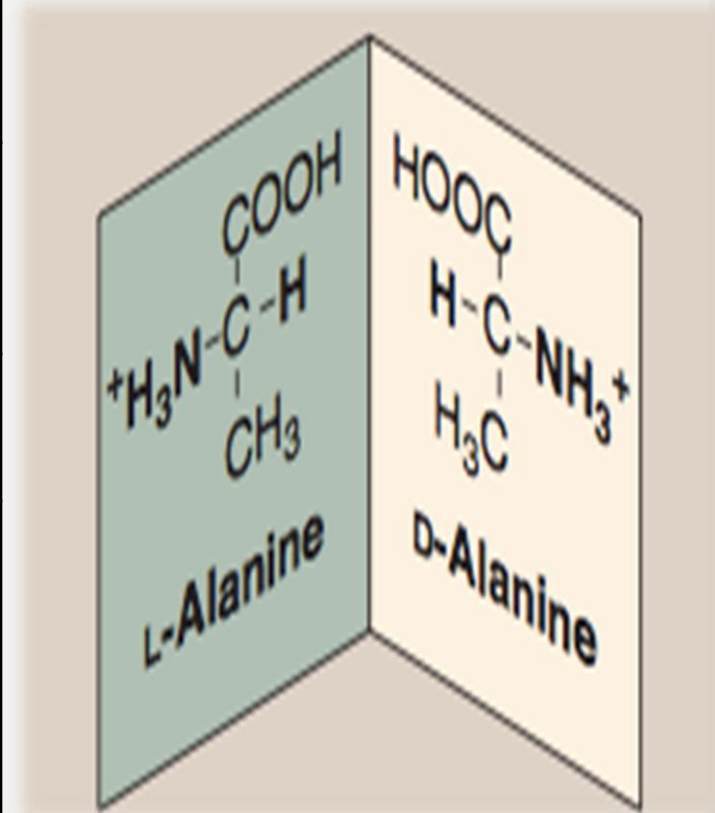


لأن بتركيب الجلايسين .. الالفا كربون مرتبطة بذرتين هيدروجين.. فمعد تحقق شرط ارتباط الالفا كربون بـ؛ مجموعات مختلفة



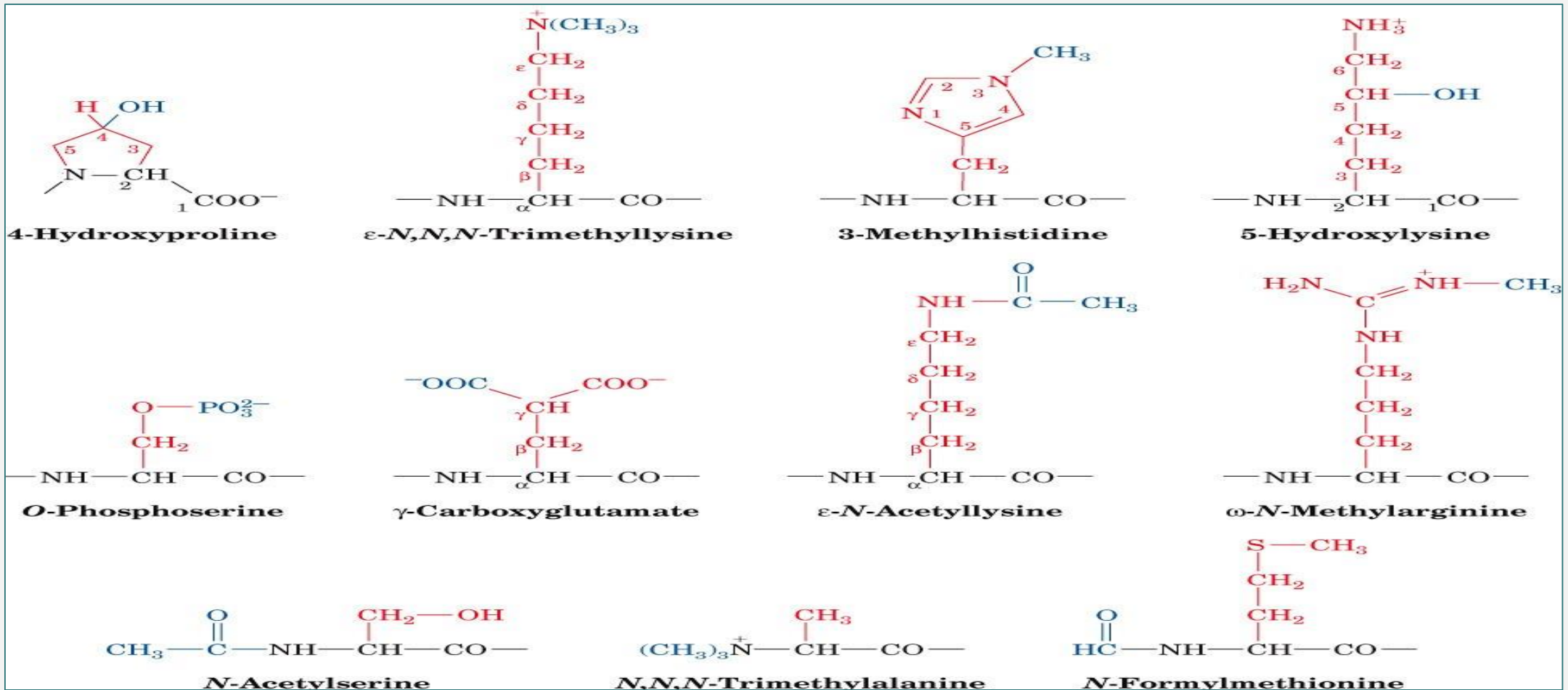
# AMINO ACID CONFIGURATION

<b>D-Amino acid</b>	<b>L-Amino acid</b>
Rotate polarized light from right	Rotate polarized light from left
They both have the same chemical form	
found in antibiotics, plants and in the cell wall of microorganisms	Found in natural amino acid  All mammalian amino acids are found in L-configuration.



# NON-STANDARDS AMINO ACID

- Some uncommon amino acid residues that are components of certain proteins.



# AMINO ACIDS DERIVATIVES

Gamma amino butyric acid (GABA)

- Derivative of: glutamic acid
- It is a neurotransmitter

dopamine

- Derivative of: tyrosine
- It is a neurotransmitter

histamine

- Derivative of: histidine
- It is the mediator of allergic reactions.

thyroxine

- Derivative of: tyrosine
- It is an important thyroid hormone.

# VIDEOS

- ✓ Classification of amino acids
- ✓ General structure of Amino acids
- ✓ PKV
- ✓ the 20 amino acids in song



## Boys Team:

- عبدالعزيز المالكي.
- مهند الزهراني.
- أحمد الرويلي .
- محمد الصهيل .
- خالد النعيم .
- إبراهيم الشايح.
- محمد الدغيثر.

\* نستقبل إقتراحاتكم وملاحظاتكم على:

 [@435biochemteam](https://twitter.com/435biochemteam)

 [435biochemistryteam@gmail.com](mailto:435biochemistryteam@gmail.com)

 [@biochemteam435](https://www.instagram.com/biochemteam435)

## Girls Team:

- شهد العنزي.
- نوره الرميح .
- بدور جليدان.
- علا النهير.
- أفنان المالكي.
- أمجاد الدهيش.
- دلال الحزيمي.
- فاطمه الدين.
- جواهر الحربي.
- جوهره المالكي.
- خوله العريني.
- لجين السواط.
- منيال باوزير.
- نوره القحطاني.
- رزان السبتي .
- رHF العباد .
- وضى العتيبي.
- ساره العنزي .