3-phosphohydroxy pyruvate $\xrightarrow{\text{Phospho Serine amino transferase}}$ glutamate $\xrightarrow{\alpha$-keto glutarate} 3-phospho Serine

Serine $\xrightarrow{\text{hydroxy methyl transferase}}$ H$_2$O, Folate, Glycine,

Cysteine

Serine $\xrightarrow{\text{acetyl transferase}}$ CoA-SH, acetyl-CoA, 3-phospho Serine thiol, O-acetyl Serine

Adenosine 5-phosphosulfate (APS)

ATP $\xrightarrow{\text{sulfide reductase}}$ 3-phosphate adenosine 5-phosphate $\xrightarrow{\text{3-phosphoadenosine}}$ 5-phosphosulfate $\xrightarrow{\text{C-reductase}}$ S$^{2-}$
Biosynthesis of aromatic amino acids

Phosphoenol pyruvate (from glycolysis)

+ Erythrose-4-phosphate

→ Phenylalanine

→ Tyrosine

→ Tryptophane

Phosphoenol pyruvate

H₂O

2-Keto-3-deoxy-arabinoheptulosonate 7-phosphate

3-Dehydroquinate

12 steps
Amino acids Catabolism:

There are seven amino acids are degraded to acetyl-CoA in which the portions of the carbon skeletons of (7) amino acids: - tryptophane, lysine, phenyl alanine, tyrosine, leucine, isoleucine, and threonine, yield acetyl-CoA and or acetoacetyl-CoA which is converted to acetyl-CoA.

Some of the final steps in the degradative pathways for leucine, lysine, and tryptophane resemble steps in the oxidation of amino acids.
Six Amino Acids are degraded to pyruvate. Then the pyruvate can be converted to either acetyl-CoA or oxaloacetate (a precursor for gluconeogenesis).

Ketogenic

\[ \text{CH}_3 - \text{CH} - \text{COO}^- + \text{NH}_3 \to \text{CH}_3 - \text{CH} - \text{COO}^- + \text{H}_2\text{O} \]

Threonine dehydrogenase

\[ \text{NAD}^+ \to \text{NADH} \]

\[ \text{NAD}^+ \to \text{NADH} \]

2-Amino-3-Ketobutyrate

\[ \text{CoA} \to \text{Acetyl-CoA} \]

Glycine

\[ \text{CH}_2 - \text{COO}^- + \text{NAD}^+ \to \text{CO}_2 + \text{NH}_3^+ \]

Serine hydroxymethyltransferase

\[ \text{CH}_2 - \text{CH} - \text{COO}^- + \text{NAD}^+ + \text{NAD}^+ \to \text{CH}_2 - \text{CH} - \text{COO}^- + \text{NADH}^+ \]

Methylenetetrahydrofolate

\[ \text{NADH}^+ \to \text{NAD}^+ \]

Glycine

\[ \text{CH}_2 - \text{CH} - \text{COO}^- + \text{NAD}^+ \to \text{CO}_2 + \text{NH}_3^+ \]

Tryptophane

\[ \text{NAD}^+ \to \text{NADH}^+ \]

Serine dehydratase

\[ \text{NADH}^+ \to \text{NAD}^+ \]

Alanine transaminase

\[ \text{CH}_3 - \text{CH} - \text{COO}^- \]

Glutamate

\[ \text{Ketoglutarate} \]

2 steps

\[ \text{CH}_2 - \text{CH} - \text{COO}^- \]

Cysteine
Four amino acids are converted to succinyl-CoA

\[
\text{CH}_3 - \text{S-CH}_2 - \text{CH}_2 - \text{CH} - \text{COO}^- \]

3 steps

\[\text{H}_3 \text{N} - \text{CH}_2 - \text{CH}_2 - \text{CH} - \text{COO}^-\]

\[\text{NH}_3\]

\[\text{CH}_3 - \text{CH}_2 - \text{C}^\text{\textit{o}} - \text{COO}^-\]

\[\alpha\text{-Keto glutarate}\]

2 steps

\[\text{H}_2\text{O} \quad \text{NH}_4^+\]

\[\text{R} \quad \text{R}\]

\[\text{threonine dehydratase}\]

\[\text{H}_3 \text{N} - \text{CH}_3 - \text{CH} - \text{CH} - \text{COO}^-\]

\[\text{CH}_3 - \text{CH} - \text{CH} - \text{C}^\text{\textit{o}} - \text{COO}^-\]

\[\alpha\text{-Keto acid dehydratase}\]

\[\text{C}^\text{\textit{o}} - \text{COO}^- - \text{CH} - \text{C}^\text{\textit{o}} - \text{SCO}^-\]

7 steps

\[\text{CH}_3 - \text{CH}_2 - \text{C}^\text{\textit{o}} - \text{SCO}^-\]

\[\text{propionyl-CoA}\]

2 steps

\[\text{CH}_3 - \text{C}^\text{\textit{o}} - \text{SCO}^-\]

\[\text{methyl malonyl-CoA}\]

\[\text{mutase}\]

\[\text{CH}_3 - \text{C}^\text{\textit{o}} - \text{SCO}^-\]

\[\text{valin}e\]

\[\text{C}^\text{\textit{o}} - \text{C}-\text{CH}_2 - \text{CH}_2 - \text{C}^\text{\textit{o}} - \text{SCO}^-\]

\[\text{succinyl-CoA}\]
Five amino acids are converted to \( \alpha \)-Keto glutarate.

1. **Arginine**
   - \( \text{H}_{3}\text{N}^+ - \text{C} = \text{O} - \text{C} - \text{H} - \text{CH}_2 - \text{CH}_2 - \text{NH}^+ \)
   - \( \text{H}_2\text{O} \) by arginase
   - \( \text{Ornithine} \)

2. **Glutamate**
   - **Semi-aldehyde**
   - **Histidine**

- **Ornithine**
  - **S-aminotransferase**
  - **Proline-\( \delta \)-Carboxylate**
  - **Proline oxidase**

- **Glutamate**
  - **Semi-aldehyde dehydrogenase**
  - **Glutaminase**
  - **\( \alpha \)-Keto glutarate**
**Gluconeogenesis**

Pyruvate that produced from some amino acids is converted to glucose in the liver.
Urea Cycle

Glutamine → Glutaminase → Glutamate

Glutamate dehydrogenase

HCO₃⁻ + NH₄⁺ → 2 ATP

Carbamoyl phosphate synthetase

Carbamoyl phosphate

Pi

Mitochondria

NH₃

Urea

NH₂-C-NH₂

COO⁻

N=CH=CH-COO⁻

Fumarate

COO⁻

00C-CH₂-C-CH-NH_-

00C-CH₂-CH-NH-(CH₂)₃-CH-COO⁻

Arginosuccinate

HHN-C-NH-(CH₂)₂-CH-CO₀⁻

Citrulline

ATP → P₃i

Citrullyl-AMP intermediate

Aspartate

00C-CH₂-CH-CO₀⁻

Argininosuccinate
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<td>Melanin synthesis from tyrosin</td>
<td>Tyrosin 3-monooxygenase</td>
<td>Lack of pigment white hairs pink skin</td>
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<td>Homogentisic acid β-dioxygenase</td>
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<td>Argininosuccinase</td>
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<td></td>
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