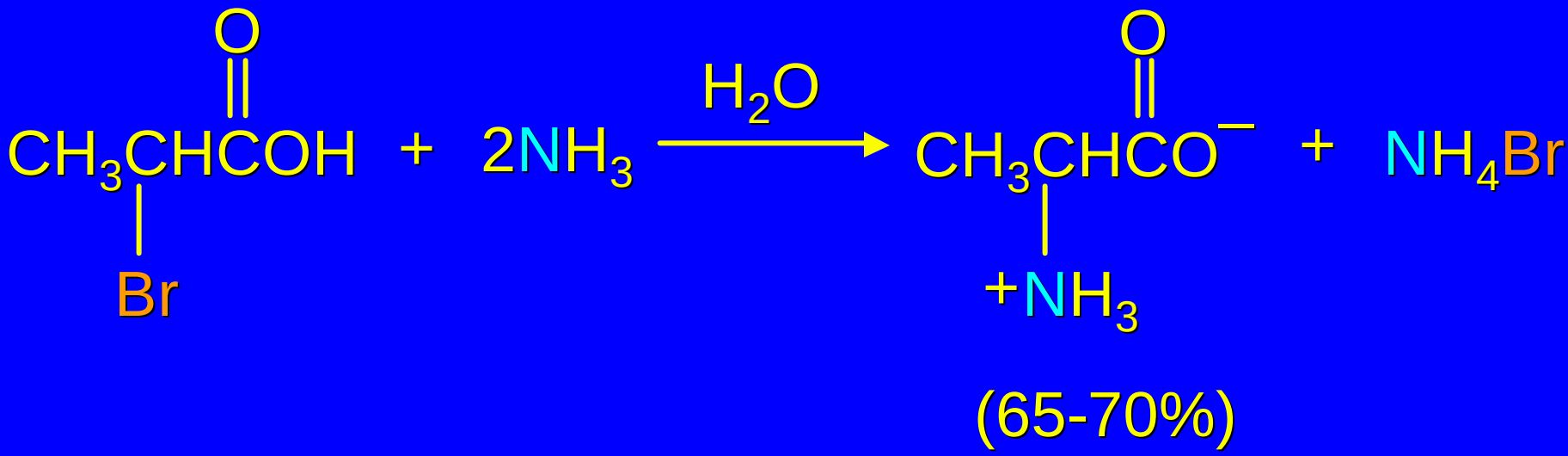
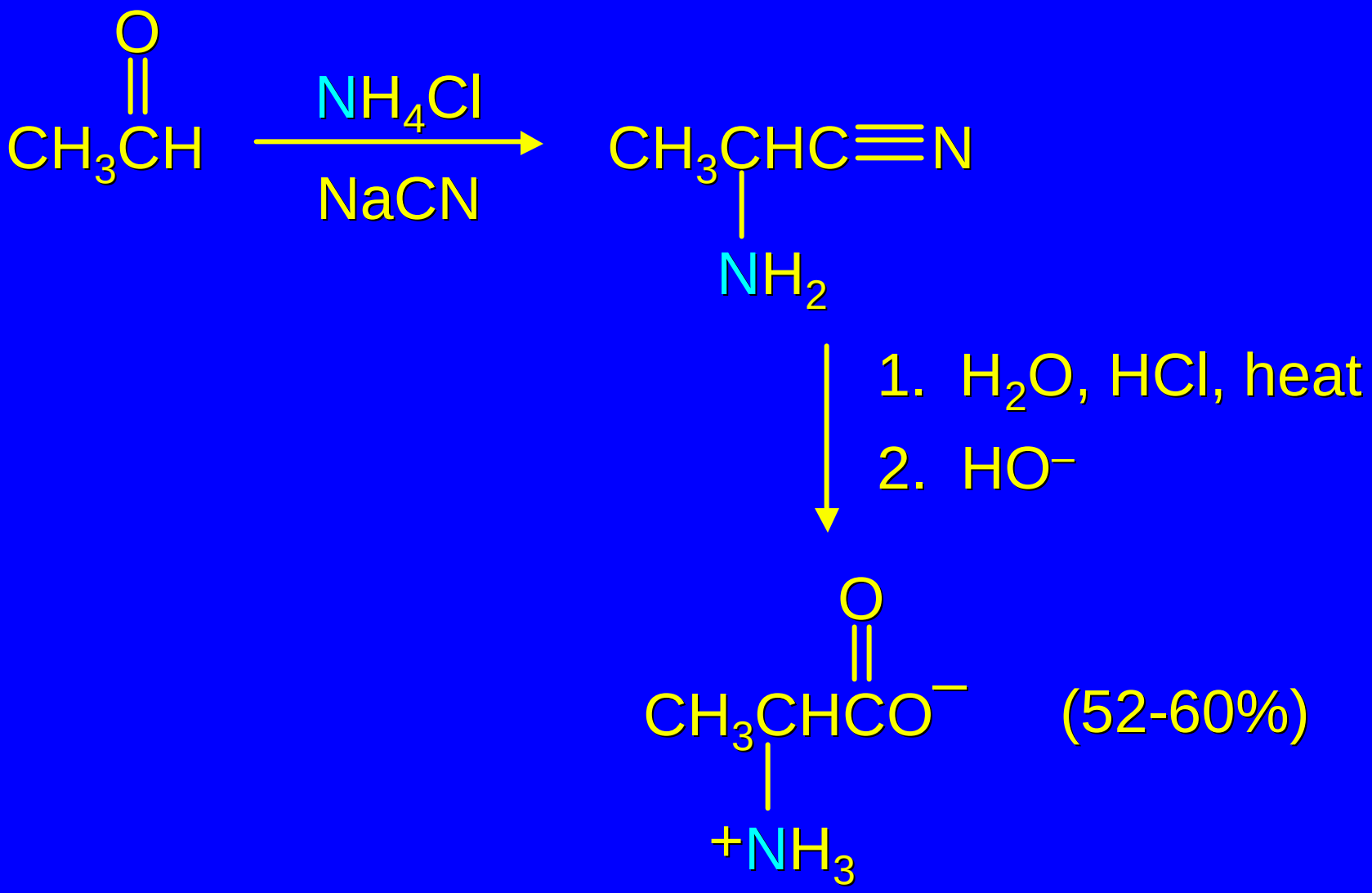
27.4
Synthesis of Amino Acids

From α-Halo Carboxylic Acids

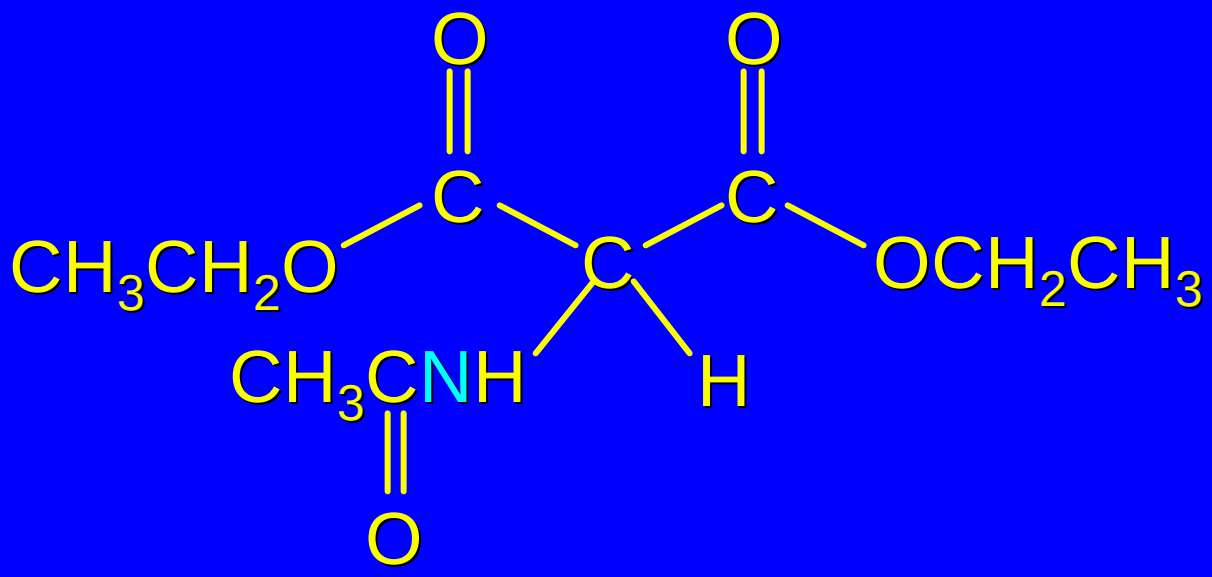


(65-70%)

Strecker Synthesis

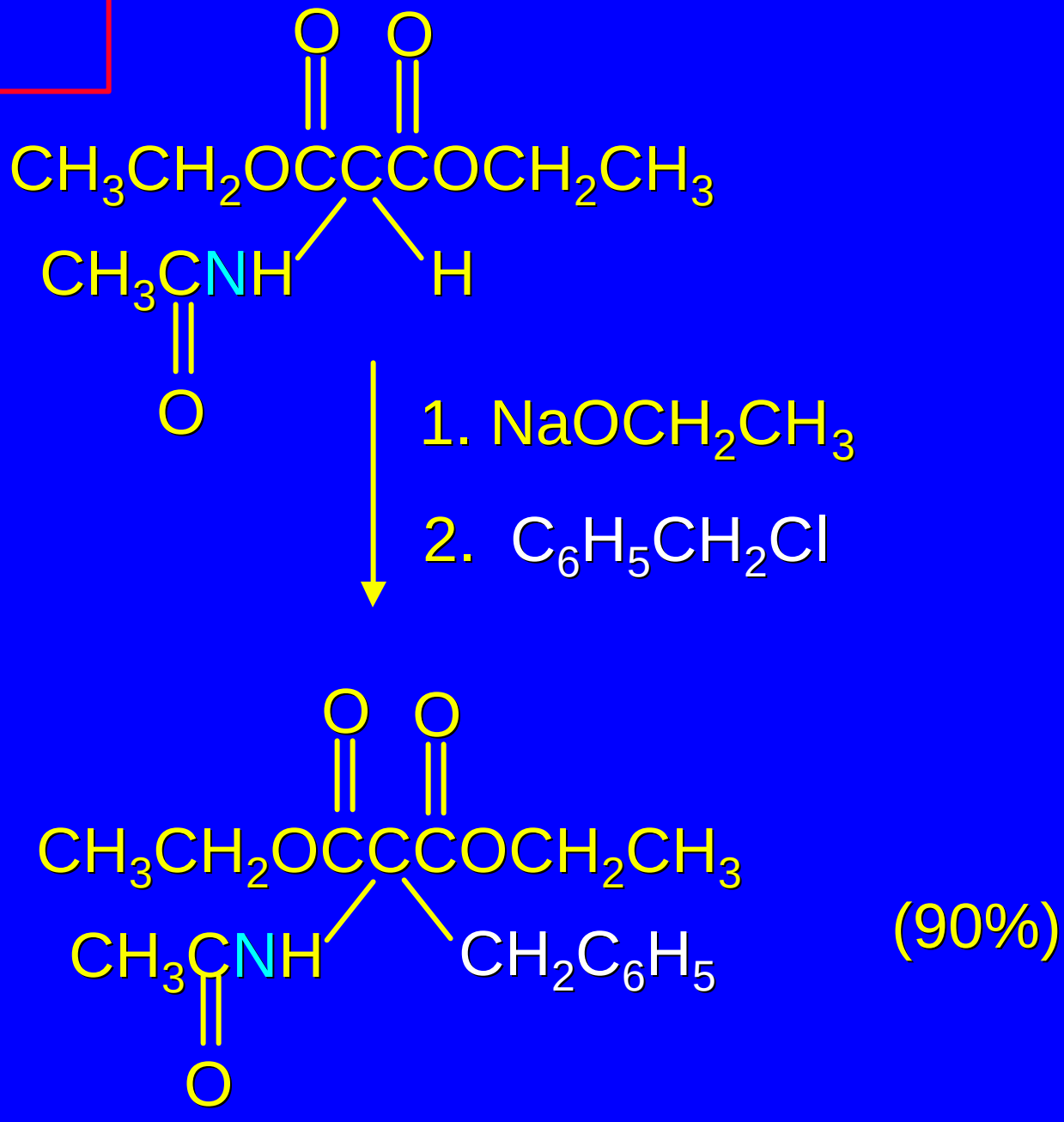


Using Diethyl Acetamidomalonate



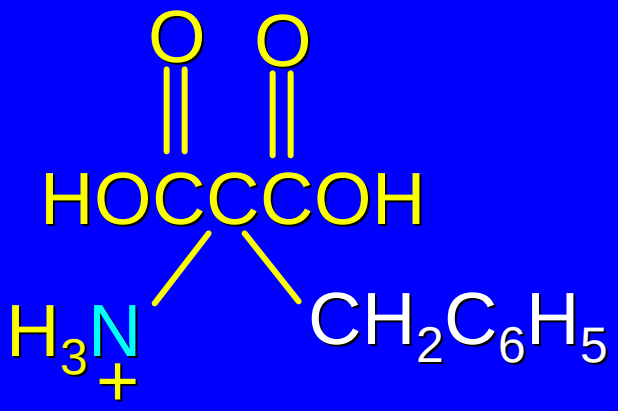
Can be used in the same manner as diethyl malonate (Section 21.7).

Example

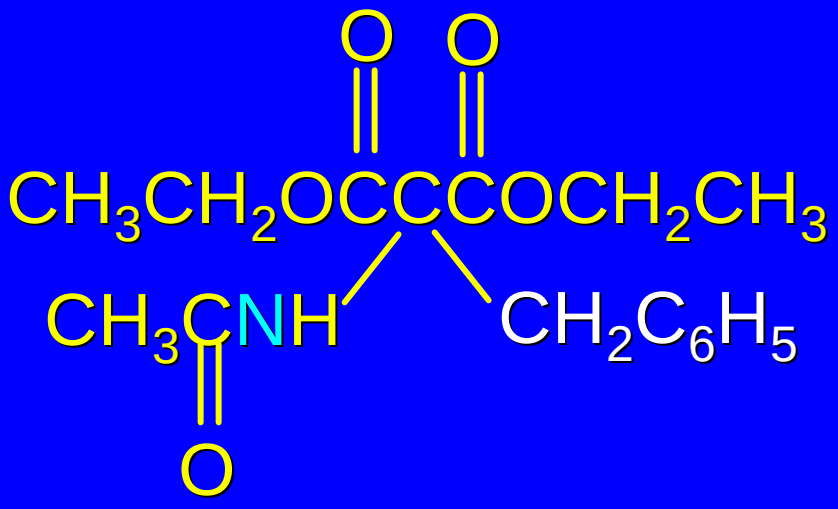

O O
CH3CH2OCCCCOCH2CH3
CH3CNH H
O
1. NaOCH2CH3
2. C6H5CH2Cl
O O
CH3CH2OCCCCOCH2CH3
CH3CNH CH2C6H5
O

(90%)

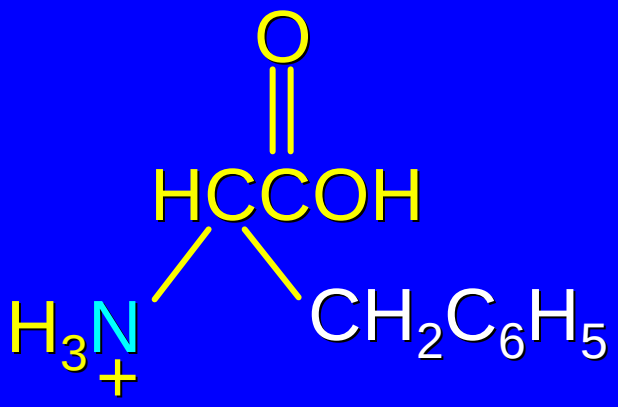
Example



HBr, H_2O, heat

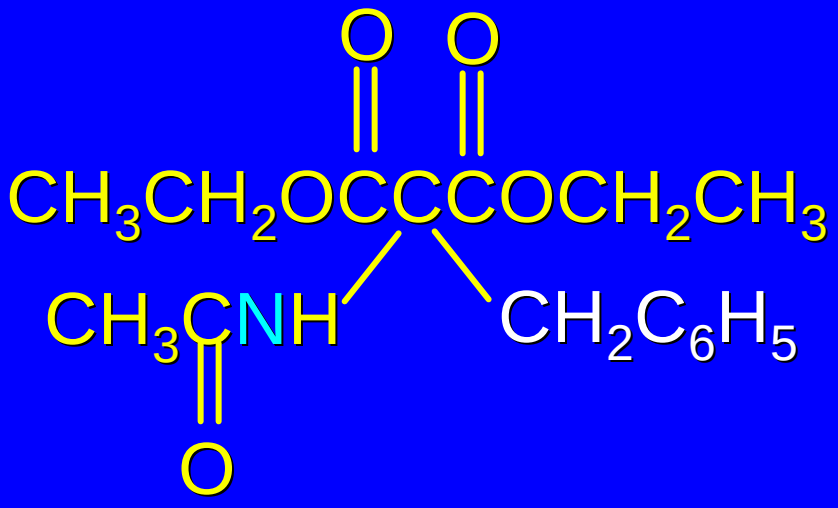


Example



(65%)

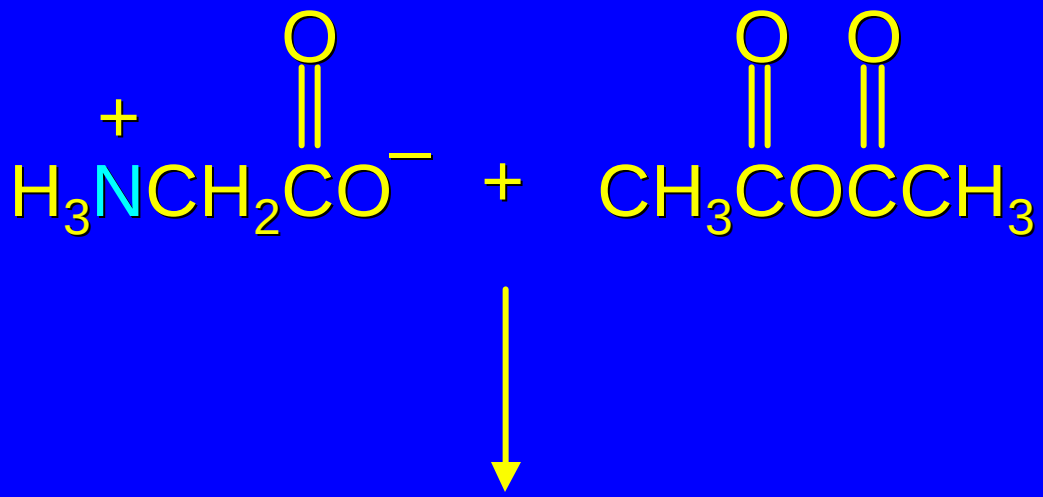
HBr, H_2O, heat



27.5
Reactions of Amino Acids

Acylation of Amino Group

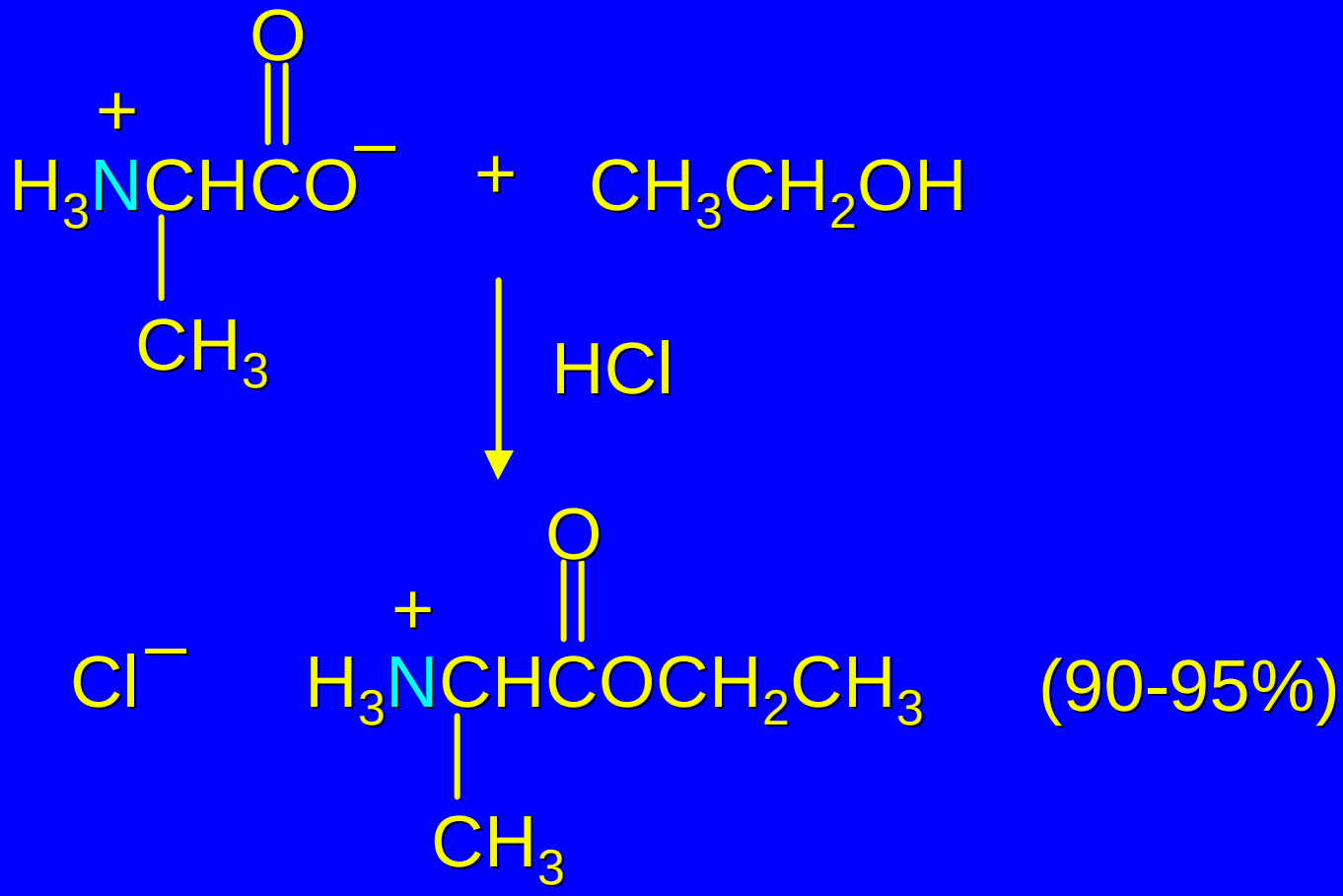
The amino nitrogen of an amino acid can be converted to an amide with the customary acylating agents.



(89-92%)

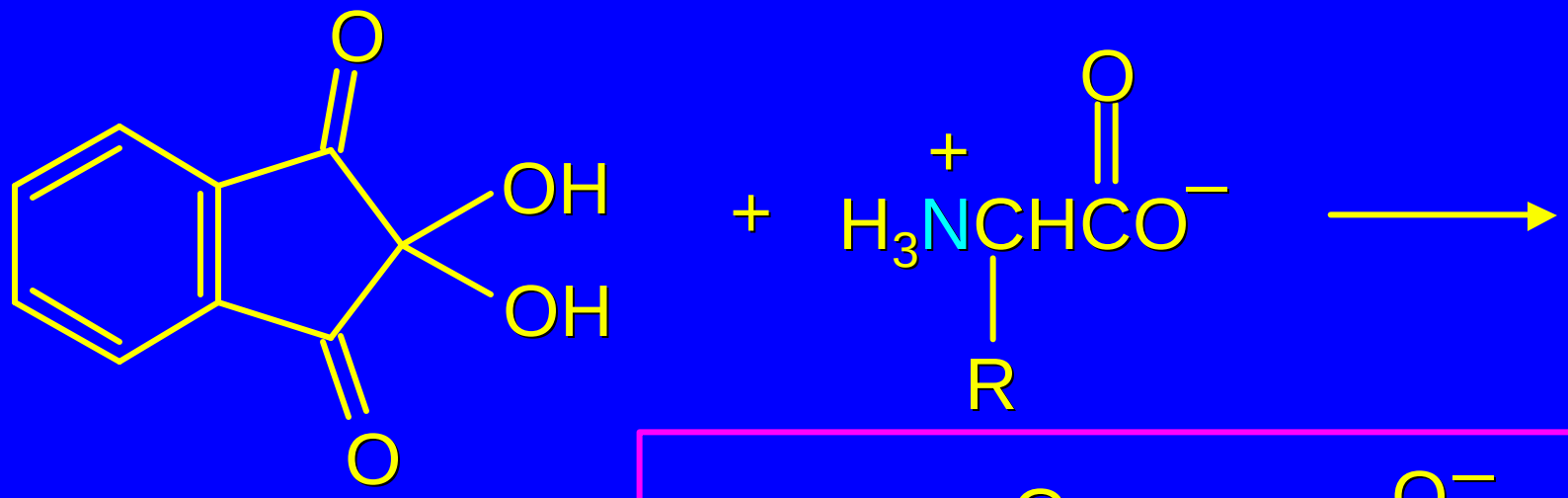
Esterification of Carboxyl Group

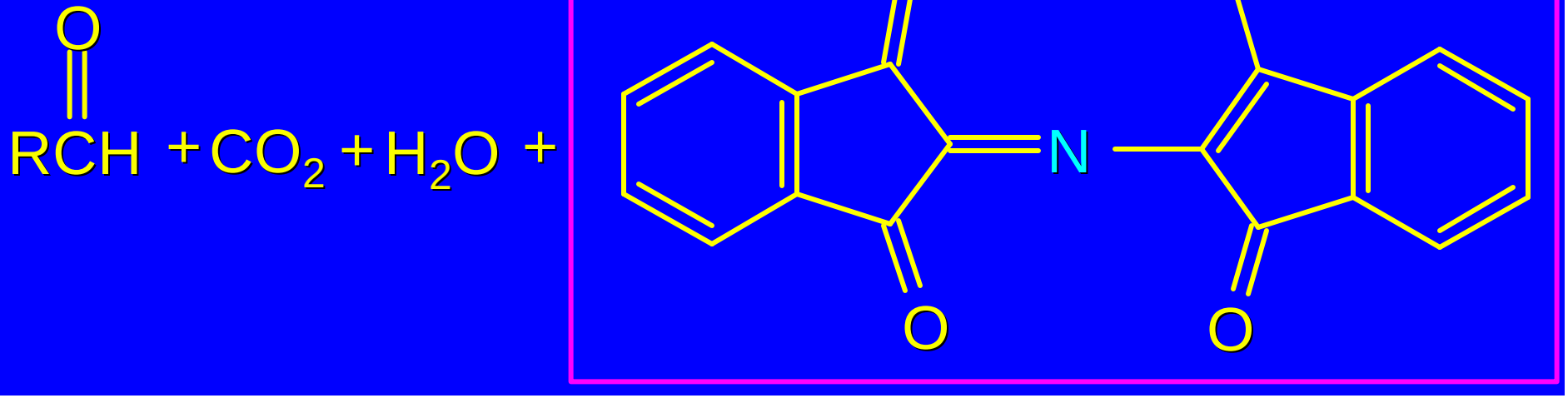
The carboxyl group of an amino acid can be converted to an ester. The following illustrates Fischer esterification of alanine.



Ninhydrin Test

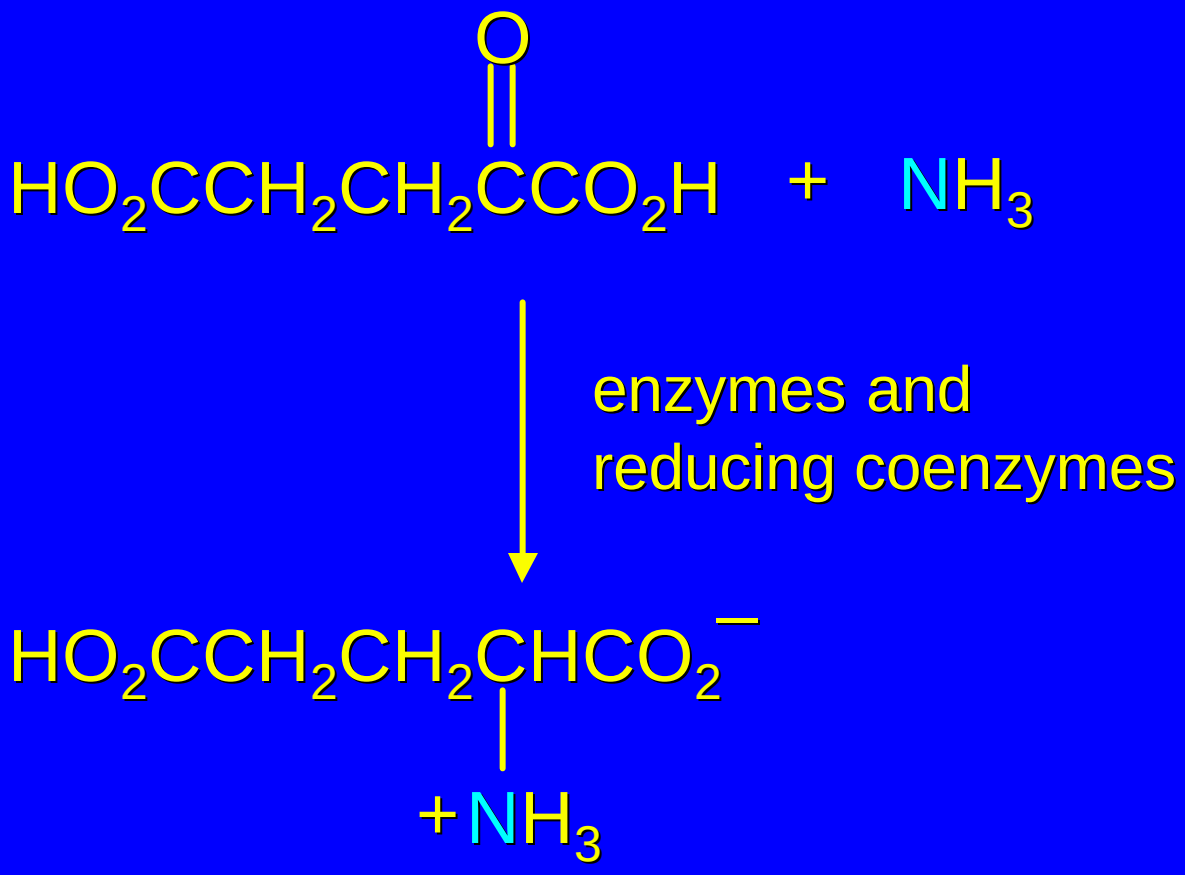
Amino acids are detected by the formation of a purple color on treatment with *ninhydrin*.





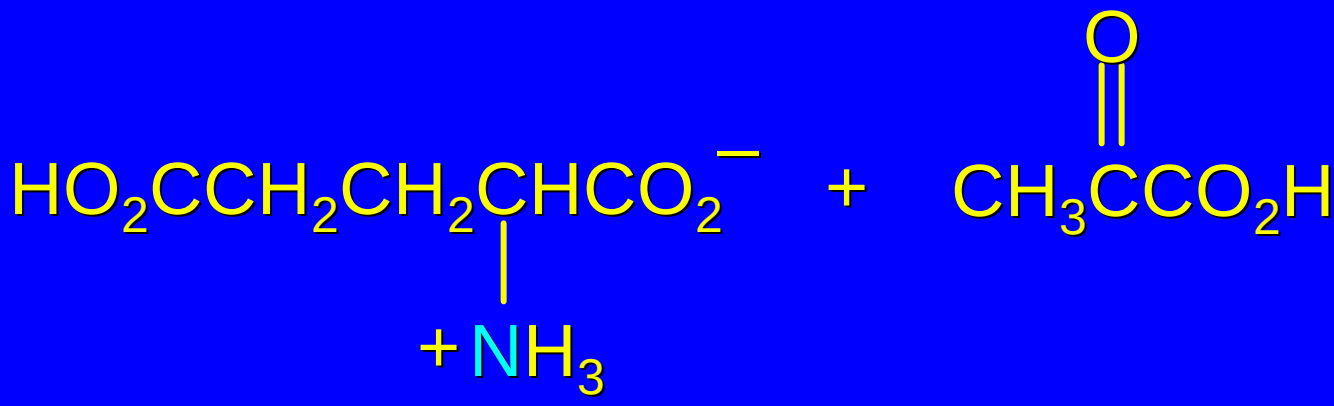
27.6
Some Biochemical Reactions of Amino Acids

Biosynthesis of L-Glutamic Acid



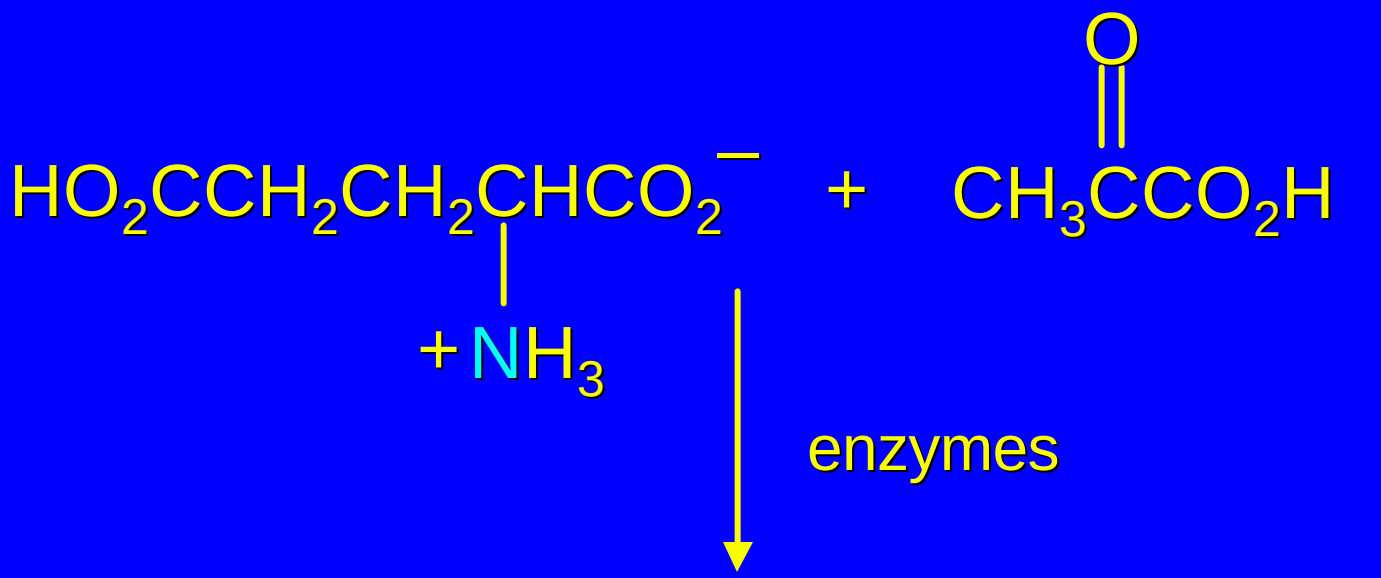
This reaction is the biochemical analog of reductive amination (Section 22.11).

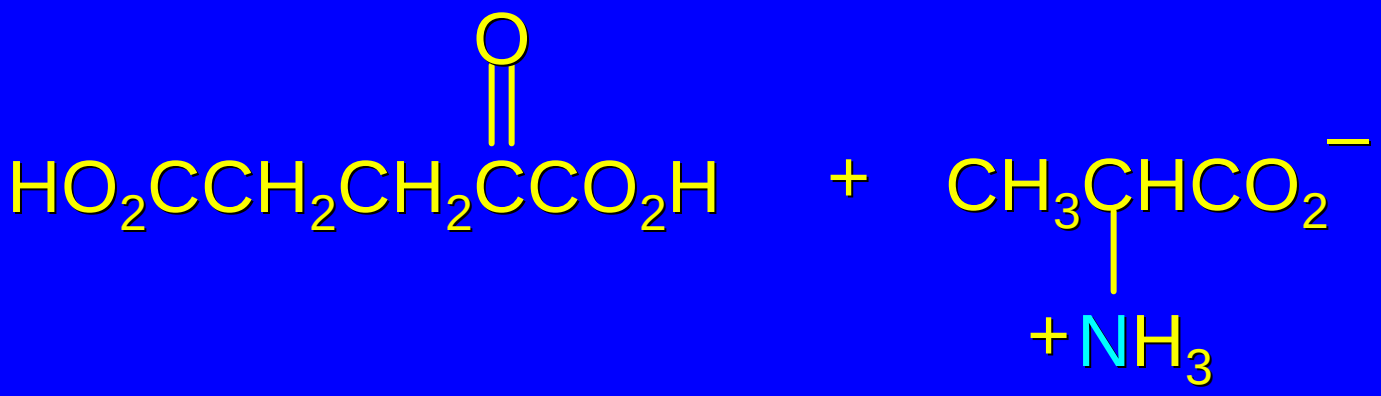
Transamination via *L-Glutamic Acid*



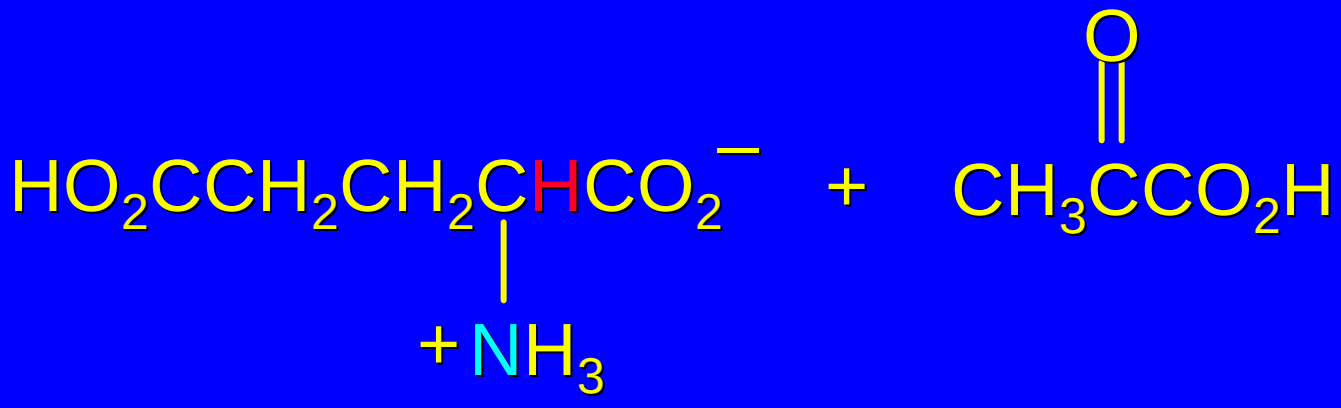
L-Glutamic acid acts as a source of the amine group in the biochemical conversion of α-keto acids to other amino acids. In the example shown, pyruvic acid is converted to L-alanine.

Transamination via *L-Glutamic Acid*



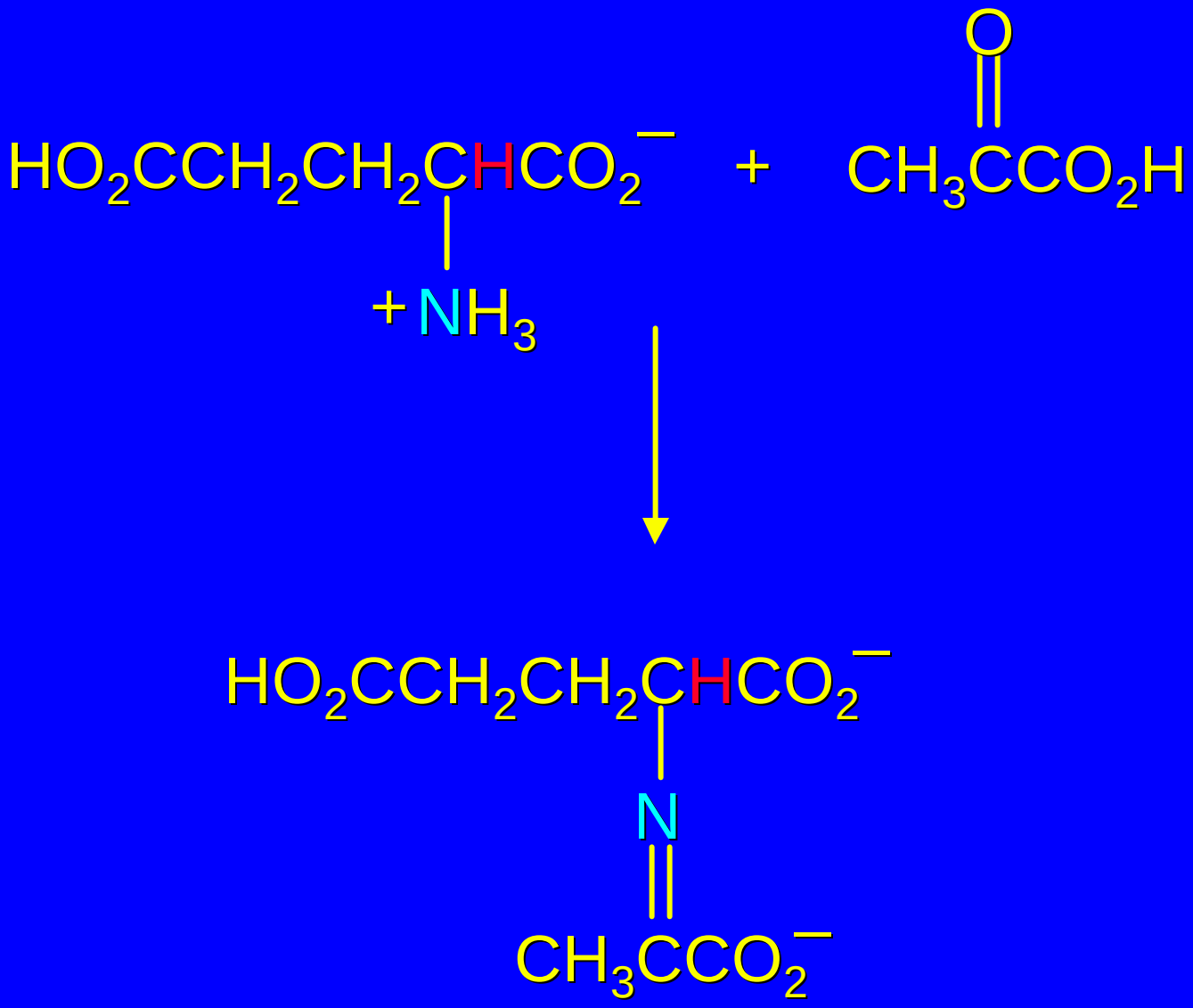


Mechanism

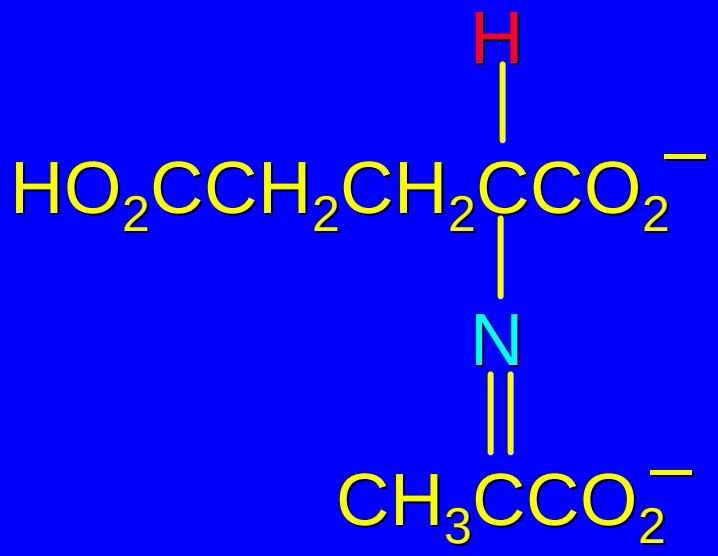


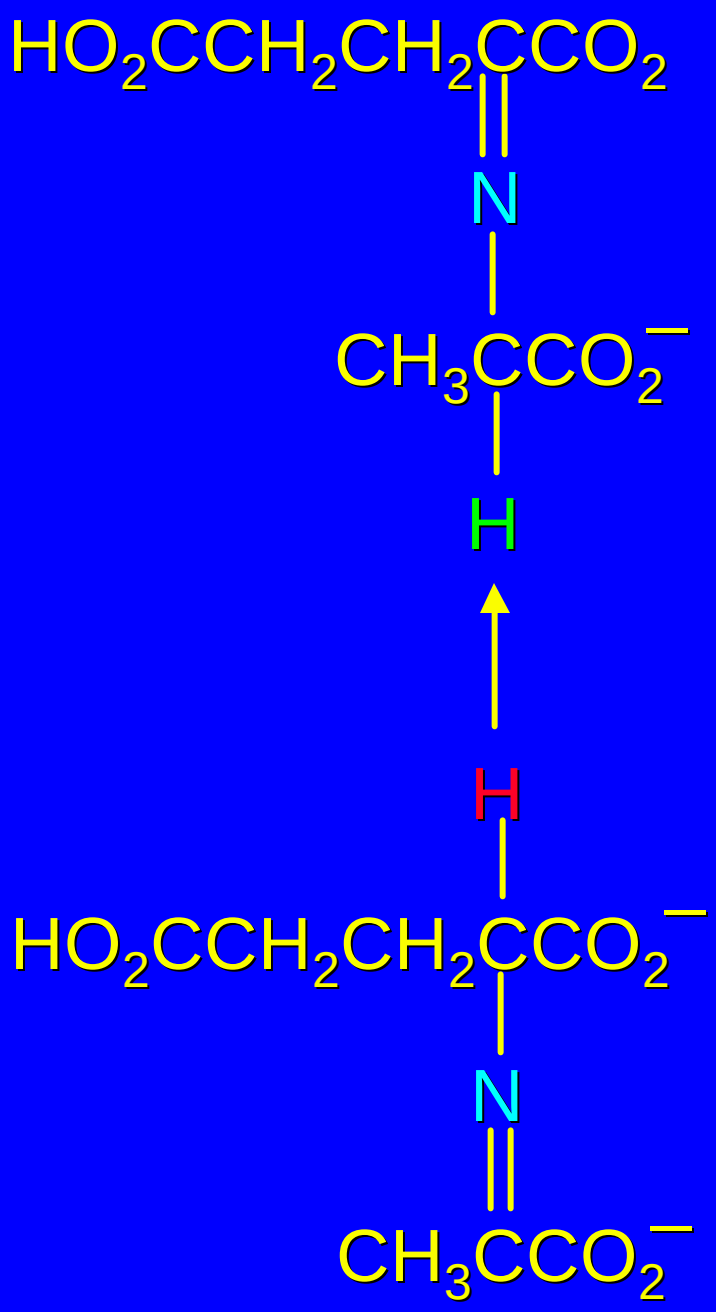
The first step is imine formation between the amino group of L-glutamic acid and pyruvic acid.

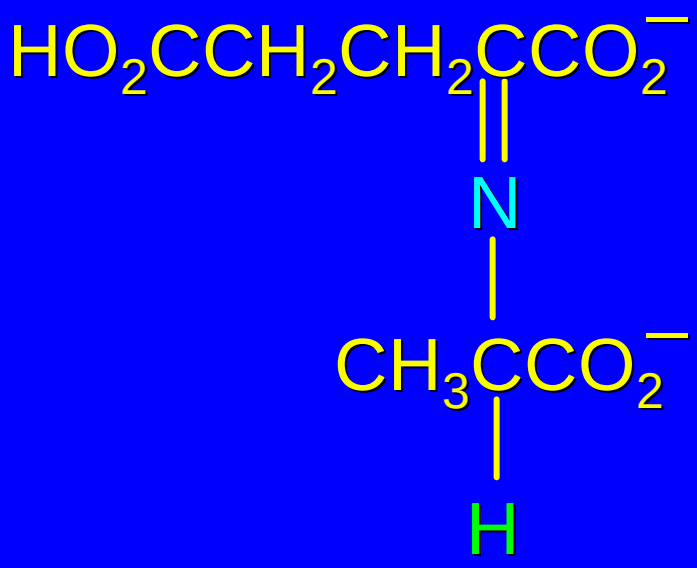
Mechanism


HO2CCH2CH2CHCO2−
+NH3
+
O
CH3CCO2H
HO2CCH2CH2CHCO2−
N
CH3CCO2−

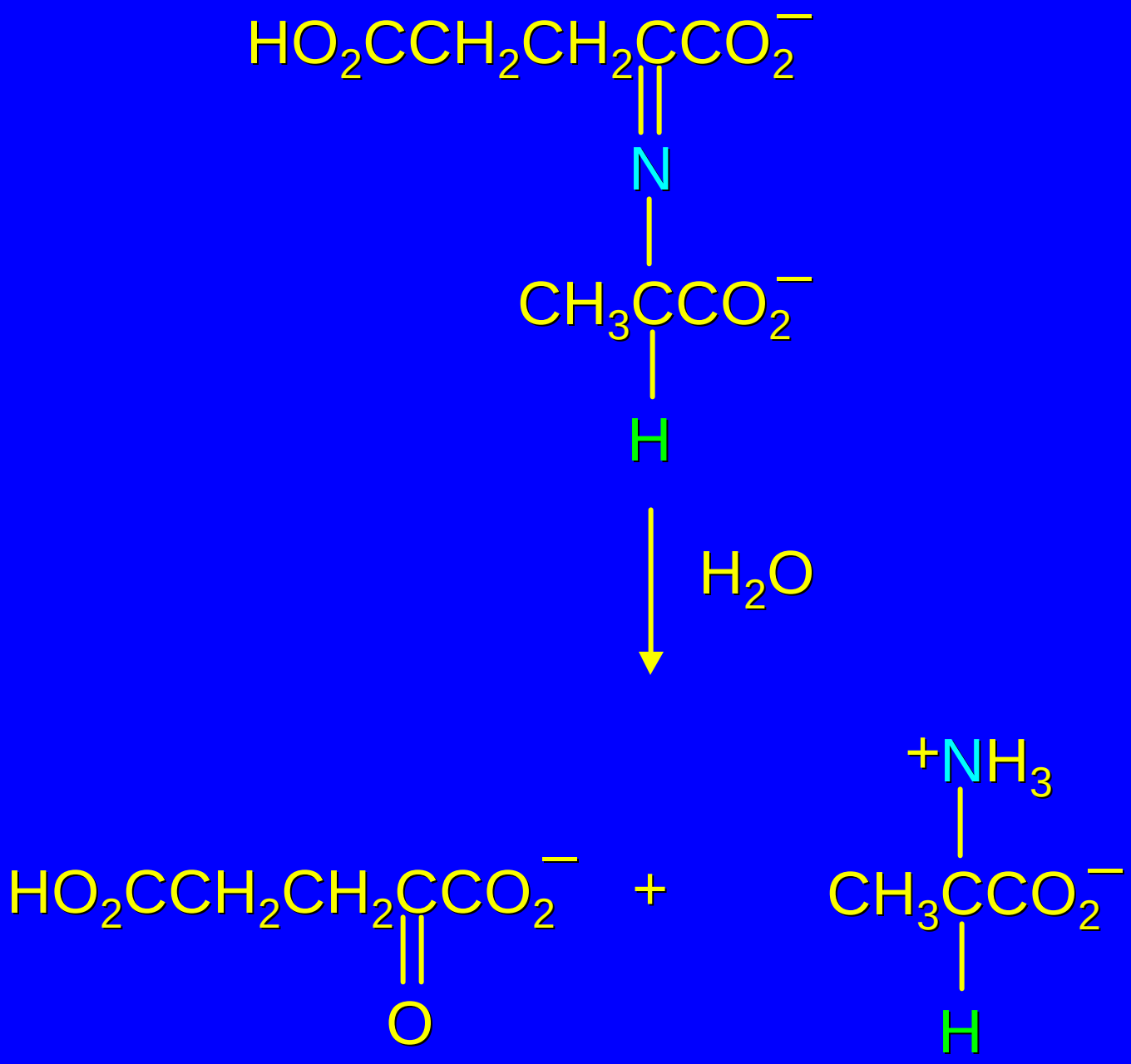
Formation of the imine is followed by proton removal at one carbon and protonation of another carbon.




HO2CCH2CH2CCO2
N
CH3CCO2−
H
H
HO2CCH2CH2CCO2−
N
CH3CCO2−

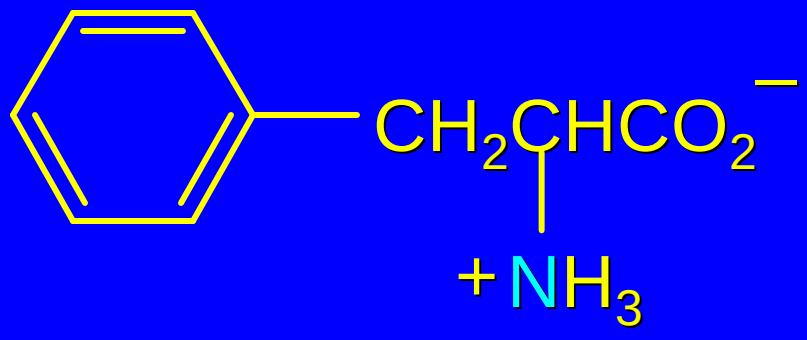


Hydrolysis of the imine function gives α-keto glutarate and L-alanine.

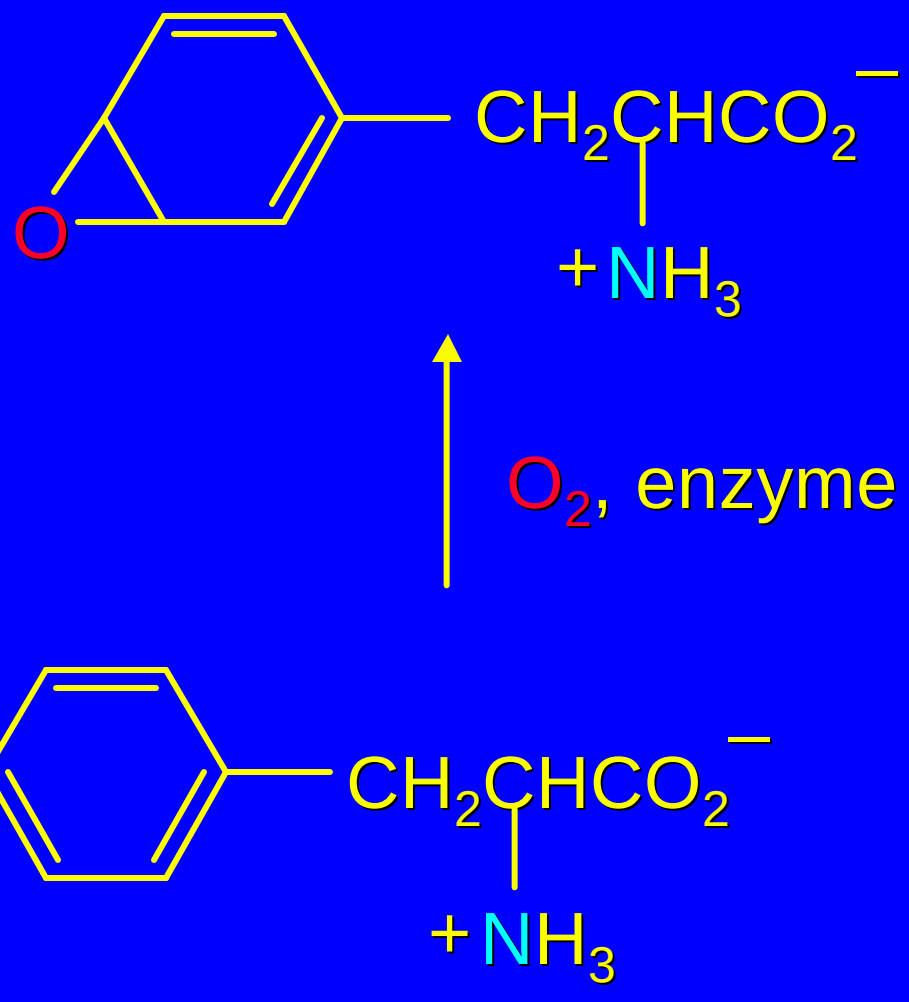

HO2CCH2CH2CCO2−
N
CH3CCO2−
H
H2O
HO2CCH2CH2CCO2−
O
+
+NH3
CH3CCO2−
H

Biosynthesis of L-Tyrosine

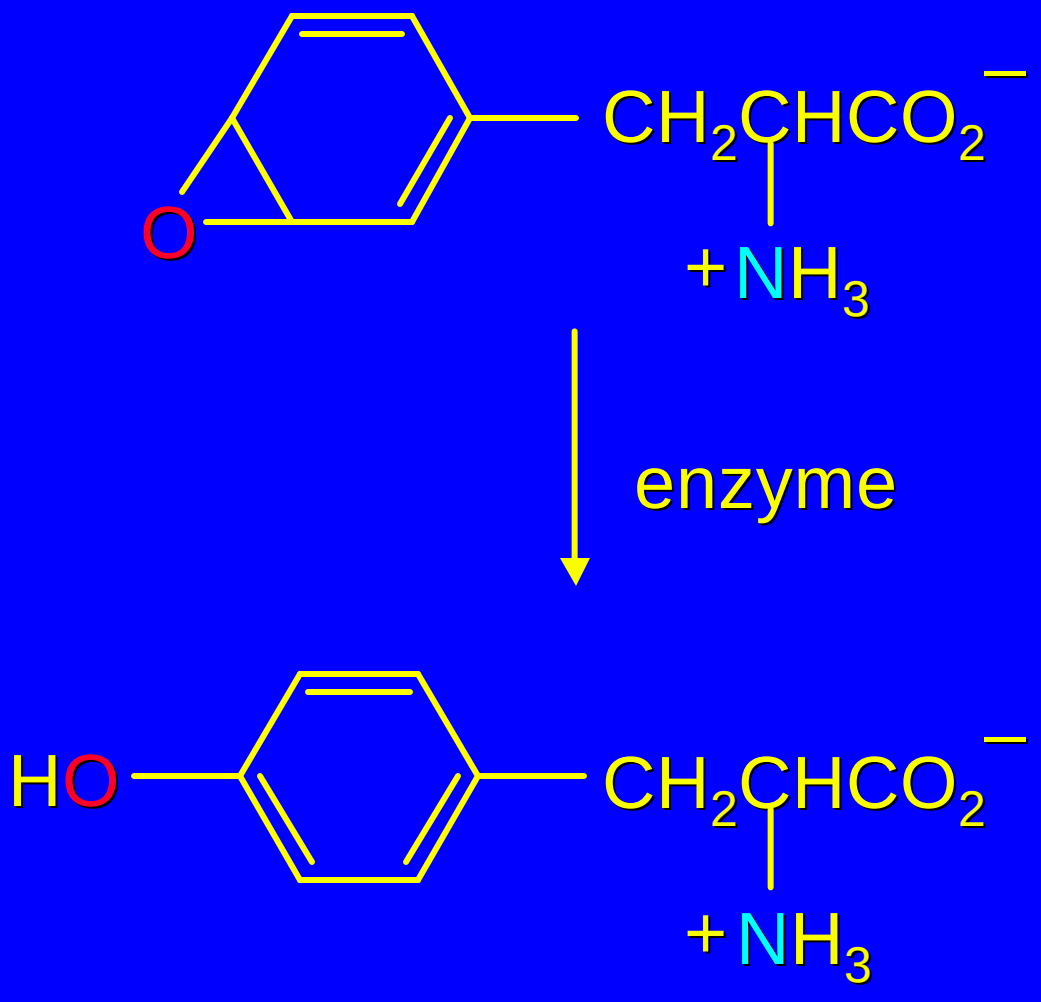
L-Tyrosine is biosynthesized from *L*-phenylalanine. A key step is epoxidation of the aromatic ring to give an *arene oxide* intermediate.



Biosynthesis of L-Tyrosine



Biosynthesis of L-Tyrosine



Biosynthesis of L-Tyrosine

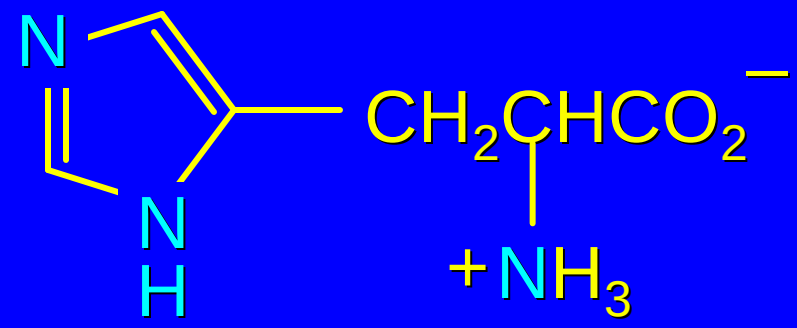
Conversion to L-tyrosine is one of the major metabolic pathways of L-phenylalanine.

Individuals who lack the enzymes necessary to convert L-phenylalanine to L-tyrosine can suffer from PKU disease. In PKU disease, L-phenylalanine is diverted to a pathway leading to phenylpyruvic acid, which is toxic.

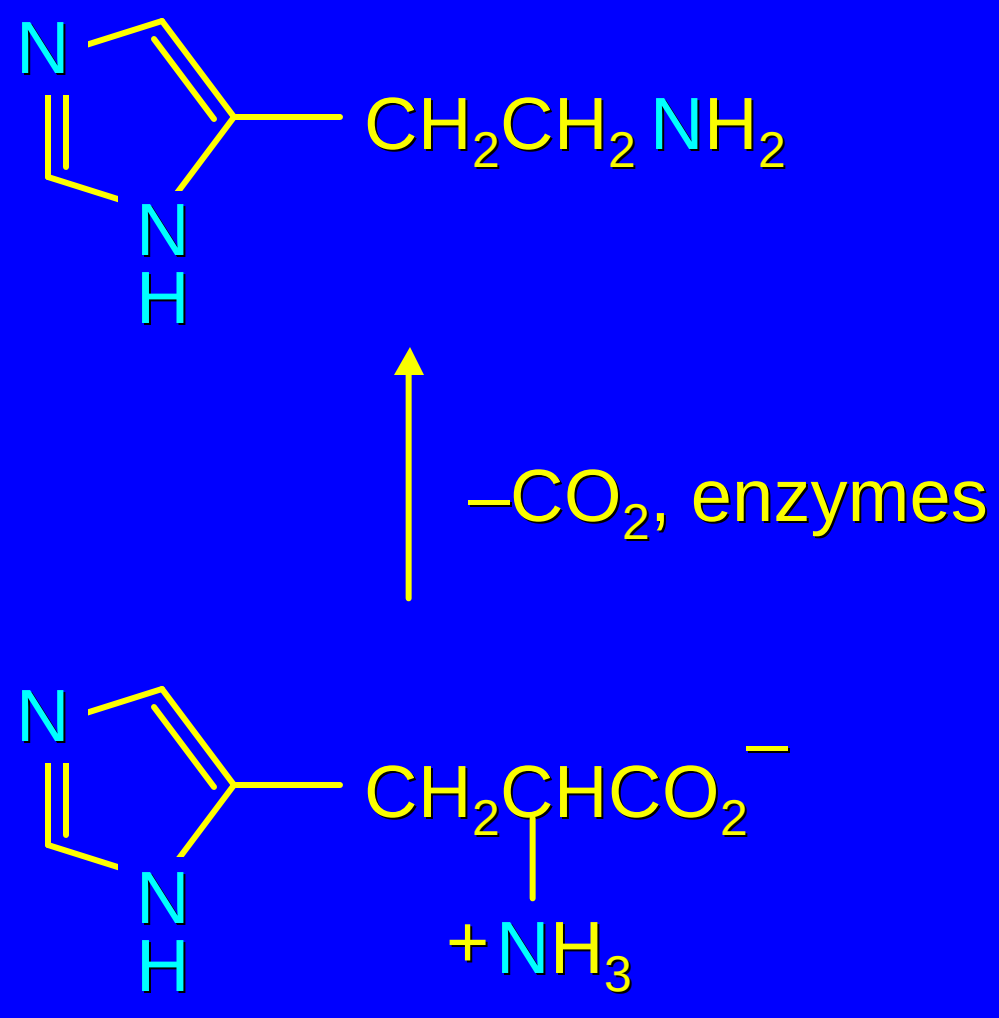
Newborns are routinely tested for PKU disease. Treatment consists of reducing their dietary intake of phenylalanine-rich proteins.

Decarboxylation

Decarboxylation is a common reaction of α-amino acids. An example is the conversion of L-histidine to histamine. Antihistamines act by blocking the action of histamine.



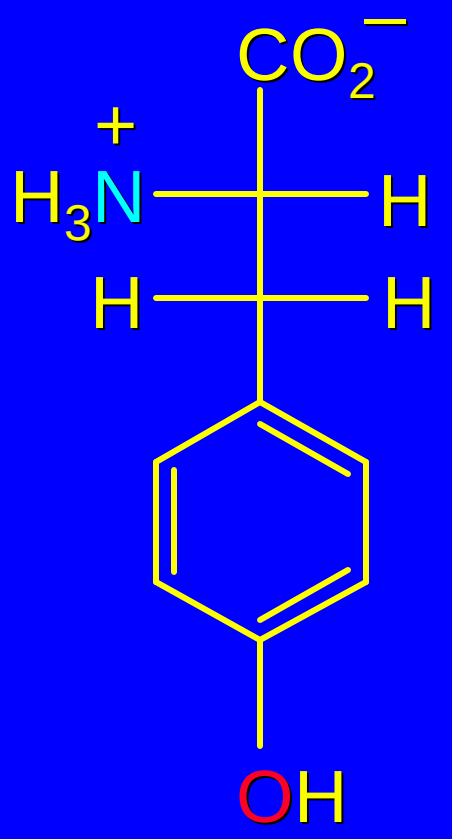
Decarboxylation



Neurotransmitters

The chemistry of the brain and central nervous system is affected by neurotransmitters.

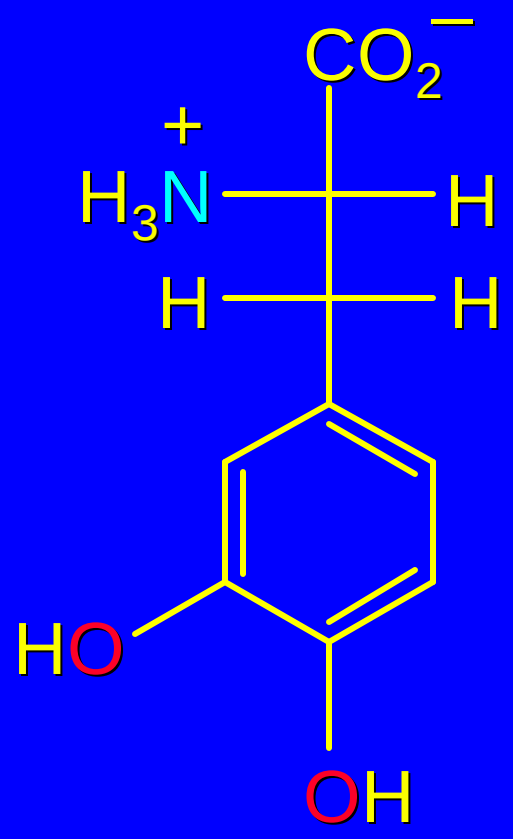
Several important neurotransmitters are biosynthesized from L-tyrosine.



L-Tyrosine

Neurotransmitters

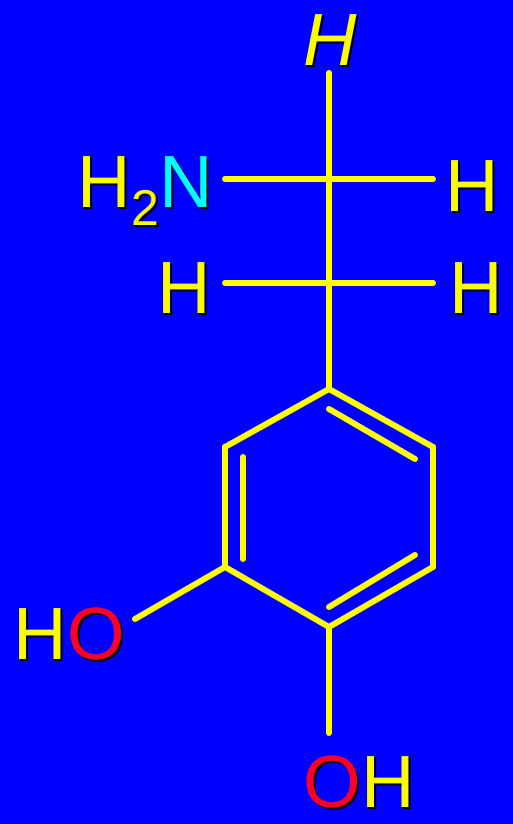
The common name of this compound is L-DOPA. It occurs naturally in the brain. It is widely prescribed to reduce the symptoms of Parkinsonism.



L-3,4-Dihydroxyphenylalanine

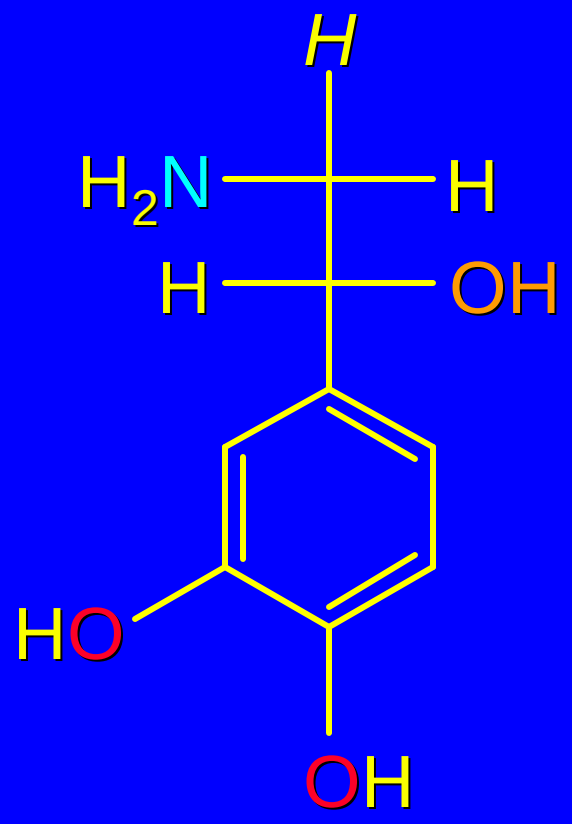
Neurotransmitters

Dopamine is formed by decarboxylation of L-DOPA.



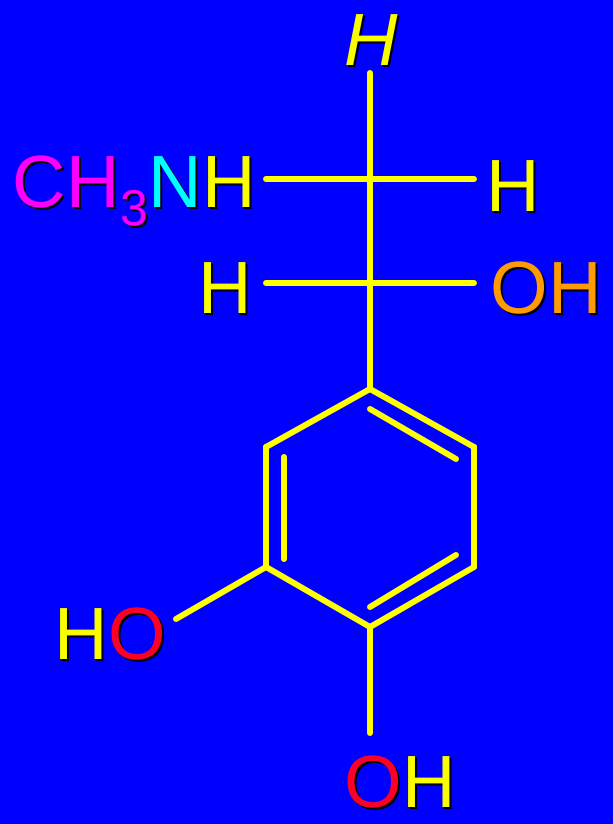
Dopamine

Neurotransmitters



Norepinephrine

Neurotransmitters



Epinephrine