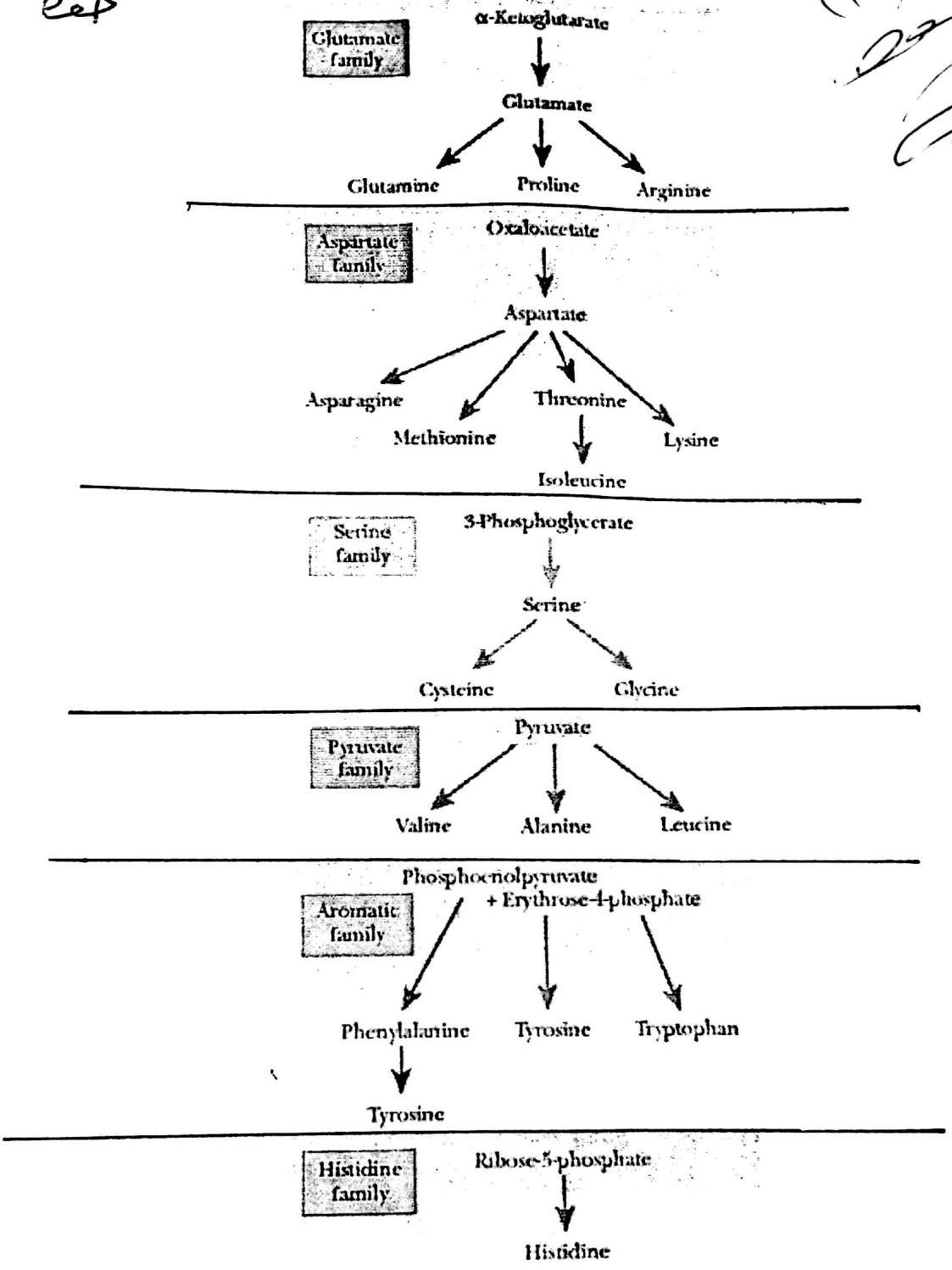
acid Synthesis

we group amino acid in Families, each family has a common precursor,



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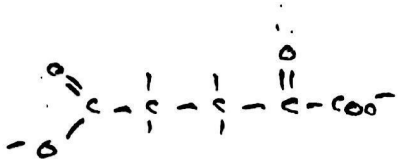
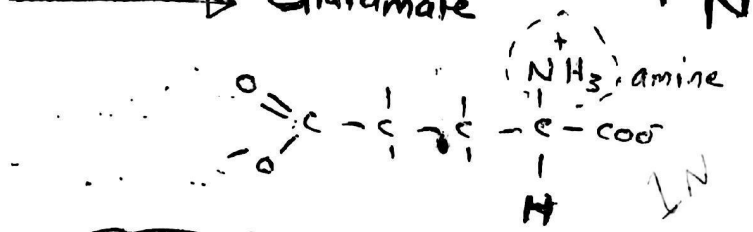
α-Ketoglutarate + NH_3 —(NADPH → NADP+)→ Glutamate



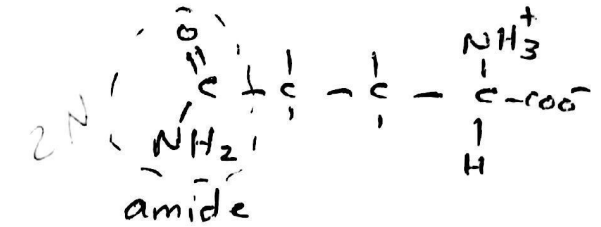


Glutamate Dehydrogenase

reductive amination reaction

* these 2 reactions are the most important reactions to put amonia (NH_3) in Organic compounds

Glutamate + NH_3 —(ATP → ADP)→ Glutamine



Glutamine Synthatase

amidation reaction

Km Glutamate Dehydrogenase > Km Glutamine Synthatase → higher affinity to NH_3

* So, when NH_3 is low in the body, the second reaction will be preferred, this makes the amount of Glutamate depleted unless there is another way to replenish it.

Glutamine (2N) + α Ketoglutarate (N) → 2 Glutamate

Glutamate Synthase "GOGAT": Glutamate oxoglutarate amino-transferase.

1N glutamate is!

1N Glutamate

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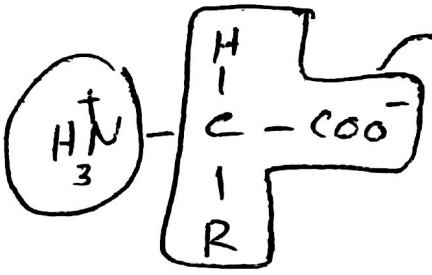
ring the Synthesis of amino-acids, we have 2 important processes frequently occur :-

- transamination
- one Carbon unit transfer

* Transamination reaction

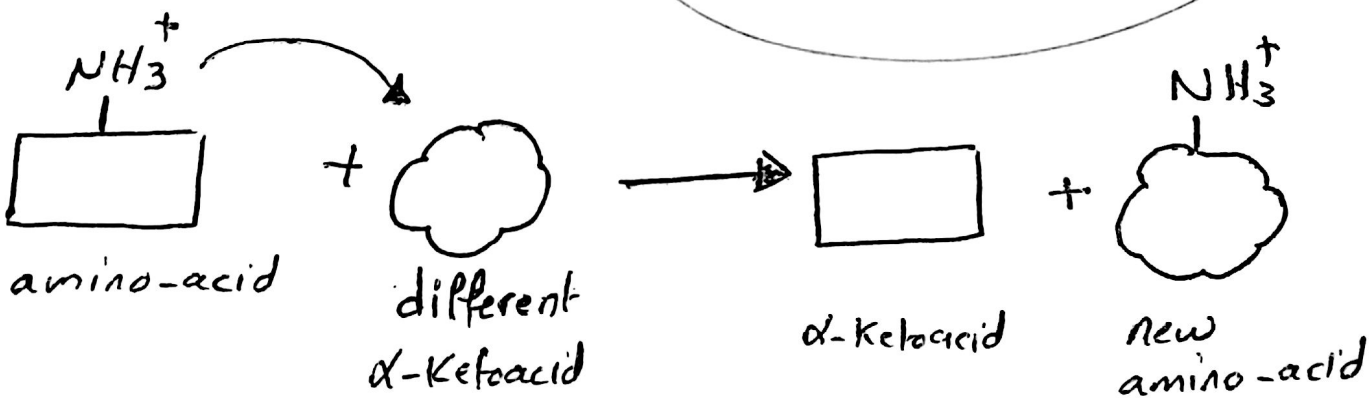
amino-acid



α-Ketoacid
"general name"

* In these reactions, we transfer amino-group from amino-acid to different α-ketoacid forming new amino-acid.

⇒ These reactions need B_6 Pyridoxal-phosphate as a coenzyme



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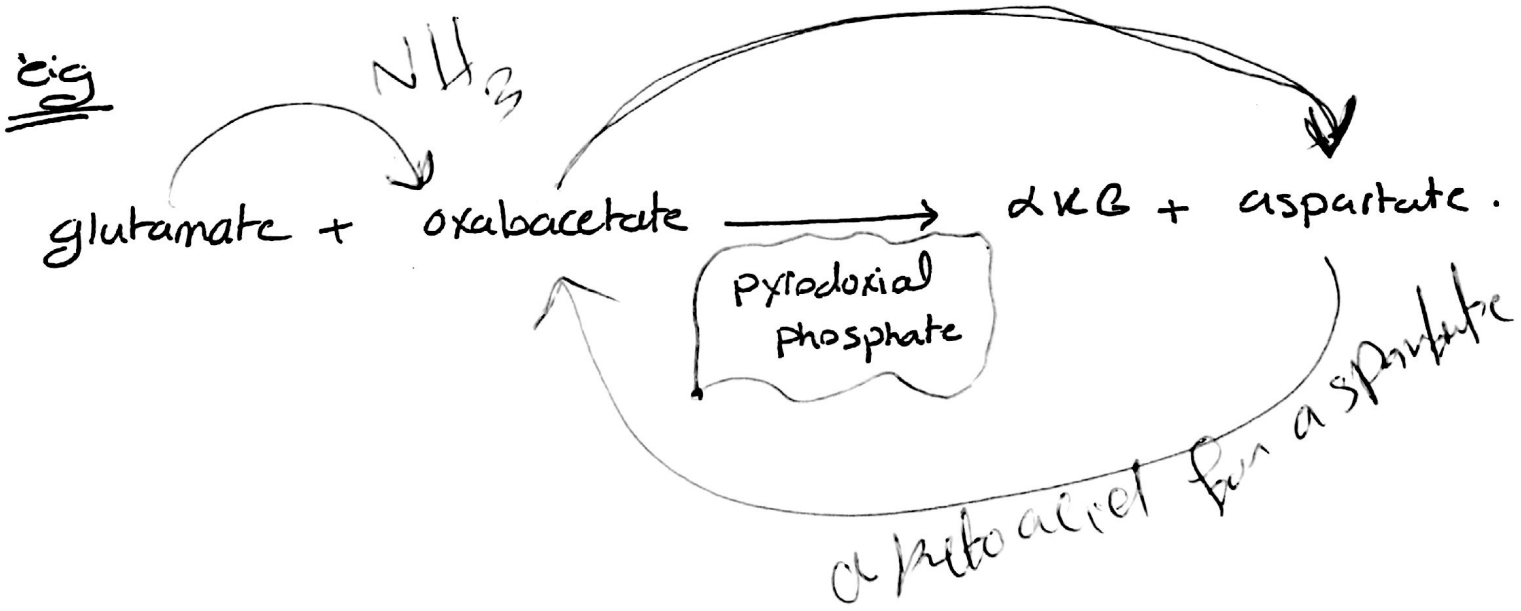
.o acids + pyrodoxial phosphate ⟹ schiff base.

pyrodoxial phosphate + NH_3 ⟹ pyradoxamin.

Usually the most imp donor of NH_3 in trans-amination reaction is glutamate

what will remain From glutamte when we take NH_3 From il- ?

α-Keto acid = α Ketoglutarate



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Carbon unit transfer 3-

in these ractions we will talk about serin Family

3-phosphoglycerate

↓

serin

↙ glycin ↘ cystein.

First we should synthesize serin from 3-phosphoglycerate

« Oxidation, transamination, dephosphorylation »

3-phosphoglycerate

oxidation ↓ (NAP+ → NADH)

3-phosphohydroxypyruvate

transamination ↓ (glutamate → KKG)

3phosphoserin

P ↩ ↓

Serin

dephosphoyration

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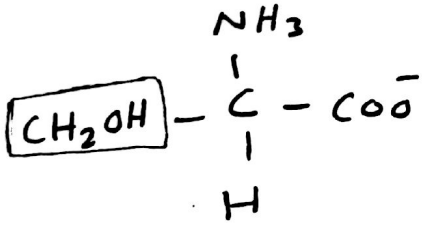
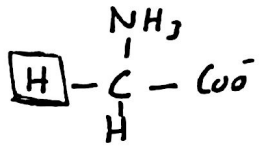
ω :-

From serin we will synthesis glycin, cystein



serin



glycin

So if we remove [CHOH] from serin, we will have glycin

methelen

and this is one carbon unit transfer

to whome we give this one carbon unit

tetrahydrofolate + methelen $\xrightarrow{CHOH}$ $5N, 10N$ methelen tetrahydrofolate.

→ From Folic acid, should be taken By pregnant women to prevent Birth defect.

★

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tetrahydrofolate can carry → metheleن
                          → Formyl.

- Biotin ⟶ CO_2
- SAM ⟶ methyl

one carbon unit] Carrier على اضافة

* cystein Synthesis

this amino acid contain S, so we should find a source of S, this source differ between plant, Bacteria and human.

in plant + Bacteria (PAPS) → source in animal
3,P,5 adenylyl

From Sulfate which will reduced to sulfite SO_3^{-2} also reduced to sulfide S^{-2} in order to synthesize cystein.?

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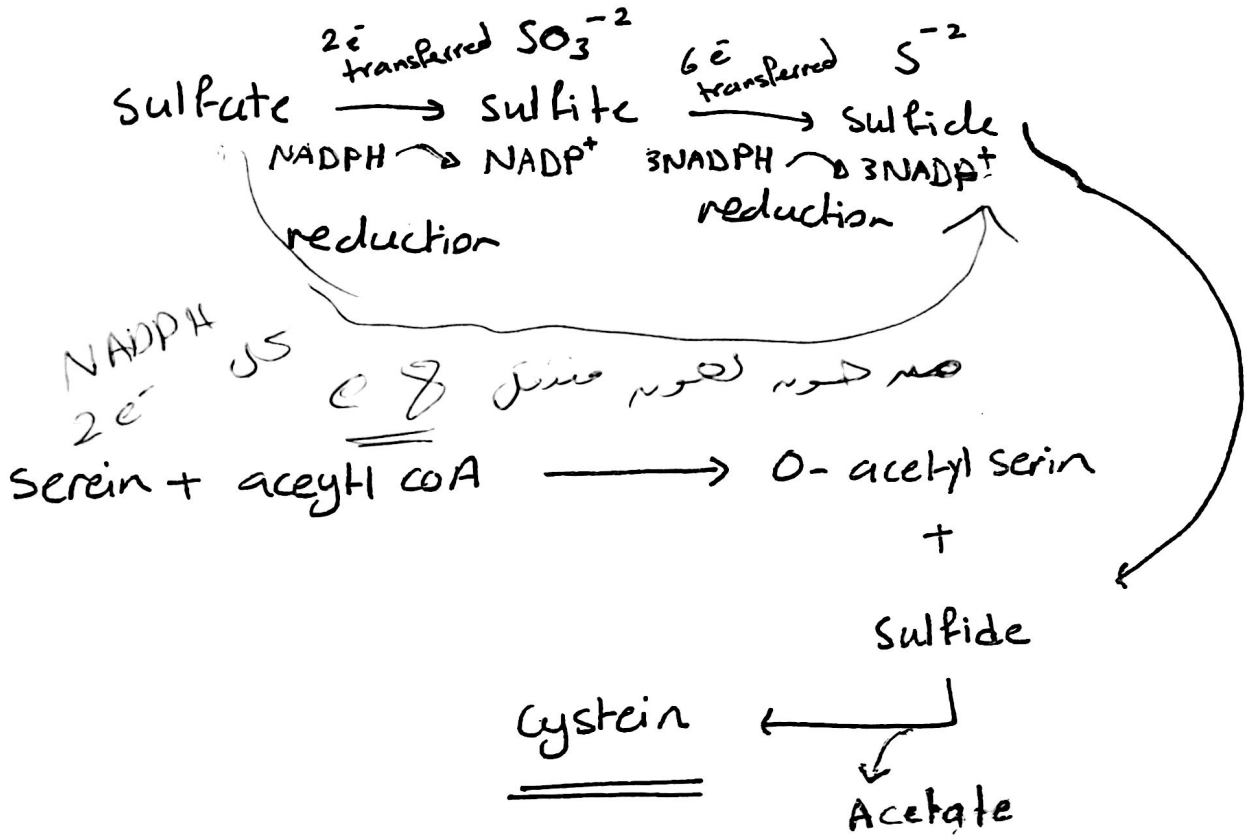
in Plant, Bacteria

source is ⟹ 3' phosph 5' adenylyl sulfate (PAPS)



what about Human, Animal ?!

we don't have enzymes that reduce sulfate to sulfide.

the source of S in Human/Animal is

Methionin (a.a contain S)

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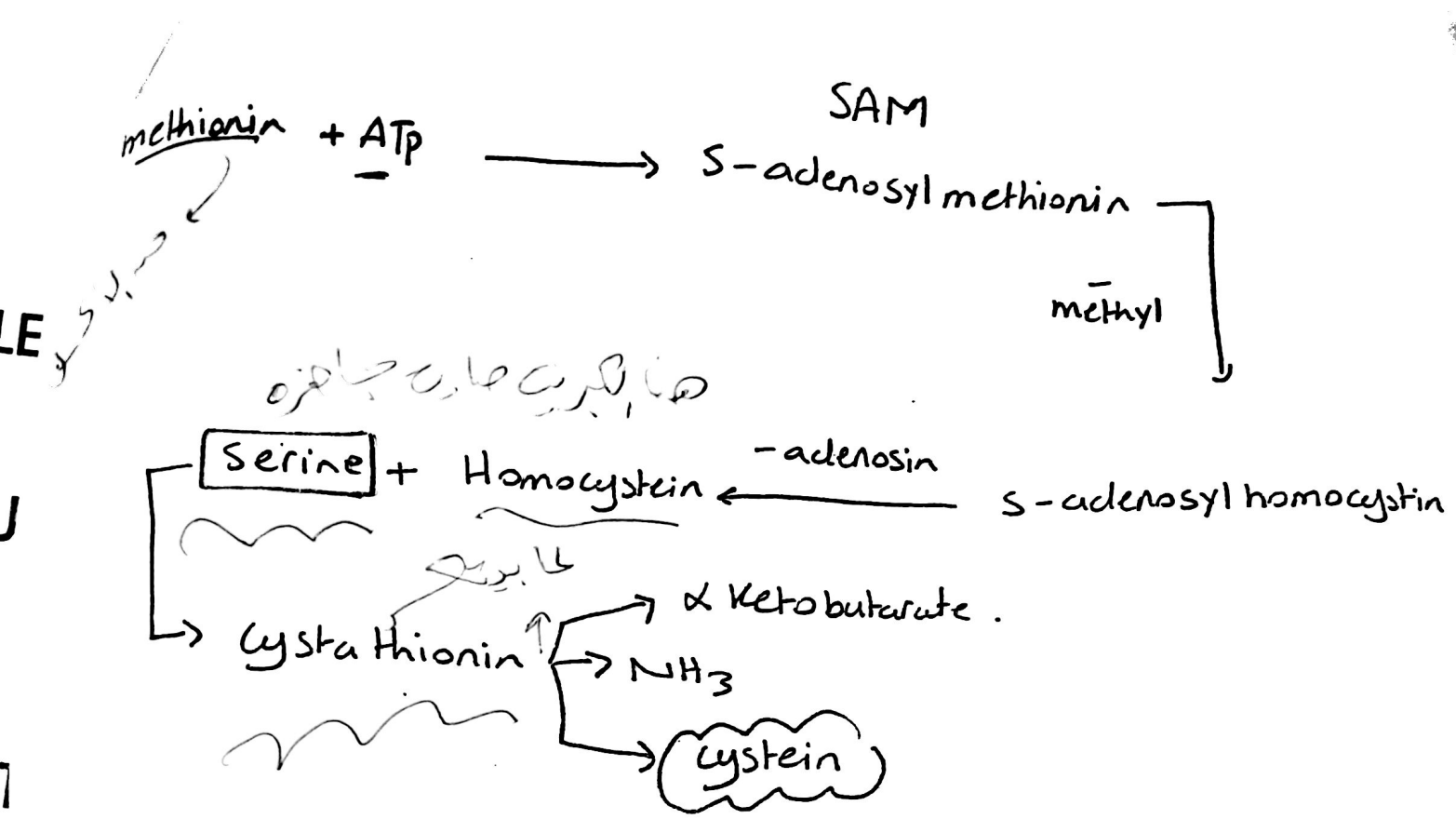

But from where we get methionin ?!

the S in methionin From where ?!

methionin is essential A.A , we can't synthesis , we should talk it from diet

you should memorize Essential / non Essential a.a.

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Essential Amino acids : we can't Synthesize or Synthesized in insufficient quantities we Should take them from Diet

Table 23.1
Amino Acid Requirements in Humans

Essential	Nonessential
Arginine*	Alanine
Histidine*	Asparagine
Isoleucine	Aspartate
Leucine	Cysteine
Lysine	Glutamate
Methionine	Glutamine
Phenylalanine	Glycine
Threonine	Proline
Tryptophan	Serine
Valine	Tyrosine

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* Histidine essential for children, but not for adults
* Arginine: we can synthesize but cleave most of it to Urea

- Kwashiorkor Disease :- prolonged Protein Deficiency
- Escherichia coli :- Can synthesize all the amino-acid it needs.

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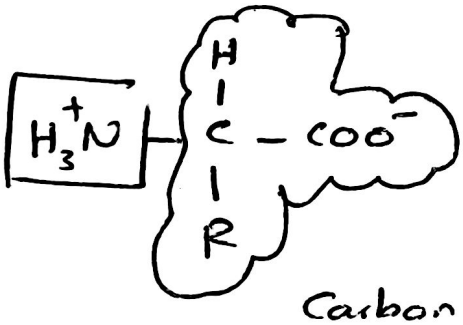
Amino-acid Catabolism



① Remove amino-group
"transamination"

Carbon Skeleton

حسب التحمض الأميني الموجود

Pyruvate
Or
oxaloacetate

Glucose

Acetyl-CoA
or
acetoacetyl-CoA

Ketone bodies
or citric acid cycle

" Glucogenic "
a.a

" Ketogenic "
a.a

* there are 4 amino-acids Can bea degraded Glucogenic or Ketogenic. you should memorize Table 23.2

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Table 23.2

Glucogenic and Ketogenic Amino Acids

Glucogenic	Ketogenic	Glucogenic and Ketogenic
Aspartate	Leucine	Isoleucine
Asparagine	Lysine	Phenylalanine
Alanine		Tryptophan
Glycine		Tyrosine
Serine		
Threonine		
Cysteine		
Glutamate		
Glutamine		
Arginine		
Proline		
Histidine		
Valine		
Methionine		

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* Fish : excret excess Nitrogen as ammonium ion NH_4^+

* Birds : " " " as Uric acid
" insoluble in water

* Human and terrestrial animals : " " " as Urea $H_2N-\overset{O}{\overset{\|}{C}}-NH_2$
" water soluble go with Urin

* Urea is Synthesized by Urea Cycle in Liver Cells only

* it occurs in Mitochodria and Cytosol of Liver Cells

you should Know the Sources of the 2 Nitrogen in Urea

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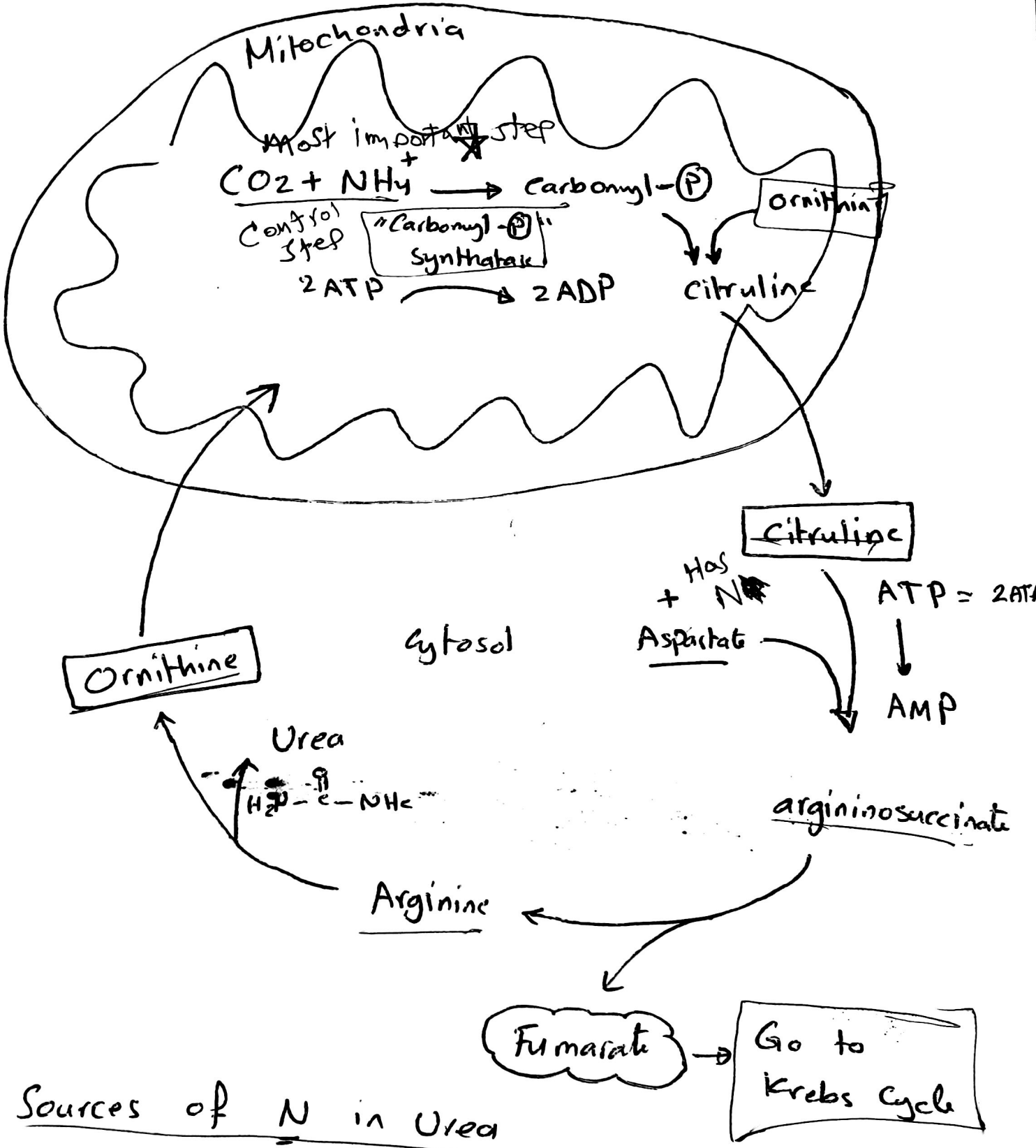

* Sources of N in Urea

① NH_4^+ in Mitochondria

② Aspartate in Cytosol

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ntrol in Urea Cycle

the most important step "control step" in Urea Cycle is the first step in mitochedria "Rate limiting step"

C]

$CO_2 + NH_4^+$ —(CPS-I, 2 ATP)→ Carbomyl-(P) + 2 ADP

Carbomyl-(P) → Commit to urea cycle.

Carbomyl-(P) Synthatase

N-acetyl-Glutamate —(+ve)→ Carbomyl-(P) Synthatase

Acetyl-CoA + glutamate ⟶ N-acetyl-glutamate

N-acetyl glutamate Synthase

Arginine —(Activation +ve)→ N-acetyl glutamate Synthase

↑ Arginine
↑ N-acetyl-glutamate ⟶ ↑ Urea Cycle

How many ATP are consumed in Urea Cycle?

4 ATP

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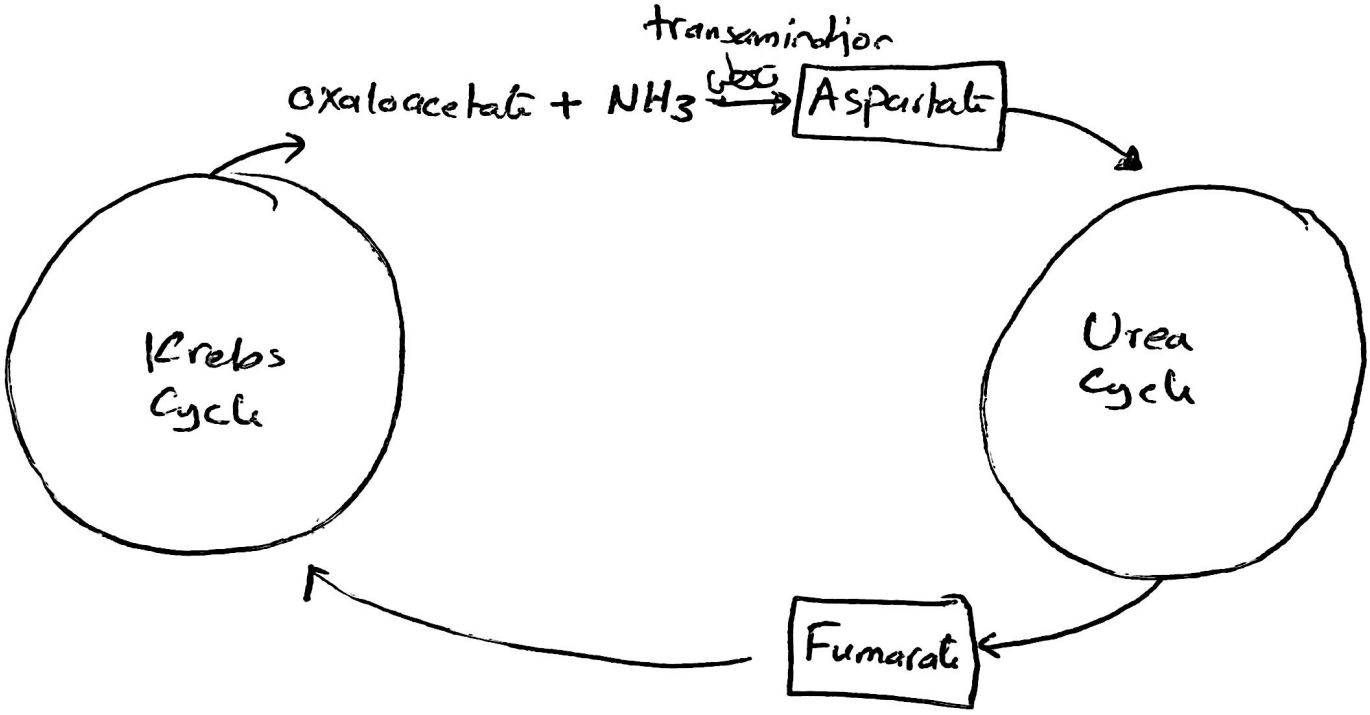
Connection between Urea-Cycle and Krebs Cycle

* Both discovered by Hans Krebs



wish you all Luck ☺

Dr. Tariq Jibril
0799-84-67-84

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