

SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES

Affiliated To The Tamil Nadu Dr. MGR Medical University, Chennai

Approved by Pharmacy Council of India, New Delhi.

Coimbatore -641035



COURSE NAME : BIOCHEMISTRY AND CLINICAL PATHOLOGY

D.PHARM/ II YEAR

**TOPIC:DEFINITION, CLASSIFICATION OF AMINO ACIDS BASED ON CHEMICAL
NATURE AND NUTRITIONAL REQUIREMENTS WITH EXAMPLES**

DESIGN THINKING STAGES IN CLASSIFICATION

Empathize: Understand the users — in this case, students, pharmacists, or researchers who use the alphabetical classification system.

Define: Clearly define the problem based on the insights from the empathize stage.

Ideate: Generate possible solutions or improvements.

Prototype: Create a tangible version of your solution

Test: Evaluate the prototype with real users.

ABOUT AMINO ACIDS

Amino Acids

Amino acids are organic compounds containing an **Amino Group** ($\sim\text{NH}_2$) and a **Carboxyl Group** ($\sim\text{COOH}$). They are the **Building Blocks of Proteins**.

Classification of Amino Acids

Based on Chemical Nature

Neutral Amino Acids

- Glycine, Alanine, Valine



Acidic Amino Acids

- Aspartic Acid, Glutamic Acid



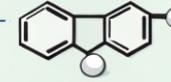
Basic Amino Acids

- Lysine, Arginine, Histidine



Aromatic Amino Acids

- Phenylalanine, Tyrosine, Tryptophan



Sulphur-Containing Amino Acids

- Cysteine, Methionine



Hydroxy Amino Acids

- Serine, Threonine



Based on Nutritional Requirements

Essential Amino Acids



Non-Essential Amino Acids



Semi-Essential Amino Acids



DEFINITION & CLASSIFICATION OF AMINO ACIDS

AMINO ACIDS: DEFINITIONS & CLASSIFICATION

BASED ON CHEMICAL NATURE

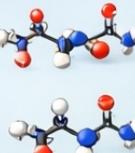
Non-Polar (Hydrophobic)

- Glycine (Gly)
- Alanine (Ala)
- Leucine (Leu)



Polar (Hydrophilic)

- Serine (Ser)
- Threonine (Thr)
- Asparagine (Asn)



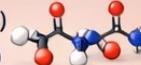
Aromatic

- Phenylalanine (Phe)
- Tyrosine (Tyr)
- Tryptophan (Trp)



Negatively Charged (Acidic)

- Aspartic Acid (Asp)
- Glutamic Acid (Glu)



Positively Charged (Basic)

- Lysine (Lys)
- Arginine (Arg)
- Histidine (His)



Sulfur-Containing

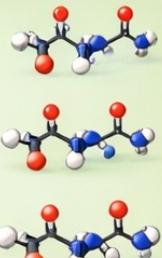
- Cysteine (Cys)
- Methionine (Met)



BASED ON NUTRITIONAL REQUIREMENTS

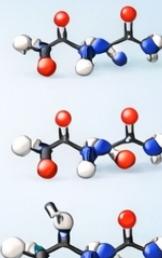
Essential Amino Acids

- Leucine
- Lysine
- Valine
- Phenylalanine
- Tryptophan
- Isoleucine
- Threonine
- Methionine



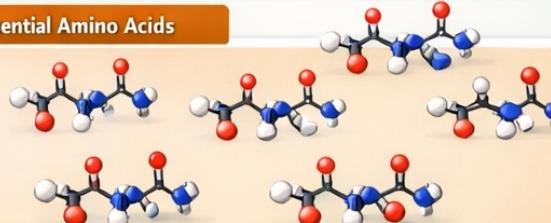
Non-Essential Amino Acids

- Alanine
- Glycine
- Serine
- Asparagine
- Aspartic Acid
- Glutamic Acid
- Proline
- Tyrosine



Conditionally Essential Amino Acids

- Arginine
- Cysteine
- Tyrosine
- Glutamine
- Proline

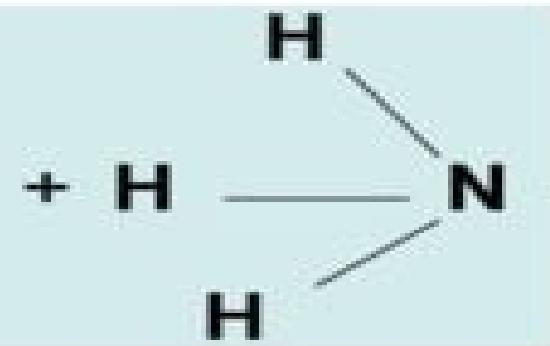


Amino Acids are the building blocks of proteins, essential for various biological functions.

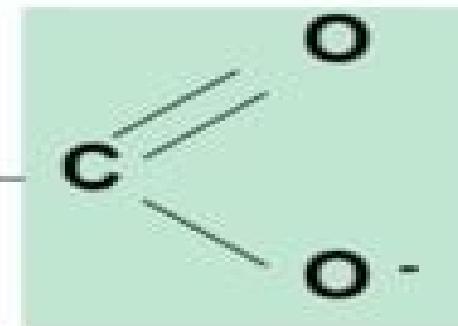
Amino Acid Structure

Hydrogen

Amino



Carboxyl



R-group
(variant)

BASED ON CHEMICAL NATURE OF AMINO ACIDS

AMINO ACIDS

BASED ON CHEMICAL NATURE

NON-POLAR

Hydrophobic

- Glycine, Alanine,
- Valine, Leucine

POLAR

Hydrophilic

- Serine,
- Threonine,
- Asparagine

ACIDIC

Negatively Charged

- Aspartic Acid,
- Glutamic Acid

BASIC

Positively Charged

- Lysine,
- Arginine,
- Histidine

AROMATIC

Ring Structure

- Phenylalanine,
- Tyrosine,
- Tryptophan

• Cysteine-Containing



BASED ON NUTRITIONAL REQUIREMENTS

ESSENTIAL AMINO ACIDS

Cannot be synthesized by the body

- Leucine,
- Isoleucine,
- Lysine,
- Methionine,
- Phenylalanine,
- Threonine,
- Tryptophan,
- Valine

NON-ESSENTIAL AMINO ACIDS

Can be synthesized by the body

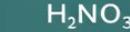
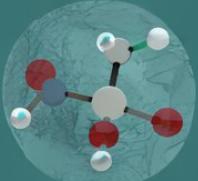
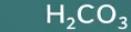
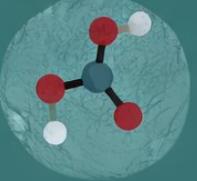
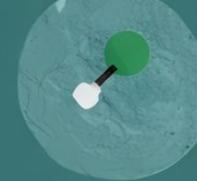
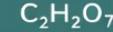
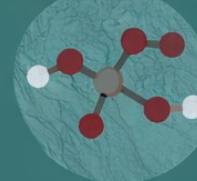
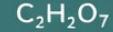
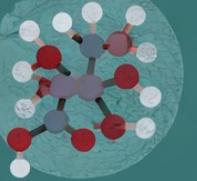
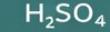
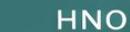
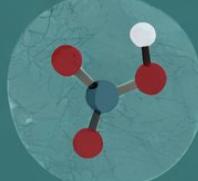
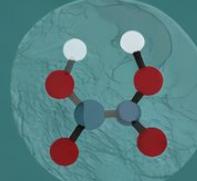
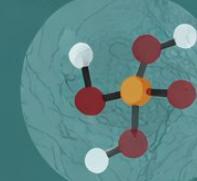
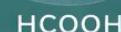
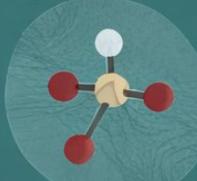
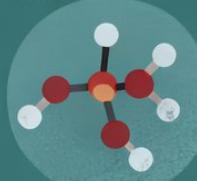
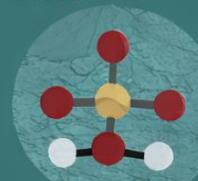
- Alanine
- Glycine
- Serine,
- Proline
- Aspartic Acid,
- Glutamic Acid,
- Cysteine,
- Asparagine

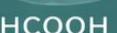
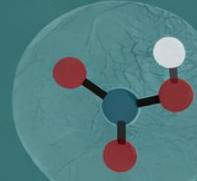
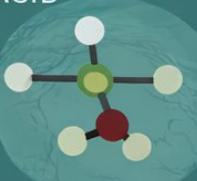
CONDITIONALLY ESSENTIAL

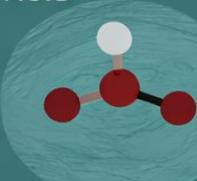
Required during stress or illness

- Arginine,
- Tyrosine,
- Cysteine,
- Glutamine

10 Common Acids

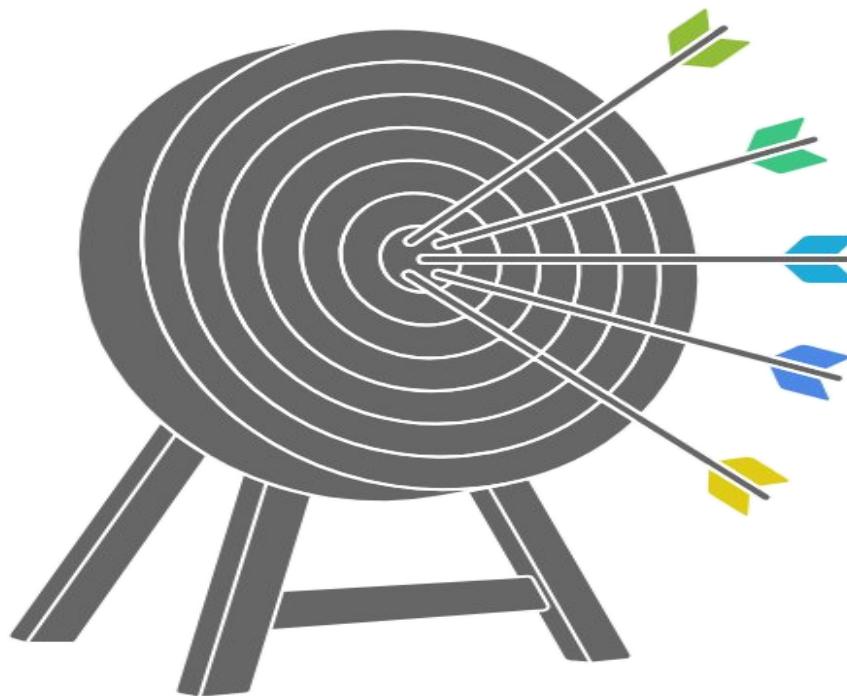
 KONTIC
ACID

 CARBONIC
ACID

 HYDROCHLORIC
ACID

 HYDROCHLORIC
ACID

 CITRIC
ACID

 SILFURIC
ACID

 NITRIC
ACID

 OXALIC
ACID

 PHOSPHORIC
ACID

 PHOSPHORIC
ACID

 SULFURIC
ACID

 ACETIC
ACID

 HYDROFLUORIC
ACID

 FORMIC
ACID

 PERCHLORIC
ACID

 CHROMIC
ACID

 HYPOCHLOROUS
ACID


CLASSIFICATION OF AMINO ACIDS

Amino Acid Classification



Protein Formation

Essential role in building proteins



Functional Groups

Amino and carboxylic acid groups



Structural Classification

Alpha, beta, gamma amino acids



Polarity and Ionization

Properties affecting interactions



Side-Chain Groups

Aliphatic, aromatic, polar types

Made with  Napkin

NOMENCLATURE OF AMINO ACIDS

Amino Acid Nomenclature

What do the systematic names and formulas refer to?

They refer to hypothetical forms where amino groups are unprotonated and carboxyl groups are undissociated.

Why is this convention used?

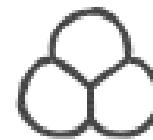
It avoids nomenclatural problems, but these structures don't represent a significant portion of amino-acid molecules.



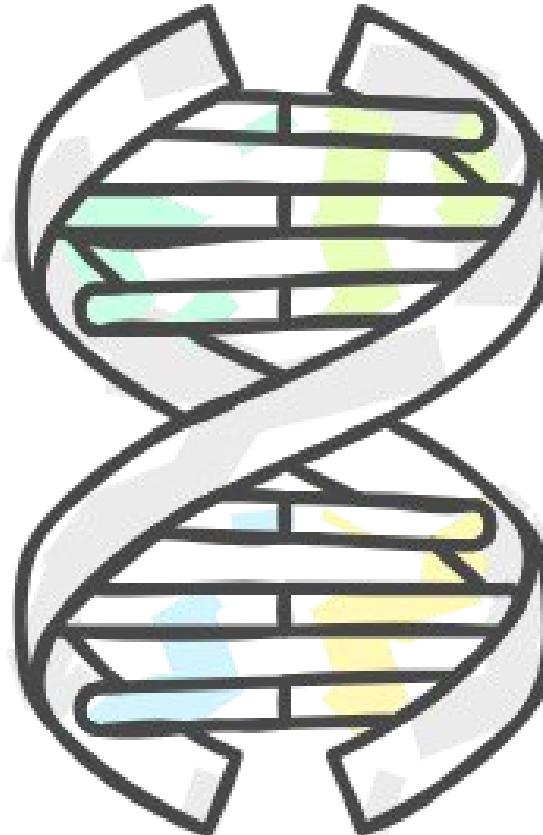
Made with  Napkin

Amino Acid Structure

α -Amino Acids



Chirality



β - and γ -
Amino Acids

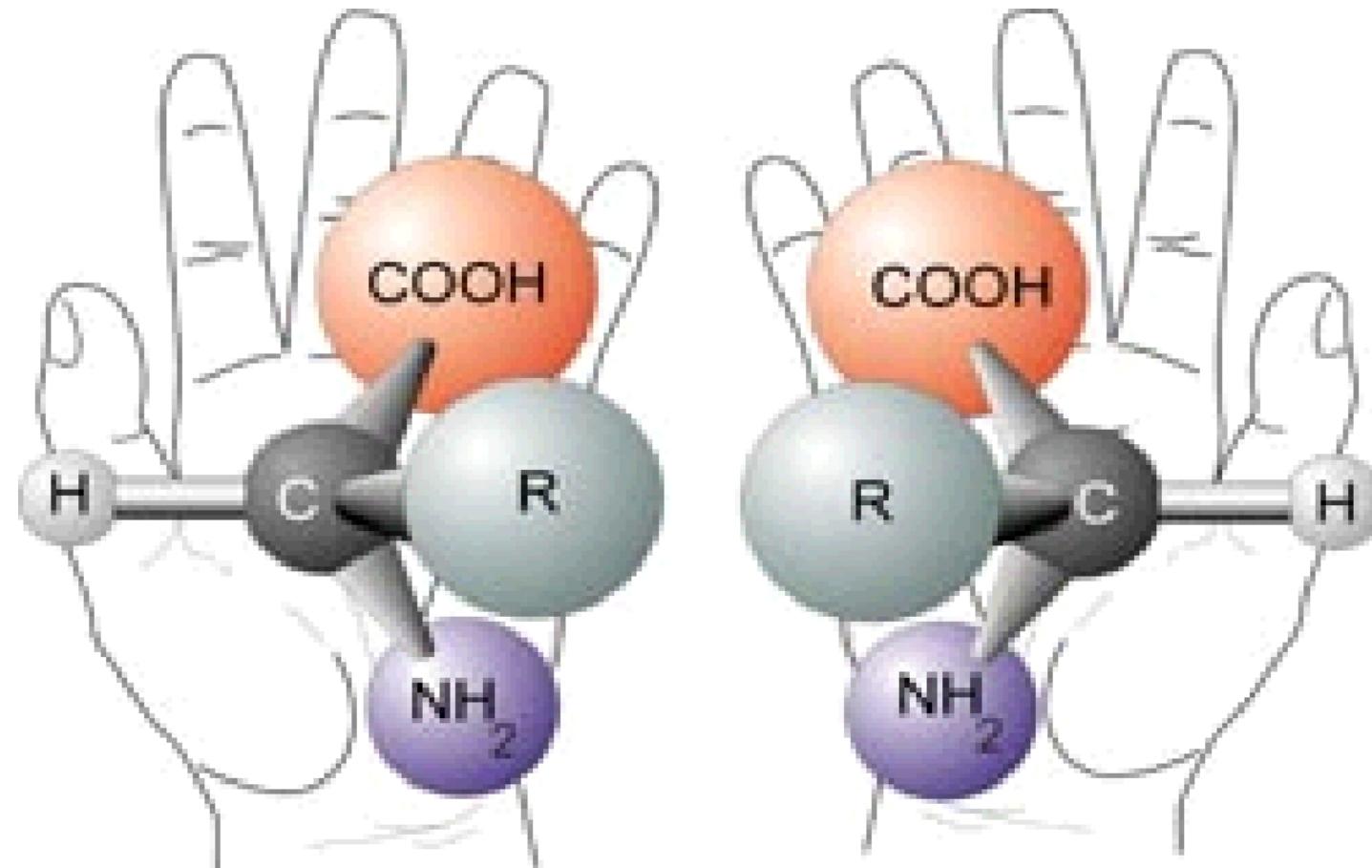


Side Chains

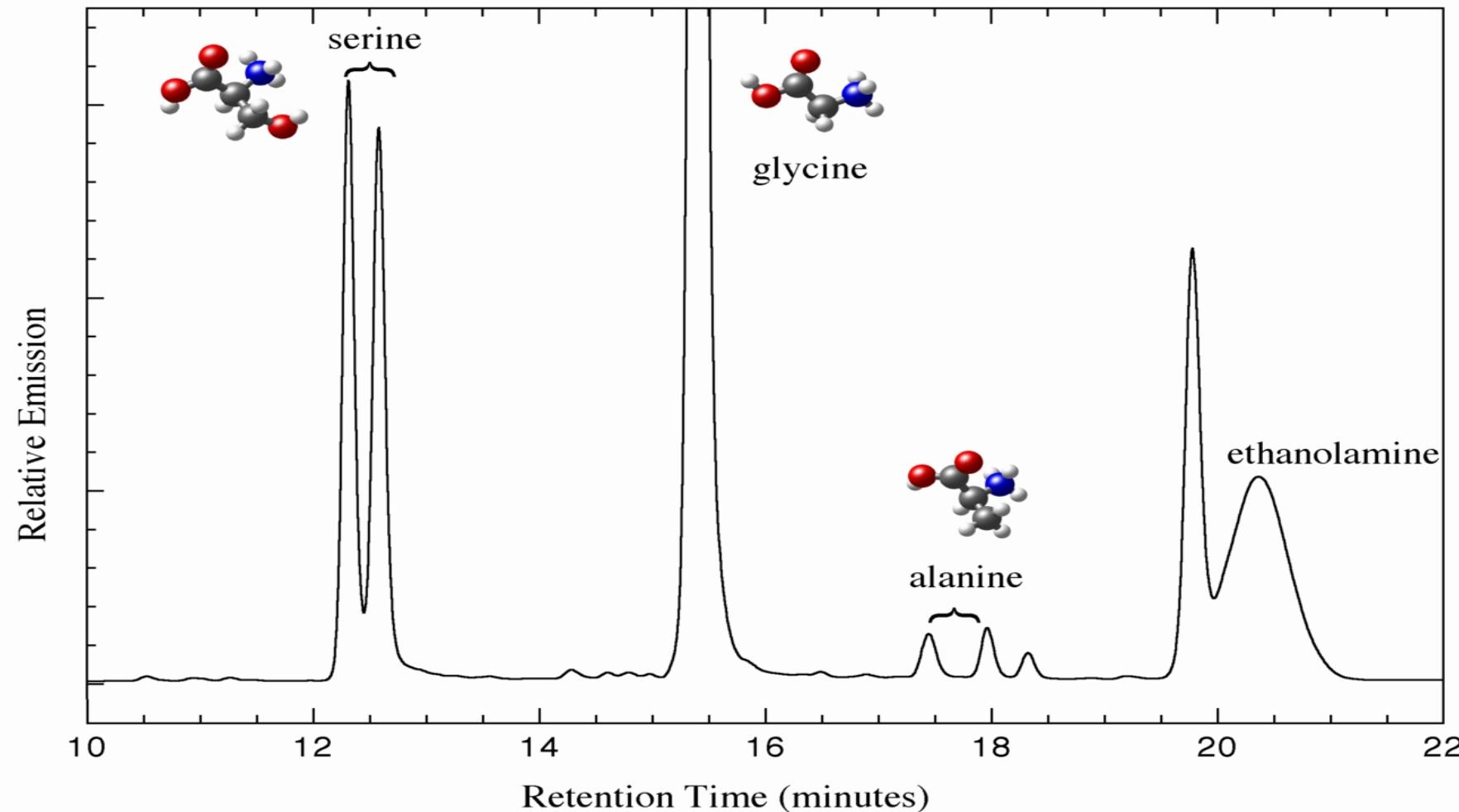


Made with ➡ Napkin

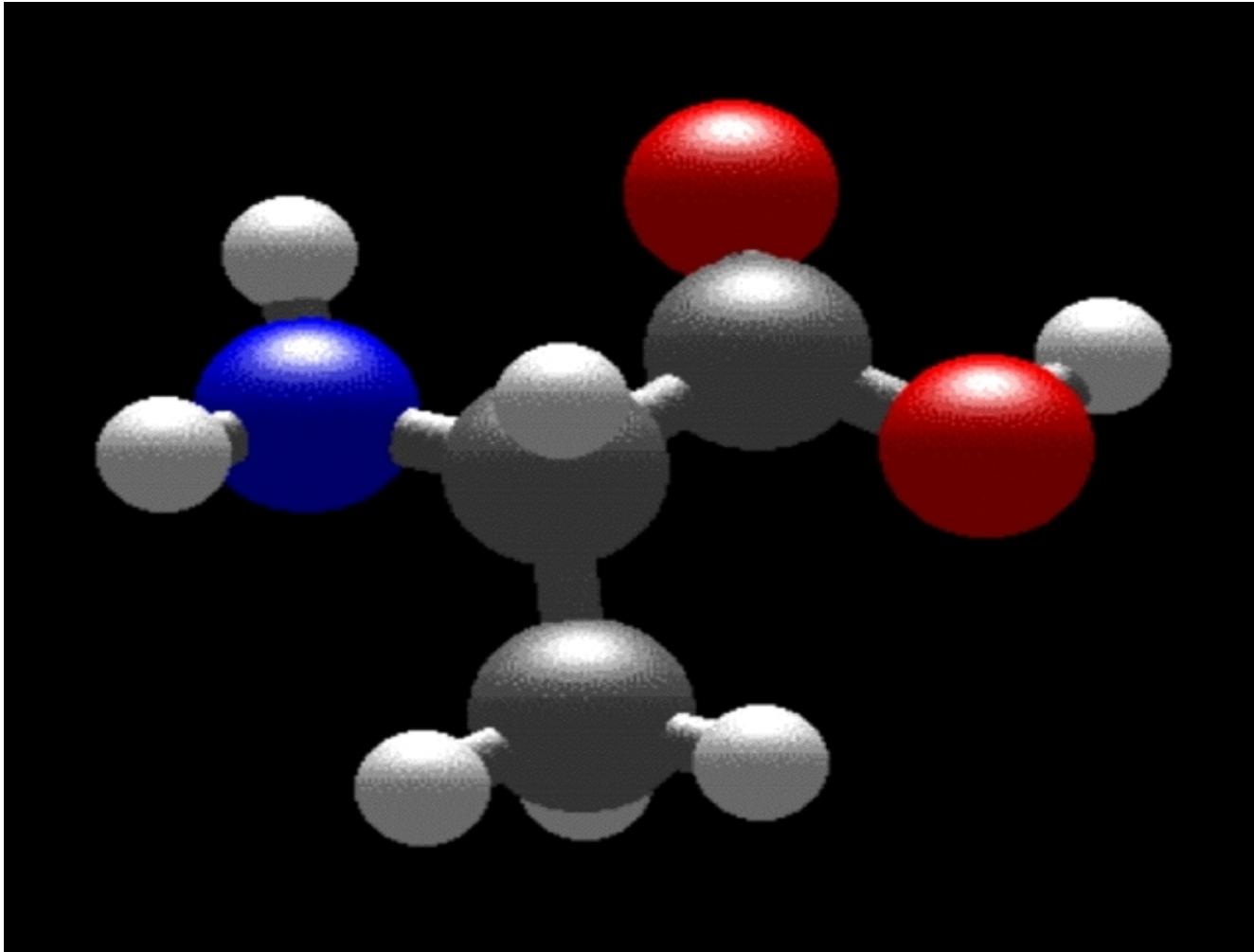
AMINO ACIDS COME IN RIGHT AND LEFT HANDED VERSIONS



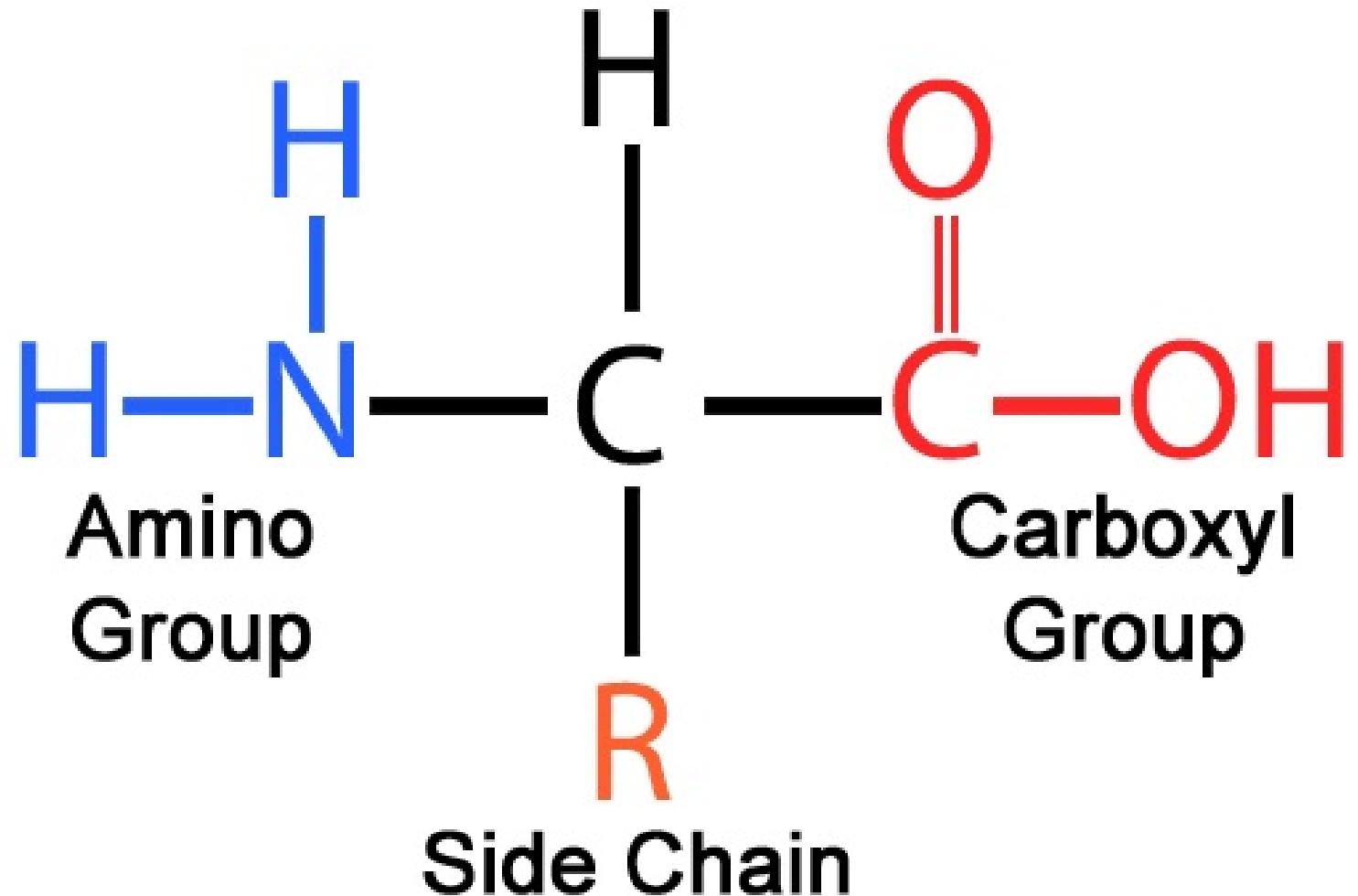
Amino Acids Produced by UV Ice Photolysis



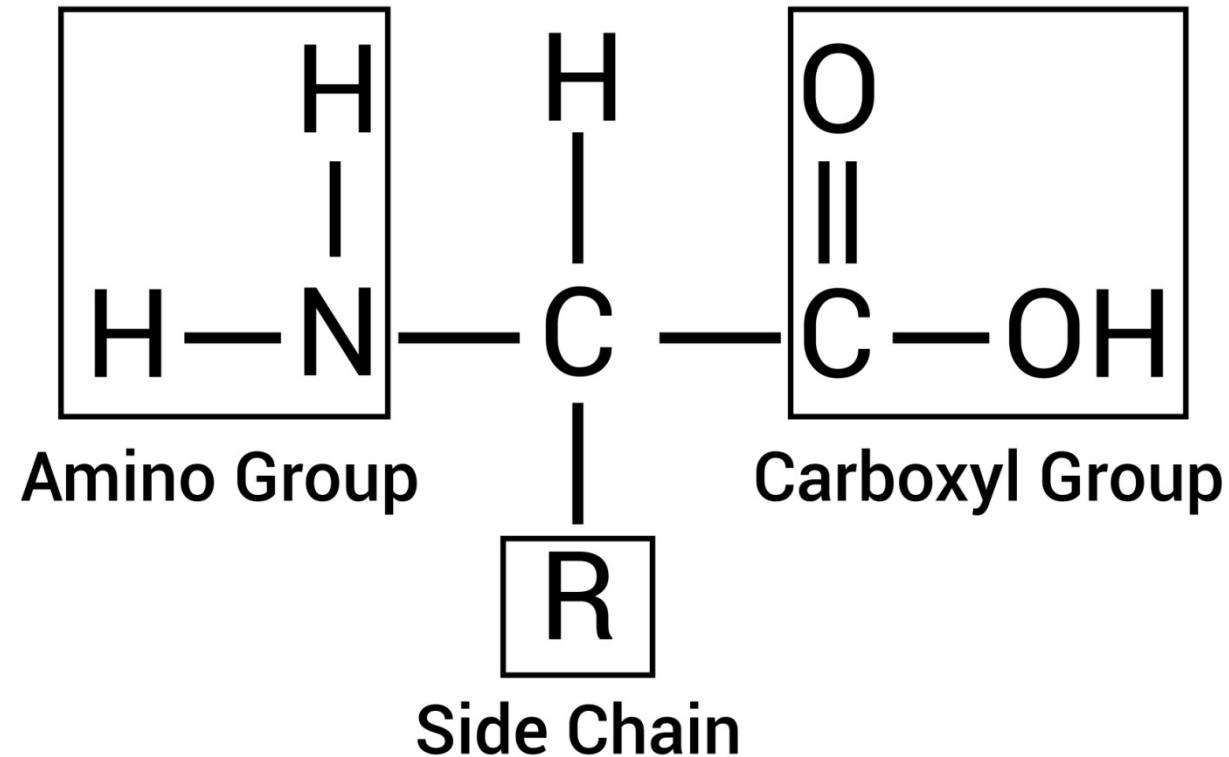
THE STRUCTURES OF THE SIMPLE AMINO ACIDS GLYCINE (LEFT) AND ALANINE (RIGHT)



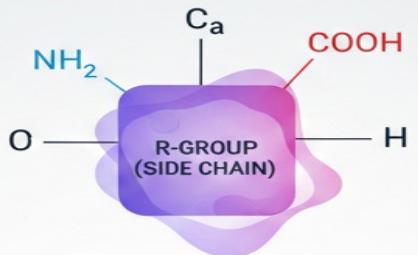
THE BASIC STRUCTURE OF ALL AMINO ACIDS



AMINO ACID CLASSIFICATION: CHEMICAL AND NUTRITIONAL

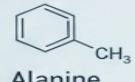


AMINO ACIDS: BUILDING BLOCKS OF LIFE

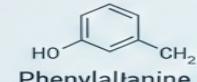


I. CLASSIFICATION BY CHEMICAL NATURE

1. NON-POLAR (HYDROPHOBIC)

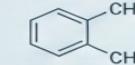


Alanine

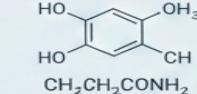


Phenylalanine

2. POLAR BUT UNCHARGED (HYDROPHILIC)



Serine



Tyrosine

3. CHARGED



Aspartate⁻

BASIC



$\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_3^+$

II. CLASSIFICATION BY NUTRITIONAL REQUIREMENTS



Must come from DIET
His, Ile, Leu, Lys, Met, Phe, Thr, Trp, Val



ESSENTIAL
Body cane from DIET



NON-ESSENTIAL
Ala, Asn, Asp, Glu, Ser



CONDITIONALLY ESSENTIAL
Essential during STRESS/GROWTH
Arg, Cys, Gly, Pro, Tyr

KEY EXAMPLES



Leucine, non-polar



Lysine
Serint, esseliat, polar

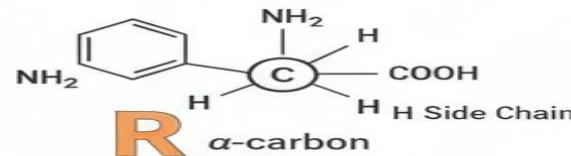


esetinl, ion, basic



CLASSIFICATION OF CHEMICAL NATURE VS NUTRITIONAL REQUIREMENTS

AMINO ACID CLASSIFICATION



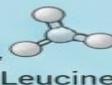
I. CHEMICAL NATURE (R-GROUP PROPERTIES)

Non-polar (Hydrophobic)



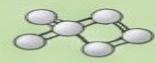
Glycine

Glycine, Alanine, Leucine, Isoleucine, Phenylalanine, Tryptophan, Methionine



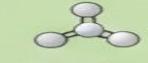
Leucine

Polar Uncharged (Hydrophilic)



Cystine

Serine, Threonine, Tyrosine, Cysteine



Aspartane

Charged (pH ~ 7.4)



Acidic (-)

Serine, Threonine, Tyrosine, Alanine, Glutamine, Cysteine

Basic



Lysinate +

II. NUTRITIONAL REQUIREMENTS (HUMANS)

Essential



Histidine, Isoleucine, Leucine, Lysine, Methionine, Tryptophane

Non-Essential



Alanine, Asparagine, Lysine, Phenylalanine, Threonine, Tryptophane, Serine

Conditionally Essential

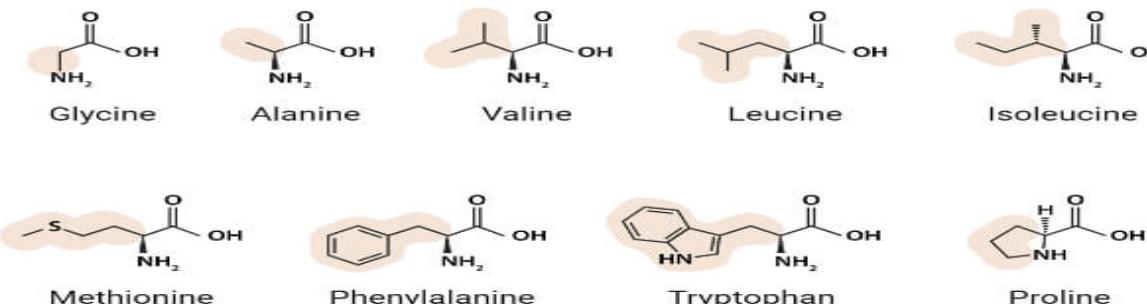


Arginine, Cysteine, Glutamine, Glutamate, Glycine, Proline, Tyrosine

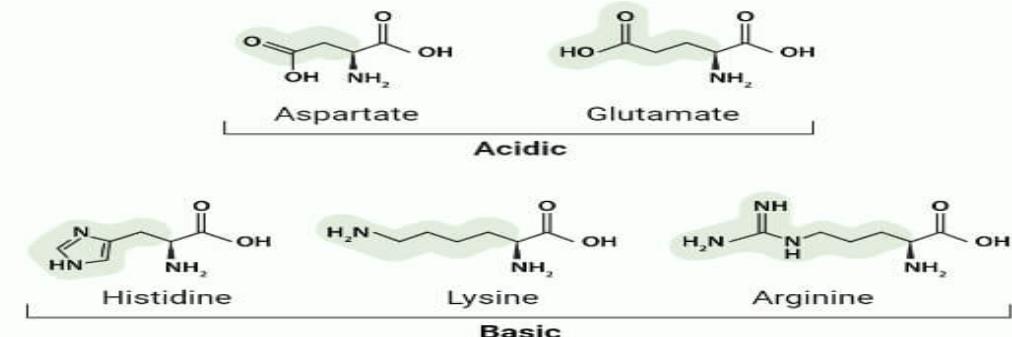
Leucine	Non-polar (Hydrophobic)	Polar Uncharged	Non-essential
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Amino Acid Chart

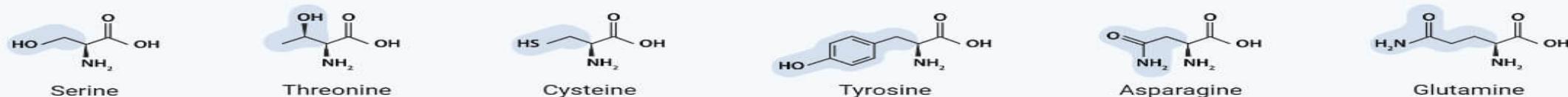
Non-polar side chains



Electrically charged side chains



Polar side chains



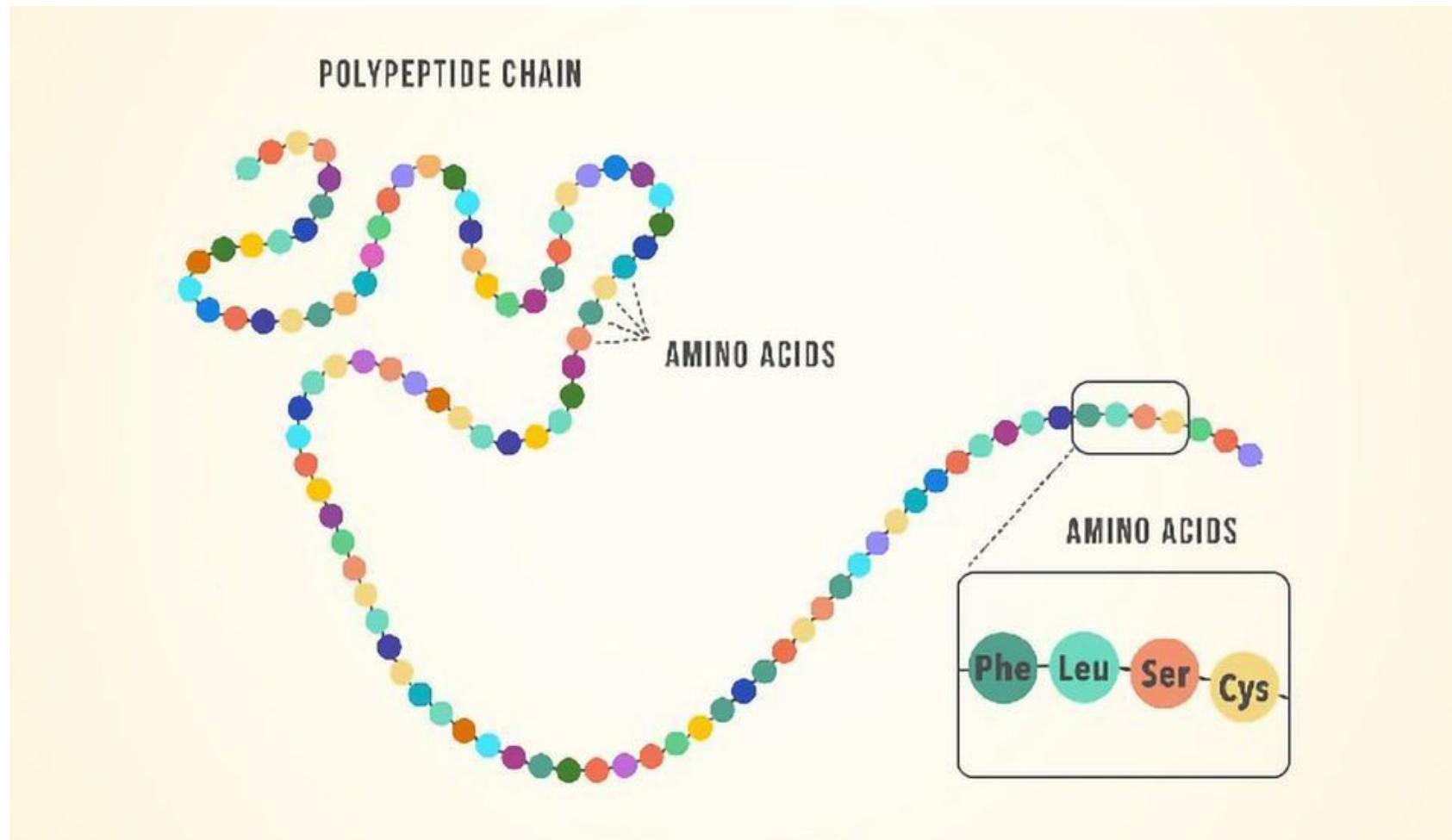
The
Biology
Notes

The 
Chemistry
Notes 

Created with
 Designed By Sagar Aryal

bio
RENDER

ESSENTIAL AMINO ACIDS: CHART, ABBREVIATIONS AND STRUCTURE



REFERENCES

1. Harper's Illustrated Biochemistry Robert K. Murray et al., McGraw-Hill Education, Latest Edition.
2. Lehninger Principles of Biochemistry David L. Nelson & Michael M. Cox, W.H. Freeman and Company.
3. Biochemistry U. Satyanarayana & U. Chakrapani, Elsevier India.
4. Textbook of Biochemistry for Medical Students D.M. Vasudevan, Sreekumari, Kannan, Jaypee Brothers Medical Publishers.
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6. Biochemistry for Pharmacy Students Pankaja Naik, CBS Publishers & Distributors.

Thank You

