Assist. Prof. Dr. Shakir .F. Tuleab
Ph. D. Biochemistry
University of Anbar
College Of Education For Pure Sciences
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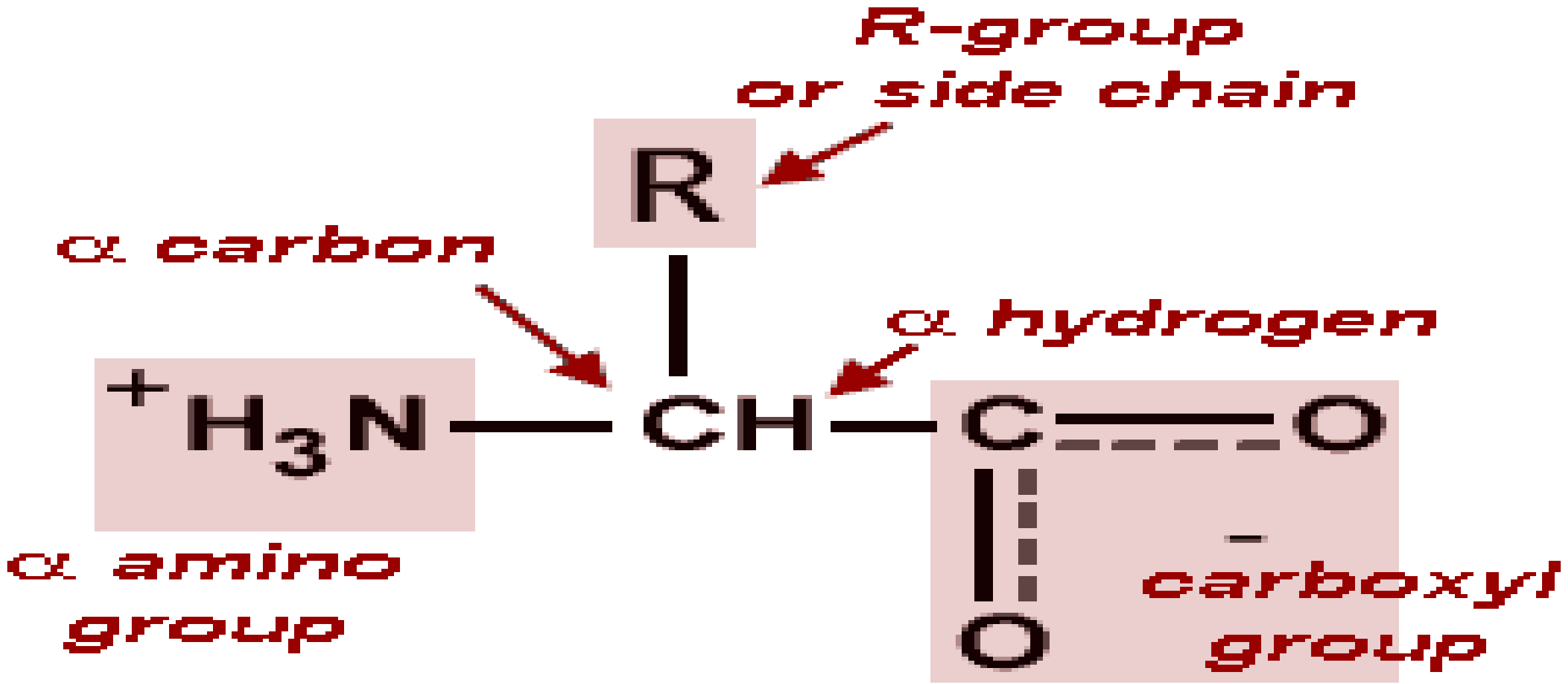
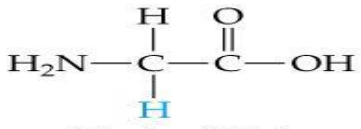
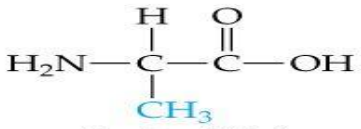
Main reactions of amino acids

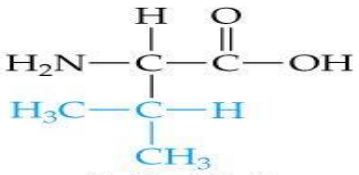


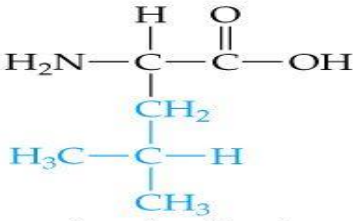
AMINO ACID STRUCTURE

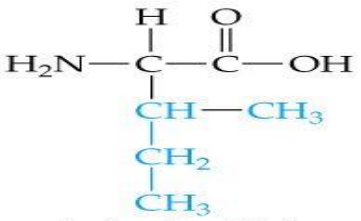
The 20 common amino acids of proteins

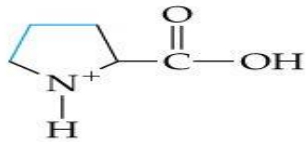

Glycine (Gly)

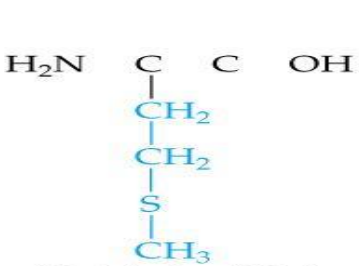

Alanine (Ala)

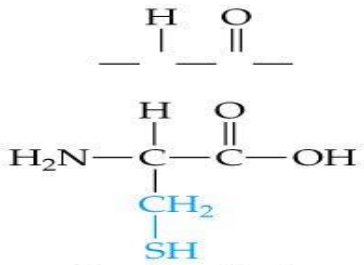

Valine (Val)

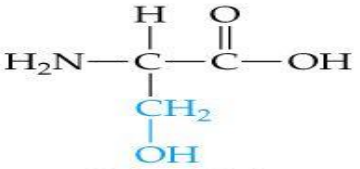

Leucine (Leu)

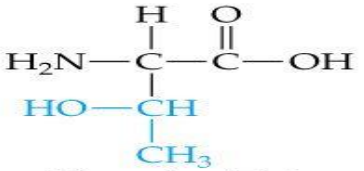

Isoleucine (Ile)

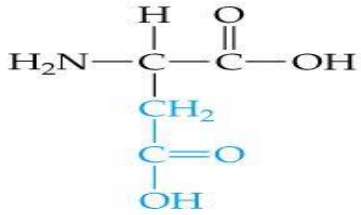

Proline (Pro)

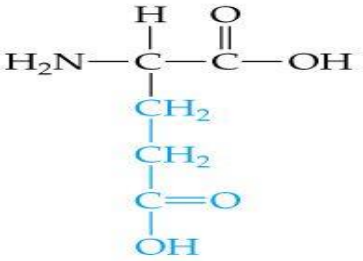

Methionine (Met)

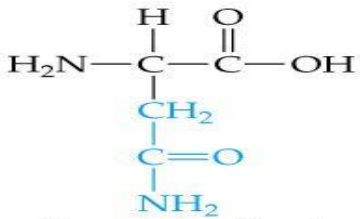

Cysteine (Cys)

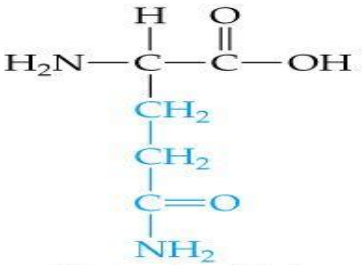

Serine (Ser)

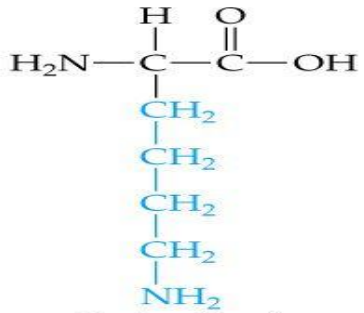

Threonine (Thr)

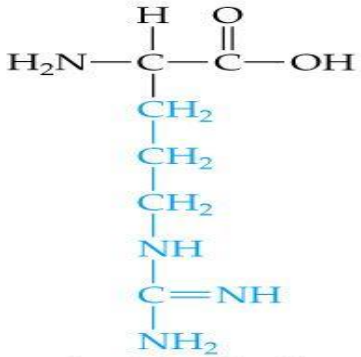

Aspartic acid (Asp)

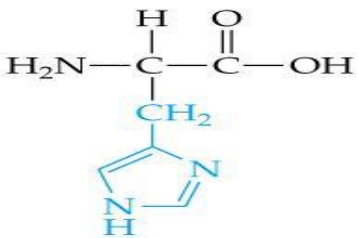

Glutamic acid (Glu)

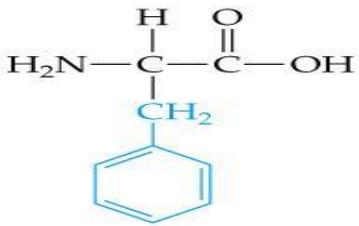

Asparagine (Asn)

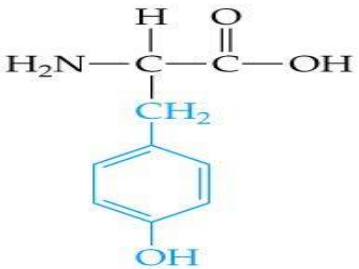

Glutamine (Glu)

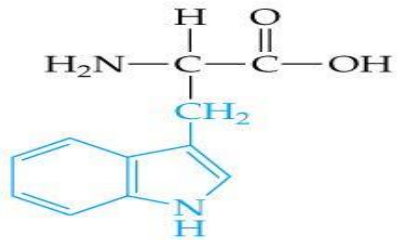

Lysine (Lys)


Arginine (Arg)

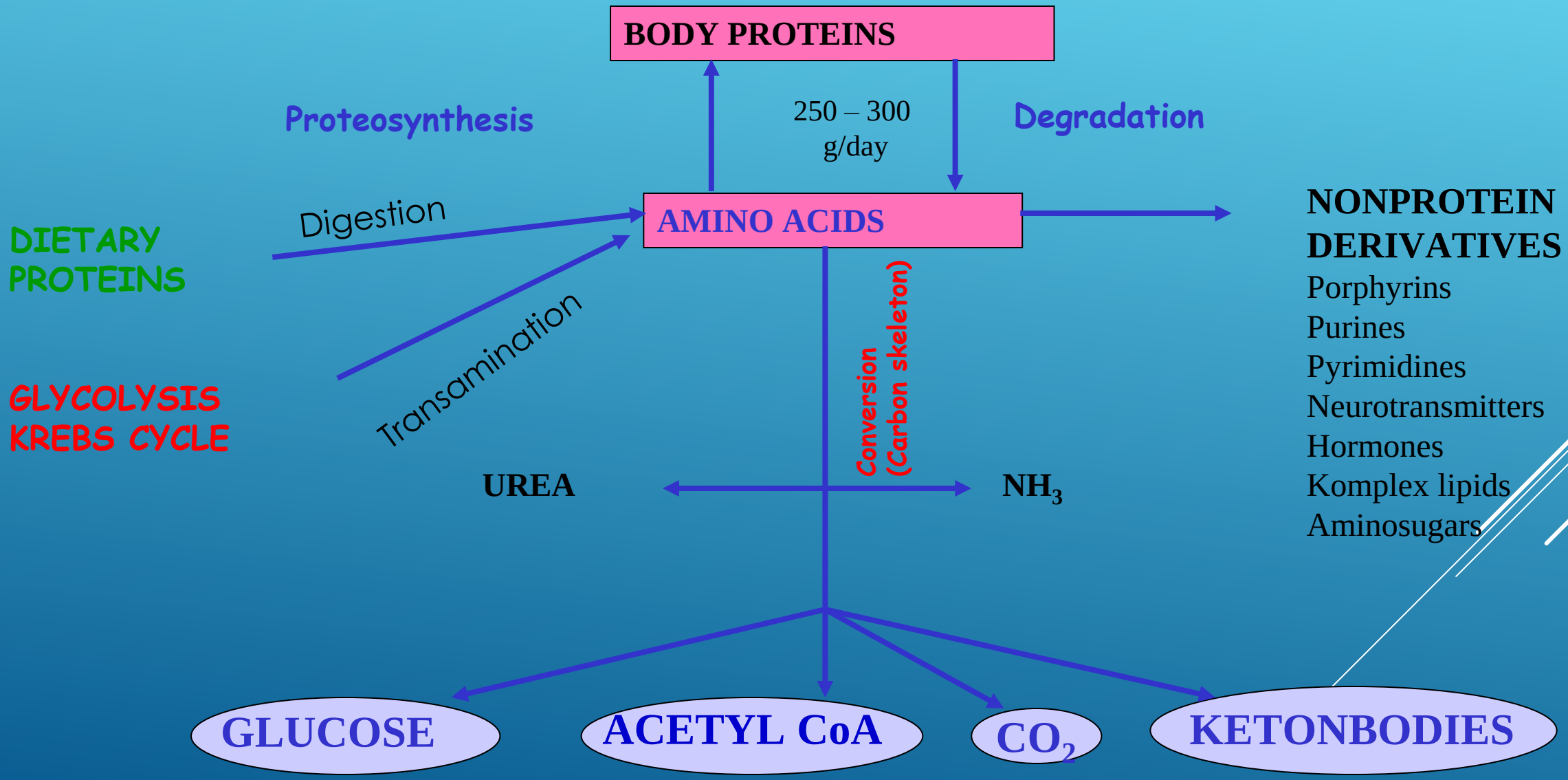

Histidine (His)


Phenylalanine (Phe)


Tyrosine (Tyr)


Tryptophan (Trp)

Metabolic relationship of amino acids



Enzymes cleaving the peptide bond

Endopeptidases – hydrolyse the peptide bond inside a chain: **pepsin, trypsin, chymotrypsin**

Exopeptidases – split the peptide bond at the end of a protein molecule: **aminopeptidase, carboxypeptidases**

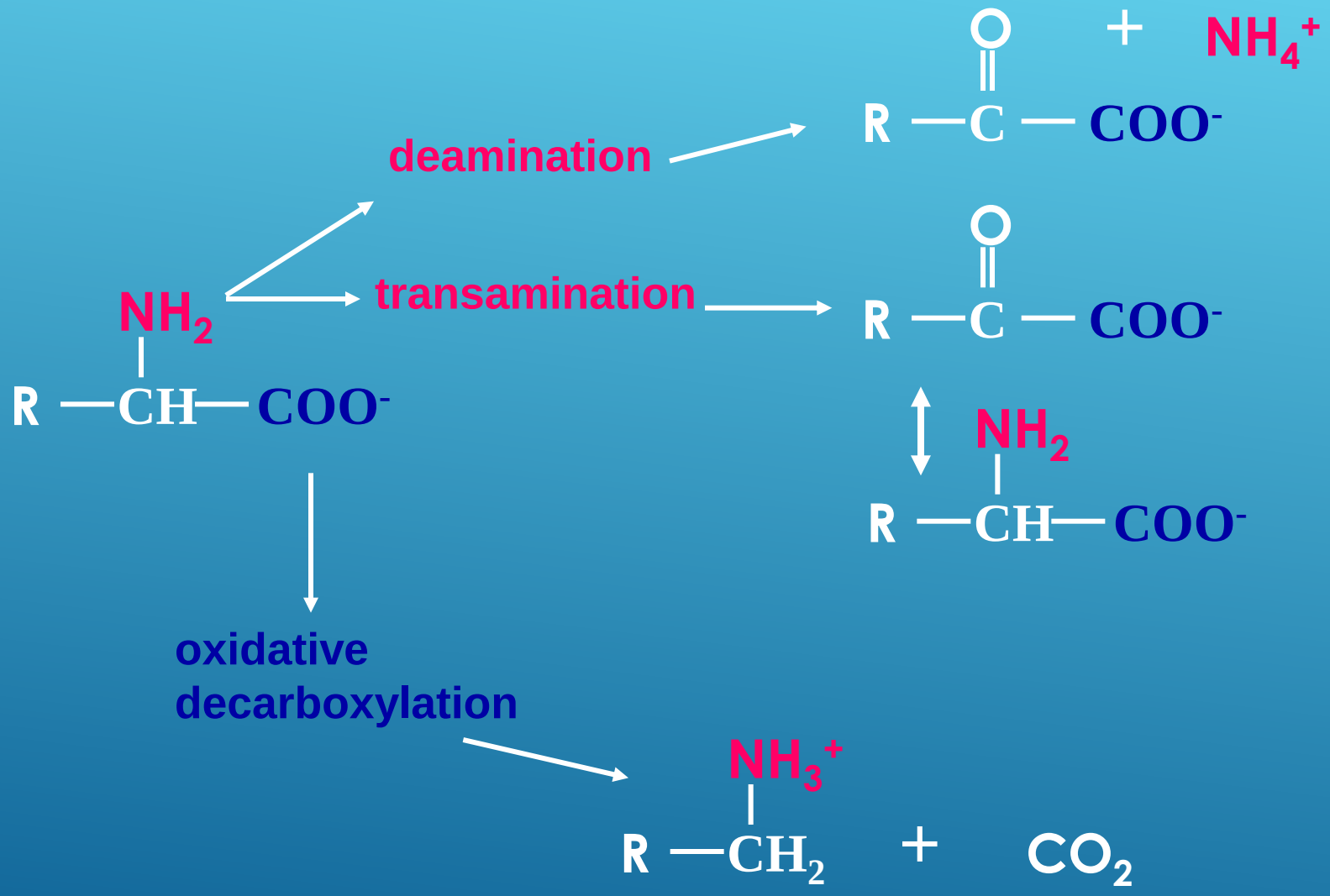
Dipeptidases

PEPSIN (PH 1.5 – 2.5) – PEPTIDE BOND DERIVED FROM TYR, PHE, BONDS BETWEEN LEU AND GLU

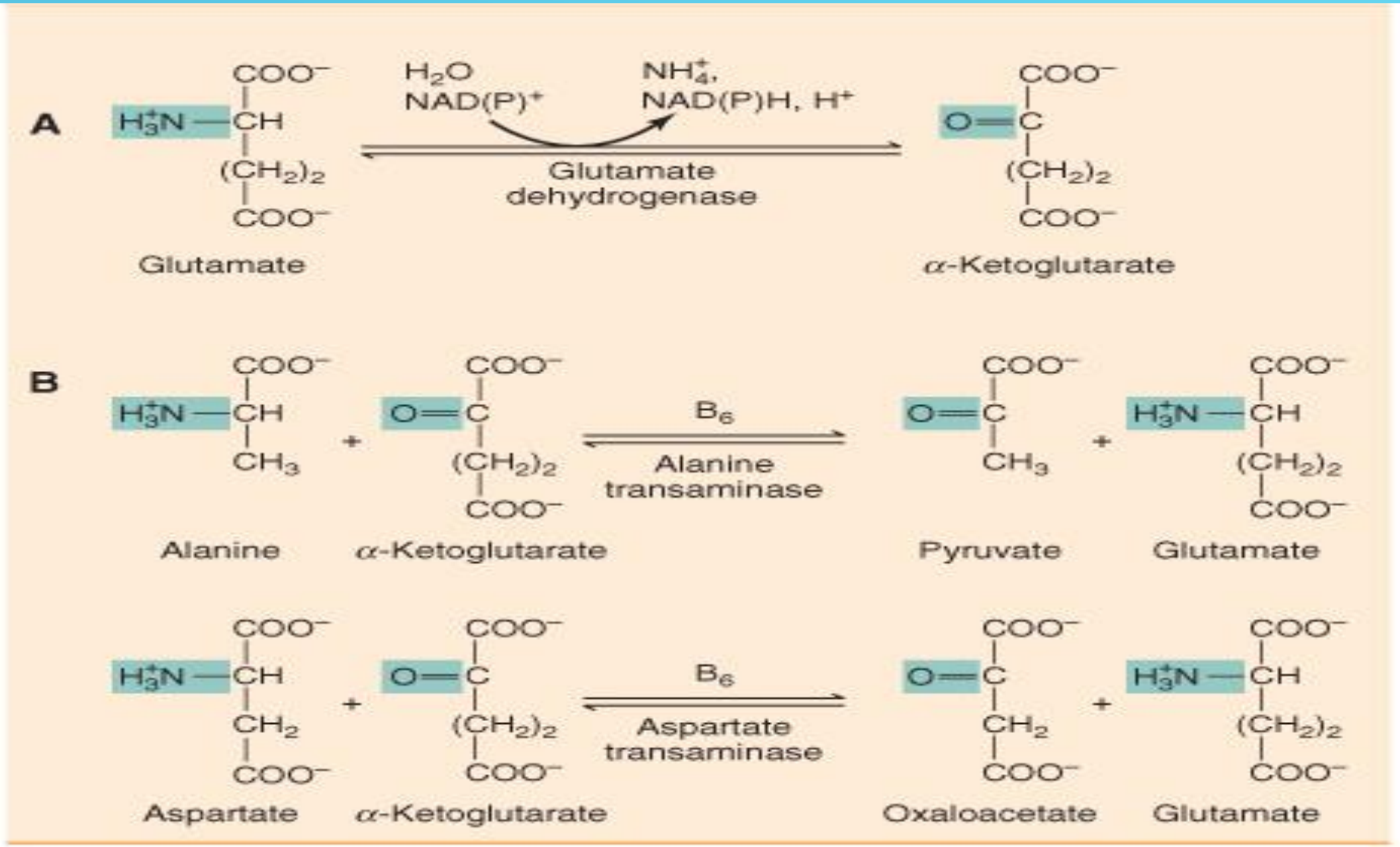
TRYPSIN (PH 7.5 – 8.5) – BONDS BETWEEN LYS & ARG

CHYMOTRYPSIN (PH 7.5 – 8.5) – BONDS BETWEEN PHE & TYR

General reactions of amino acid catabolism



The fate of the amino group during amino acid catabolism



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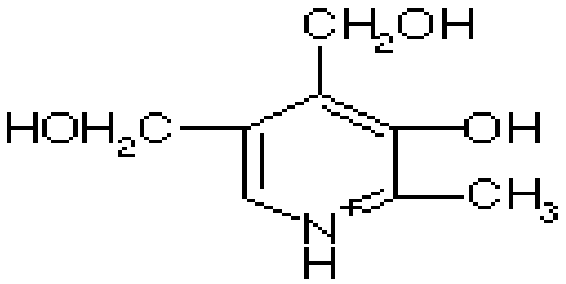
Transamination reaction

The first step in the catabolism of most amino acids is removal of α-amino groups by enzymes **transaminases or aminotransferases**

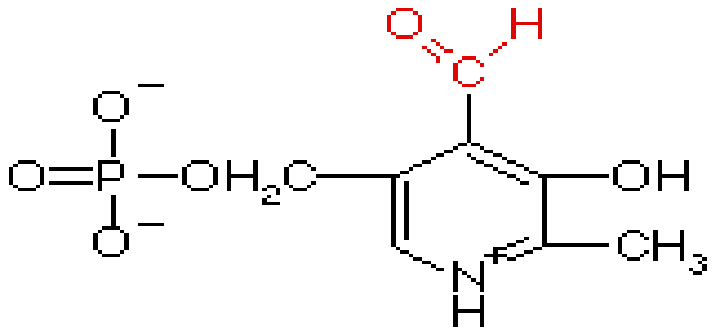
All aminotransferases have the same prostethic group and the same reaction mechanism.

THE PROSTETHIC GROUP IS **PYRIDOXAL PHOSPHATE** (**PPL**), THE COENZYME FORM OF PYRIDOXINE (VITAMIN B_6)

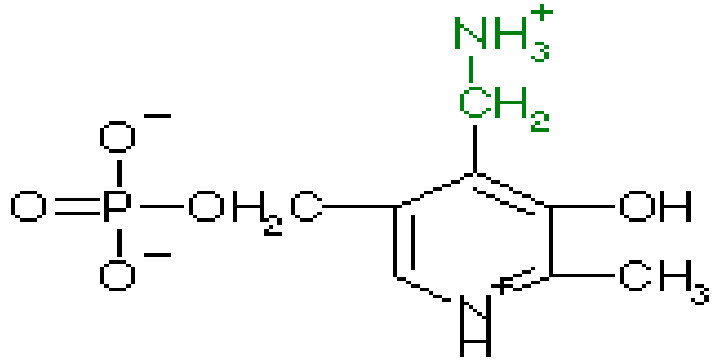
Active metabolic form of vitamin B_6



Pyridoxine
(Vitamin B_6)



Pyridoxal phosphate
(PLP)



Pyridoxamine phosphate
(PMP)

ALL AMINO ACIDS EXCEPT THREONINE, LYSINE, AND PROLINE CAN BE TRANSAMINATED

TRANSAMINASES ARE DIFFER IN THEIR SPECIFICITY FOR L-AMINO ACIDS.

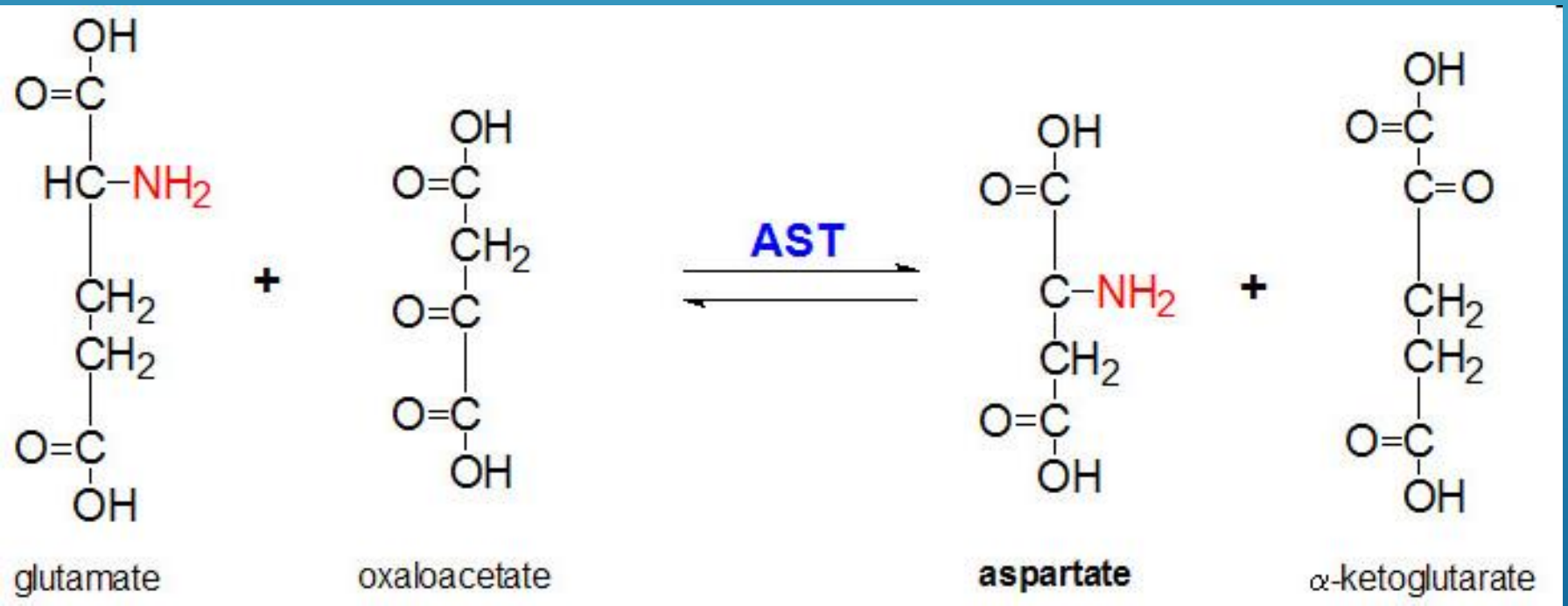
THE ENZYMES ARE NAMED FOR THE AMINO GROUP DONOR

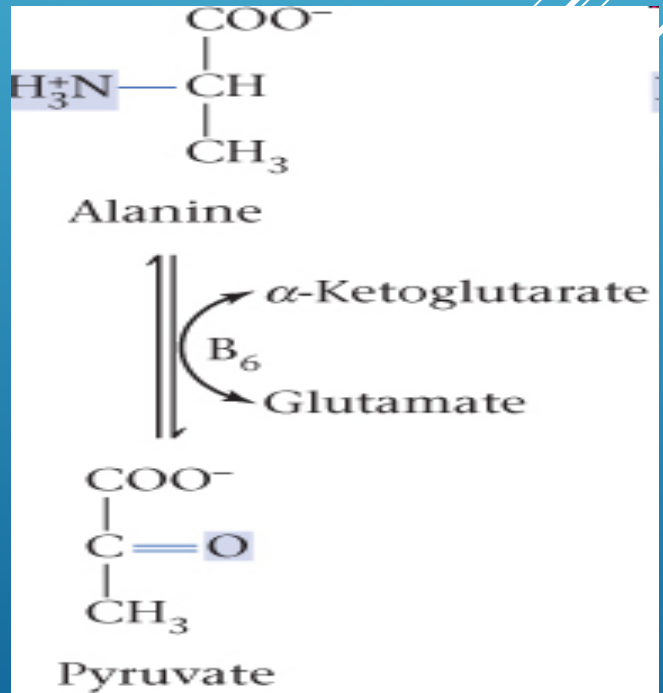
Clinically important transaminases

Alanine-α-ketoglutarate transferase ALT
(also called glutamate-pyruvate transaminase – GPT)

Aspartate-α-ketoglutarate transferase AST
(also called glutamate-oxalacetate transferase – GOT)

Important in the diagnosis of heart and liver damage caused by heart attack, drug toxicity, or infection.



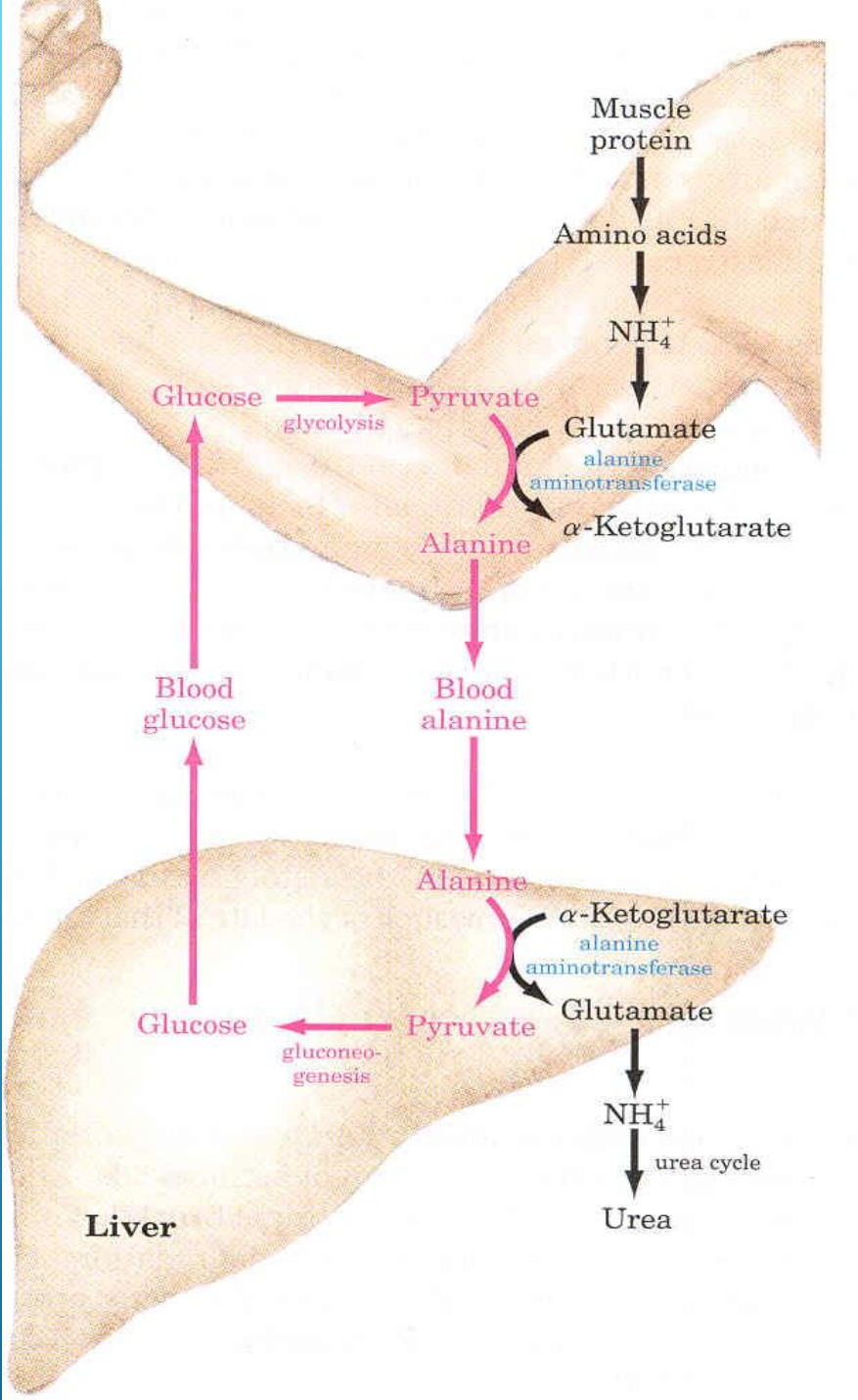


Glucose-alanine cycle

Alanine plays a special role in transporting amino groups to liver

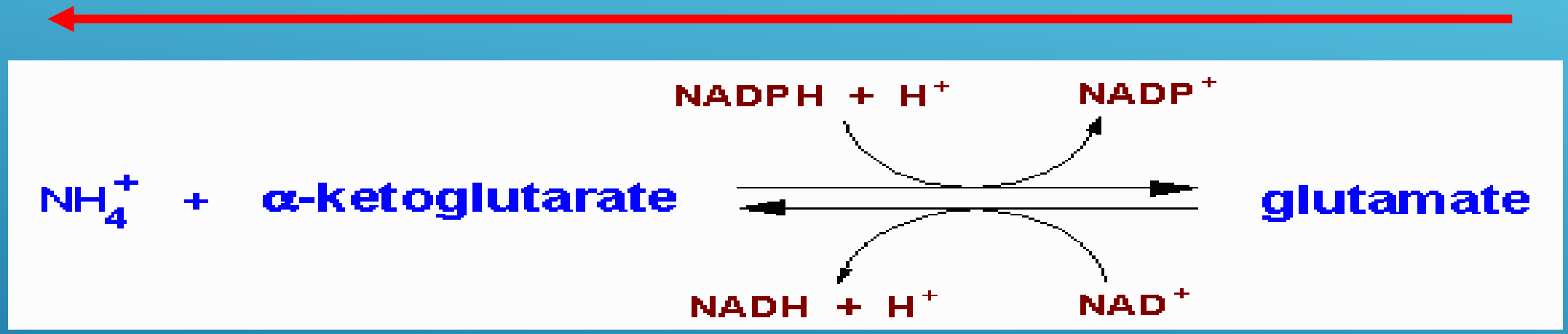
Ala is the carrier of ammonia and of the carbon skeleton of pyruvate from muscle to liver.

The ammonia is excreted and the pyruvate is used to produce glucose, which is returned to the muscle



Glutamate releases its amino group as ammonia in the liver

The amino groups from many of the α-amino acids are collected in the liver in the form of the amino group of L-glutamate molecules



Glutamate undergoes **oxidative deamination** catalyzed by **L-glutamate dehydrogenase**.

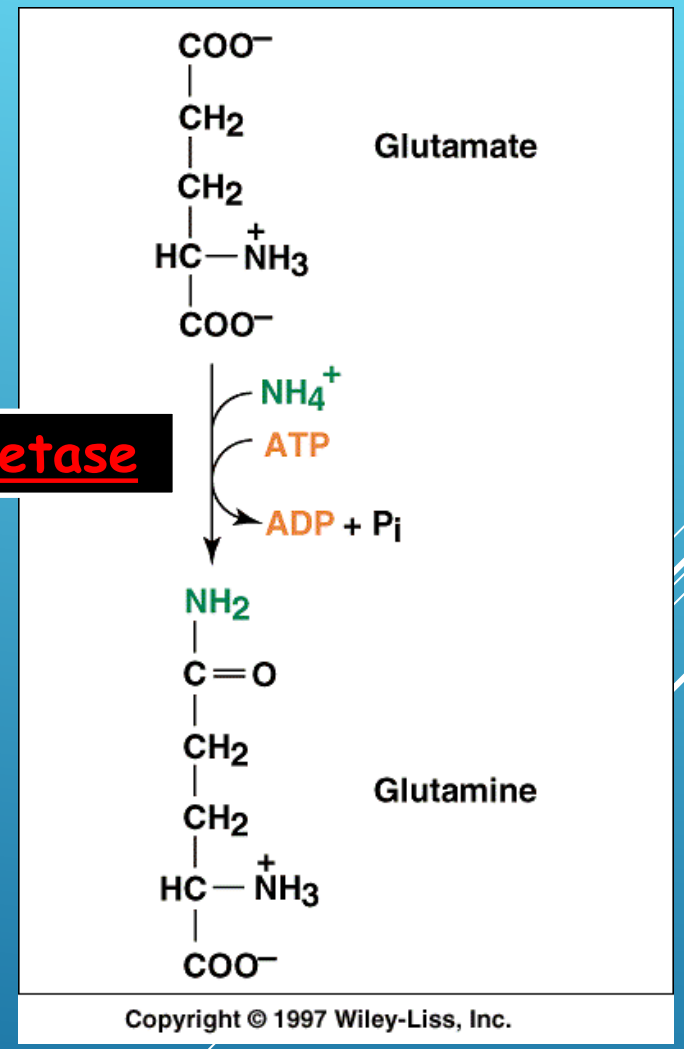
Enzyme is present in mitochondrial matrix.

It is the only enzyme that can use either NAD^+ or $NADP^+$ as the acceptor of reducing equivalents.

Combine action of an aminotransferase and glutamate dehydrogenase referred to as **transdeamination**.

Ammonia transport in the form of glutamine

Excess ammonia is added to glutamate to form glutamine.

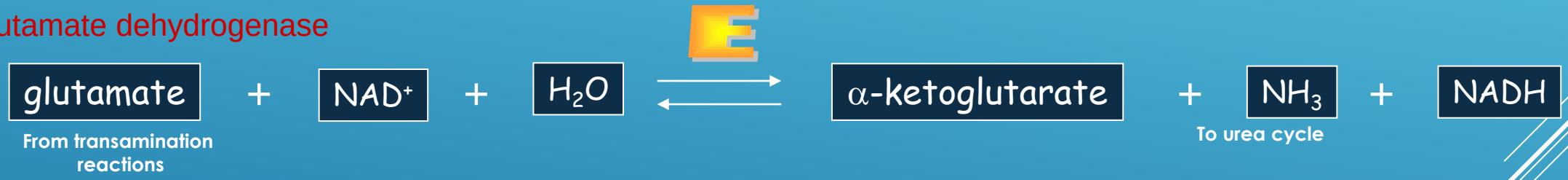


Glutamine enters the liver and NH_4^+ is liberated in mitochondria by the enzyme glutaminase.

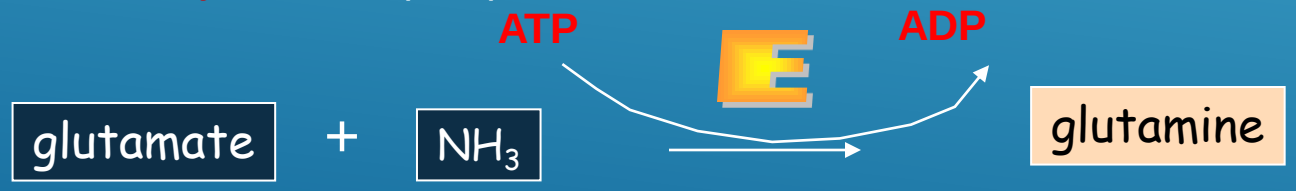
Ammonia is remove by urea synthesis.

Relationship between glutamate, glutamine and α-ketoglutarate

A. Glutamate dehydrogenase



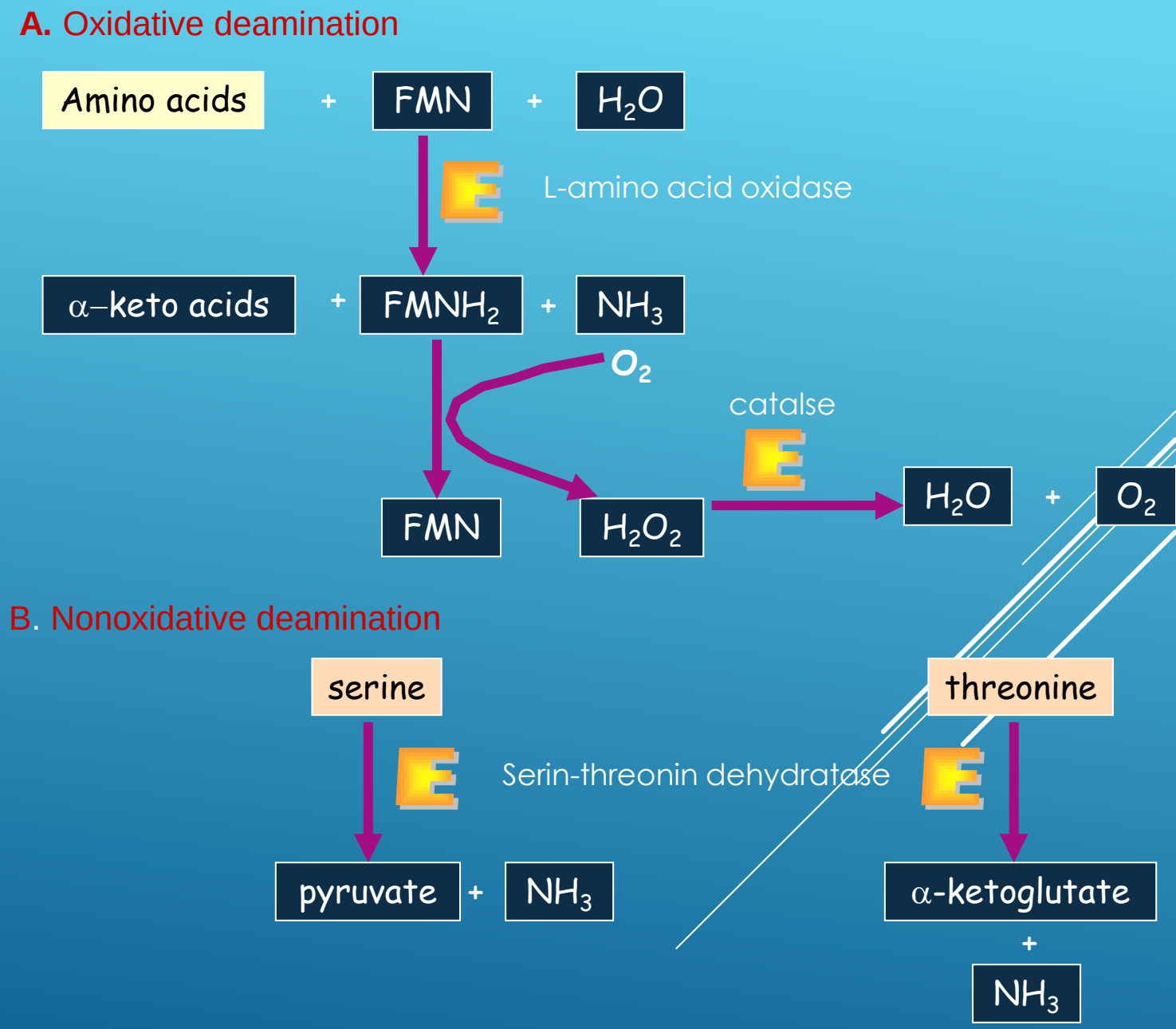
B. Glutamine synthetase (liver)



C. Glutaminase (kidney)

Oxidative deamination

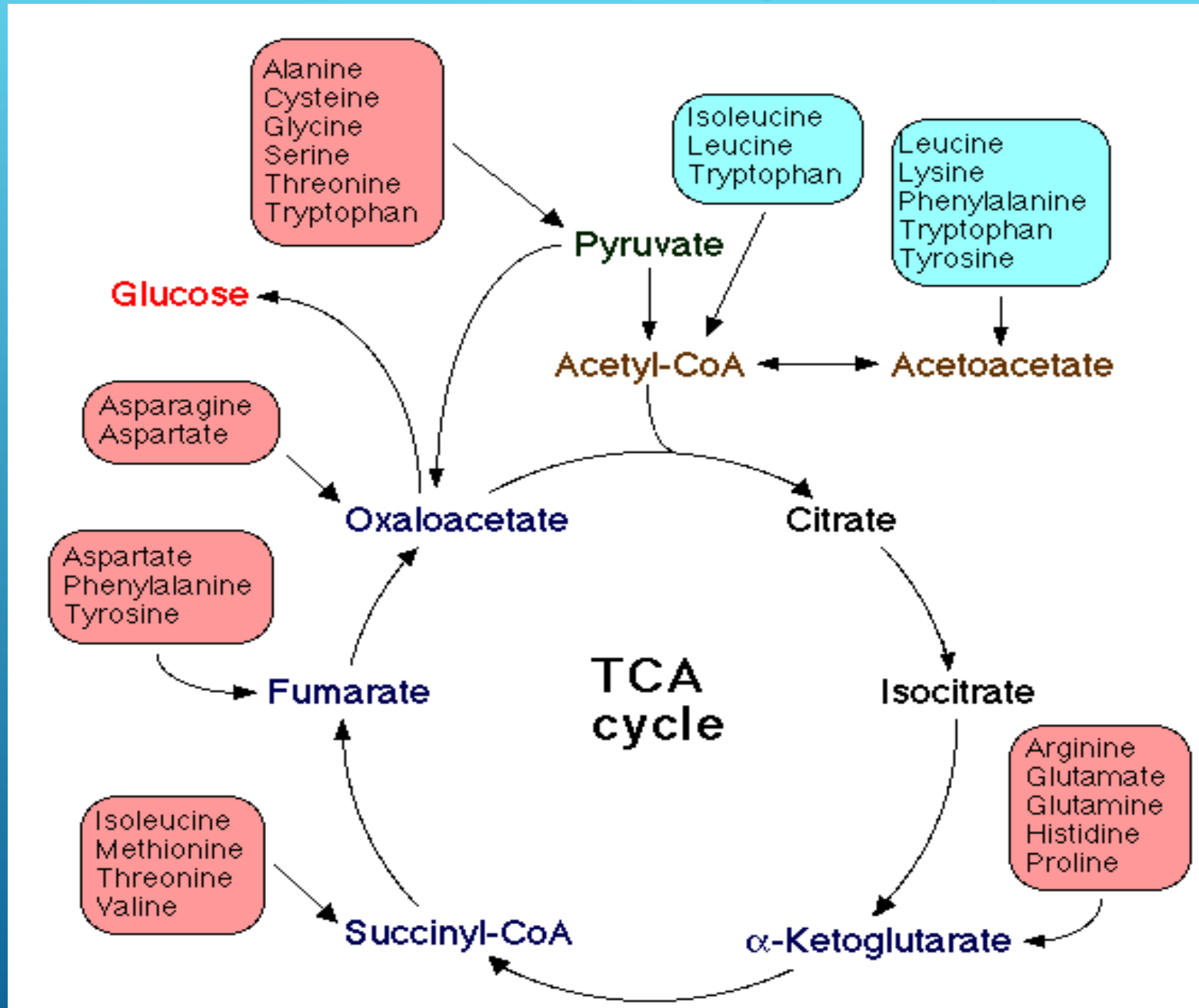
L-amino acid oxidase produces ammonia and α-keto acid directly, using FMN as cofactor. The reduced form of flavin must be regenerated by O_2 molecule. This reaction produces H_2O_2 molecule which is decompensated by catalase.



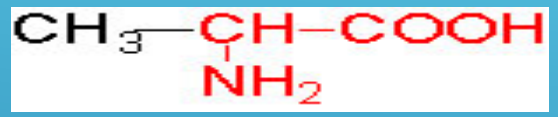
Amino acid metabolism and central metabolic pathways

20 amino acids are converted to 7 products:

- *pyruvate*
- *acetyl-CoA*
- *acetoacetate*
- *α-ketoglutarate*
- *succynyl-CoA*
- *oxalacetate*
- *fumarate*



- **The C3 family: alanine, serine, cysteine and threonine are converted to pyruvate**



Alanine

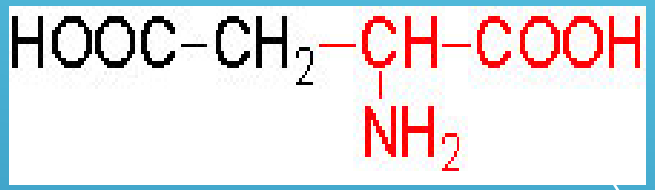
Serine

Cysteine

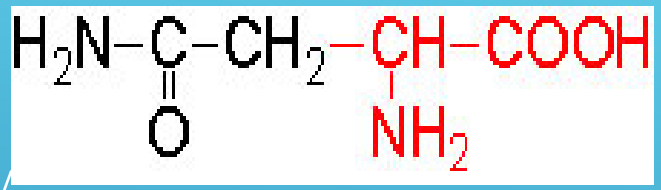
Threonine

Pyruvate

The C4 family: aspartate and asparagine are converted into oxalacetate



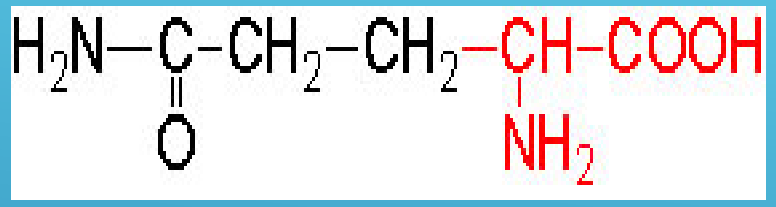
Aspartic acid



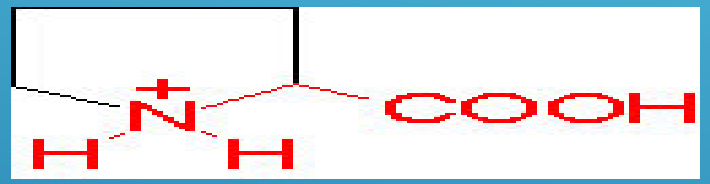
Asparagine

Oxalacetate

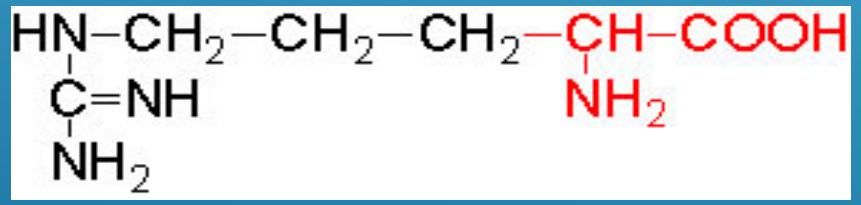
The C5 family: several amino acids are converted into α-ketoglutarate through glutamate



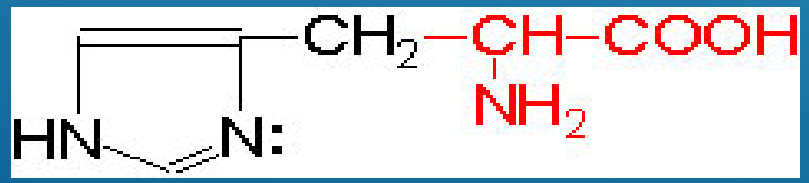
Glutamine



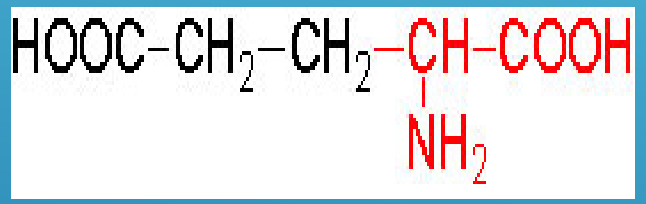
Proline



Arginine

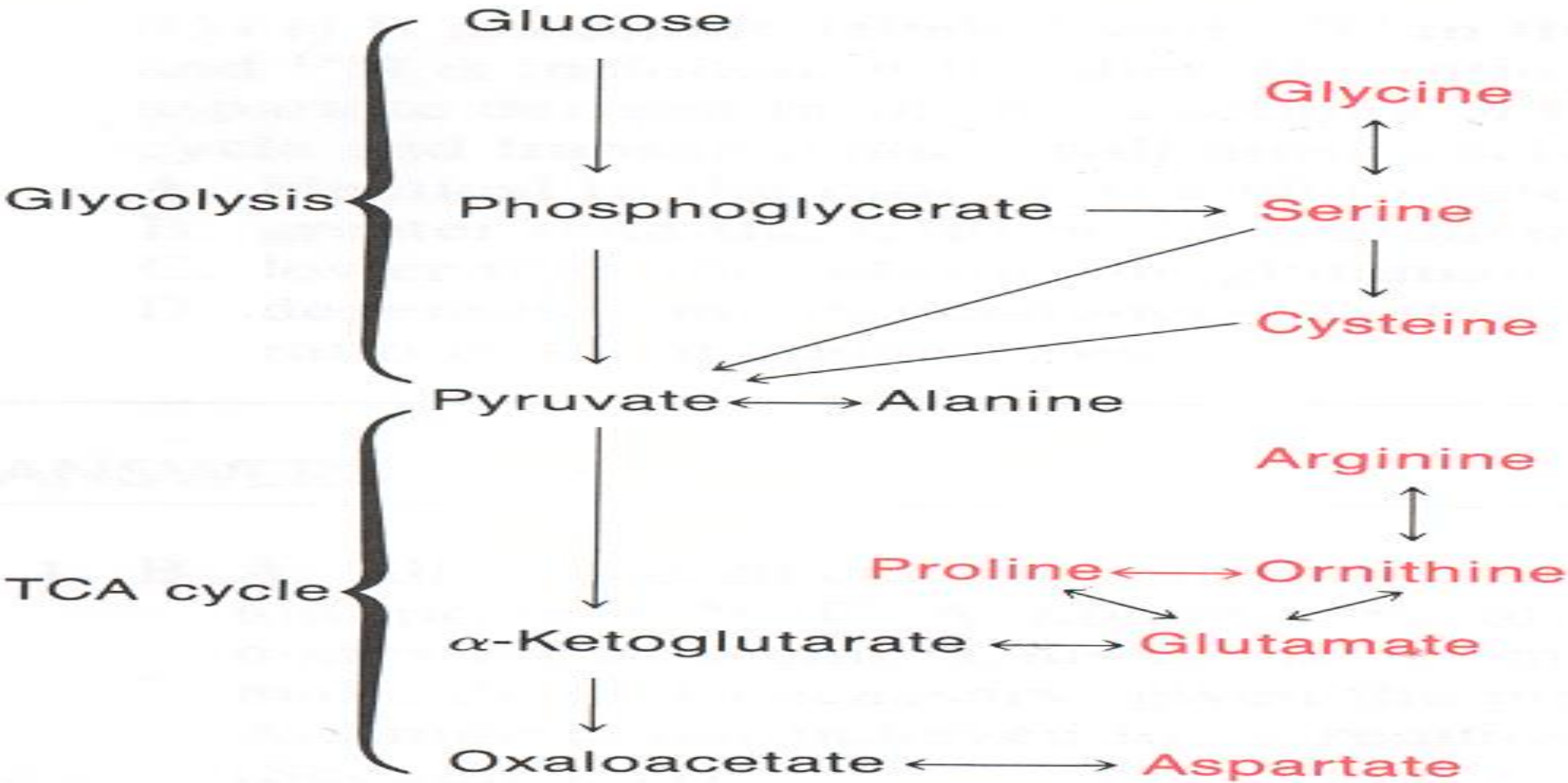


Histidine



α–ketoglutarate

Interconversion of amino acids and intermediates of carbohydrate metabolism and Krebs cycle



Enzymes which metabolised amino acides containe vitamines as cofactors

THIAMINE B_1 (thiamine diphosphate)
oxidative decarboxylation of α-ketoacids

RIBOFLAVIN B_2 (flavin mononucleotide FMN, flavin adenine dinucleotide FAD)
oxidses of α-aminoacids

NIACIN B_5 – nicotinic acid (nikotinamide adenine dinucleotide NAD^+
nikotinamide adenine dinukleotide phosphate $NADP^+$)
dehydrogenases, reductase

PYRIDOXIN B_6 (pyridoxalphosphate)
transamination reaction and decarboxylation

FOLIC ACID (tetrahydropholate)
Meny enzymes of amino acid metabolism


Thank you for attention