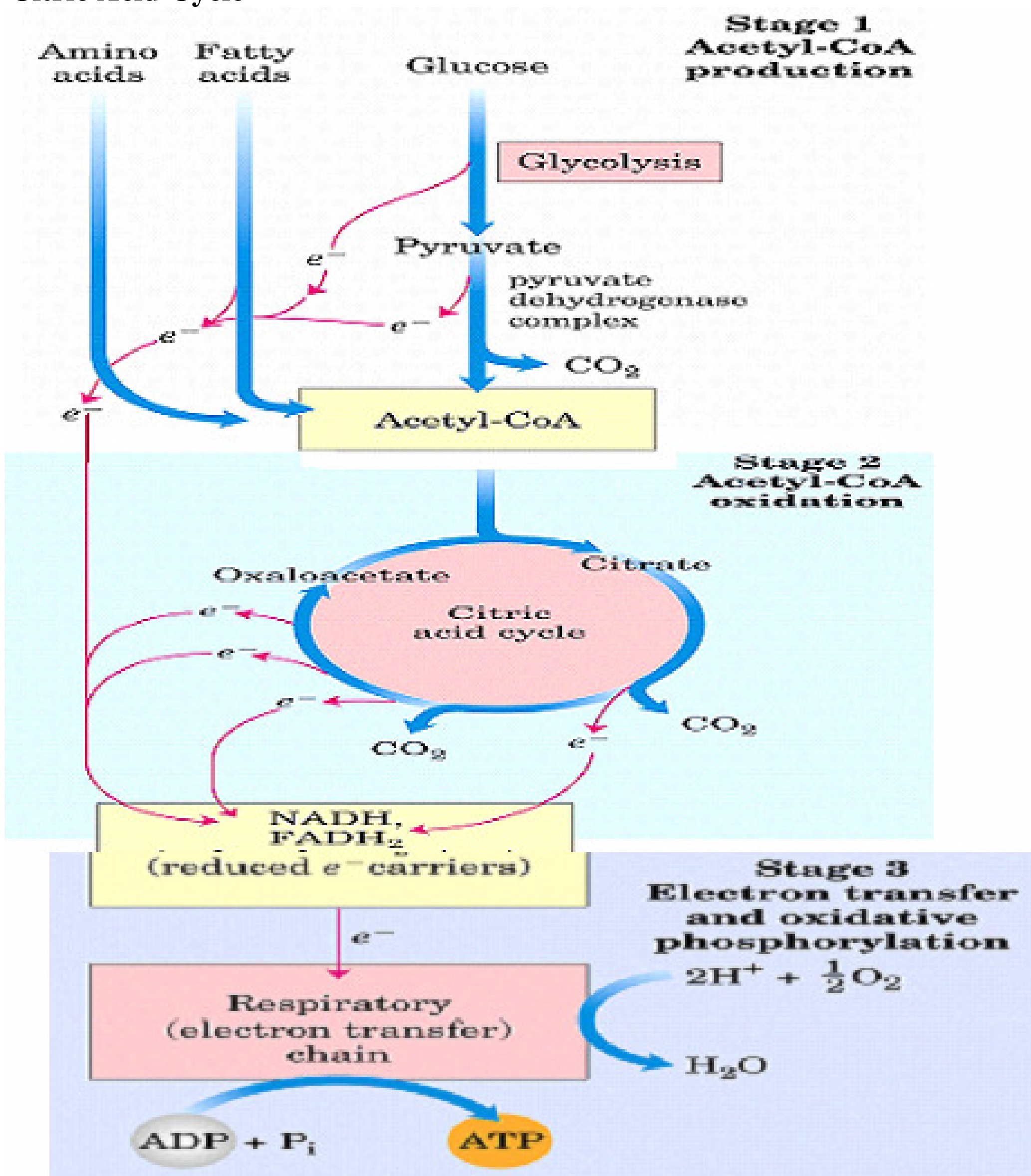
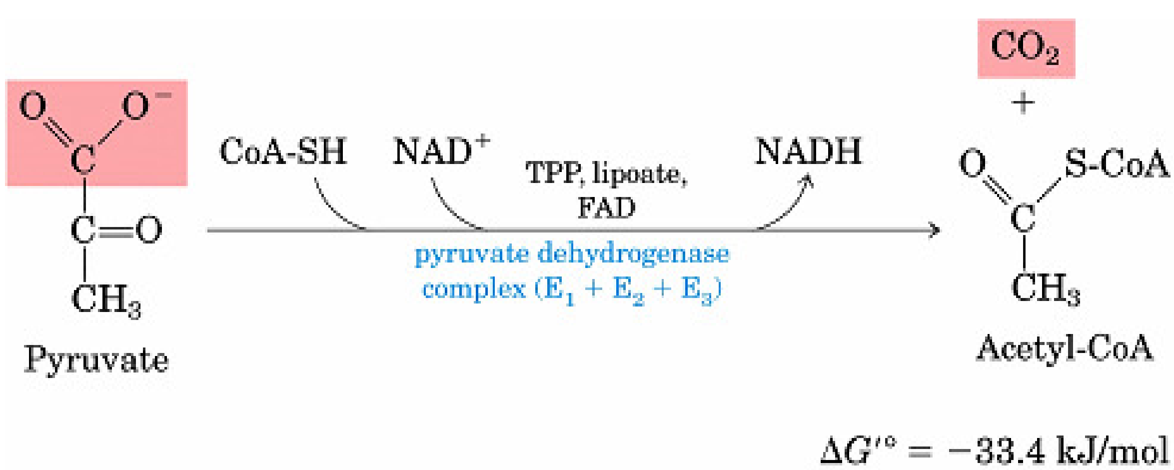
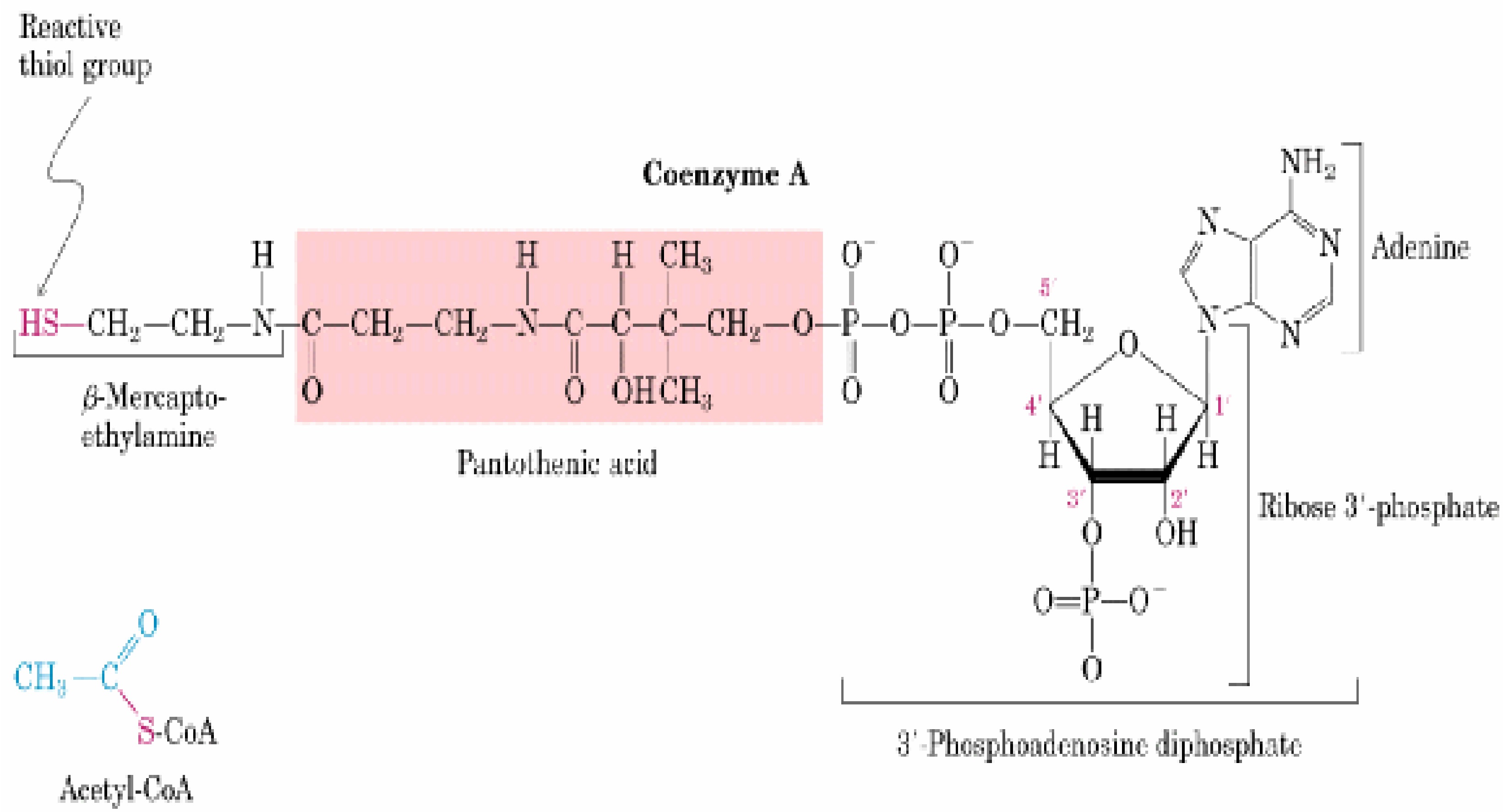
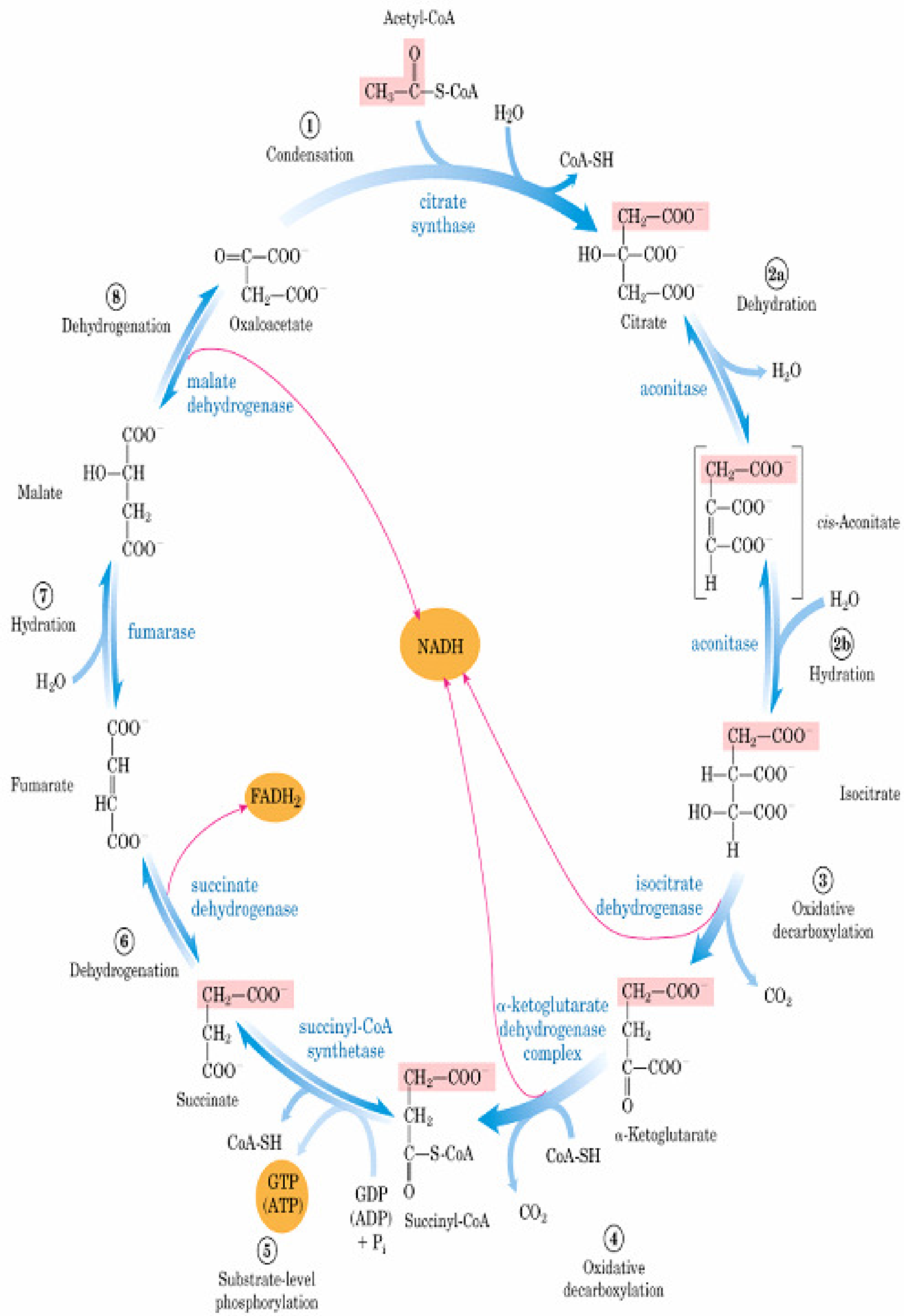
The Citric Acid Cycle



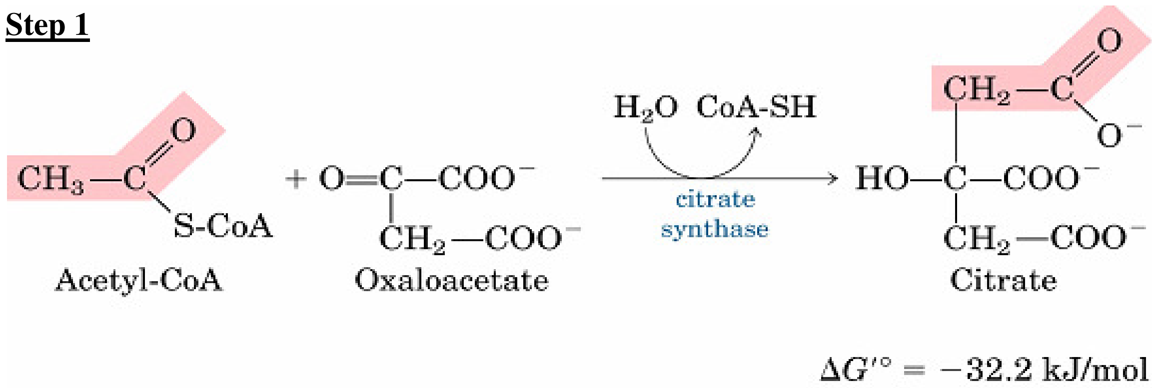



Reactive thiol group
Coenzyme A
β-Mercapto-ethylamine
Pantothenic acid
Adenine
Ribose 3′-phosphate
3′-Phosphoadenosine diphosphate
Acetyl-CoA

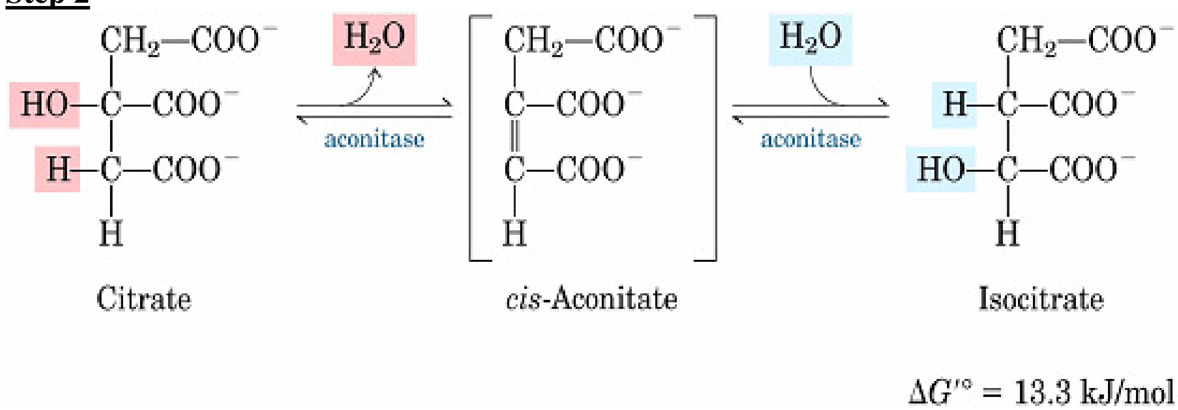
Citric acid cycle (8 steps)



Step 1



Step 2



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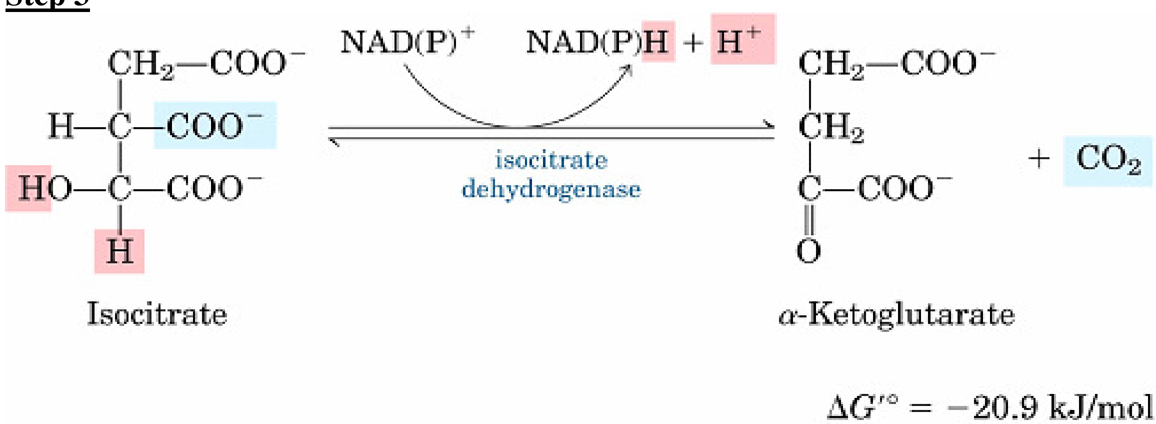

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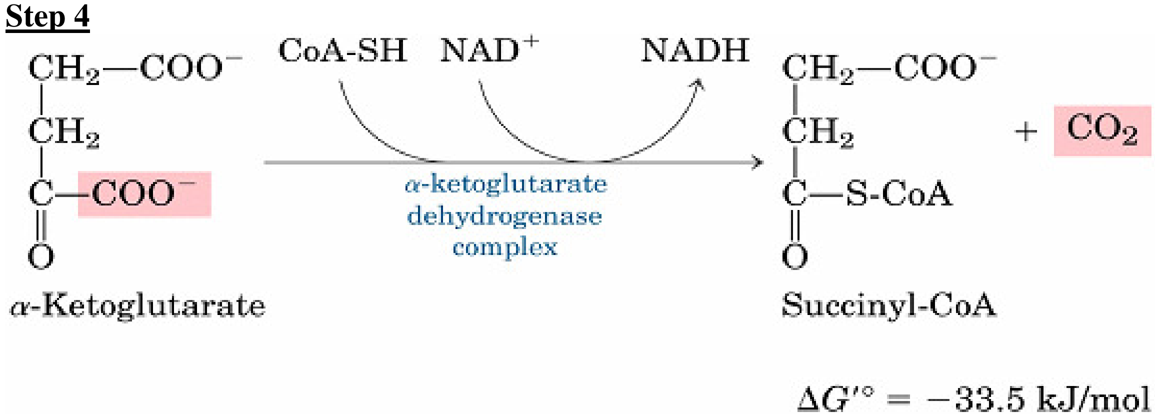
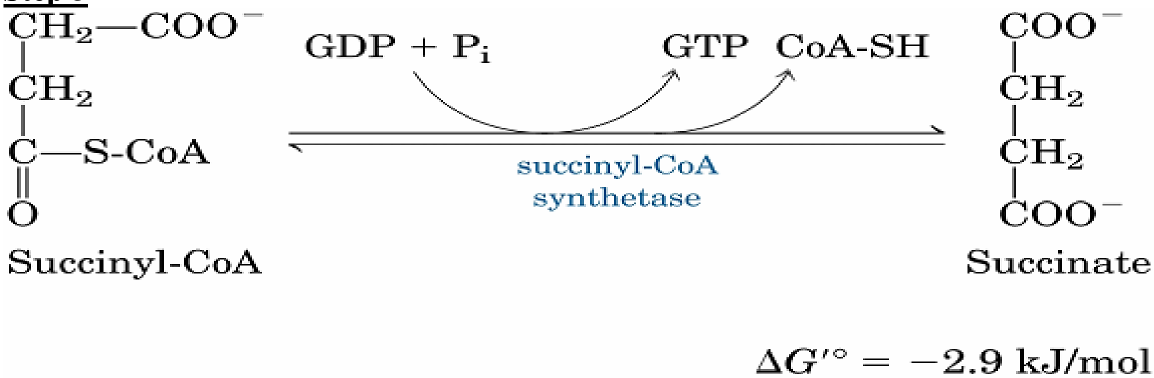
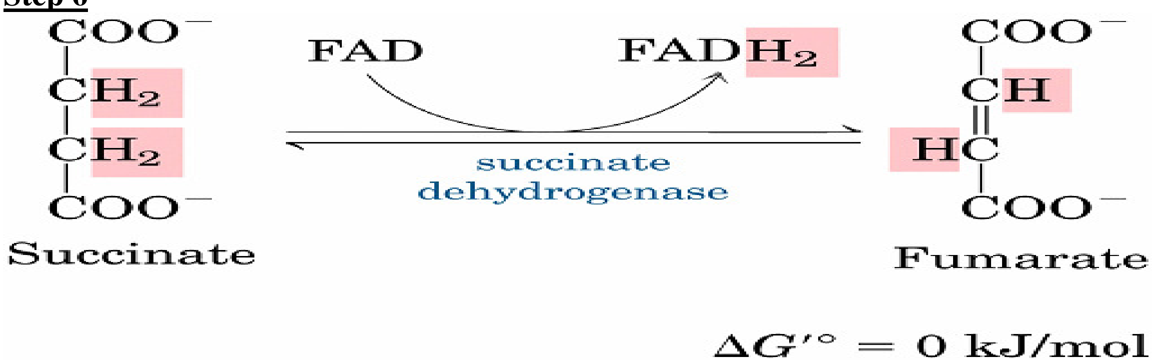


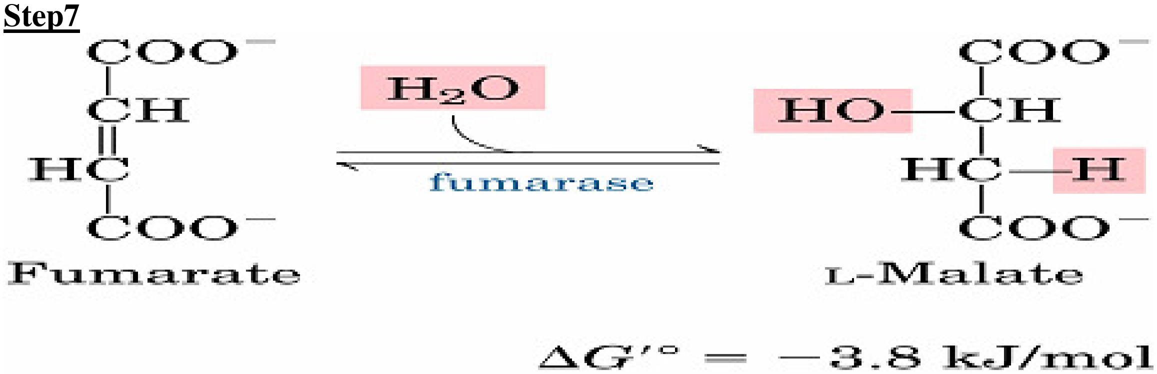
Step 5



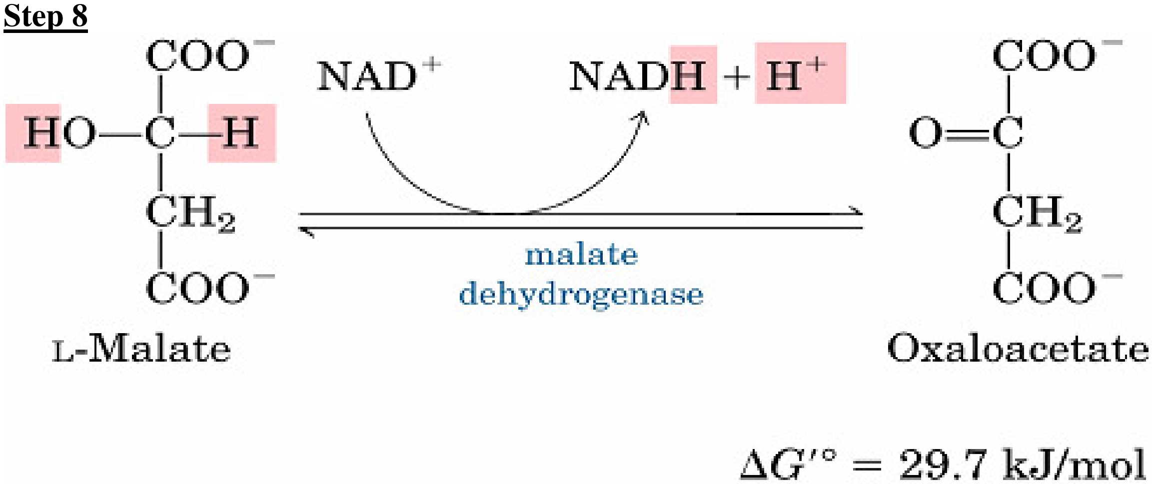
Step 6

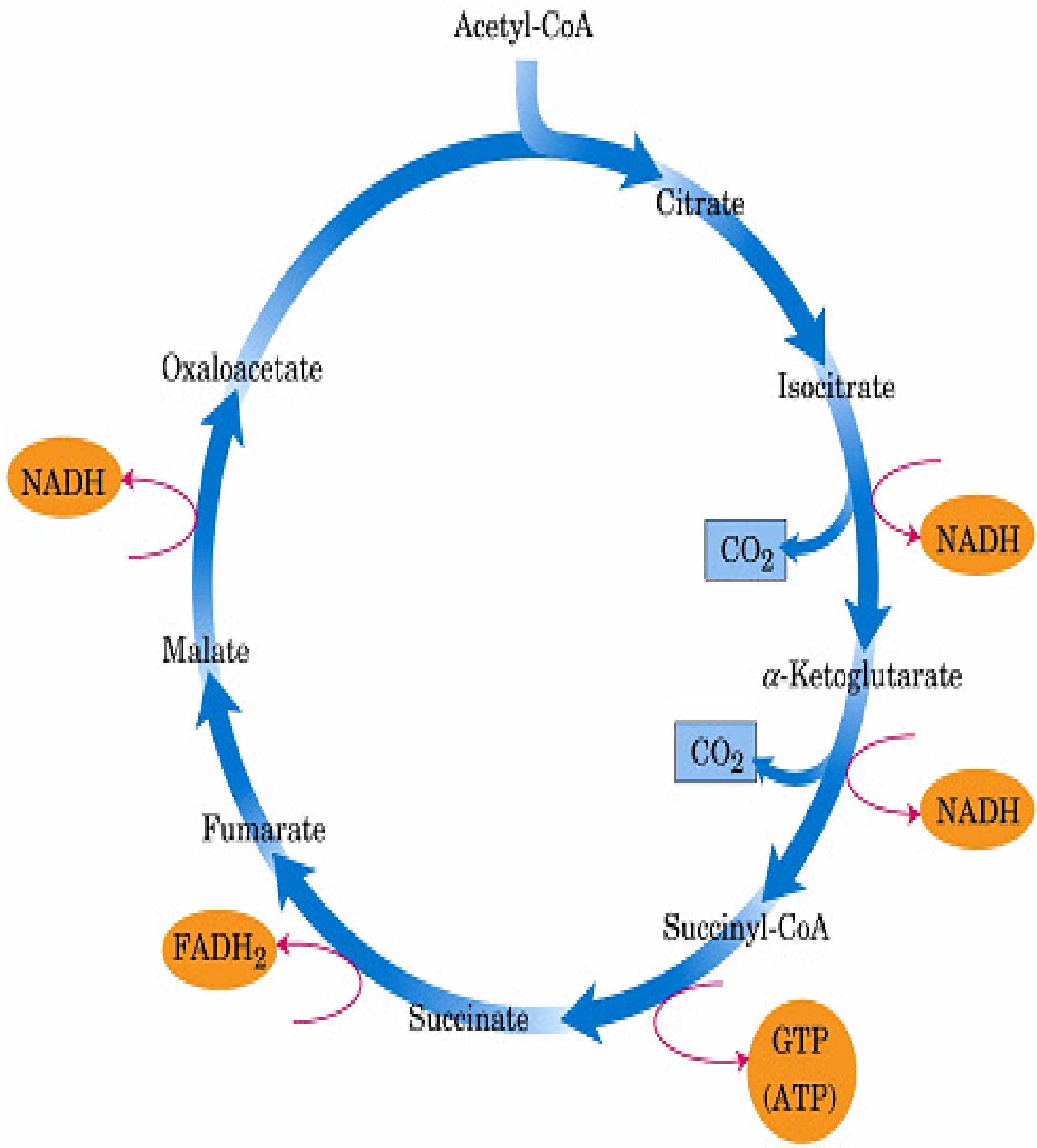


Step7

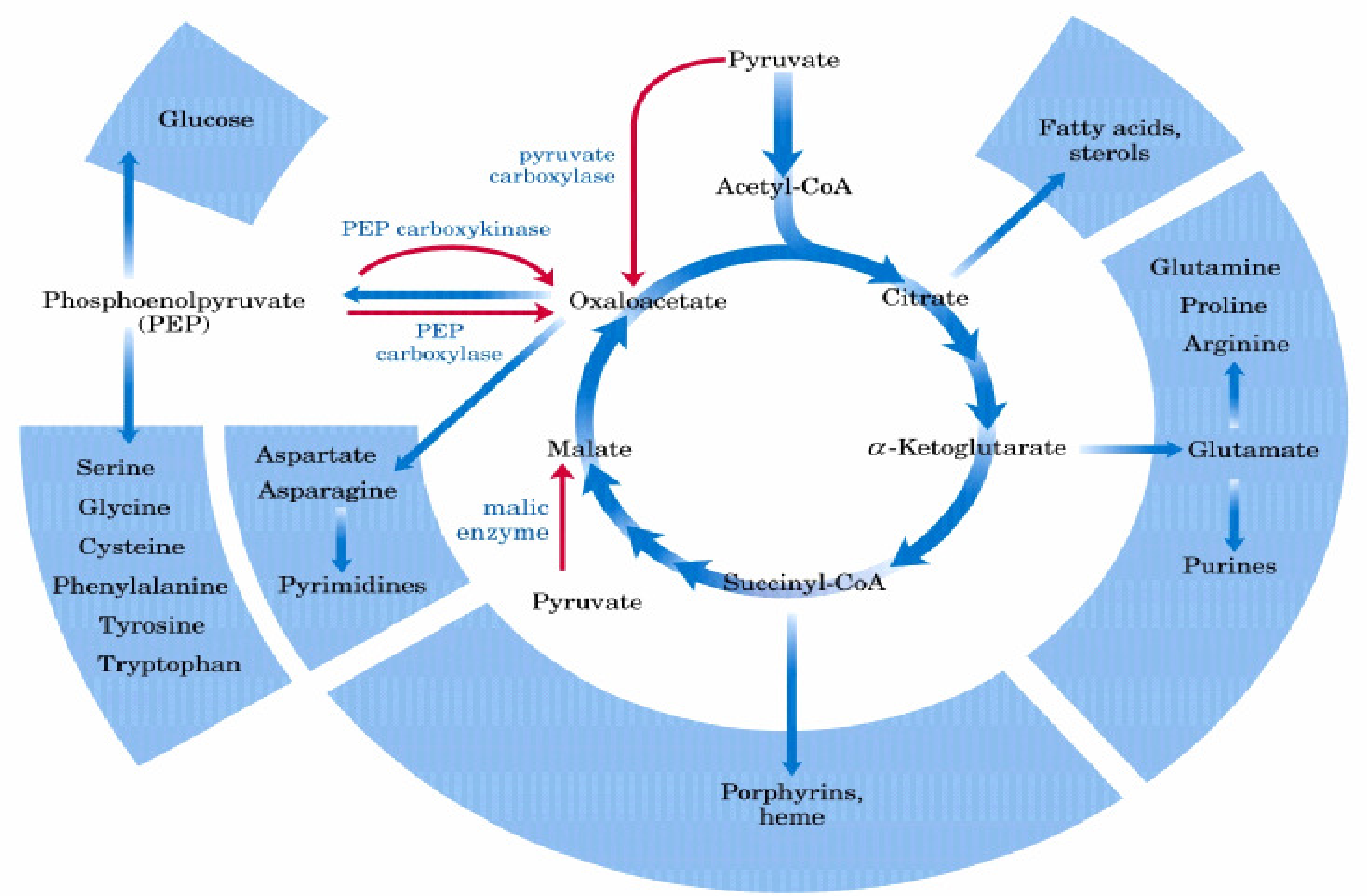


Step 8





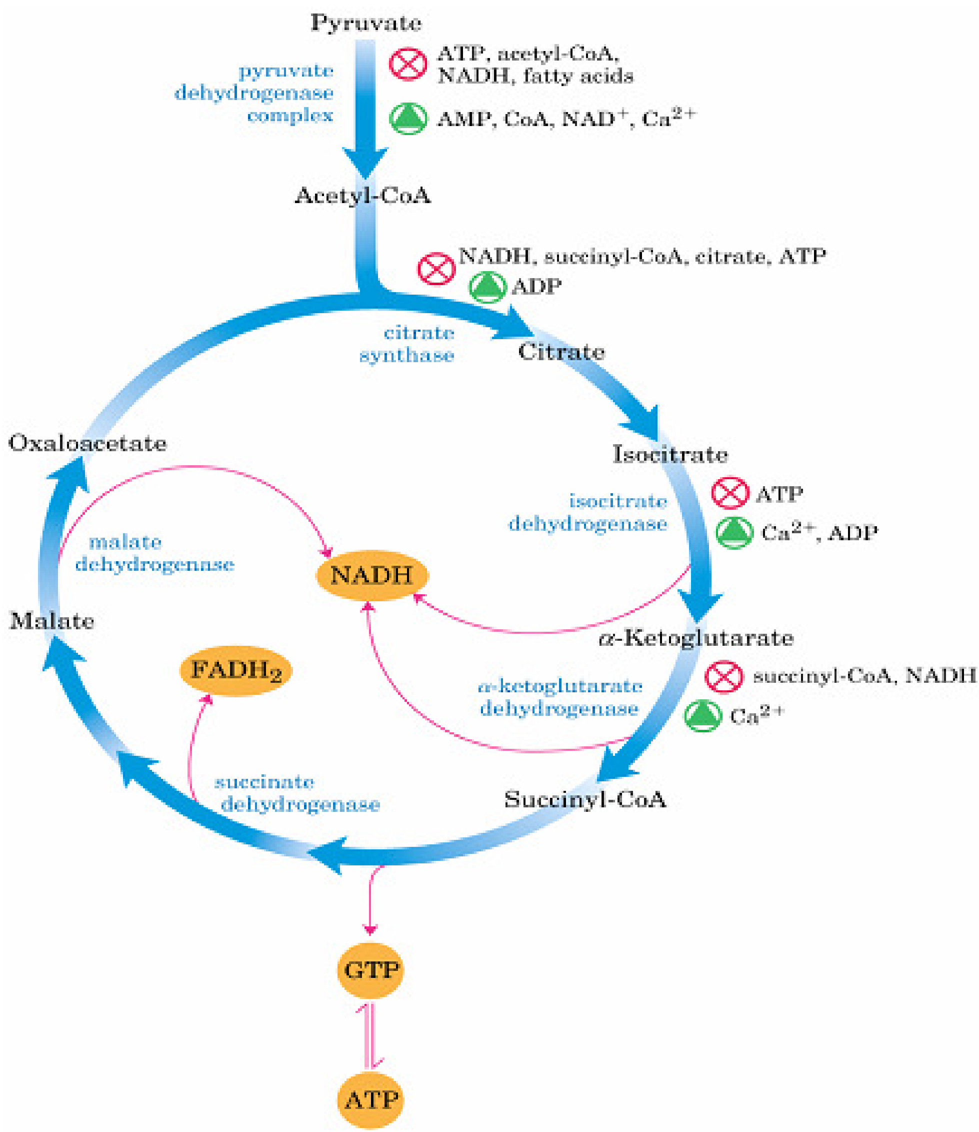
Acetyl-CoA
Citrate
Isocitrate
CO_2
NADH
α-Ketoglutarate
CO_2
NADH
Succinyl-CoA
GTP
(ATP)
Succinate
$FADH_2$
Fumarate
Malate
NADH
Oxaloacetate


Glucose
Phosphoenolpyruvate
(PEP)
Serine
Glycine
Cysteine
Phenylalanine
Tyrosine
Tryptophan
PEP carboxykinase
PEP
carboxylase
pyruvate
carboxylase
Pyruvate
Acetyl-CoA
Oxaloacetate
Citrate
Fatty acids,
sterols
Aspartate
Asparagine
Pyrimidines
Malate
malic
enzyme
Pyruvate
α-Ketoglutarate
Succinyl-CoA
Glutamine
Proline
Arginine
Glutamate
Purines
Porphyrins,
heme

Anaplerotic Reactions

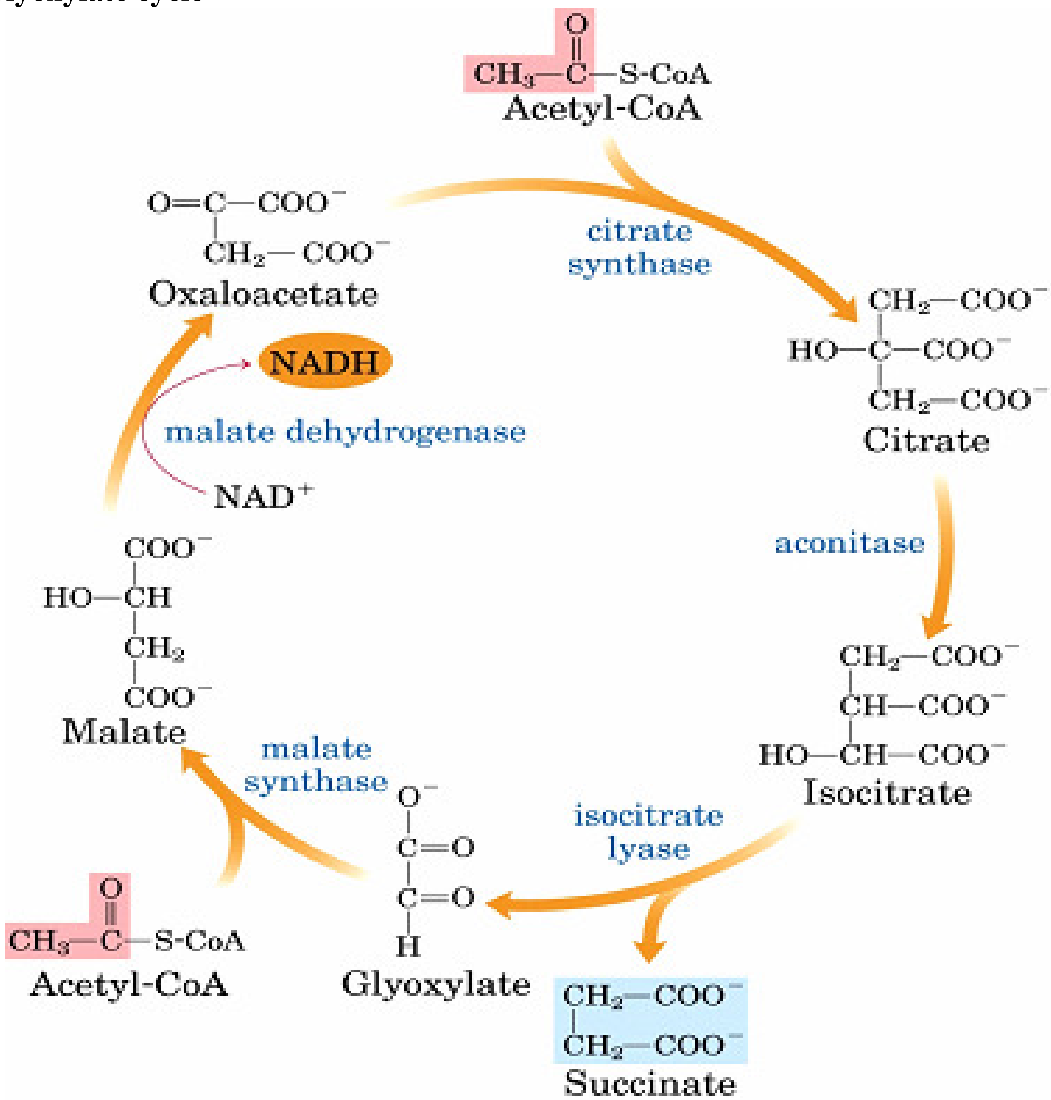
Reaction	Tissue(s)/organism(s)
Pyruvate + HCO_3^- + ATP $\xrightarrow{\text{pyruvate carboxylase}}$ oxaloacetate + ADP + P_i	Liver, kidney
Phosphoenolpyruvate + CO_2 + GDP $\xrightarrow{\text{PEP carboxykinase}}$ oxaloacetate + GTP	Heart, skeletal muscle
Phosphoenolpyruvate + HCO_3^- $\xrightarrow{\text{PEP carboxylase}}$ oxaloacetate + P_i	Higher plants, yeast, bacteria
Pyruvate + HCO_3^- + NAD(P)H $\xrightarrow{\text{malic enzyme}}$ malate + $NAD(P)^+$	Widely distributed in eukaryotes and prokaryotes

Regulation of the citric acid cycle



Each of the three strongly exergonic steps in the cycle – those catalysed by citrate synthase, isocitrate dehydrogenase and α-ketoglutarate dehydrogenase can become rate-limiting step under some circumstances

Glyoxylate cycle



Vertebrates cannot convert fatty acids, or the acetate derived from them to carbohydate. In many organisms other than vertebrates, the **glyoxylate cycle** serves as a mechanism for converting acetate to carbohydate.

Relationship between the glyoxylate and citric acid cycles