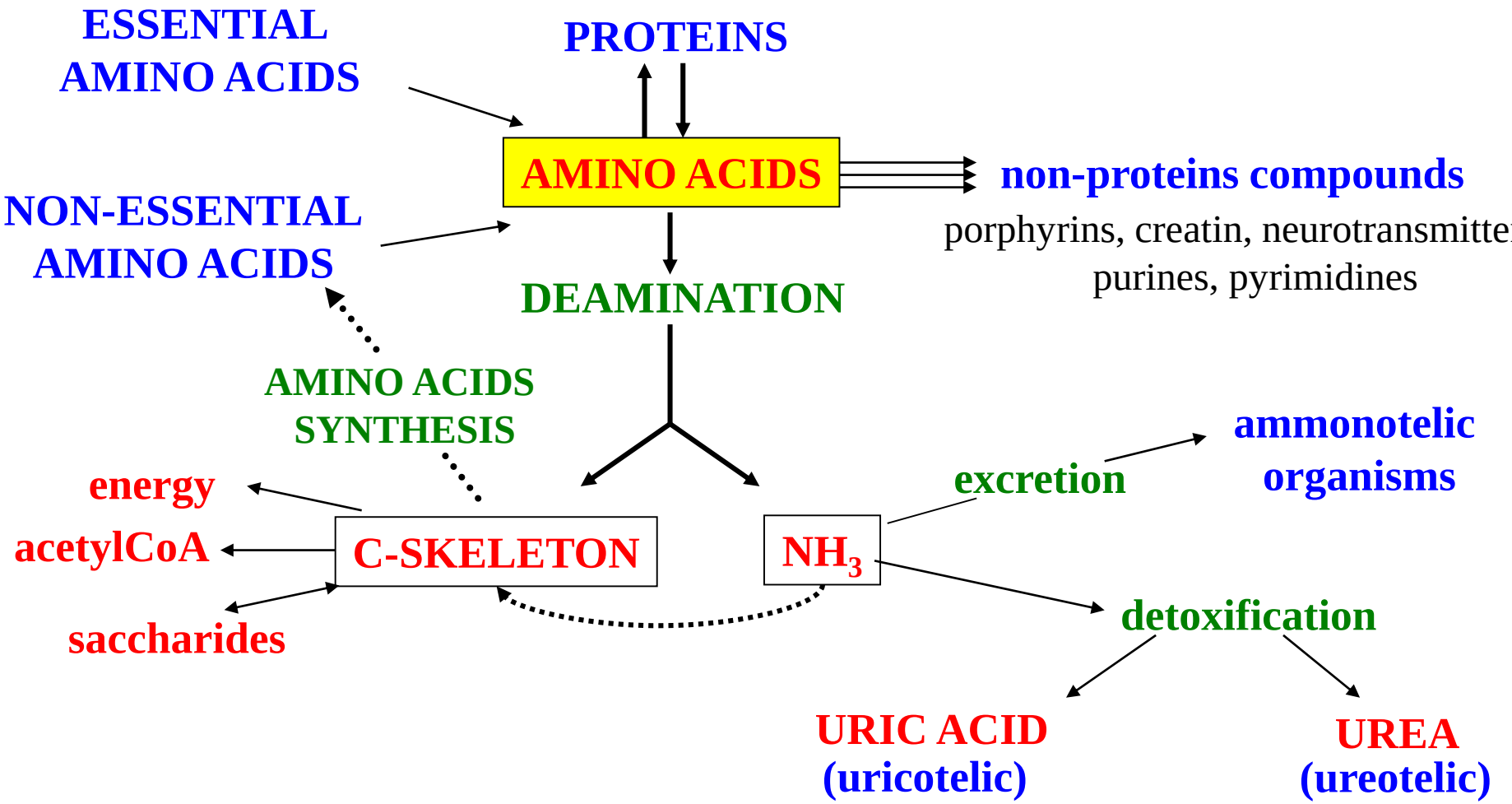
Enzymes of amino acids metabolism

10th week


ESSENTIAL AMINO ACIDS
PROTEINS
AMINO ACIDS
non-proteins compounds
porphyrins, creatin, neurotransmitters, purines, pyrimidines
NON-ESSENTIAL AMINO ACIDS
DEAMINATION
AMINO ACIDS SYNTHESIS
energy
acetylCoA
saccharides
C-SKELETON
NH3
excretion
ammonotelic organisms
detoxification
URIC ACID (uricotelic)
UREA (ureotelic)

Amino acids reactions

1. **Decarboxylation**

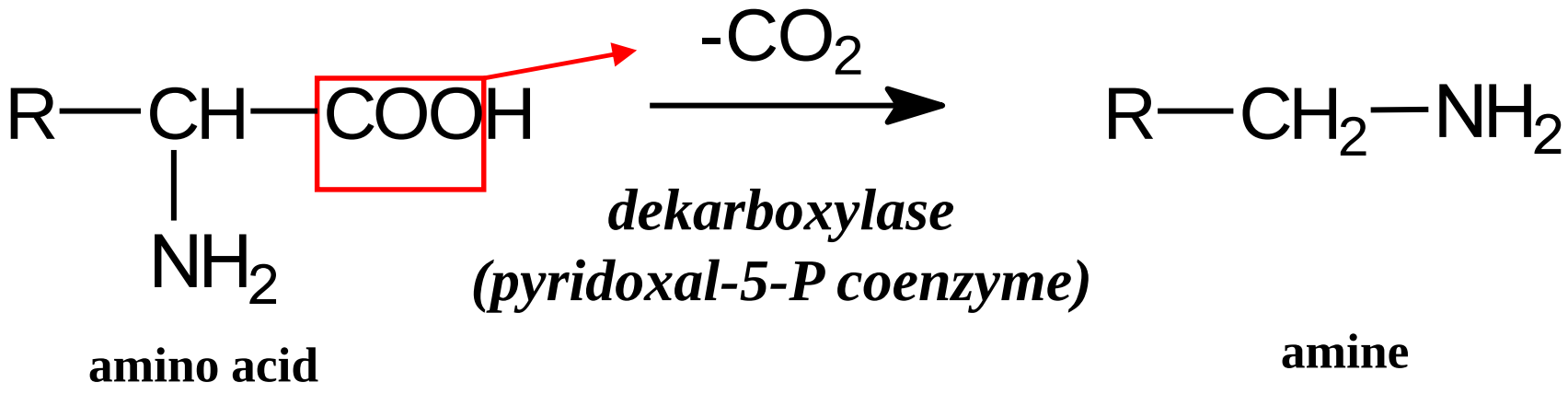
2. **Deamination**

- direct (oxidative, non-oxidative)
- indirect

3. Transamination

Decarboxylation

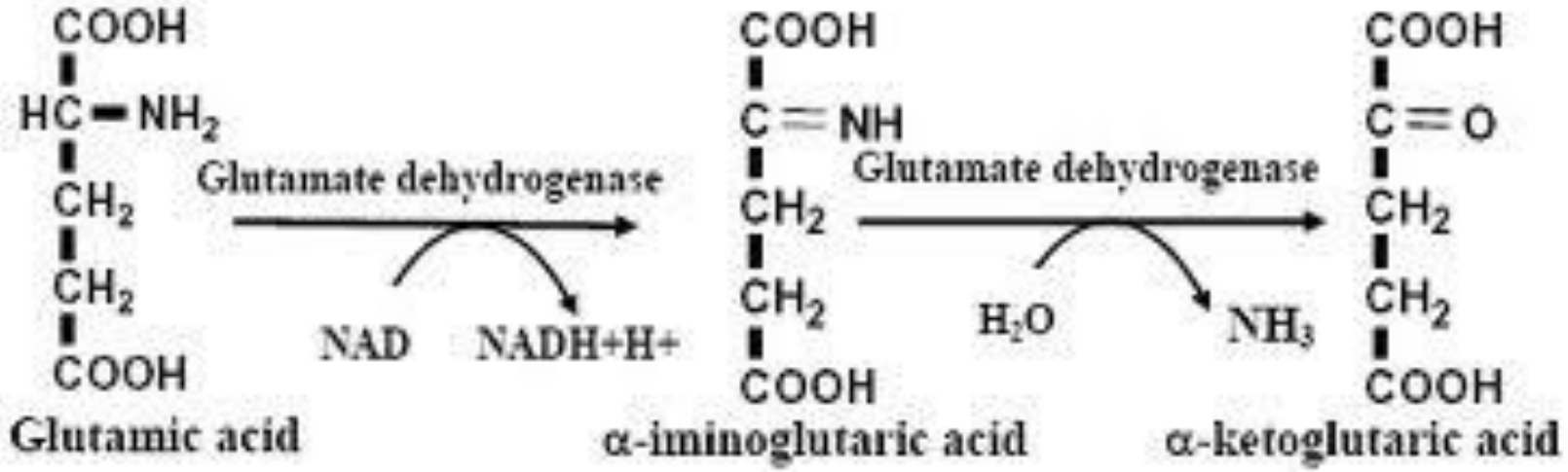
- **removal of the carboxyl group from the α-carbon**
- loss of the negative charge of the original AA to form positively charge amine



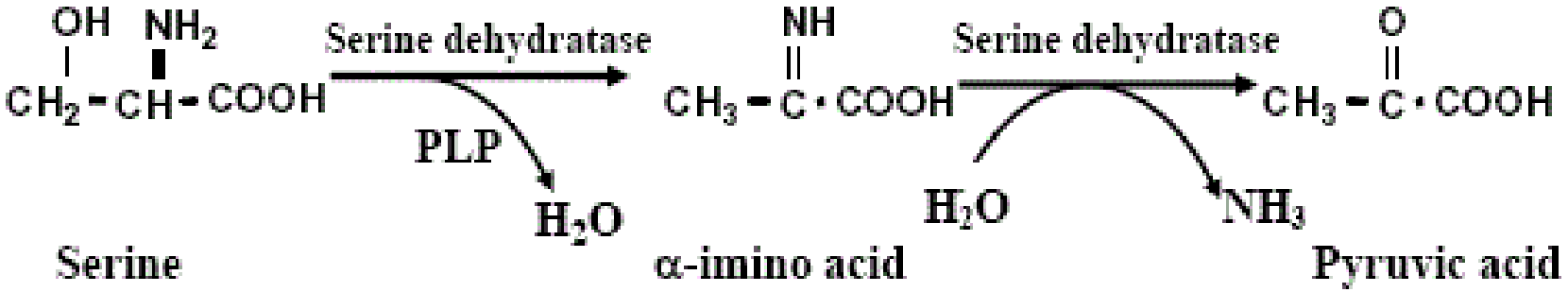
Direct deamination – oxidative

- **arginine, threonine, lysine** – only direct deamination
- glutamate dehydrogenase (NAD^+)
- L-amino oxidase (FMN)
- D-amino oxidase (FAD)

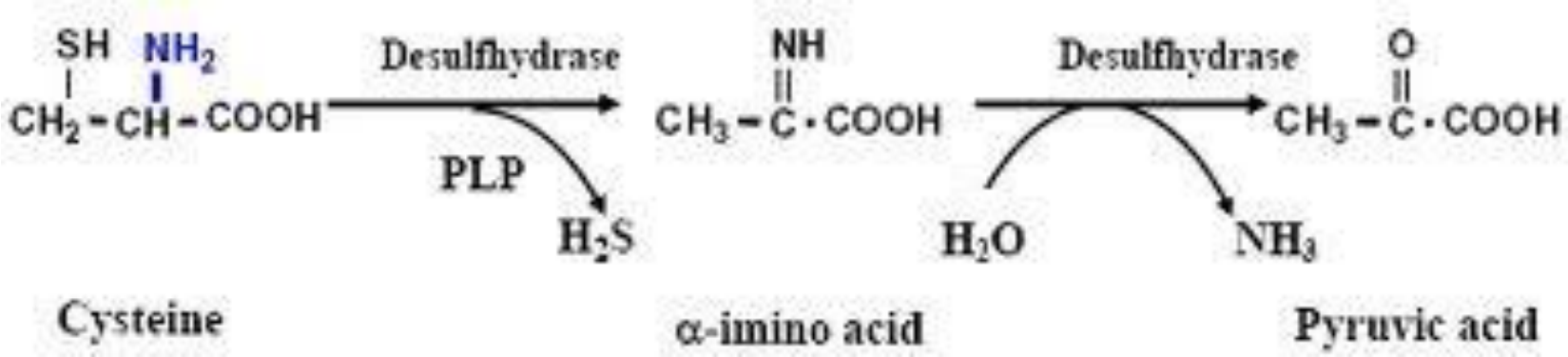
Glutamate dehydrogenase **(NAD^+)**



Serine deamination (*serine dehydratase*)

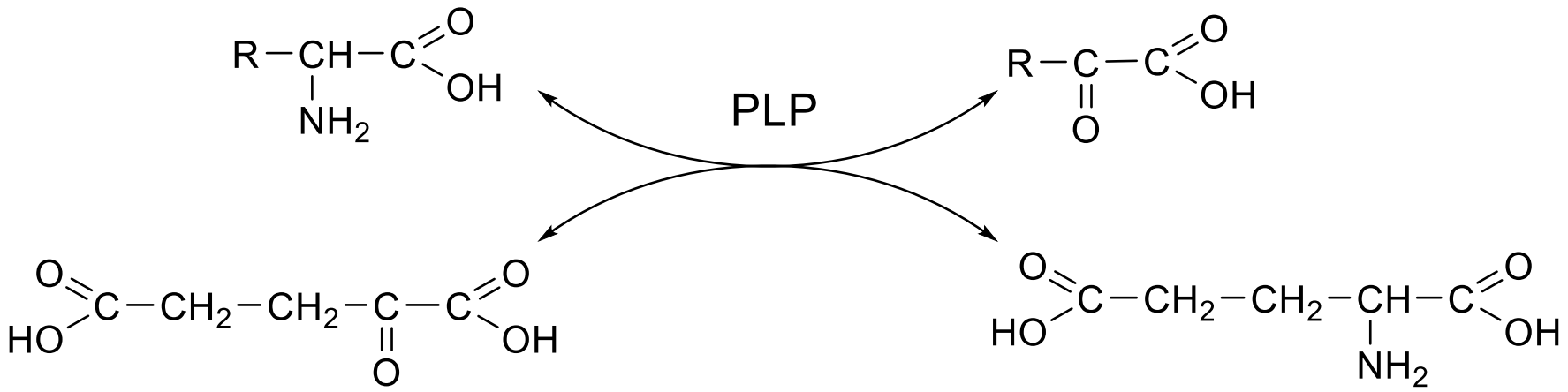


Cysteine deamination (*cysteine desulfhydrase*)



Transamination

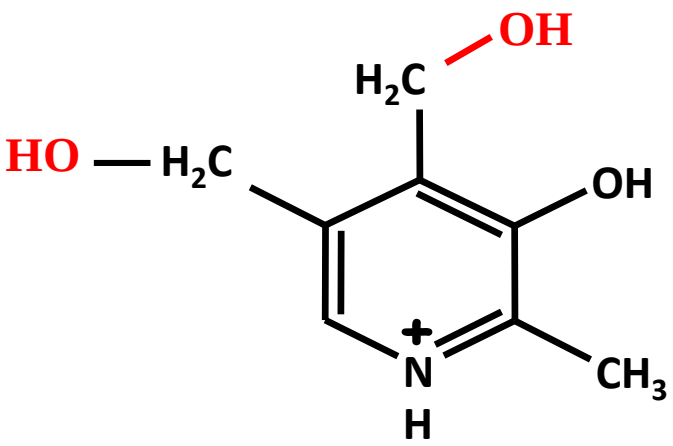
- 1st step of indirect deamination
- the last step of non-essential amino acids synthesis



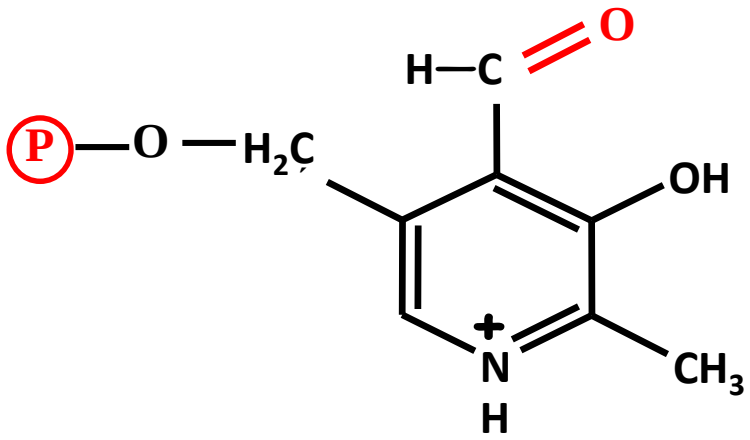
NH_2 group donor: amino acids (except for Lys and Thr)

NH_2 group acceptor: α-keto acids α-ketoglutarate
pyruvate
oxaloacetate

Aminotransferases contain a coenzyme pyridoxal-5-phospahte

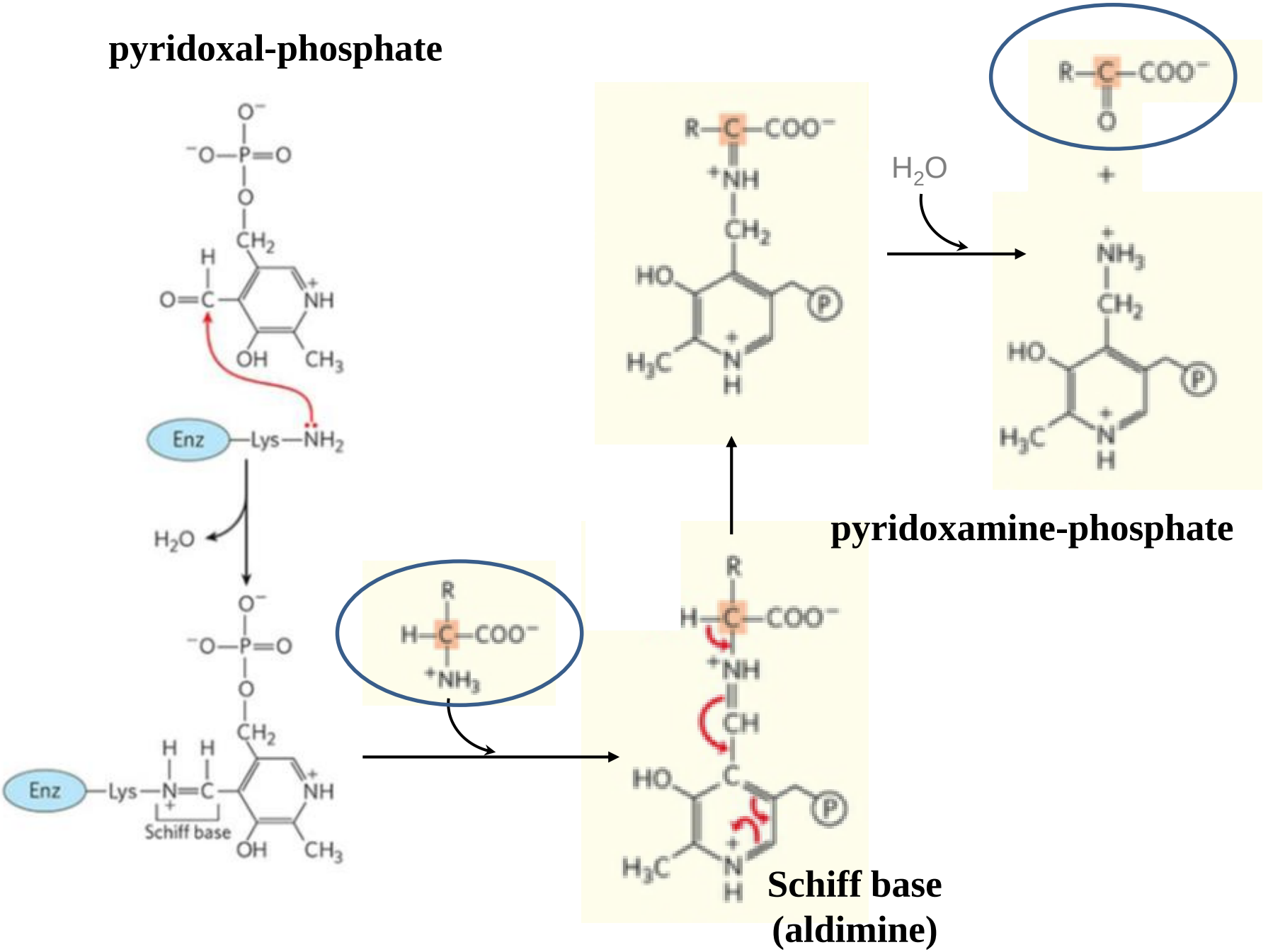


pyridoxine (vitamin B6)
precursor of PLP



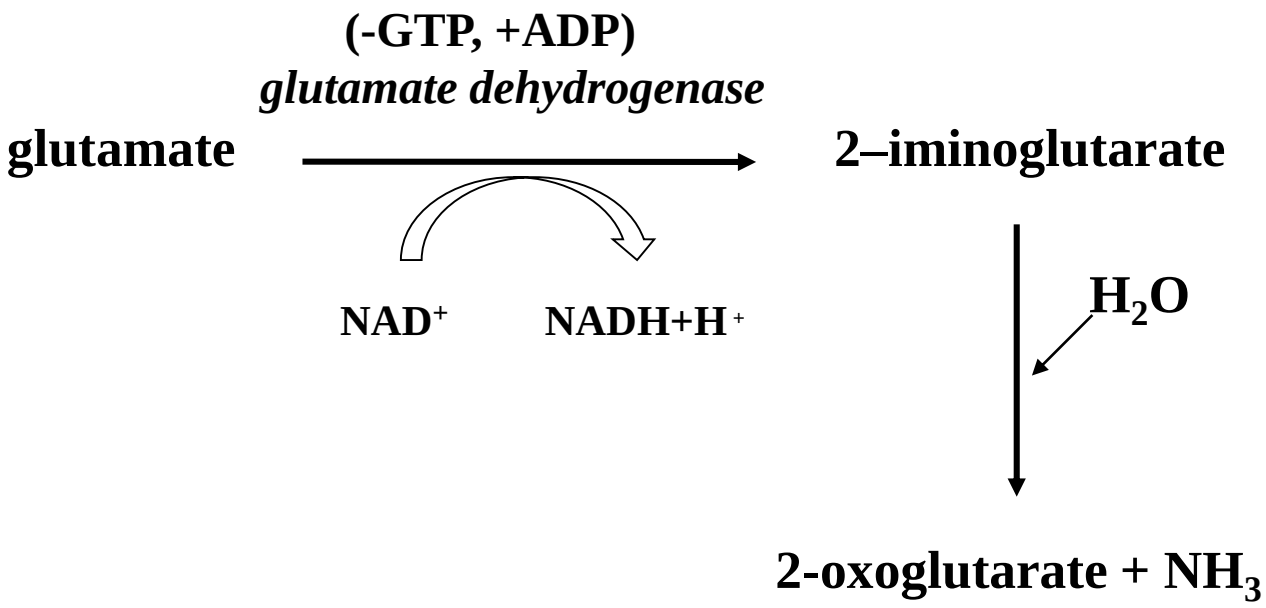
pyridoxal-5-phosphate
(PLP)

pyridoxal-phosphate



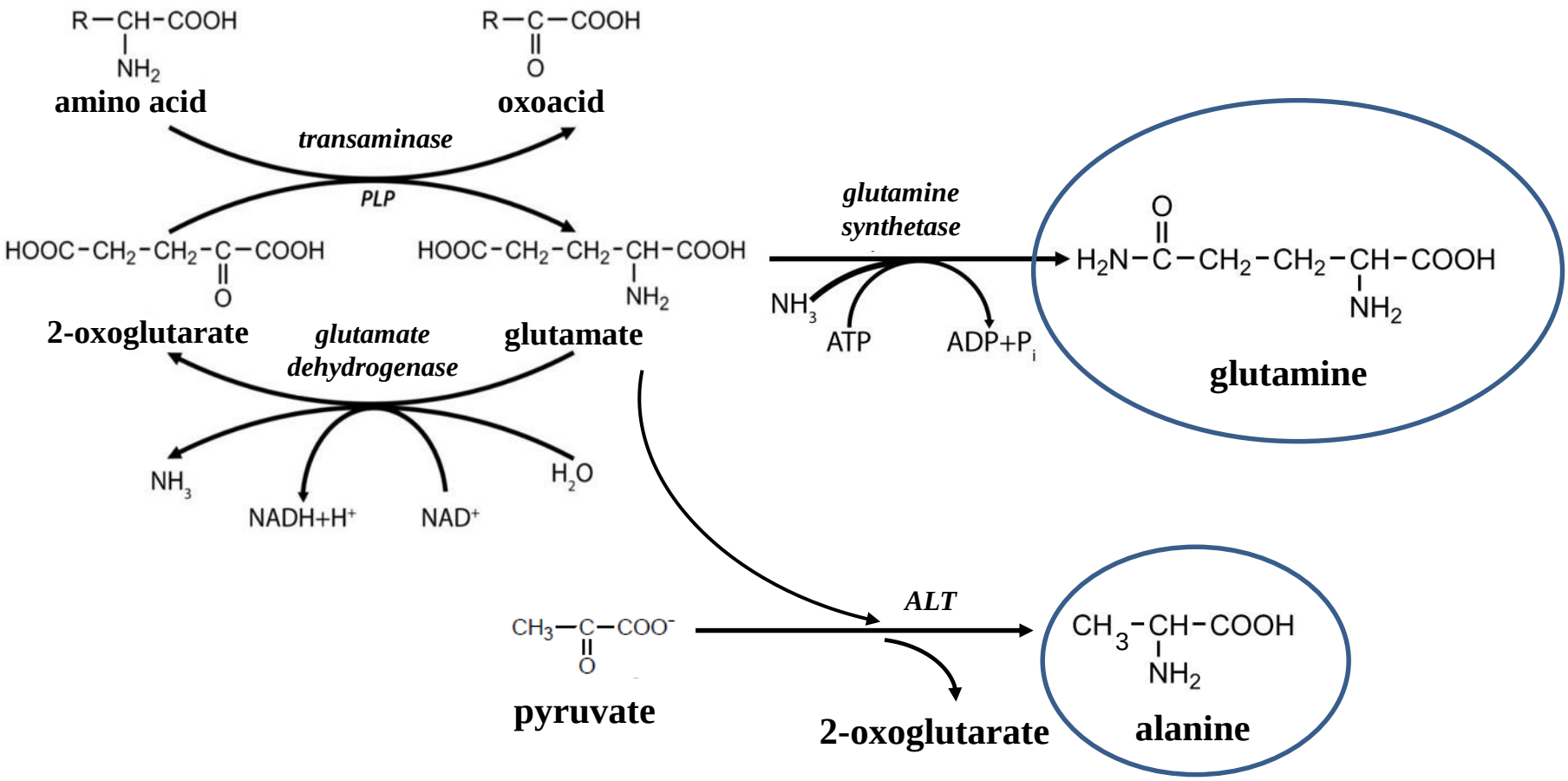
pyridoxamine-phosphate

Oxidative deamination of glutamate

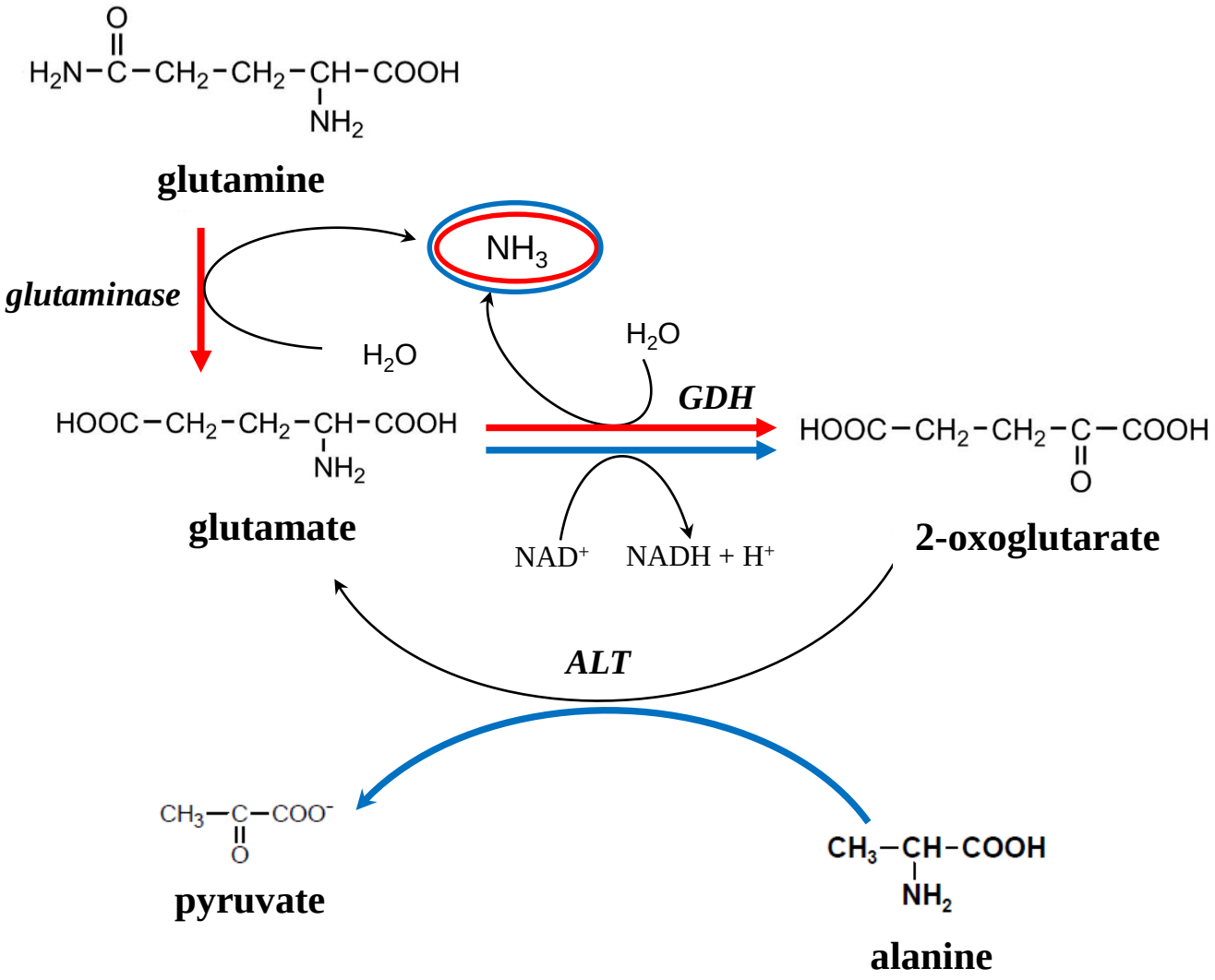


- 2nd step of indirect deamination - oxidative deamination of glutamate
- reversible reaction

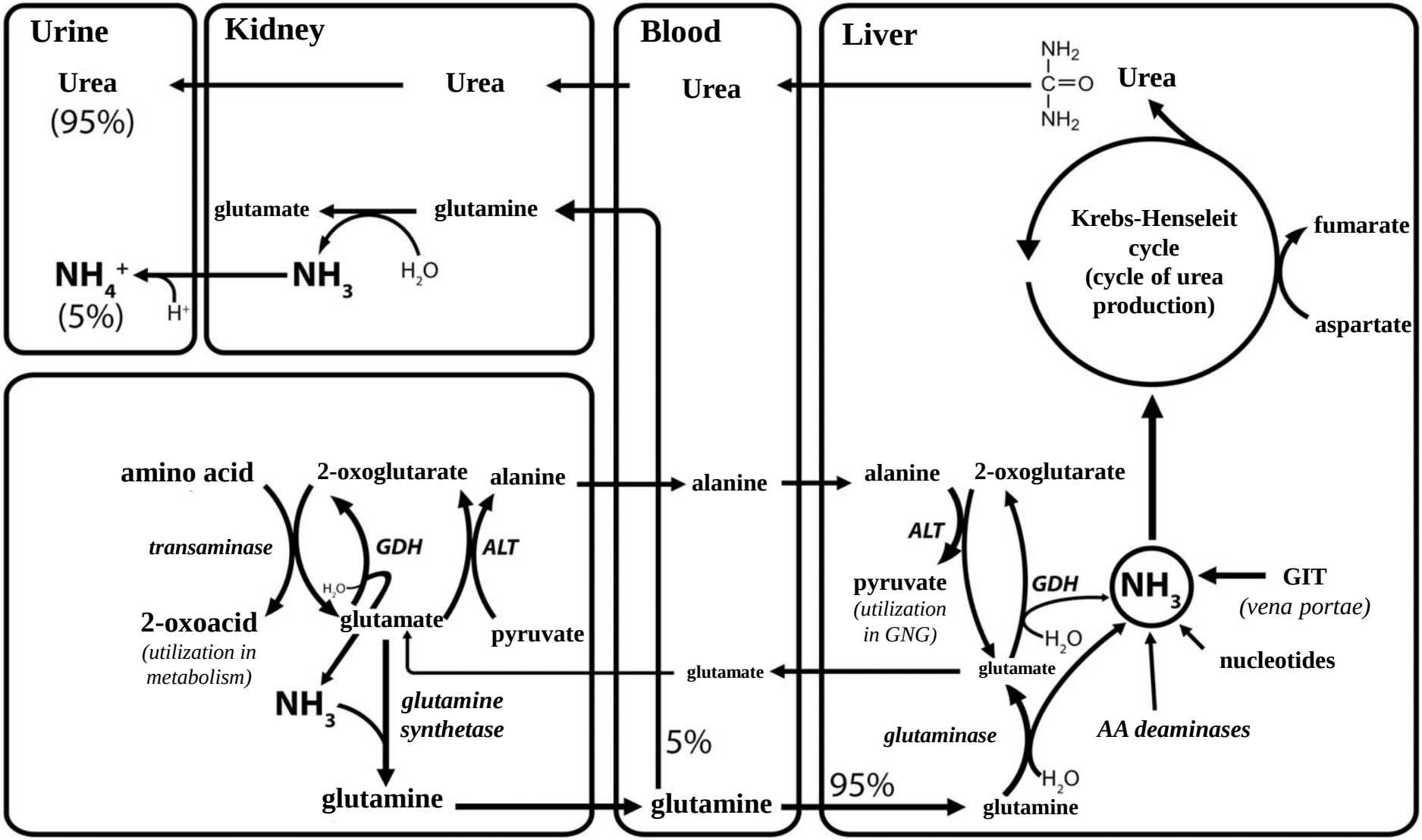
Extrahepatic tissues



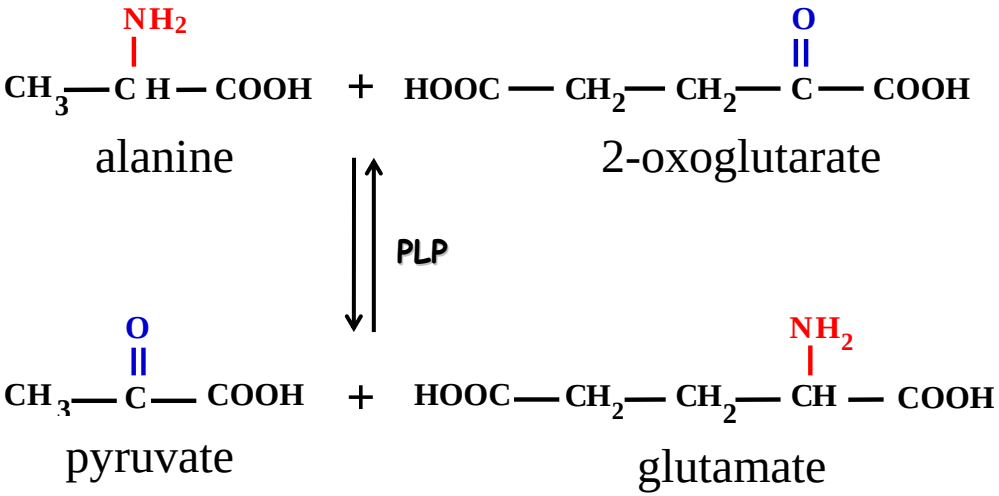
Liver


glutamine
glutaminase
NH3
H2O
H2O
GDH
glutamate
2-oxoglutarate
NAD+
NADH + H+
ALT
pyruvate
alanine

Metabolism of ammonia



Alanine aminotransferase



- **ALT subcellular distribution:** cytosol (85 %)
  mitochondria (15 %)
- **ALT organ distribution:**

  Liver - the highest levels (10 times higher than in skeletal muscle and myocard
  - 10 000 times higher than in plasma

  Erythrocytes – higher levels than in plasma (7 times)

ALT functions in the organism

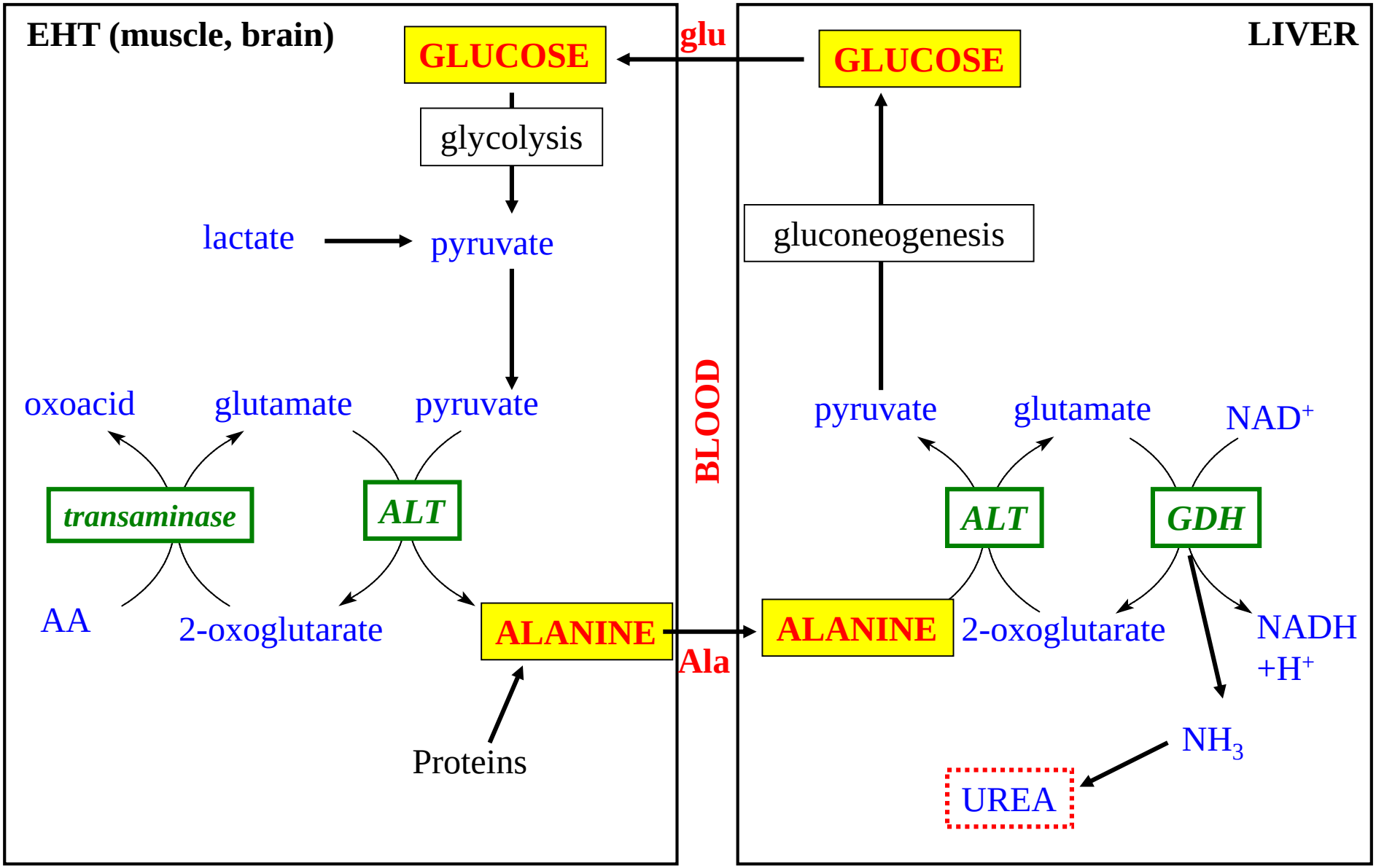
Liver:

- synthesis of pyruvate from alanine for gluconeogenesis

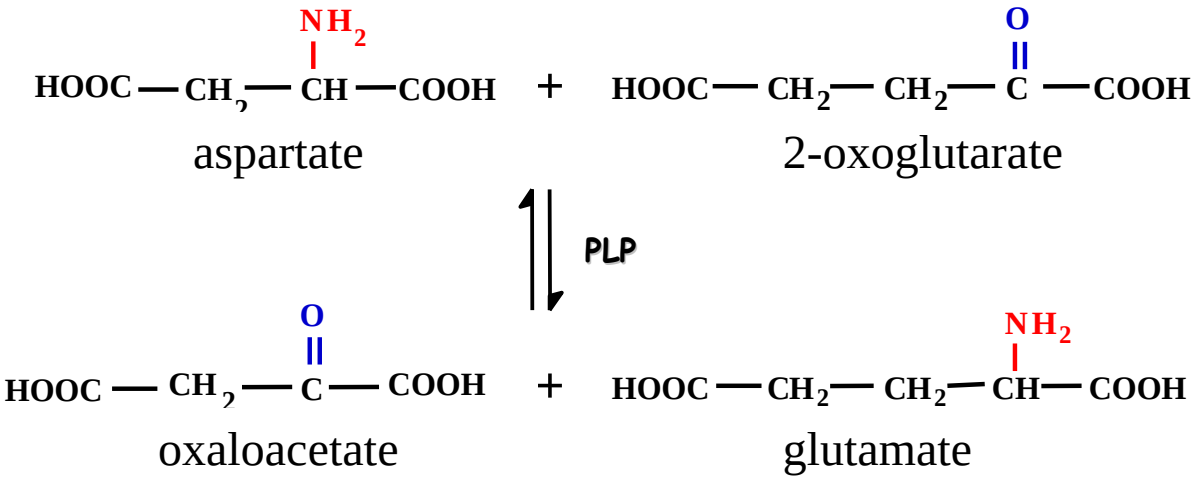
Muscle and other EHT:

- synthesis of alanine from pyruvate (the importance of ALT for the ammonia transport in the form of alanine)

Glucose - alanine cycle



Aspartate aminotransferase



- **AST subcellular distribution:** mitochondria (80 %)
  cytosol (20 %)
- **AST organ distribution:**
  Myocard – higher levels than in skeletal muscle and liver
  Erythrocytes – higher levels than in plasma (40 times)

AST functions in the organism

All tissues:

- part of the malate-aspartate shuttle (NADH transport from cytosol to mitochondria)
- aspartate production for reactions requiring aspartate (purines and pyrimidines synthesis)

Liver:

- synthesis of aspartate for urea cycle
- synthesis of oxaloacetate for gluconeogenesis

Myocard:

- synthesis of oxaloacetate for Krebs cycle (as one of the sources)

Distributions of transaminases

In organs: **ALT** activity predominates **in liver**
AST activity predominates **in myocard (muscle)**

Subcellular distribution:

	mitochondria	cytosol
ALT	15 %	85 %
AST	80 %	20 %

ALT - located in cytosol
- gluconeogenesis from alanine (**in liver**)

AST - formation of oxalacetate
- Krebs cycle – in matrix of mitochondria (**myocard**)