Biosynthesis of Non-Essential Amino Acid

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Types of Amino Acid

- Non-Essential Amino Acid

  Amino Acid that can be synthesized in every organism.
- Essential Amino Acid

  Amino Acid that only can be synthesized by most of bacteria and plants, whereas the animals get these Amino Acid from the food.

Essential and Non-Essential Amino Acid

Essential Amino Acid	Non-Essential
Arginine*	Alanine
Histidine	Asparagine
Isoleucine	Aspartate
Leucine	Cysteine
Lysine	Glutamate
Methionine*	Glutamine
Phenylalanine*	Glycine
Threonine	Proline
Tyrptophan	Serine
Valine	Tyrosine

Biosynthesis of Amino Acid

- Amino Acid mostly contains of Nitrogens in the form of NH_4^+ and carbon atoms.
- NH_4^+ group comes from glutamate or glutamine.
- Carbon atoms come from glucose as a monosacaride.

Biosynthesis of Amino Acid

Glutamine Synthesis is catalyzed by Glutamine synthetase :

(1) Glutamate + ATP $\longrightarrow$ γ-glutamyl phosphate + ADP

(2) γ-Glutamyl phosphate + NH_4^+ $\longrightarrow$ glutamine + P_i + H^+

Sum: Glutamate + NH_4^+ + ATP $\longrightarrow$ glutamine + ADP + Pi + H^+ (22–1)

Glutamate Synthesis is catalyzed by Glutamate synthetase :

α-Ketoglutarate + glutamine + NADPH + H^+ $\longrightarrow$ 2 glutamate + $NADP^+$

The net reaction of both synthesis :

$$\alpha\text{-Ketoglutarate} + NH_4^+ + NADPH + ATP \longrightarrow$$
$$\text{L-glutamate} + NADP^+ + ADP + P_i$$

Biosynthesis of Amino Acid

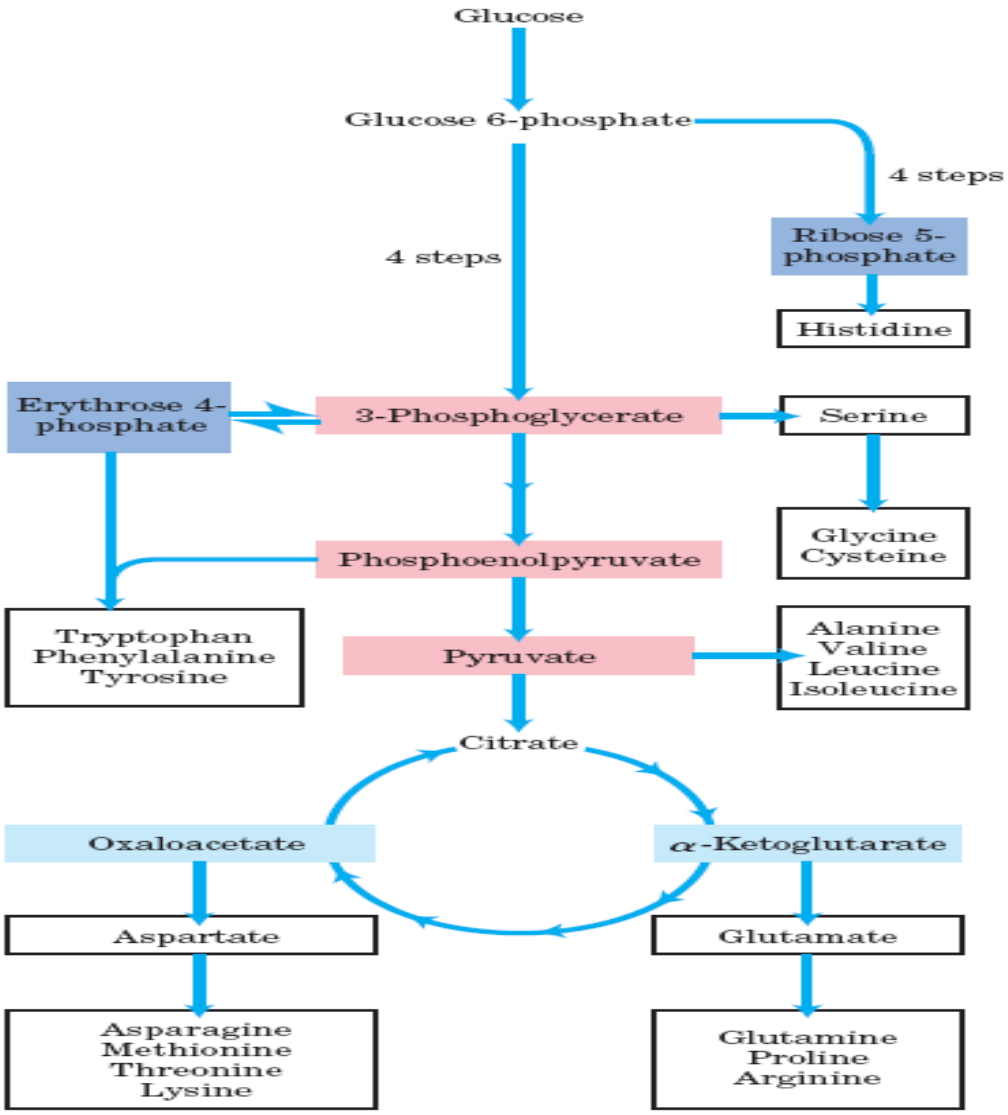


FIGURE 22–9 Overview of amino acid biosynthesis. The carbon skeleton precursors derive from three sources: glycolysis (pink), the citric acid cycle (blue), and the pentose phosphate pathway (purple).

TABLE 22–1 Amino Acid Biosynthetic Families, Grouped by Metabolic Precursor

α-Ketoglutarate
Glutamate
Glutamine
Proline
Arginine

3-Phosphoglycerate
Serine
Glycine
Cysteine

Oxaloacetate
Aspartate
Asparagine
Methionine*
Threonine*
Lysine*

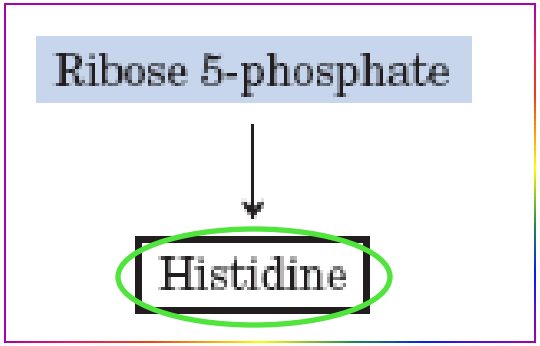
Pyruvate
Alanine
Valine*
Leucine*
Isoleucine*

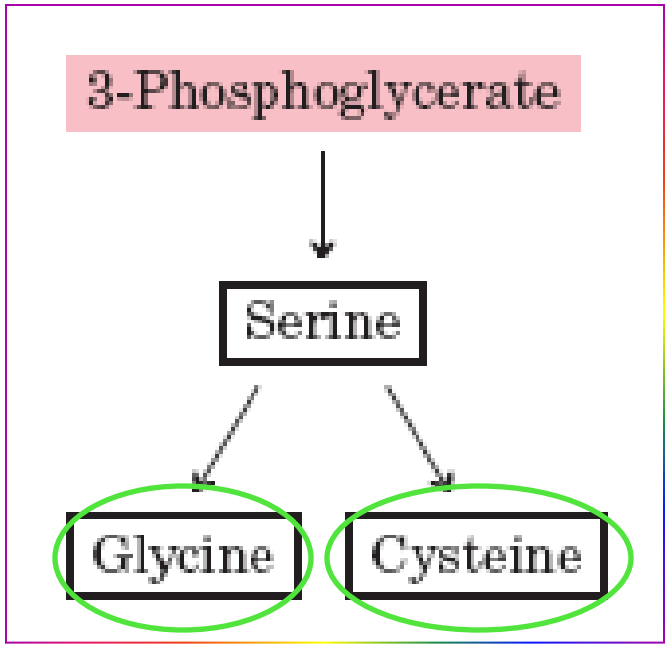
Phosphoenolpyruvate and erythrose 4-phosphate
Tryptophan*
Phenylalanine*
Tyrosine†

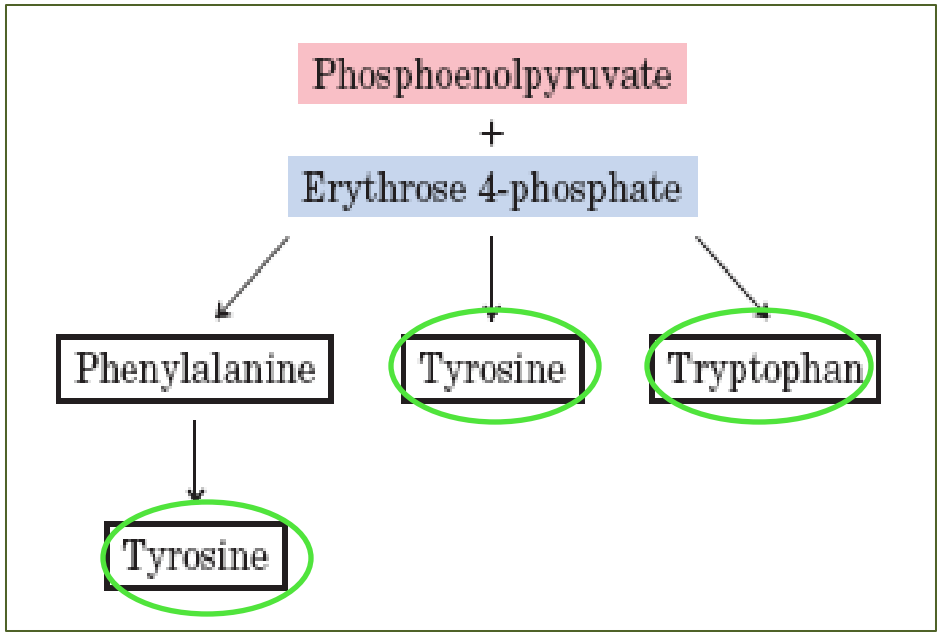
Ribose 5-phosphate
Histidine*

*Essential amino acids.
†Derived from phenylalanine in mammals.

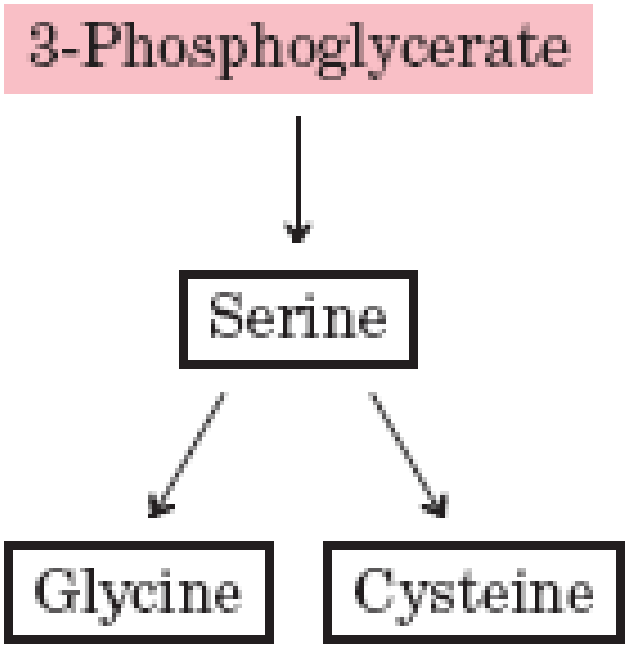
The Individual Amino Acid



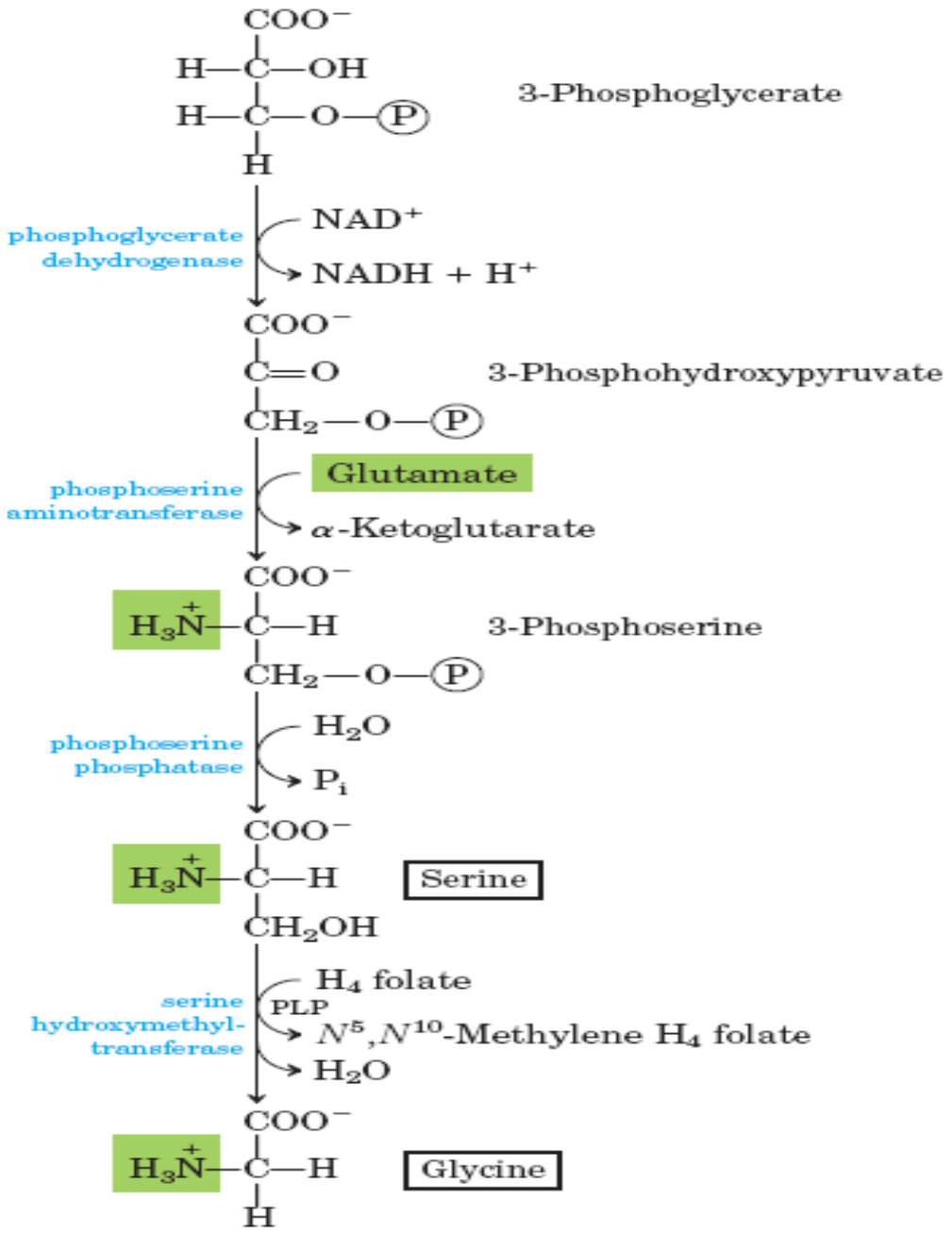




Amino Acid is derived from 3-Phosphoglycerate



Biosynthesis of serine from 3-phosphoglycerate and of glycine from serine in all organisms.



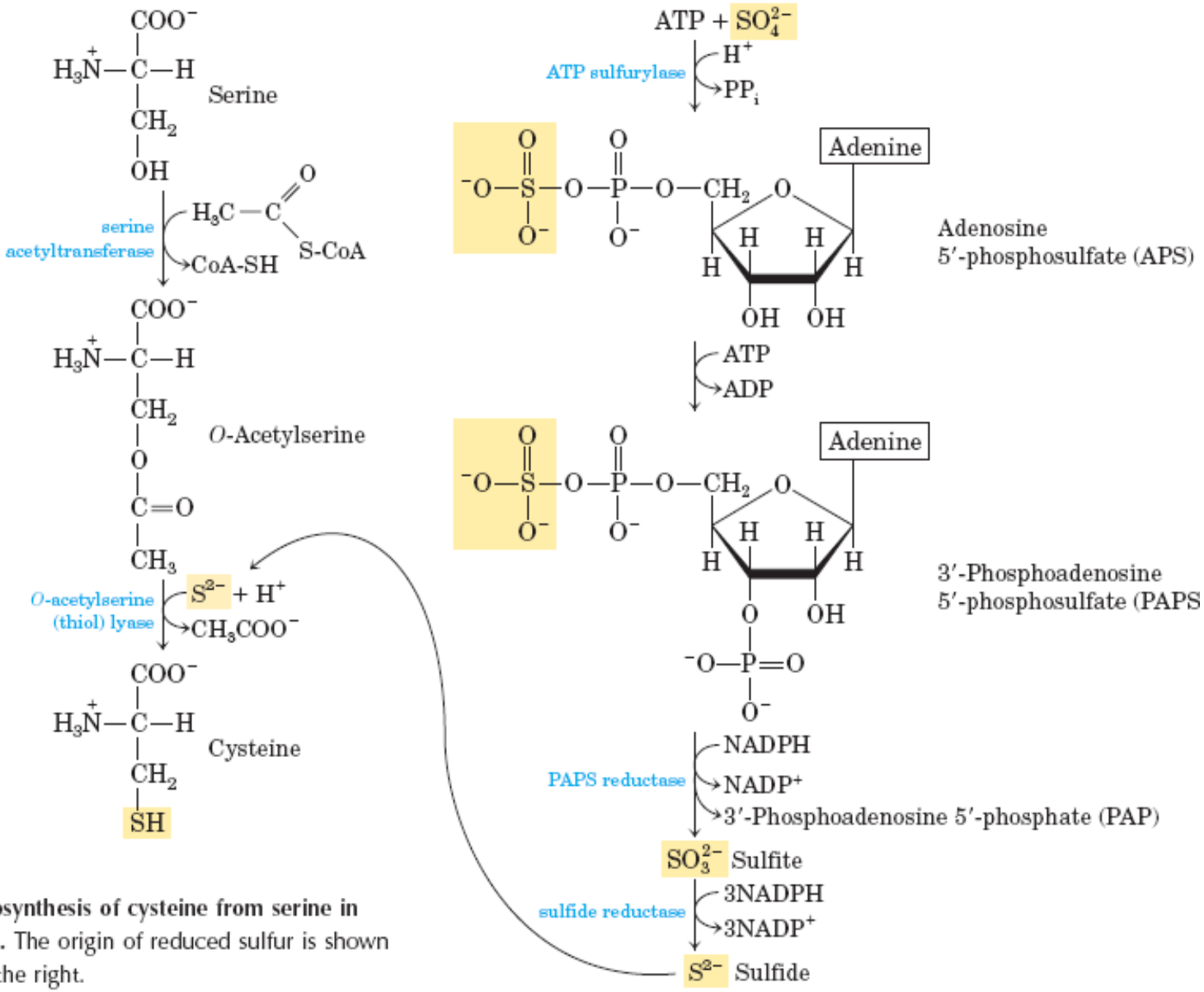
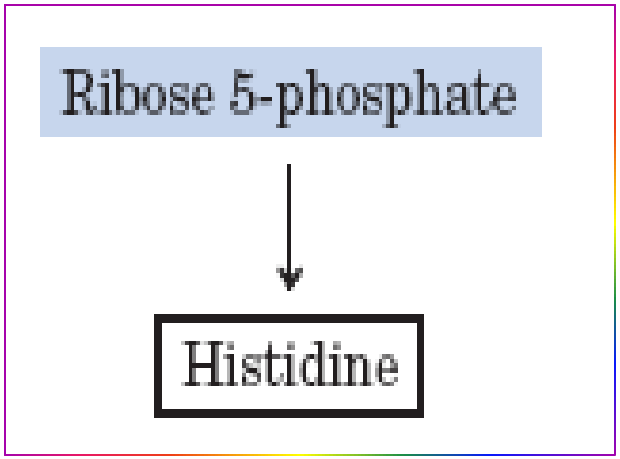
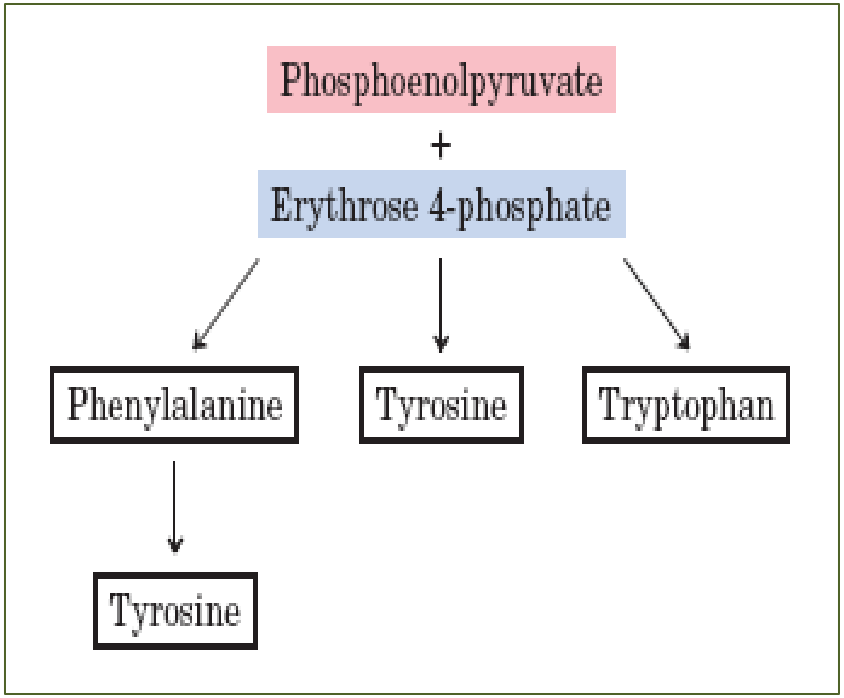


FIGURE 22–13 Biosynthesis of cysteine from serine in bacteria and plants. The origin of reduced sulfur is shown in the pathway on the right.

Amino Acid is derived from Ribose 5-Phosphate



Amino Acids are derived from Phosphoenolpyruvate and Erythrose 4-Phosphate



Conclusion

- Source of amino groups in Amino Acid are derived from glutanime and glutamate in the process of transamination.
- Source of carboxyl and hydroxyl groups are derived from monosaccharides (glucose).
- Individual Amino Acid is kind of amino acid which is derived from the other amio acid but, it can’t convert to be another Amino Acid.
- There are 6 metabolic precursors in biosythesis

Refferences

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