

Amino acid biosynthesis

Sections/problems listed with an asterisk (*) do not discuss the exact reaction indicated, but do discuss a closely related reaction.

Alanine (from pyruvate)

- Alanine aminotransferase (EC 2.6.1.2) [Section 14.4E*](#)

Aspartate (from oxaloacetate):

- Aspartate aminotransferase (EC 2.6.1.1) [Section 14.4E](#)

Glutamate (from *alpha*-ketoglutarate)

- Glutamate aminotransferase (EC 2.6.1.1) [Section 14.4E](#)

Glutamine (from glutamate)

- Glutamine synthase (EC 6.3.1.2) [Section 10.2D](#), [Section 12.2A](#)

Asparagine (from aspartate)

- Asparagine synthase (EC 6.3.5.4) [Section 10.2E](#), [Section 12.2B](#)

Arginine (from glutamate via ornithine, urea cycle)

- N-acetylglutamate synthase (EC 2.3.1.1) [Section 12.3*](#)
- Acetylglutamate kinase (EC 2.7.2.8) [Section 10.2D*](#), [Section 12.2*](#)
- N-acetyl-*gamma*-glutamyl-phosphate reductase (1.2.1.38) [Section 16.4D*](#)
- Acetylorithine aminotransferase (EC 2.6.1.11) [Section 14.4E*](#)
- Acetylorithine deacetylase (EC 3.5.1.16) [Chapter 12*](#)

to arginine via urea cycle:

- Ornithine transcarbamylase (EC 2.1.3.3) [Section 12.2A,B*](#)
- Argininosuccinate synthetase (EC 6.3.4.5) [Section 12.6](#), [Section 14.1D](#)
- Argininosuccinate lyase (EC 4.3.2.1) [Section 14.1D](#)
- Arginase (EC 3.5.3.1) [P12.16](#)

Proline (from glutamate)

- Glutamate-5-kinase (EC 2.7.2.11) [Section 16.4D](#)
- Glutamate-5-semialdehyde dehydrogenase (EC 1.2.1.41) [Section 16.4D](#), reverse of [P11.2](#)
- Pyrroline-5-carboxylate reductase (EC 1.5.1.2) [Section 16.4D](#)

Serine (from 3-phosphoglycerate)

- Phosphoglycerate dehydrogenase (EC 1.1.1.95) [Section 16.4*](#)
- Phosphoserine transaminase (EC 2.6.1.52) [Section 14.4E*](#)
- Phosphoserine phosphatase (EC 3.1.3.3) [Section 10.3*](#)

Cysteine (from serine)

- Cystathionine *beta*-synthase (EC 4.2.1.22) [Section 14.4G*](#)
- Cystathionine *gamma*-lyase (EC 4.4.1.1) [Section 14.4G](#)

or, in bacteria:

- O-acetylserine sulphydrolase (EC 2.5.1.47) [Section 14.4F](#)

Glycine (from serine)

- Serine hydroxymethyltransferase (EC 2.1.2.1) [Section 14.4D](#)

Lysine (from aspartate)

- Aspartate kinase (EC 2.7.2.4) [P16.3](#); [Section 10.2D*](#),
- Aspartate-semialdehyde dehydrogenase (EC 1.2.1.11) [Section 16.4*](#); [P16.3](#)
- Dihydrodipicolinate synthase (EC 4.2.1.52) [Section 13.3*](#), [Section 11.6*](#), [Section 14.1*](#); [P11.7](#), [C14.3](#)
- Dihydrodipicolinate reductase (EC 1.3.1.26) [Section 16.5*](#); [P16.4a](#)
- Tetrahydropyridine-2-carboxylate N-succinyltransferase (EC 2.3.1.117) [P11.9](#)
- Succinyldiaminopimelate transaminase (EC 2.6.1.17) [Section 14.4E*](#)
- Succinyl-diaminopimelate desuccinylase (EC 3.5.1.18) [P12.8](#)
- Diaminopimelate decarboxylase (EC 4.1.1.20) [Section 14.4C](#)

Methionine (from aspartate via homoserine)

- Aspartate kinase (EC 2.7.2.4) [Section 10.2D*](#); [P16.3](#)
- Aspartate-semialdehyde dehydrogenase (EC 1.2.1.11) [Section 16.4*](#); [P16.3](#)
- Homoserine dehydrogenase (EC 1.1.1.3) [Section 16.4*](#)
- Homoserine transsuccinylase (EC 2.3.1.46) [Section 12.3*](#)
- Cystathionine *gamma*-synthase (EC 4.2.1.22) [Section 14.4G](#)
- Cystathionine *beta*-lyase (EC 4.4.1.8) [Section 14.4F*](#)
- Methionine synthase (EC 2.1.1.13) [P9.5](#)

Threonine (from homoserine)

- Homoserine kinase (EC 2.7.1.39) [Section 10.2*](#)
- Threonine synthase (EC 4.2.3.1) [P14.10c](#), [Section 14.4G*](#)

Isoleucine, leucine, and valine (from pyruvate):

- Acetolactate synthase (EC 2.2.1.6) [P14.12](#) [Section 14.5*](#)
- Ketol acid reductoisomerase (EC 1.1.1.86) [Section 15.7C](#)
- Dihydroxyacid dehydratase (EC 4.2.1.9) [P14.5](#)

to isoleucine:

- Branched-chain-amino-acid aminotransferase (EC 2.6.1.42) [Section 14.4E*](#)

to valine:

- Valine—pyruvate aminotransferase (EC 2.6.1.66) [Section 14.4E*](#)

to leucine:

- 2-isopropylmalate synthase (EC 2.3.3.13) [Section 13.3*](#)
- Isopropylmalate isomerase (EC 4.2.1.33) [P14.7](#)
- 3-isopropylmalate dehydrogenase (EC 1.1.1.85) [Section 16.4*](#)
- Leucine aminotransferase (EC 2.6.1.6) [Section 14.4E*](#)

Aromatic amino acids

Erythrose-4-phosphate to chorismate:

- DAHP synthase (EC 2.5.1.54) [Section 15.2C](#)
- Dehydroquinate synthase (EC 4.2.3.4) [C13.1](#), [14.1A](#)
- Dehydroquinate dehydratase (EC 4.2.1.10) [Section 14.1D](#)
- Shikimate dehydrogenase (EC 1.1.1.25) [Section 16.4*](#)
- Shikimate kinase (EC 2.7.1.71) [P10.2](#) [Section 10.2*](#)

- 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase (EC 2.5.1.19) Section 14.3B, Section 15.4
- Chorismate synthase (EC 4.2.3.5) Section 14.3B, Section 17.3C

chorismate to tryptophan:

- Anthranilate synthase (EC 4.1.3.27) P14.8a
- Anthranilate phosphoribosyltransferase (EC 2.4.2.18) Section 11.5*
- Phosphoribosyl anthranilate isomerase (EC 5.3.1.24) P11.12, P13.12
- Indole-3-glycerol phosphate synthase (EC 4.1.1.48) Section 15.5B
- Tryptophan synthase (EC 4.2.1.20) Section 13.3C, E13.7, Section 15.5B

chorismate to phenylalanine/tyrosine:

- Chorismate mutase (EC 5.4.99.5) Section 15.10
- Prephenate decarboxylase (EC 4.2.1.51) Section 14.3B
- Aromatic-amino-acid aminotransferase (EC 2.6.1.57) Section 14.4E*
- Tyrosine aminotransferase (EC 2.6.1.5) Section 14.4E*

Histidine

- ATP phosphoribosyltransferase (EC 2.4.2.17) Section 11.5*
- Phosphoribosyl-ATP diphosphatase (EC 3..6.1.31) Section 10.3*
- Phosphoribosyl-AMP cyclohydrolase (EC 3.5.4.19) P12.12
- 1-(5-phosphoribosyl)-5-[(5-phosphoribosylamino)methylideneamino]imidazole-4-carboxamide isomerase (EC 5.3.1.16) P14.8b
- Imidazole glycerol-phosphate synthase (no EC number assigned) Section 11.6*, C11.1
- Imidazoleglycerol-phosphate dehydratase (4.2.1.19) Section 14.3B
- Histidinol-phosphate transaminase (EC 2.6.1.9) Section 14.4E*
- Histidinol-phosphatase (EC 3.1.3.15) Section 10.3*
- Histidinol dehydrogenase (EC 1.1.1.23) Section 16.4D*

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