Amino acids Chemistry

- Dr. A. Hariharan M.D.,

Overview

I. Definition.

II. Classification of amino acids.

Introduction

- Major nutrition required to survive:

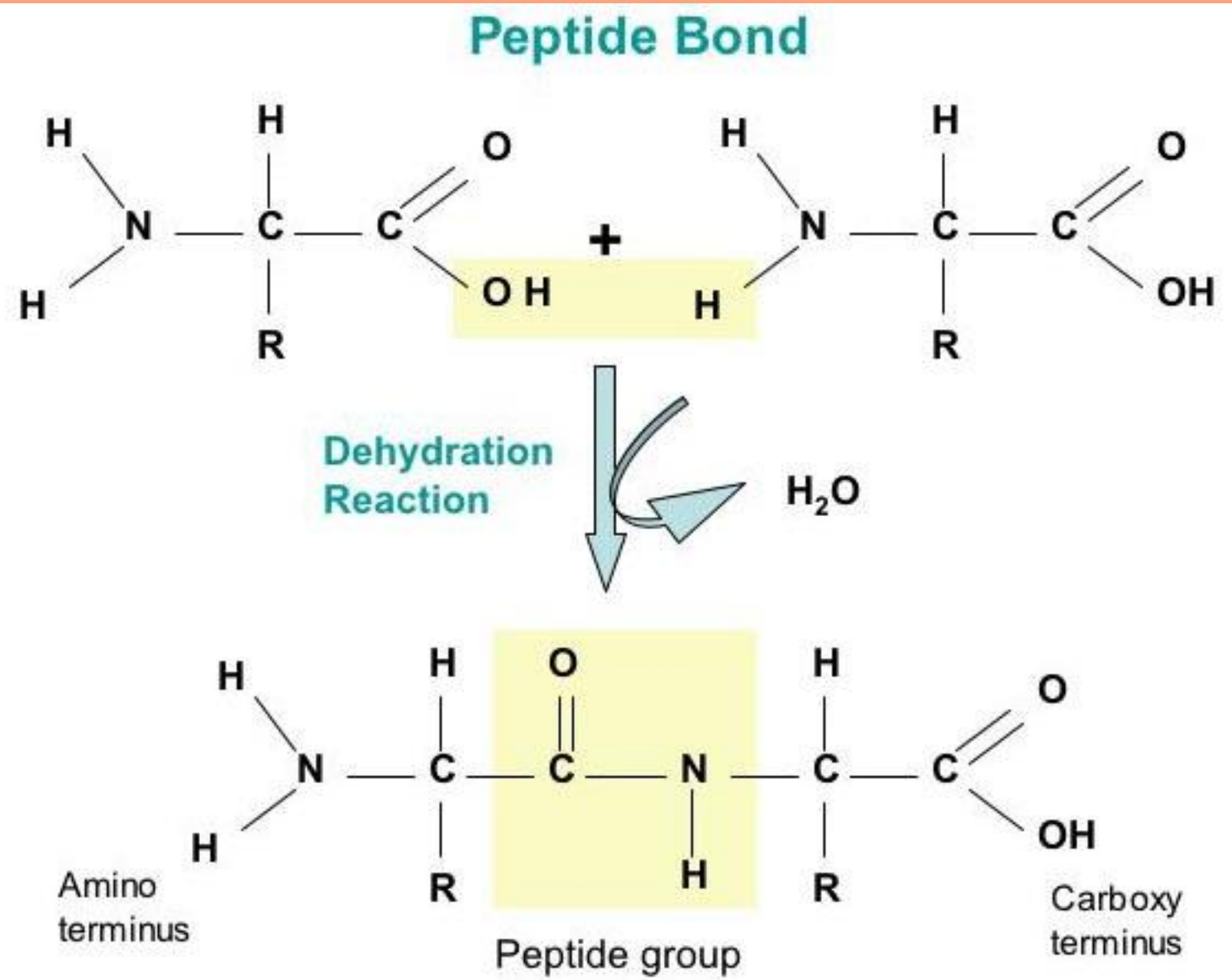
1. Carbohydrate.
2. Protein.
3. Lipid.
4. Vitamin.
5. Minerals.

Classification of amino acids

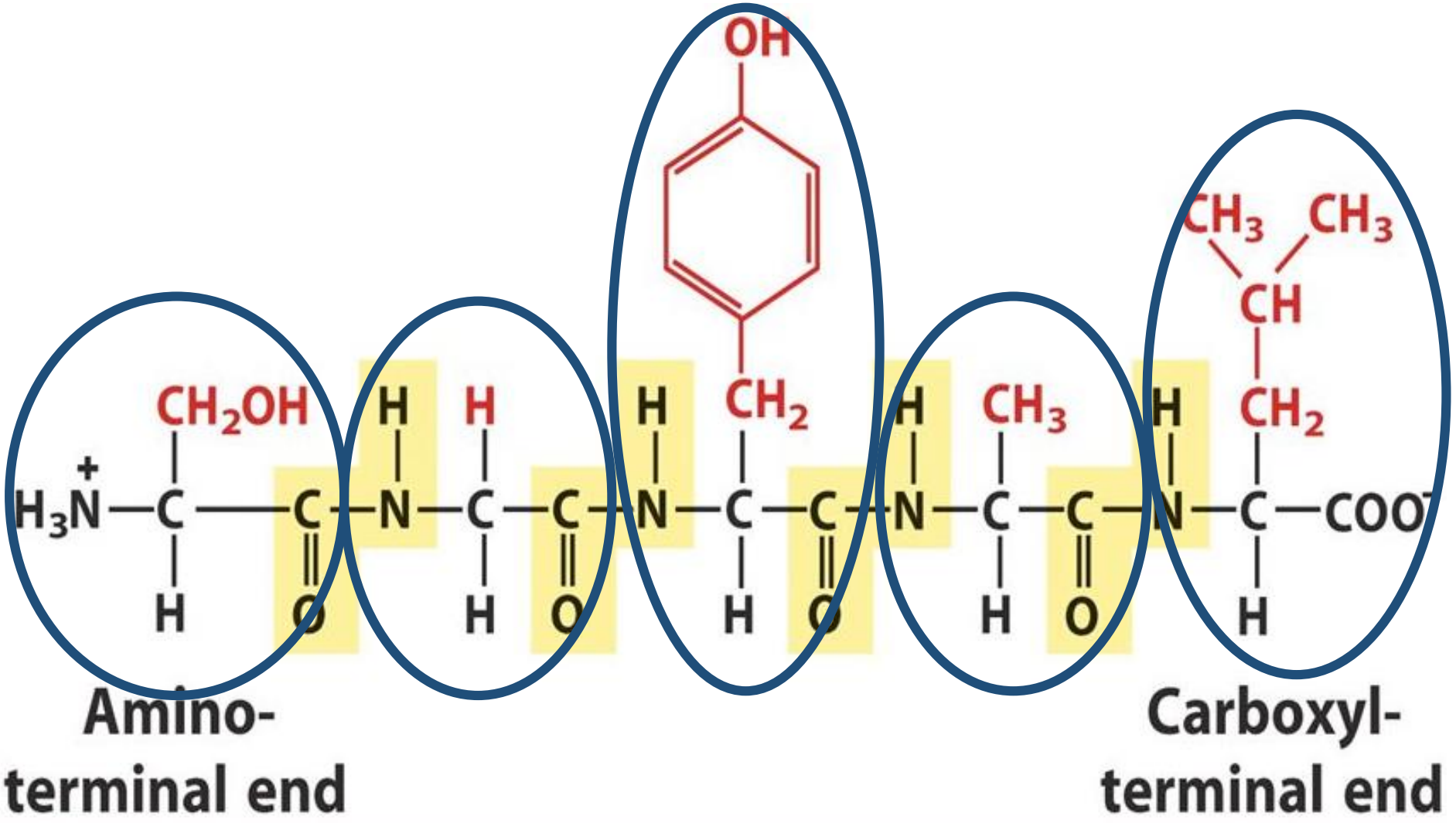
1. **Definition:**

Amino acid are simple organic compounds that contain basic amino acid (NH_2), an acidic carboxyl group, a hydrogen atom and a side chain (R group) attached to a central α – carbon atom.

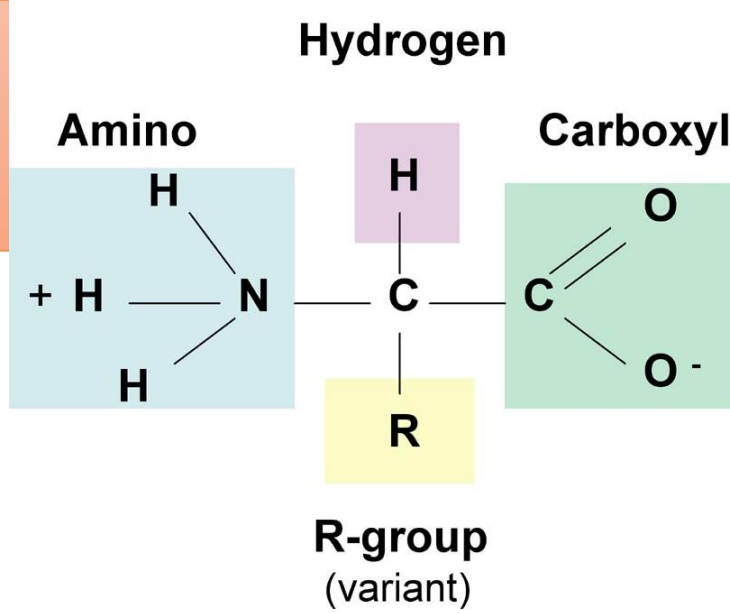
Introduction



Introduction

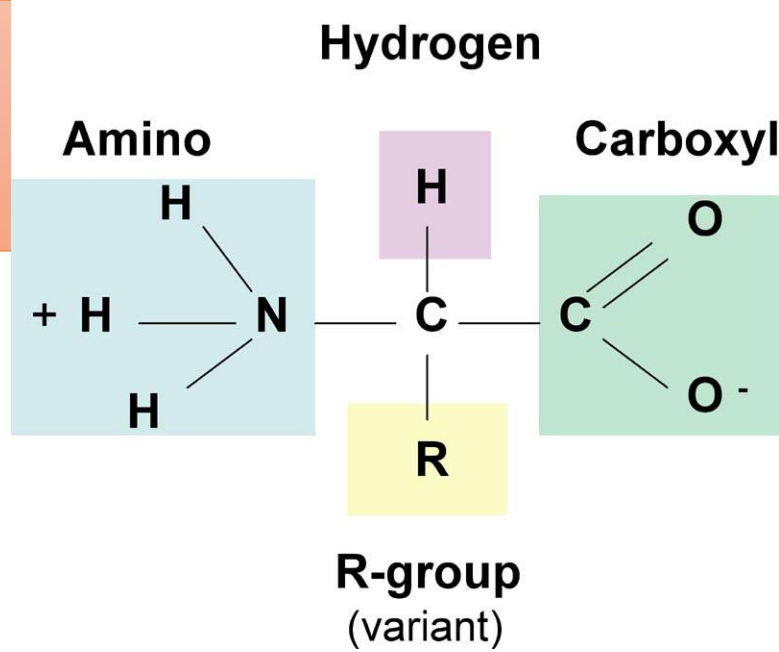


Classification of amino acids



1. Based on the variable side chain.
2. Based on Polarity.
3. Based on nutritional requirement.
4. Based on metabolic fate.

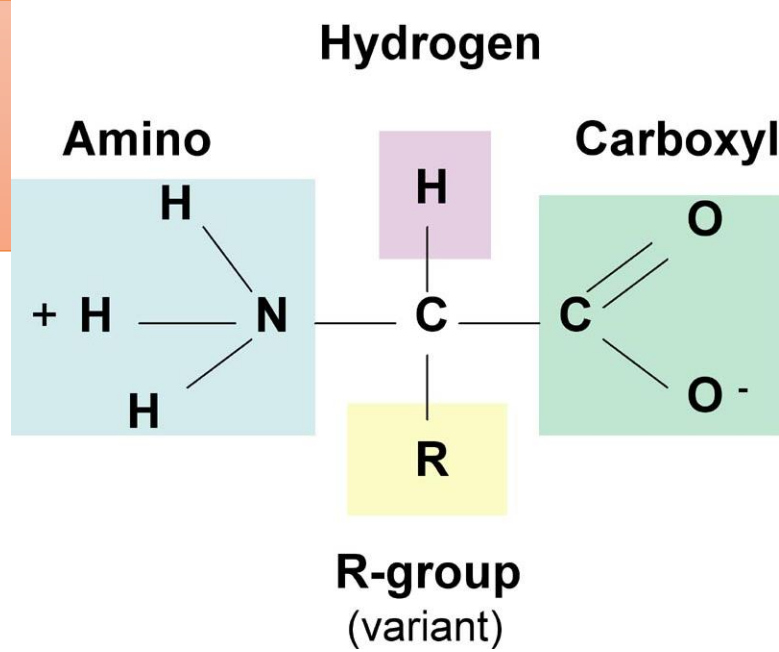
Based on the variable side chain



1. Simple amino acid.
2. Branched chain amino acid.
3. Hydroxy (-OH) group containing amino acid.
4. Sulfur (S) containing in side chain.
5. Acidic amino acid(-COOH).

Based on the variable side chain

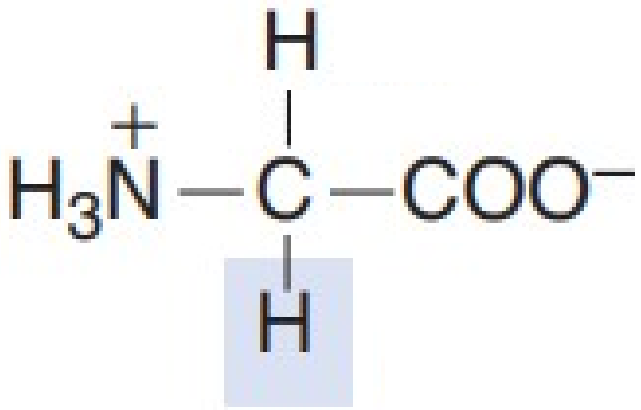
6. Amino acid with amide in side chain.
7. Basic (-NH_2) amino acids.
8. Aromatic amino acid.
9. Imino acid.



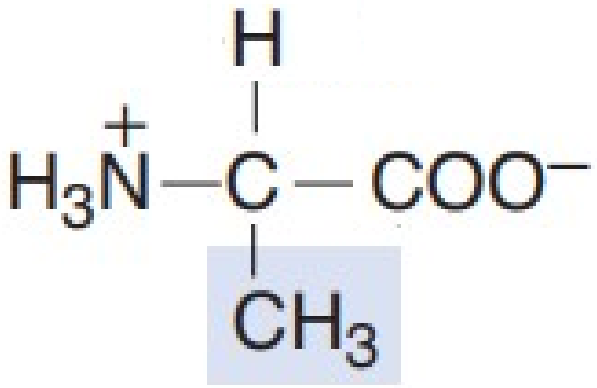
Based on the variable side chain

1. **Simple amino acid:**

Glycine



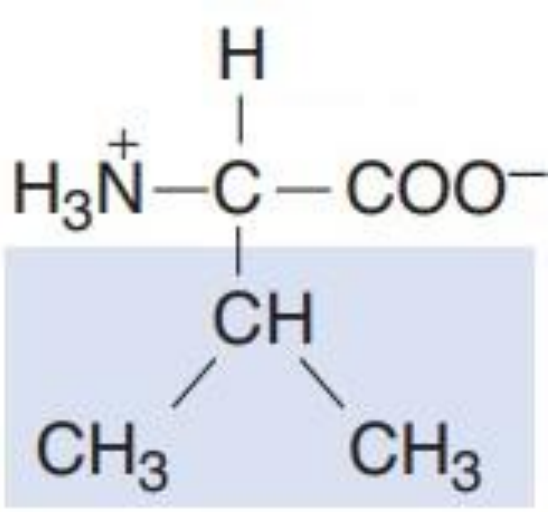
Alanine



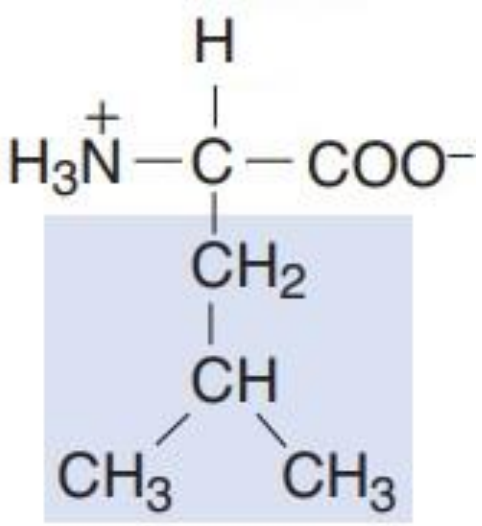
Based on the variable side chain

2. Branched chain amino acid:

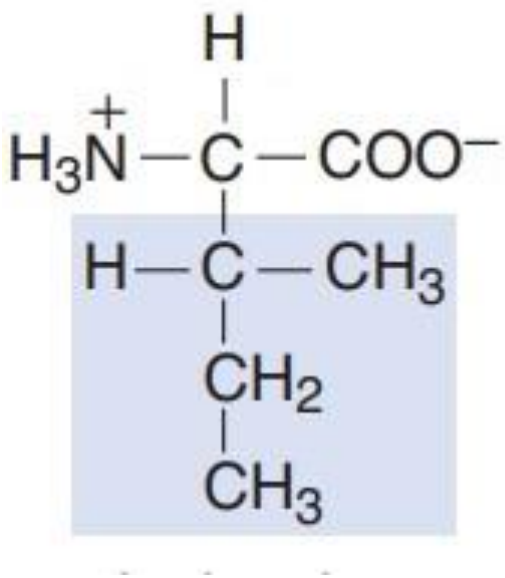
Valine



Leucine



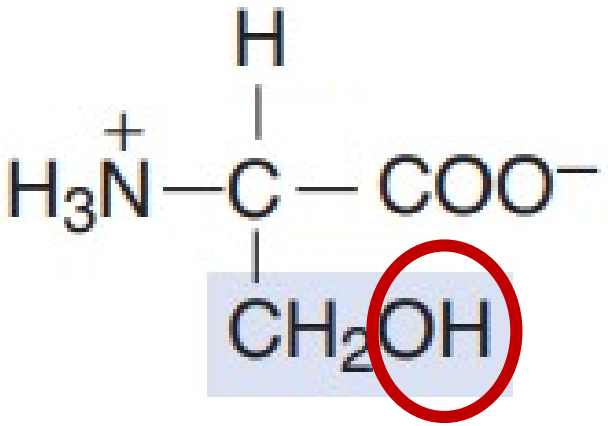
Isoleucine



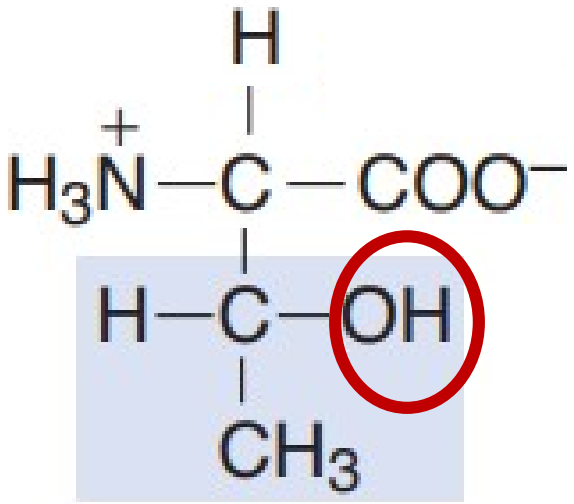
Based on the variable side chain

3. Hydroxy (-OH) group containing amino acid:

Serine



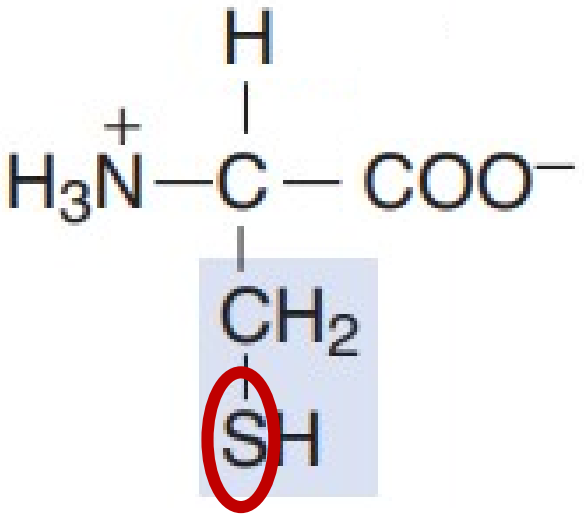
Threonine



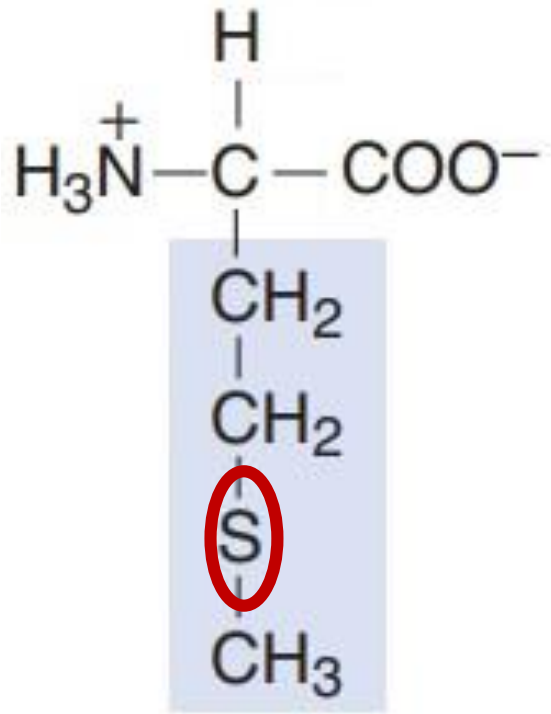
Based on the variable side chain

4. <u>Sulfur (S) containing in side chain:</u>

<u>Cysteine</u>



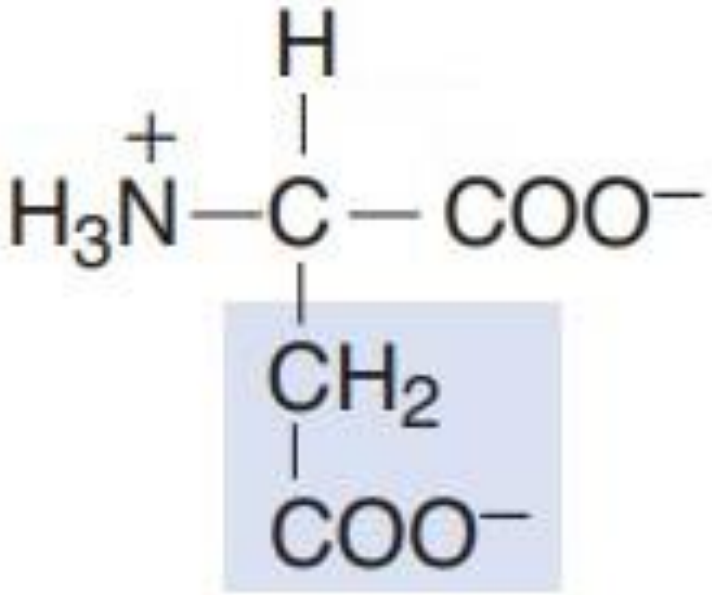
<u>Methionine</u>



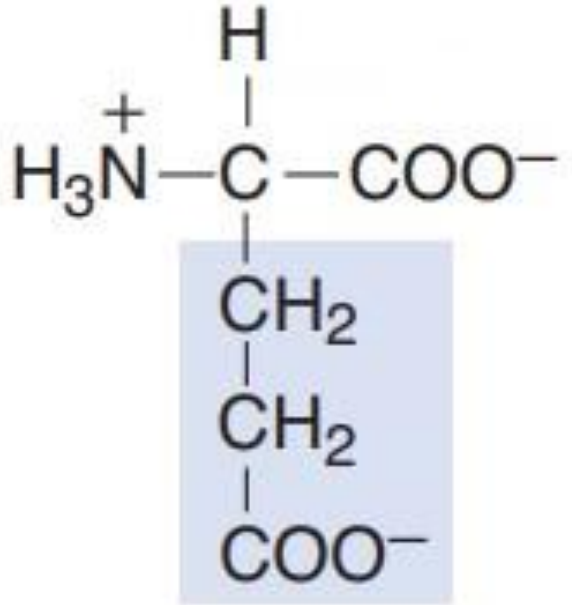
Based on the variable side chain

5. <u>Acidic amino acid(-COOH):</u>

<u>Aspartic acid</u>



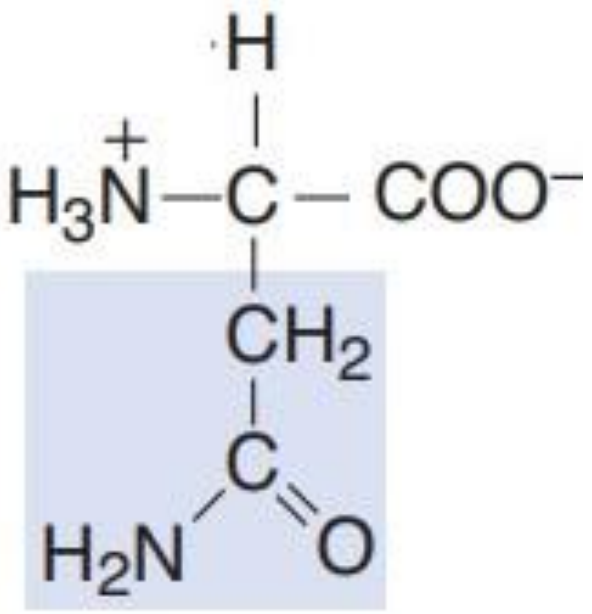
<u>Glutamic acid</u>



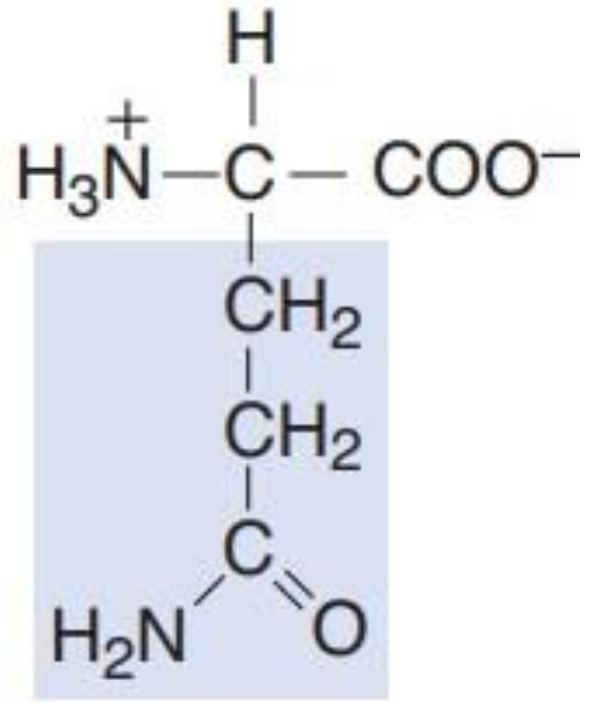
Based on the variable side chain

6. Amino acid with amide in side chain:

Asparagine



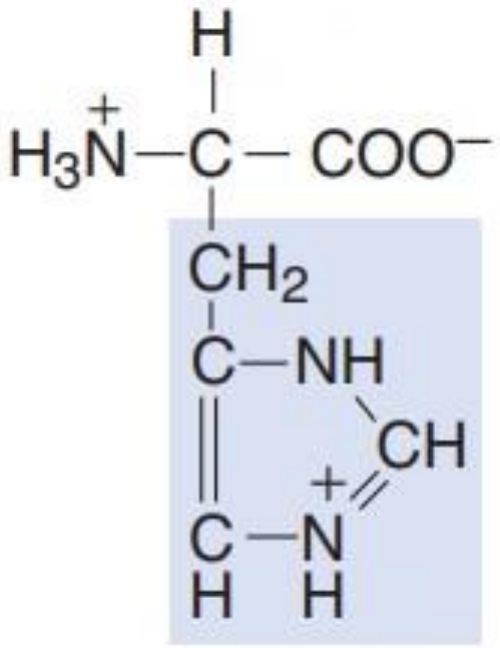
Glutamine



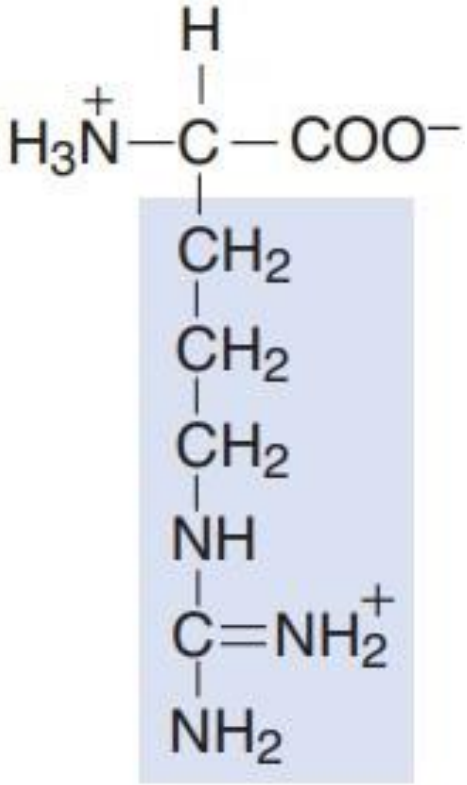
Based on the variable side chain

7. Basic (-NH_2) amino acids:

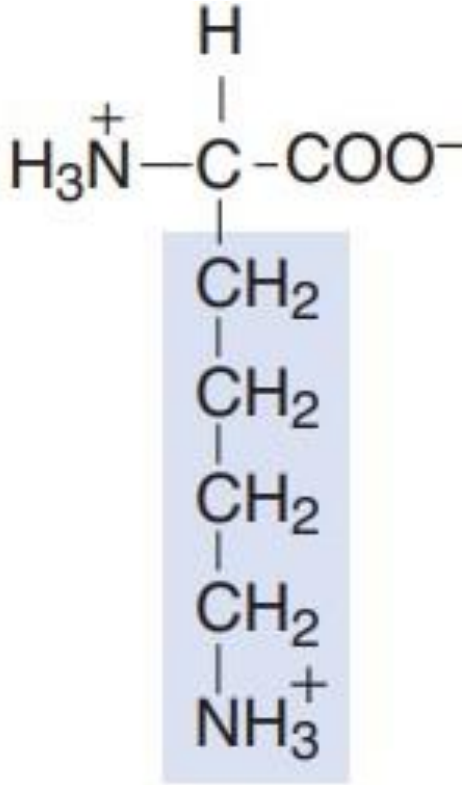
Histidine



Arginine



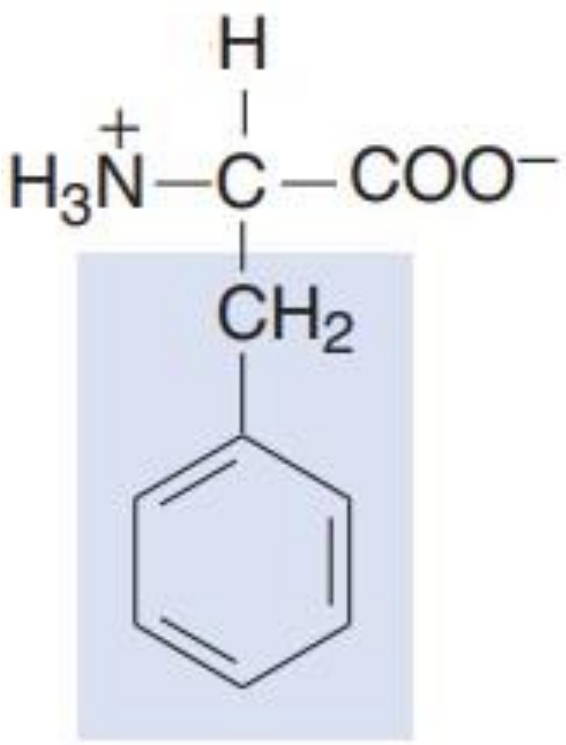
Lysine



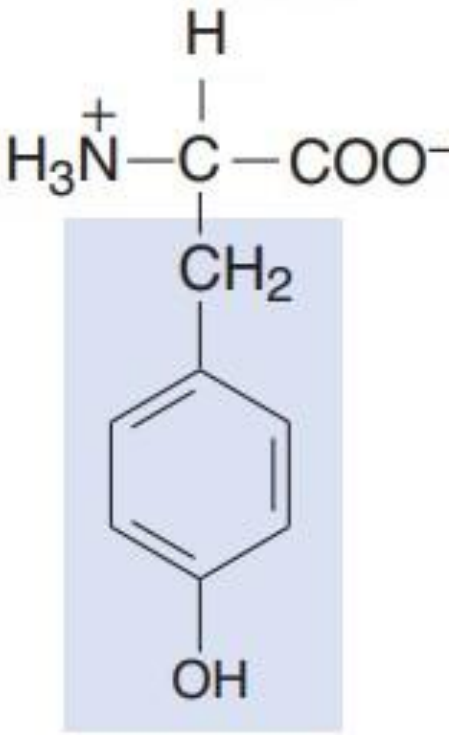
Based on the variable side chain

8. Aromatic amino acid:

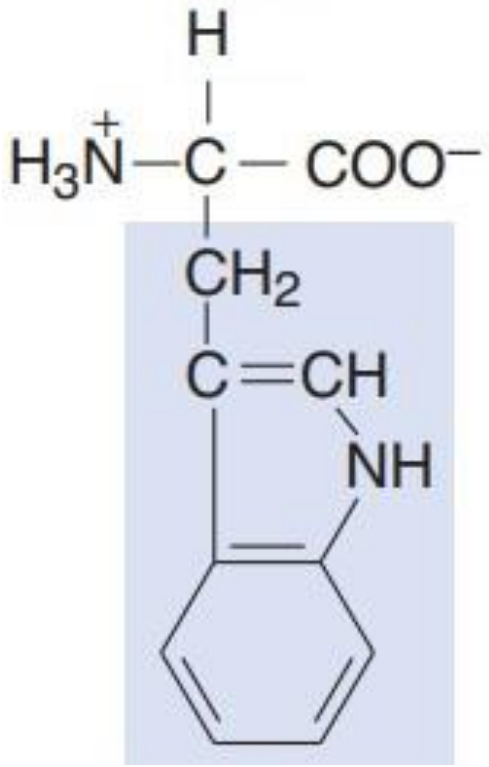
Phenylalanine



Tyrosine



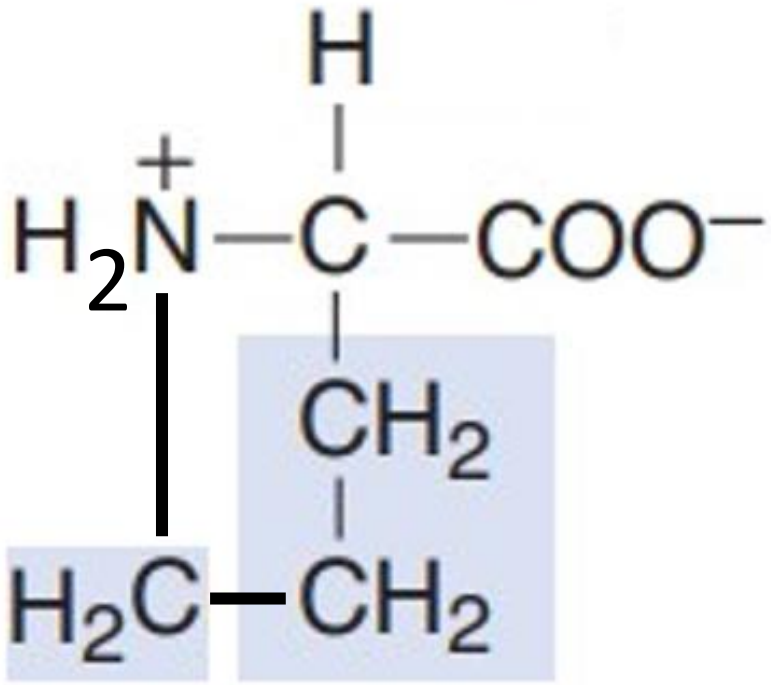
Tryptophan



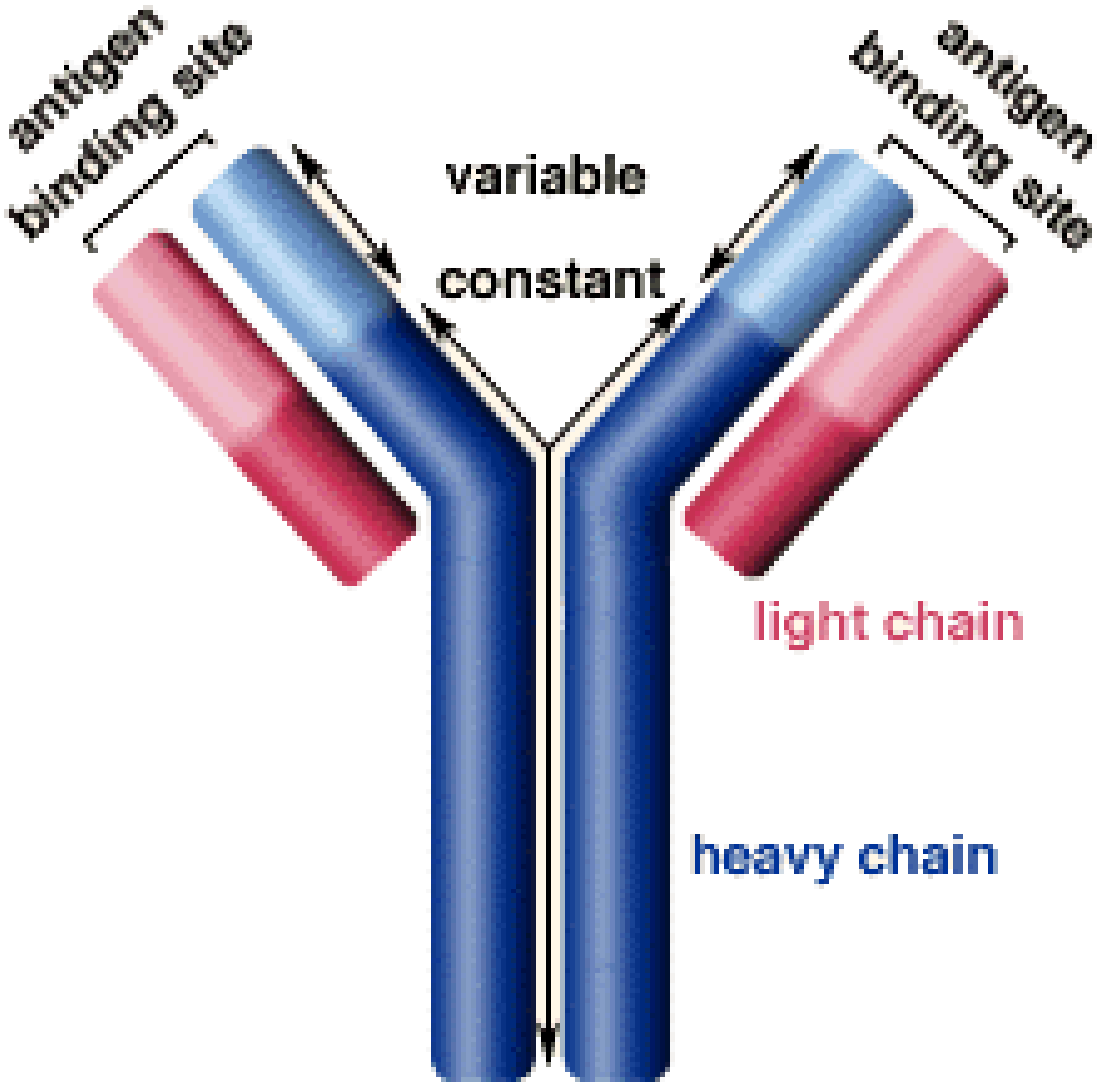
Based on the variable side chain

9. **Imino acid:**

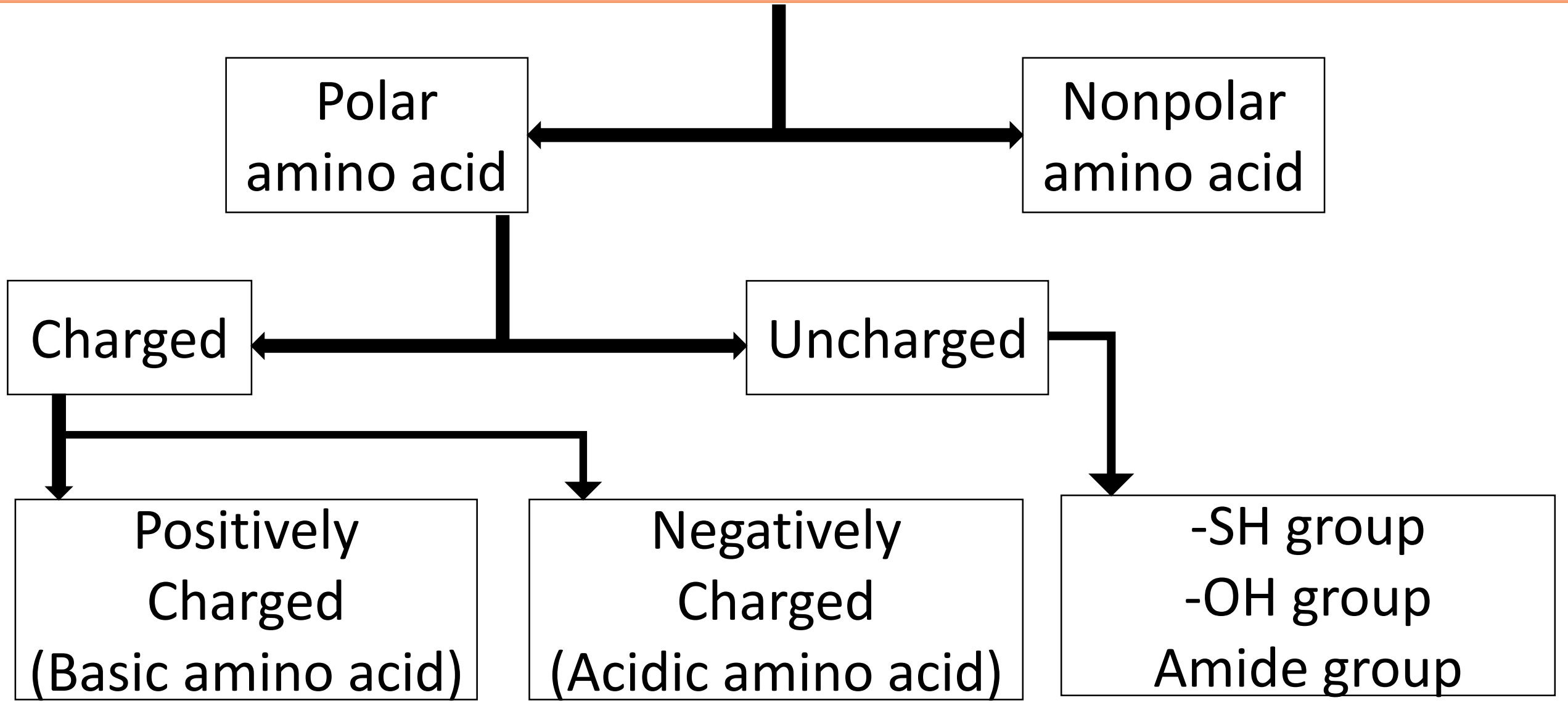
Proline



Why we need to know this classification???



Based on side chain characteristics (Polarity)



Based on nutritional requirement

1. Essential amino acids.
2. Semi essential amino acids.
3. Nonessential amino acid.

Based on nutritional requirement

1. **Essential amino acids:** Those amino acid which cannot be synthesised in the body. Hence these amino acids are to be supplied in the diet.

"METT VIL PHLY"

Based on nutritional requirement

1. **Essential amino acids:**

"METT VIL PHLY"

ME → **Me**thionine.

T → **T**heronine.

T → **T**ryptophan.

V → **V**aline.

I → **I**soleucine.

L → **L**eucine.

PH → **Ph**enyl Alanine.

LY → **Ly**sine.

Based on nutritional requirement

2. **Semi essential amino acids:** Growing children required them in the food, but not essential in adults.

E.g., Histidine and arginine.

3. **Non essential amino acid:** Amino acids which can be synthesised in the body, hence not required in the diet.

E.g., Rest of the amino acid.

Based on metabolic fate

1. Ketogenic amino acids.
2. Glucogenic amino acids.
3. Both Glucogenic and ketogenic amino acids.

Based on metabolic fate

1. **Purely Ketogenic amino acids:** Amino acids that are converted to acetyl CoA and thereby to ketogenic pathway.

E,g., Leucine.

Based on metabolic fate

2. **<u>Both Ketogenic and glucogenic amino acids:</u>** These are the amino acid which can be used for production of both ketone bodies and glucose.

E,g., Aromatic amino acids except histidine.

Isoleucine.

Lysine.

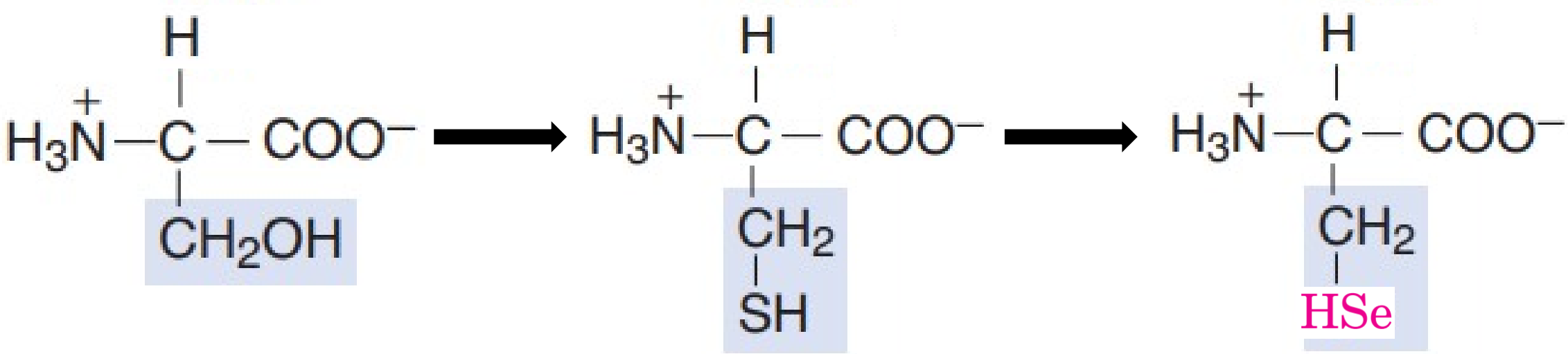
Based on metabolic fate

3. **<u>Glucogenic amino acids:</u>** These are the amino acid which can be used for production of glucose.

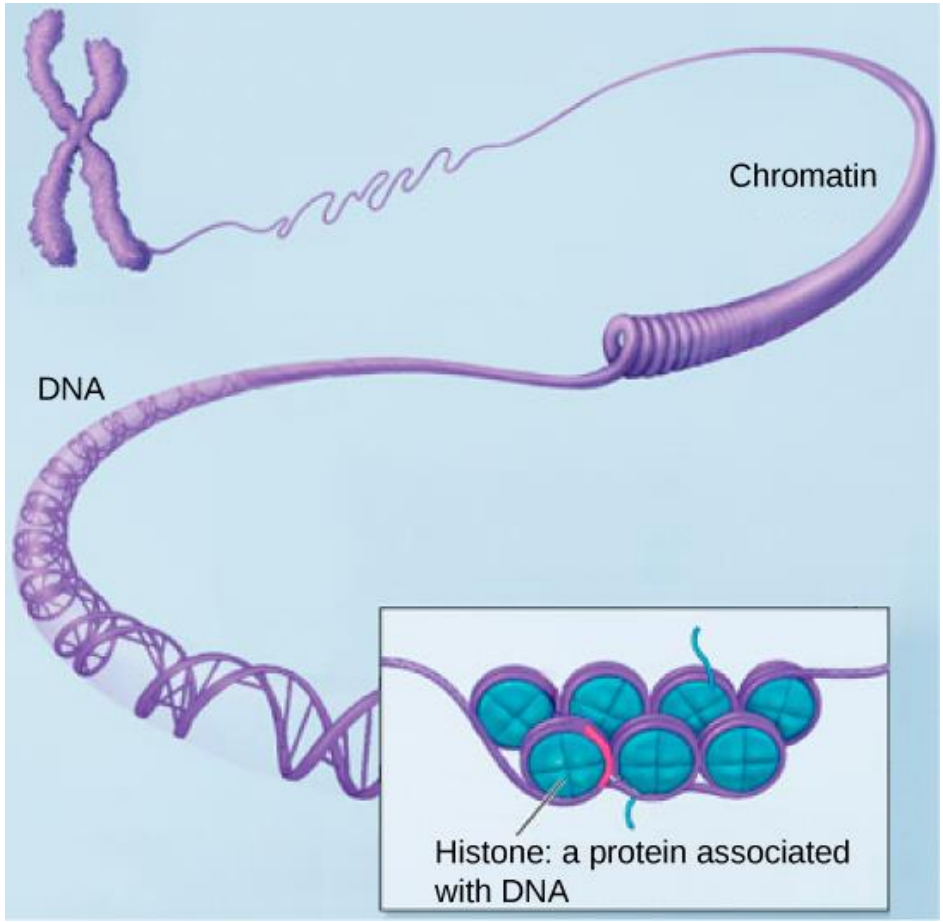
E,g., Rest of the amino acids.

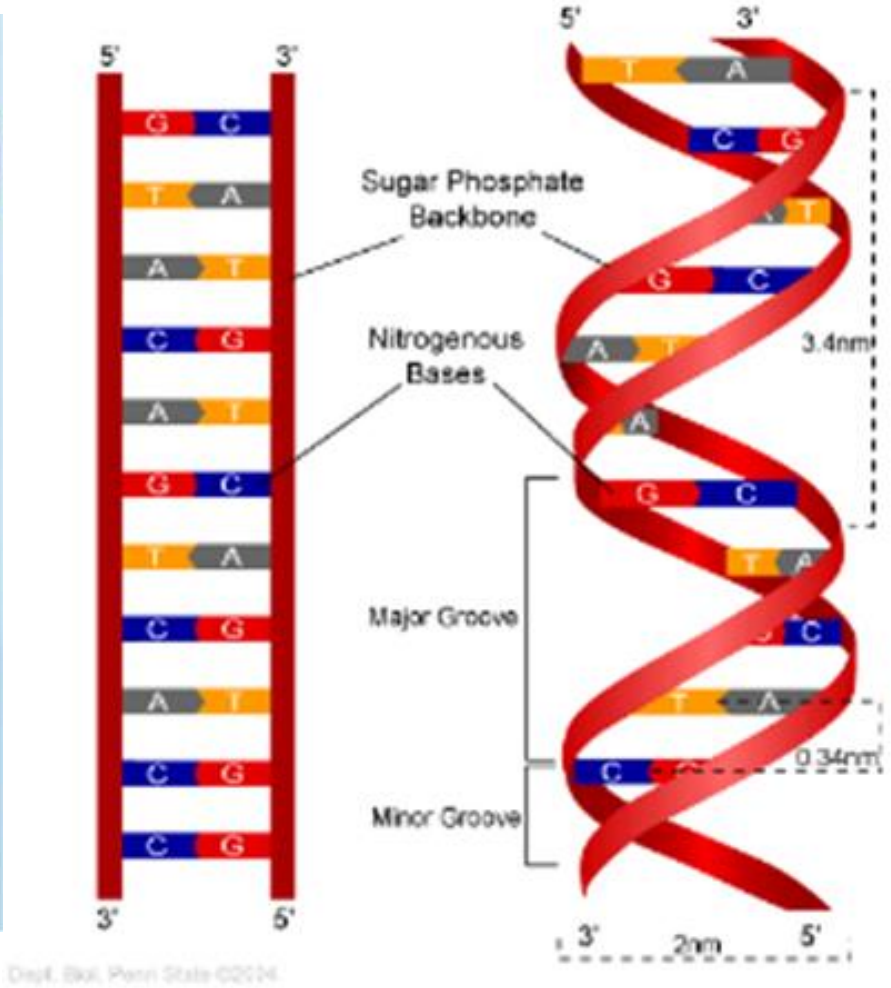
21st amino acid - **Selenocysteine**

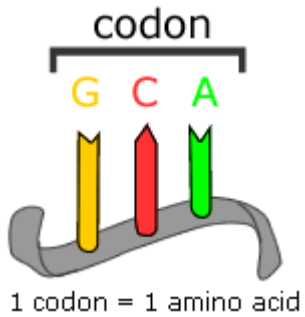
❖**21st amino acid:**



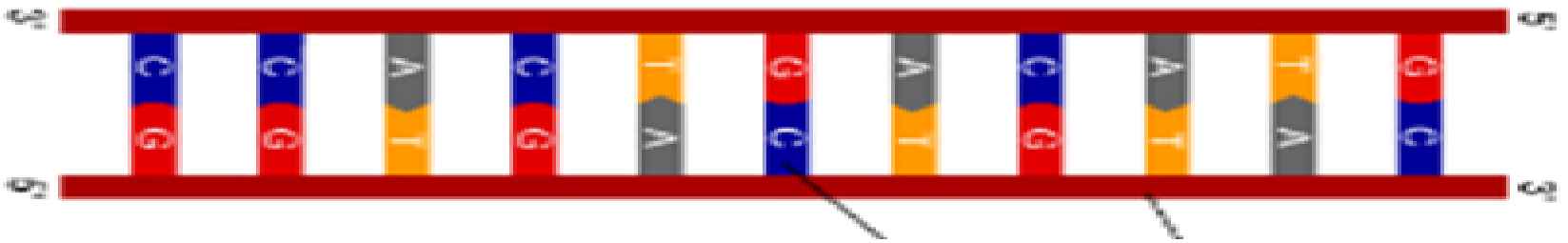
21st amino acid - **Selenocysteine**

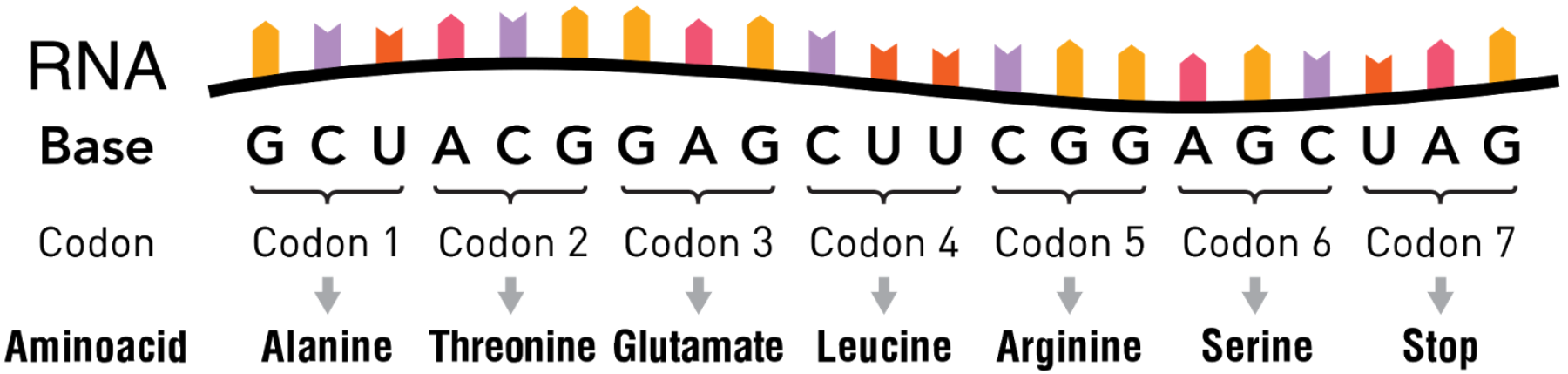


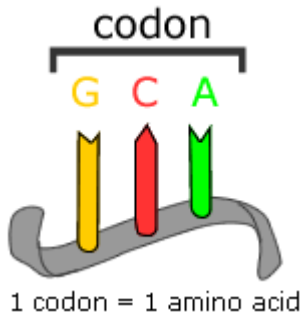




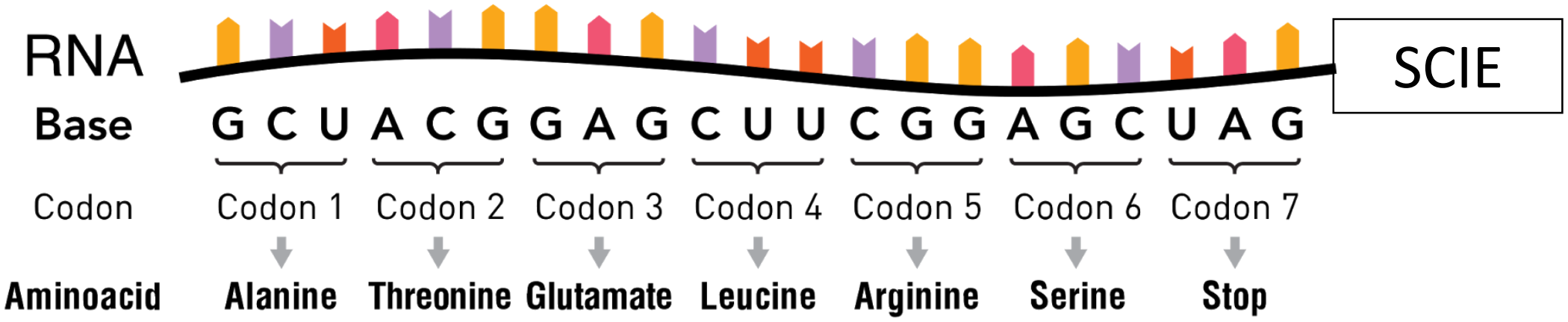
21st amino acid - **Selenocysteine**







21st amino acid - **Selenocysteine**



SCIE

21^{st} amino acid - **Selenocysteine**

❖**21^{st} amino acid:**

- It is selenocysteine.
- The precursor for selenocysteine is serine.
- Serine is modified to cysteine. Selenium replaces sulphur of cysteine.
- It is coded by stop codon, UGA.

21st amino acid - **Selenocysteine**

❖ **21st amino acid:**

- Selenocysteine containing enzymes are,
  - Glutathione peroxidase.
  - 5’ deiodinase.
  - Thioredoxine reductase

22^{nd} amino acid - pyrrolysine

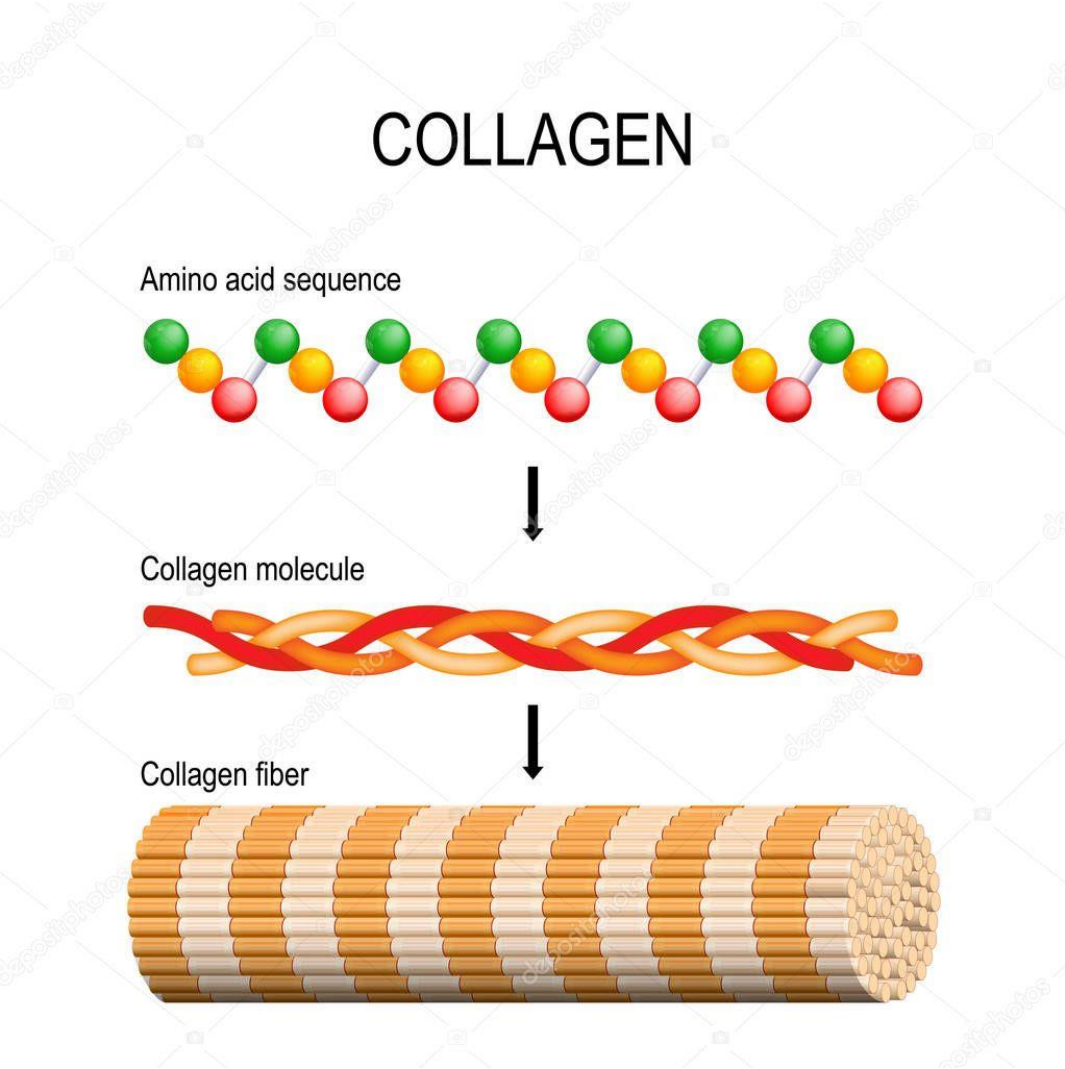
❖**<u>22^{nd} amino acid:</u>**

- It is pyrrolysine.
- It is coded by UAG stop codon.
- It is present in bacterial enzymes.

Non standard amino acid

- Derived amino acid.

Derived amino acid



Derived amino acid

- Derived amino acid are the one which is formed in the body by posttranslational modification. They don’t have any codon.

- Type:

1. Derived amino acid present in protein.
2. Derived amino acid which is not present in protein.

Derived amino acid

❖Type:

1. Derived amino acid present in protein.

- E.g.,

  ➢Proline → hydroxyproline.

  ➢Lysine → hydroxylysine.

  ➢Gamma carboxy glutamate

Collagen (Hydroxylation)

Derived amino acid

❖Type:

2. Derived amino acid not seen in protein.

- E.g.,

  - ➢Ornithine.
  - ➢Argininosuccnate.
  - ➢Citrulline.

] Urea cycle

Amino acid used as drug

1. D-Penicillamine as copper chelating agent.
2. N-acetyl cysteine is used in cystic fibrosis.
3. Gabapentin is used as an anticonvulsant.
4. Azaserine → Anticancer drugs.
5. Cycloserine → Anti tuberculosis drug.

THANK YOU