

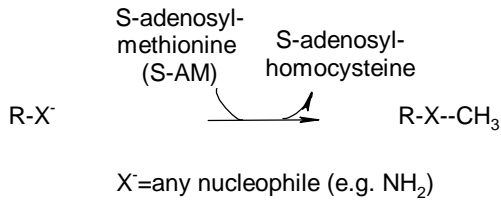
General Transformations by Enzyme

		Example	Substrate	Enzyme/Process	Product	
Decarboxylation	$\begin{array}{c} \text{O} \\ \parallel \\ \beta\text{-C-O}^- \\ \\ \alpha\text{-C} \\ \\ \text{C=O} \end{array}$ <p>β-keto acid</p>	$\begin{array}{c} \text{H}^+ \\ \curvearrowright \\ \text{CO}_2 \\ \text{spontaneous} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \text{C} \\ \\ \text{C=O} \end{array}$	oxalosuccinate	α -ketoglutarate	
	$\begin{array}{c} \text{O} \\ \parallel \\ \alpha\text{-C-C-O}^- \\ \\ \text{NH}_2 \end{array}$	$\begin{array}{c} \text{H}^+ \\ \curvearrowright \\ \text{CO}_2 \\ \text{E-PLP} \end{array}$	$\begin{array}{c} \text{H} \\ \\ \alpha\text{-C} \\ \\ \text{NH}_2 \end{array}$	histidine	histidine decarboxylase	histamine
	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-CO}_2^- \end{array}$	$\begin{array}{c} \text{NAD}^+ \\ \curvearrowright \\ \text{NADH} \\ \text{SCoA} \quad \text{CO}_2 \end{array}$ <p>Thiamine-PP, FAD, Lipoate</p>	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-SCoA} \end{array}$	pyruvate	pyruvate oxidase particle	acetyl CoA
Thioesterase	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-SCoA} \end{array}$	$\begin{array}{c} \text{H}_2\text{O} \\ \curvearrowright \\ \text{-SCoA} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-O}^- \end{array}$			
Activation	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-O}^- \end{array}$	$\begin{array}{c} \text{ATP} \\ \curvearrowright \\ \text{AMP} \\ \text{SCoA} \quad \text{PPi} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-SCoA} \end{array}$	fatty acid	fatty acyl CoA (fatty acid activation)	
Reduction	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-O}^- \end{array}$	$\begin{array}{c} \text{NADPH} + \text{H}^+ \\ \curvearrowright \\ \text{NADP}^+ \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-H} \end{array}$			
	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-H} \end{array}$	$\begin{array}{c} \text{NADPH} + \text{H}^+ \\ \curvearrowright \\ \text{NADP}^+ \end{array}$	$\begin{array}{c} \text{OH} \\ \\ \text{C-H} \\ \\ \text{H} \end{array}$		step in fatty acid biosynthesis	
	$\begin{array}{c} \text{C}=\text{C} \\ \quad \end{array}$	$\begin{array}{c} \text{NADPH} + \text{H}^+ \\ \curvearrowright \\ \text{NADP}^+ \end{array}$	$\begin{array}{c} \text{CH-CH} \\ \quad \end{array}$		step in fatty acid biosynthesis	
Oxidation	$\begin{array}{c} \text{CH-CH} \\ \quad \end{array}$	$\begin{array}{c} \text{FAD} \\ \curvearrowright \\ \text{FADH}_2 \end{array}$	$\begin{array}{c} \text{C}=\text{C} \\ \quad \end{array}$		step in fatty acid oxidation	
	$\begin{array}{c} \text{OH} \\ \\ \text{C-H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{NAD}^+ \\ \curvearrowright \\ \text{NADH} + \text{H}^+ \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-H} \end{array}$		step in valine metabolism	
	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-H} \end{array}$	$\begin{array}{c} \text{NAD}^+ \\ \curvearrowright \\ \text{NADH} + \text{H}^+ \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{C-O}^- \end{array}$		step in valine metabolism	
Hydration/Dehydration	$\begin{array}{c} \text{C}=\text{C} \\ \quad \end{array}$	$\begin{array}{c} \text{H}_2\text{O} \\ \curvearrowright \\ \rightleftharpoons \end{array}$	$\begin{array}{c} \text{OH} \quad \text{H} \\ \quad \\ \text{C} \quad \text{C} \\ \quad \end{array}$		step in fatty acid oxidation/ biosynthesis	

General Transformations by Enzyme

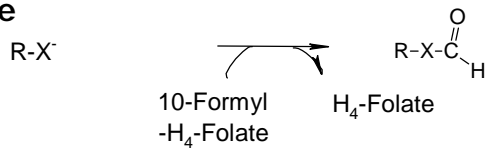
			Example		
			Substrate	Enzyme/Process	Product
E-PLP Reactions					
Transamination	$\text{R}'-\overset{\text{O}}{\parallel}{\text{C}}-\text{CO}_2^- \xrightleftharpoons[\alpha\text{-KGA}]{\text{Glu}}$	$\text{R}'-\overset{\text{H}}{\underset{\text{NH}_2}{\text{C}}}-\text{CO}_2^-$	pyruvate		alanine
α -decarboxylation	$\begin{array}{c} \text{O} \\ \parallel \\ \text{---C---} \\ \\ \text{NH}_2 \end{array} \xrightarrow[\text{CO}_2]{\text{H}^+}$	$\begin{array}{c} \text{---C---} \\ \\ \text{NH}_2 \end{array}$	histidine	histidine decarboxylase	histamine
Aldolase-like reaction (α -elimination)	$\begin{array}{c} \text{---C---} \\ \\ \text{OH} \end{array} \begin{array}{c} \text{---C---} \\ \\ \text{NH}_2 \end{array} \text{---CO}_2^- \xrightarrow[\text{C=O}]{\text{H}^+}$	H---C---CO_2^-	serine	serine hydroxymethylase	glycine
β -elimination	$\begin{array}{c} \text{H} \\ \\ \text{---C---} \\ \\ \text{X} \end{array} \begin{array}{c} \text{H} \\ \\ \text{---C---} \\ \\ \text{NH}_2 \end{array} \text{---CO}_2^- \xrightarrow[\text{H}_2\text{O}]{\text{H}^+} \begin{array}{c} \text{H} \\ \\ \text{---C---} \\ \\ \text{O} \end{array} \begin{array}{c} \text{H} \\ \\ \text{---C---} \\ \\ \text{NH}_2 \end{array} \text{---CO}_2^-$ <p>X = good leaving group, such as OH, OP, SH</p>		serine	serine dehydrase	pyruvate

Methylation



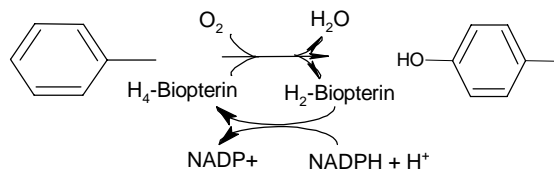
norepinephrine → epinephrine

Addition of aldehyde



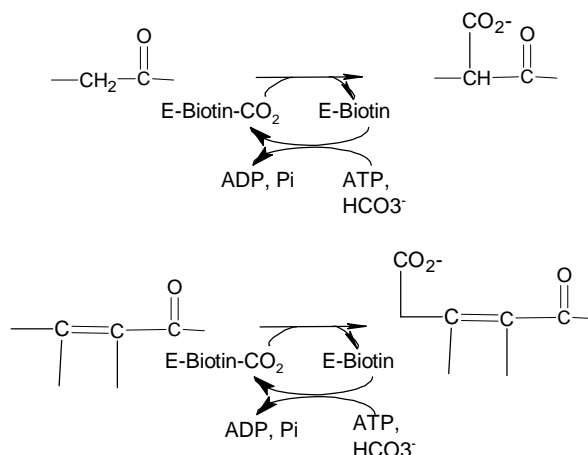
GAR → (purine biosynthesis) → FGAR

Monoxygenation



phenylalanine → tyrosine
phenylalanine hydroxylase

Carboxylation



propionyl CoA → methylmalonyl CoA

step in leucine metabolism