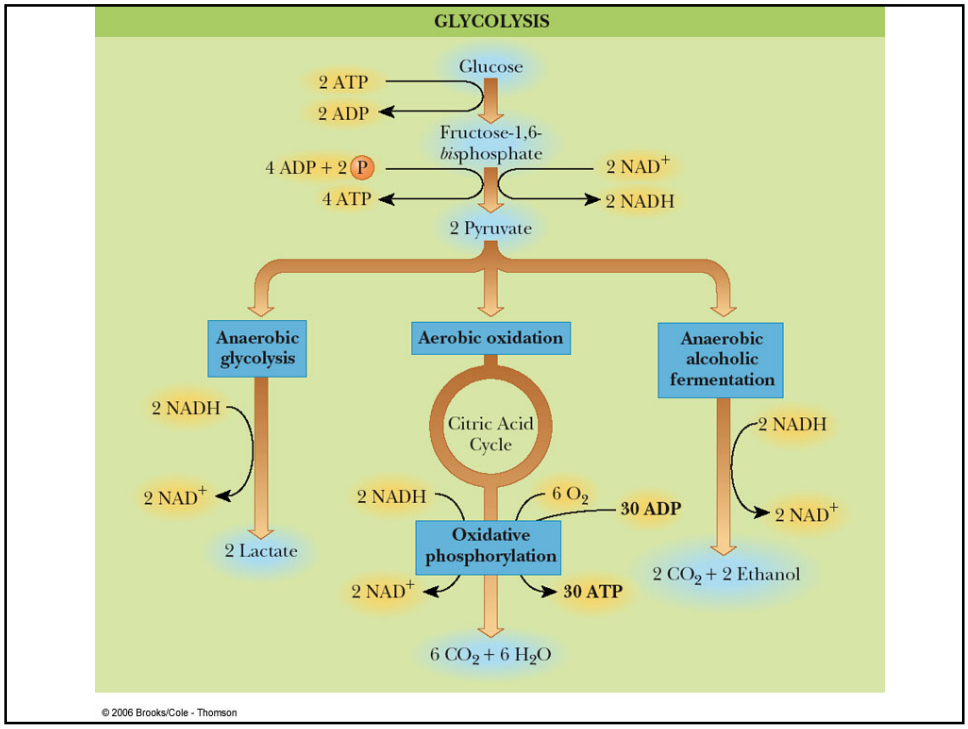
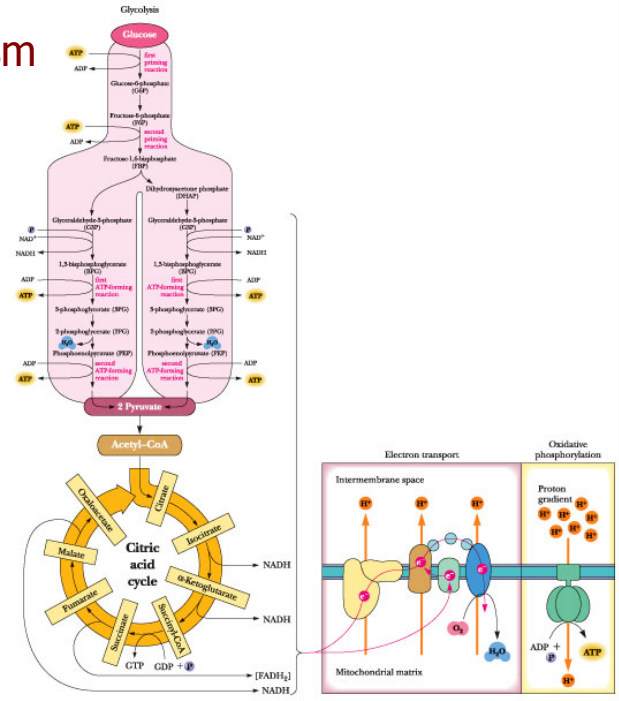


Aerobic Catabolism of Glucose

Respiration

O_2 consumption & CO_2 prodction

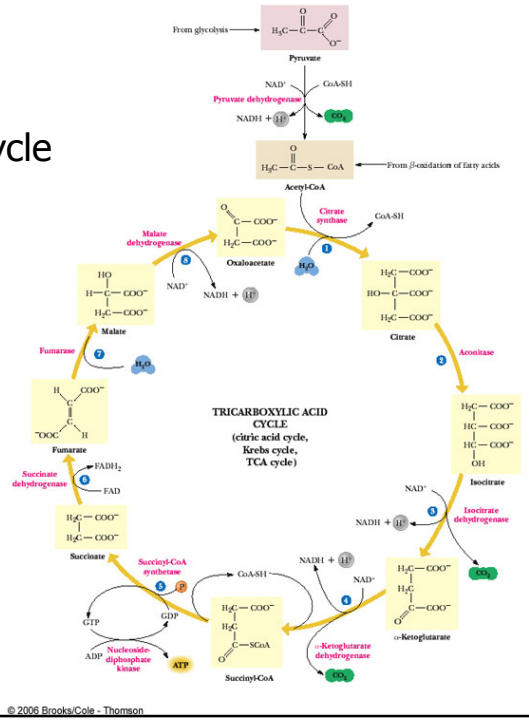


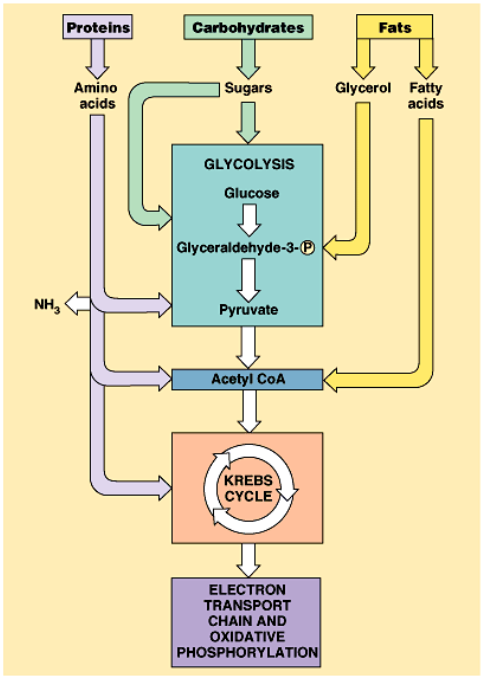
Citric acid cycle

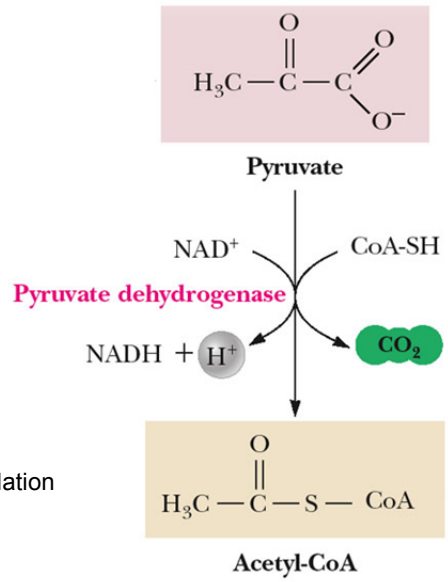
TriCarboxylic acid cycle

TCA cycle

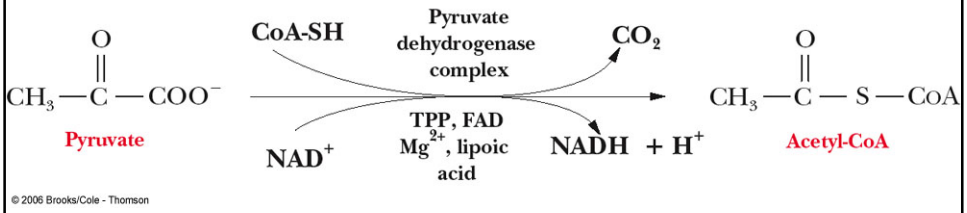
Krebs cycle





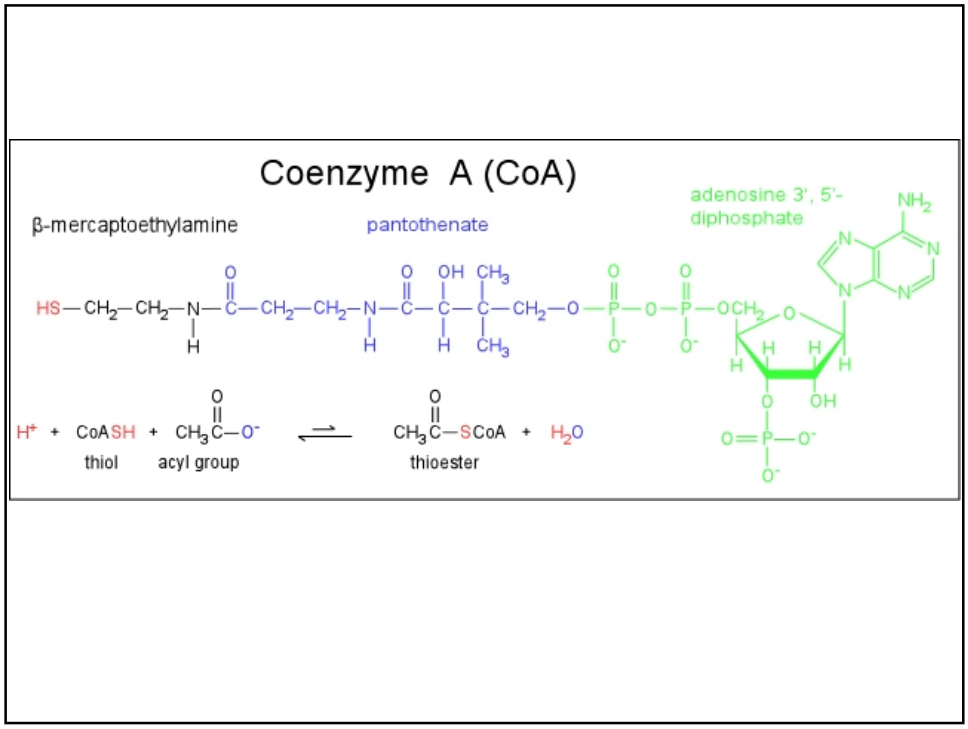


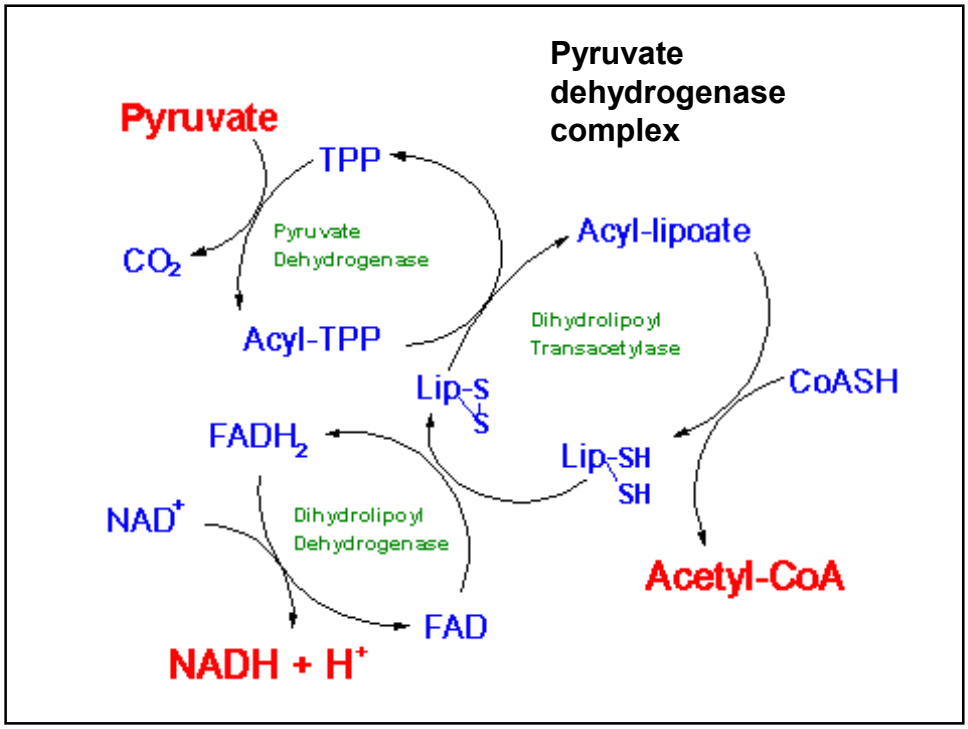
Oxidative decarboxylation



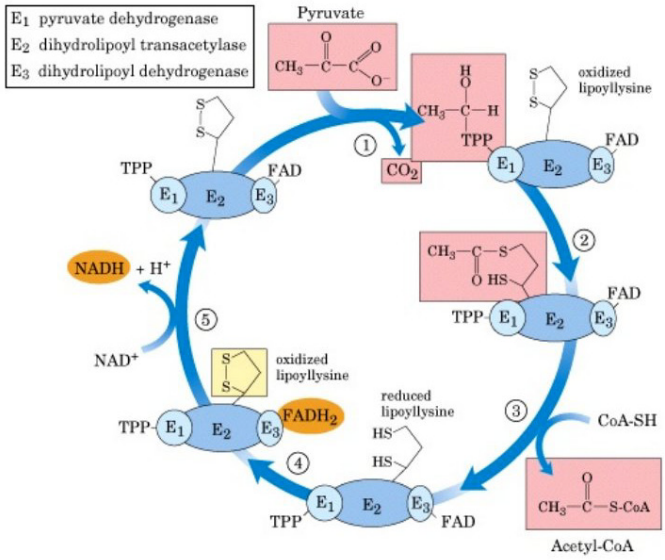
NAD: Nicotinamide Adenine Dinucleotide
FAD: Flavin Adenine Dinucleotide
TPP: Thiamine PyroPhosphate
Lipoate: Lipoic acid
CoA: Coenzyme A

Oxidative decarboxylation

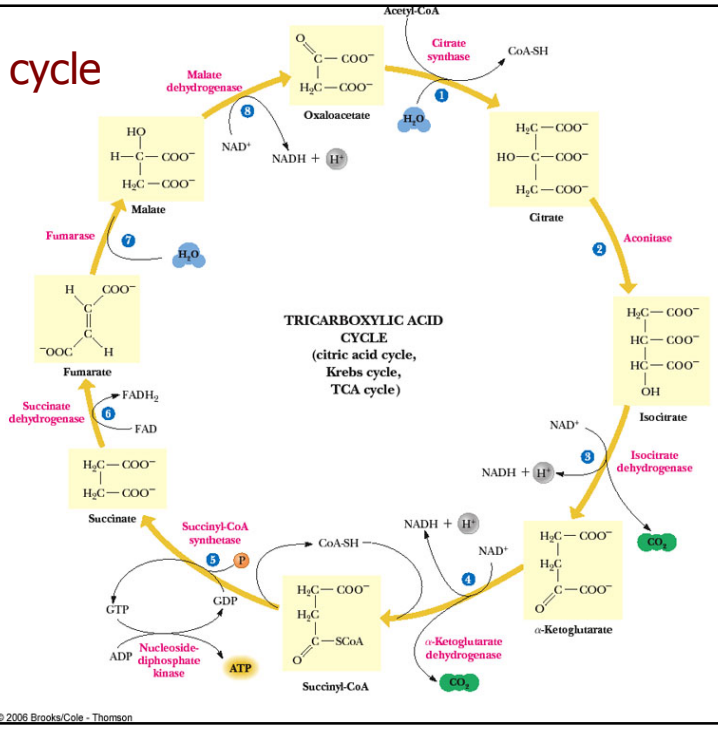

Coenzyme A (CoA)
β-mercaptoethylamine
pantothenate
adenosine 3', 5'-diphosphate
thiol
acyl group
thioester

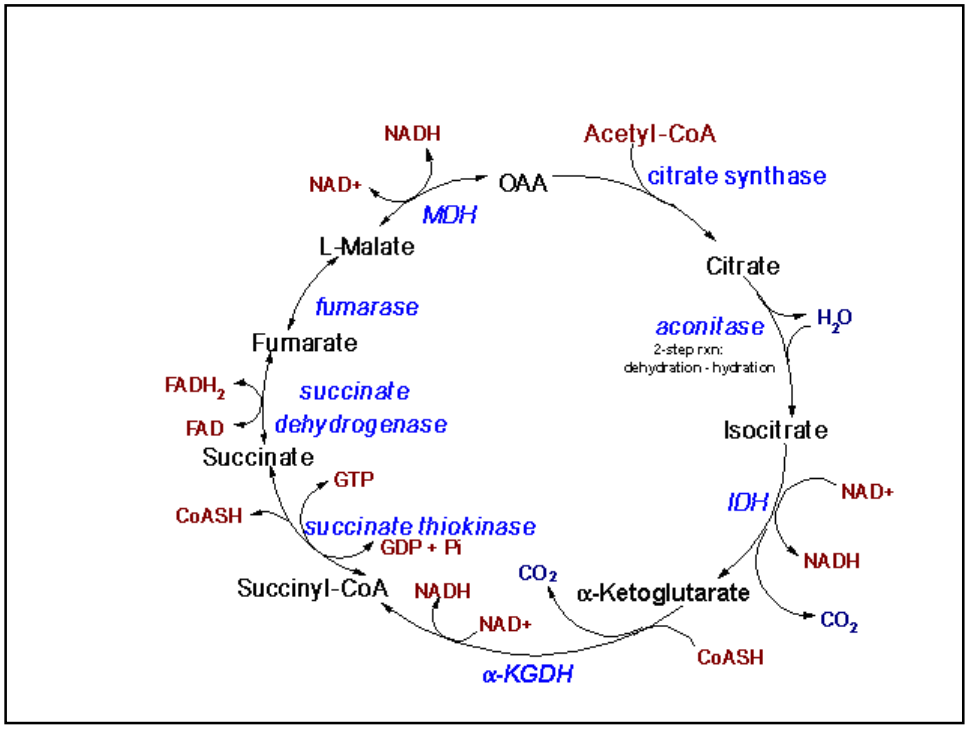

Pyruvate dehydrogenase complex
Pyruvate
TPP
CO2
Pyruvate Dehydrogenase
Acyl-TPP
Acyl-lipoate
Dihydrolipoyl Transacetylase
Lip-S S
CoASH
FADH2
Lip-SH SH
NAD+
Dihydrolipoyl Dehydrogenase
Acetyl-CoA
FAD
NADH + H+

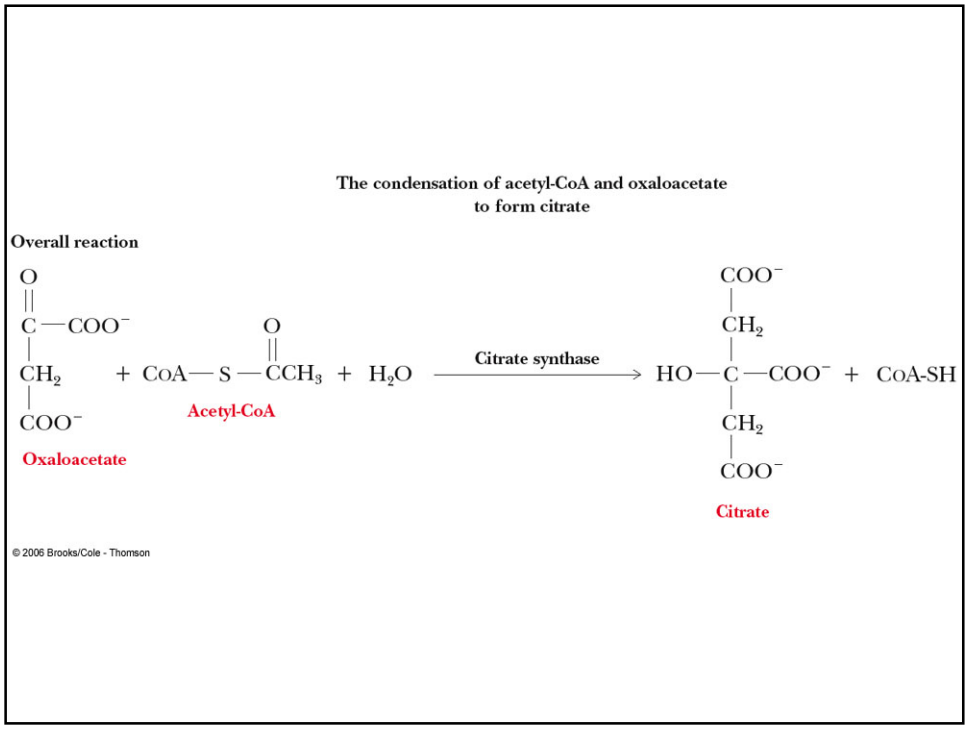
Oxidative decarboxylation of pyruvate by pyruvate dehydrogenase complex

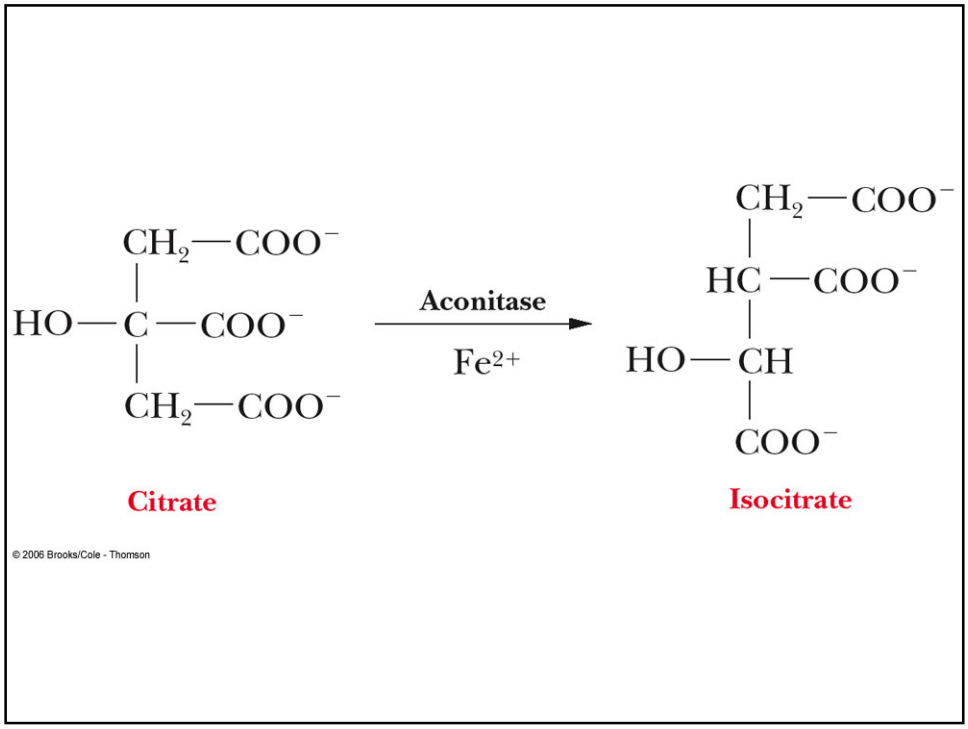


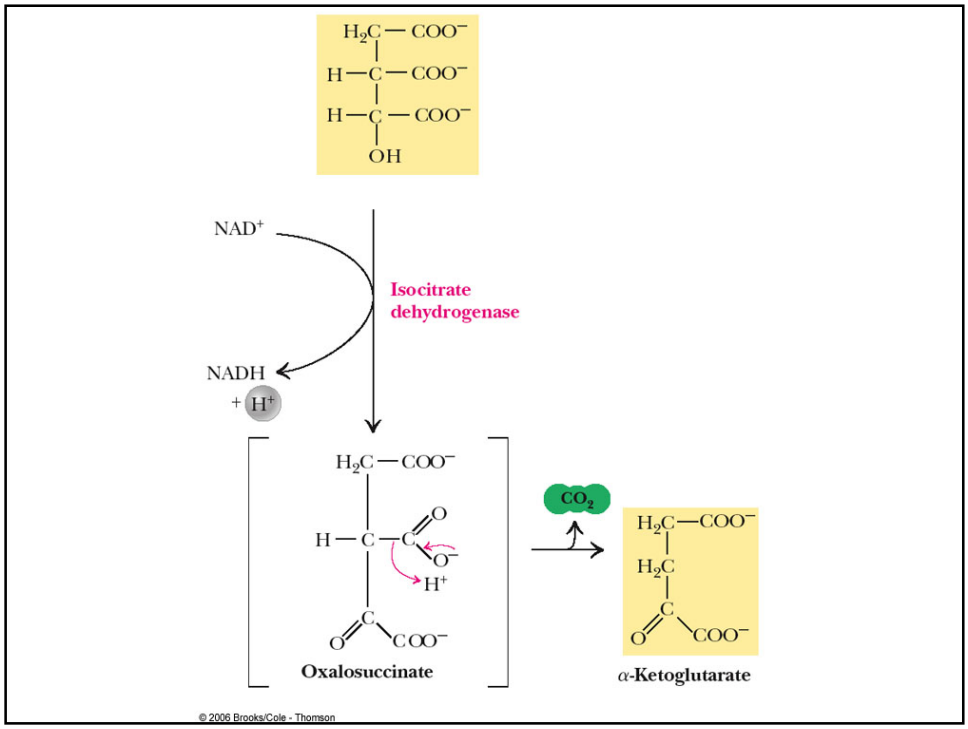
Citric acid cycle

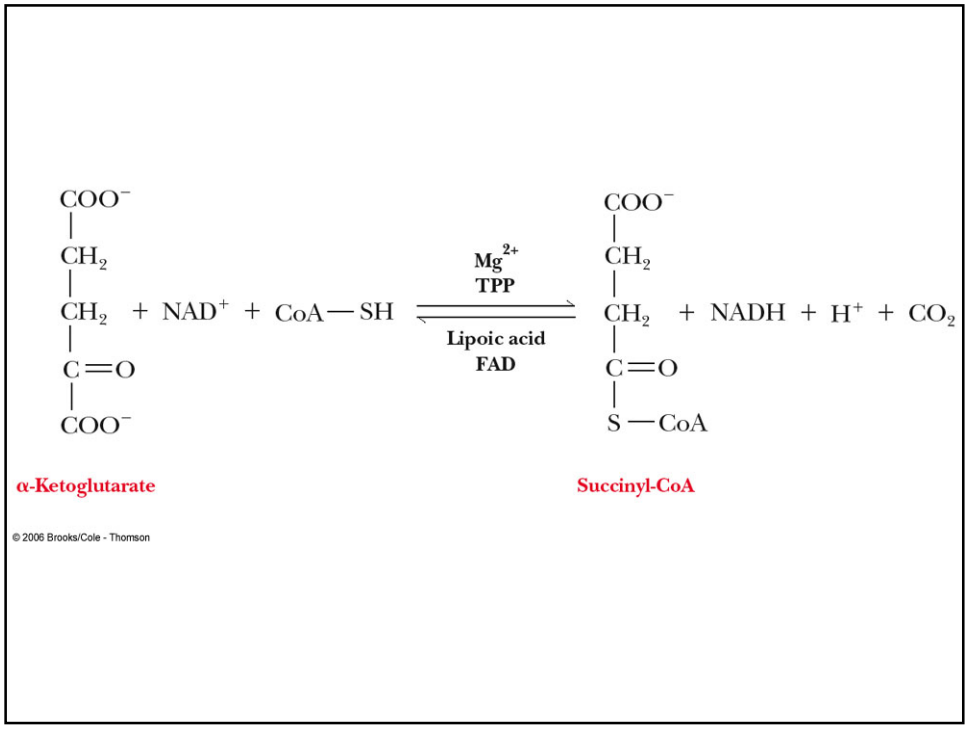


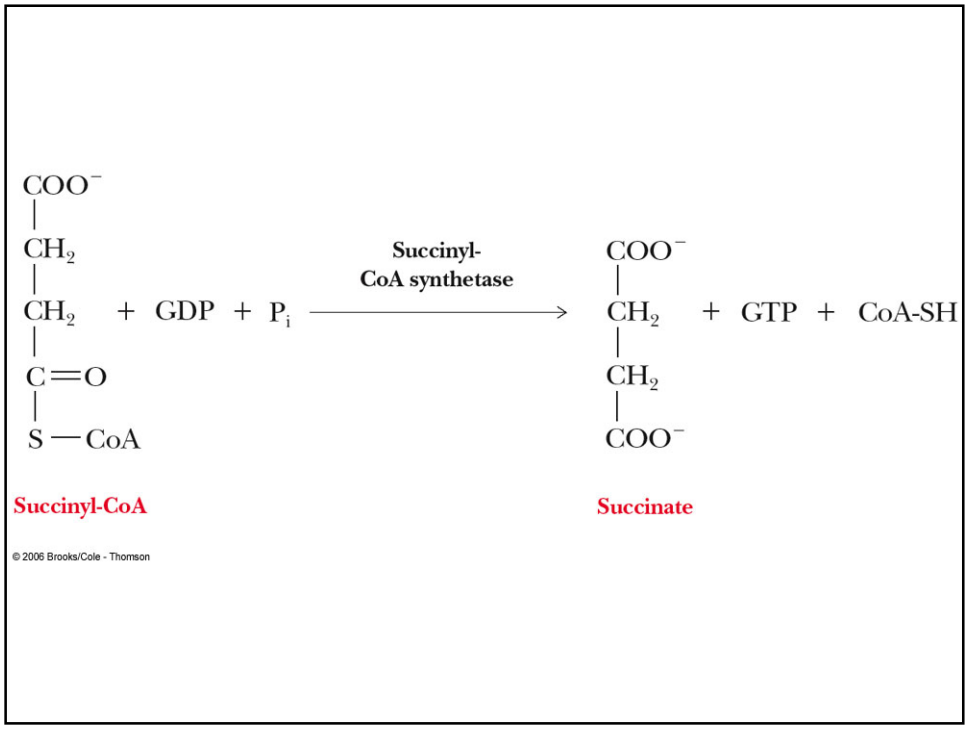

NADH
Acetyl-CoA
NAD+
OAA
citrate synthase
MDH
L-Malate
Citrate
fumarase
aconitase
H2O
2-step rxn:
dehydration - hydration
Fumarate
FADH2
succinate
FAD
dehydrogenase
Isocitrate
Succinate
GTP
IDH
NAD+
CoASH
succinate thiokinase
GDP + Pi
NADH
CO2
Succinyl-CoA
NADH
α-Ketoglutarate
NAD+
CO2
CoASH
α-KGDH


The condensation of acetyl-CoA and oxaloacetate
to form citrate
Overall reaction
Citrate synthase
Acetyl-CoA
Oxaloacetate
Citrate
© 2006 Brooks/Cole - Thomson


Aconitase
Fe^{2+}
Citrate
Isocitrate
© 2006 Brooks/Cole - Thomson


NAD^+
Isocitrate dehydrogenase
NADH
$+ H^+$
CO_2
Oxalosuccinate
α-Ketoglutarate
© 2006 Brooks/Cole - Thomson


COO⁻
CH2
CH2
C=O
COO⁻
+ NAD⁺ + CoA—SH
Mg2+
TPP
Lipoic acid
FAD
COO⁻
CH2
CH2
C=O
S—CoA
+ NADH + H⁺ + CO2
α-Ketoglutarate
Succinyl-CoA
© 2006 Brooks/Cole - Thomson


COO⁻
CH2
CH2
C=O
S—CoA
+ GDP + Pi
Succinyl-
CoA synthetase
COO⁻
CH2
CH2
COO⁻
+ GTP + CoA-SH
Succinyl-CoA
Succinate
© 2006 Brooks/Cole - Thomson

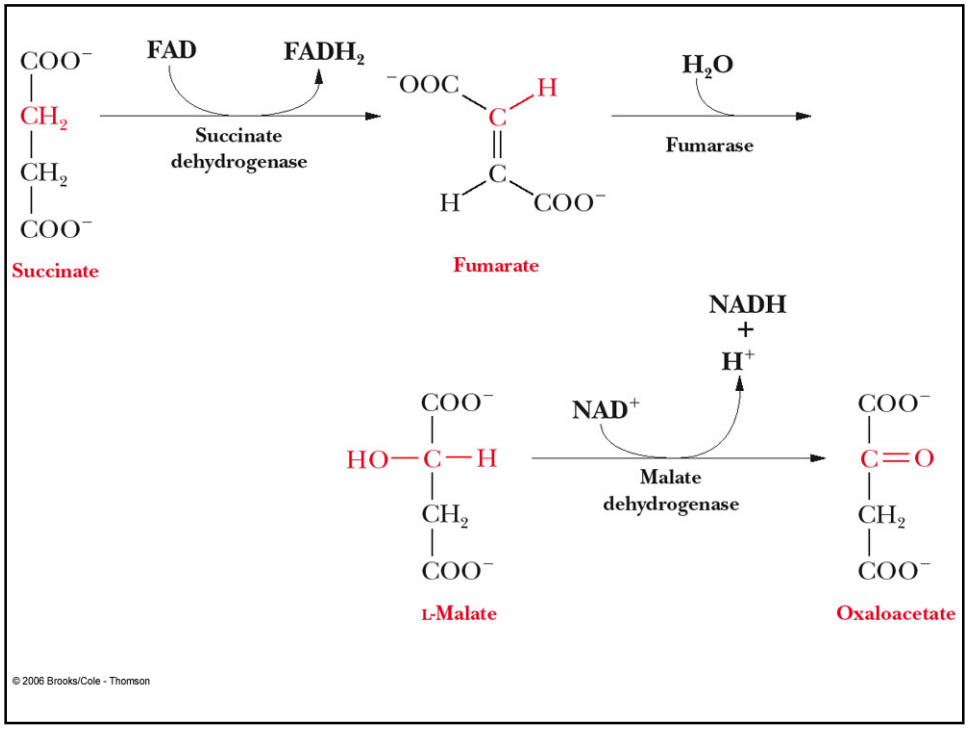
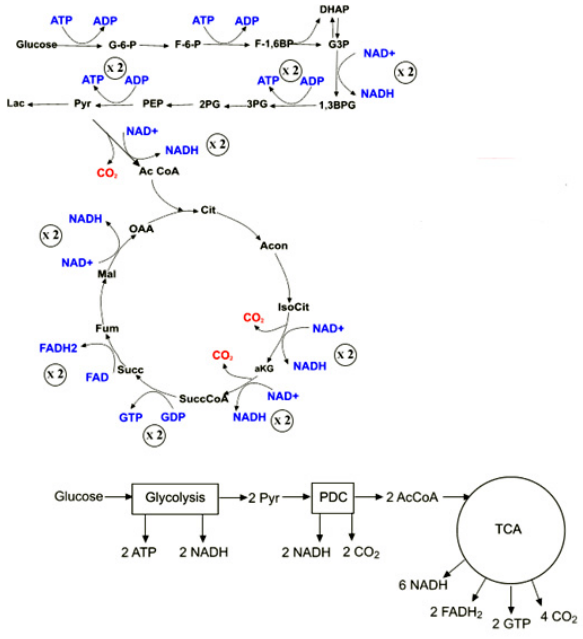


Table 19.2

The Energetics of Conversion of Pyruvate to CO_2

Step	Reaction	$\Delta G^{\circ\prime}$ kJ mol^{-1}	$\Delta G^{\circ\prime}$ kcal mol^{-1}
	Pyruvate + CoA-SH + NAD^+ → Acetyl-CoA + NADH + CO_2	−33.4	−8.0
1	Acetyl-CoA + Oxaloacetate + H_2O → Citrate + CoA-SH + H^+	−32.2	−7.7
2	Citrate → Isocitrate	+6.3	+1.5
3	Isocitrate + NAD^+ → α-Ketoglutarate + NADH + CO_2 + H^+	−7.1	−1.7
4	α-Ketoglutarate + NAD^+ + CoA-SH → Succinyl-CoA + NADH + CO_2 + H	−33.4	−8.0
5	Succinyl-CoA + GDP + P_i → Succinate + GTP + CoA-SH	−3.3	−0.8
6	Succinate + FAD → Fumarate + $FADH_2$	~0	~0
7	Fumarate + H_2O → L-Malate	−3.8	−0.9
8	L-Malate + NAD^+ → Oxaloacetate + NADH + H^+	+29.2	+7.0
Overall:	Pyruvate + 4 NAD^+ + FAD + GDP + P_i + 2 H_2O → CO_2 + 4 NADH + $FADH_2$ + GTP + 4 H^+	−77.7	−18.6

Pathway in summary



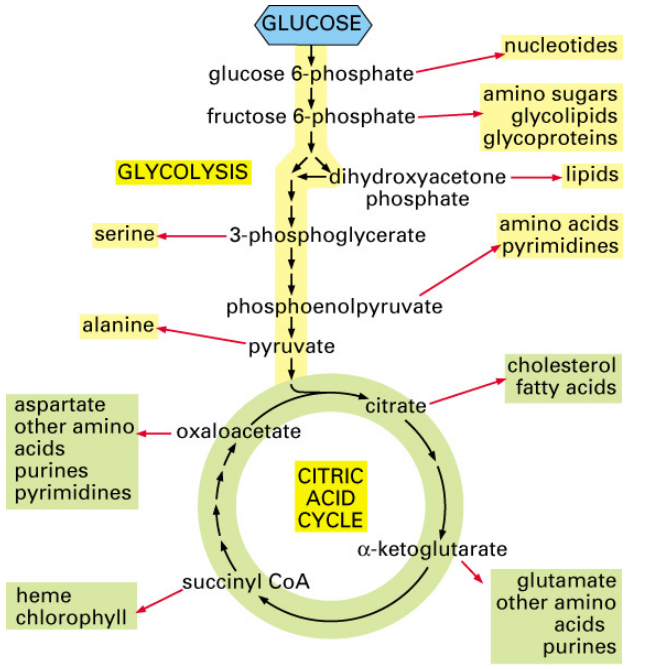
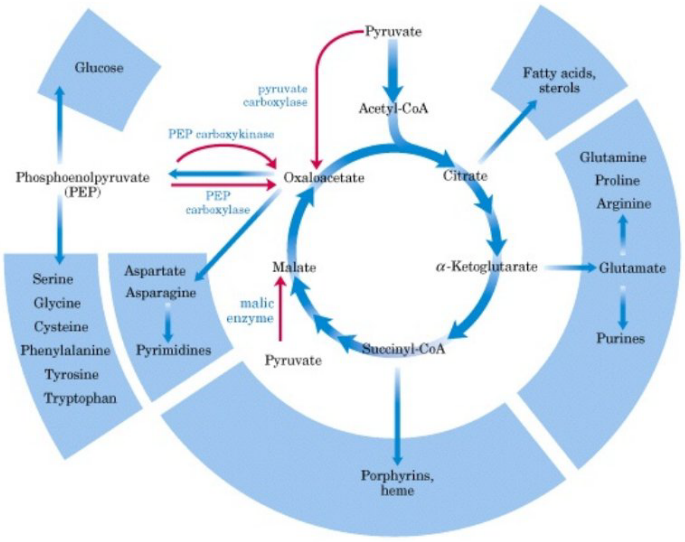


Figure 2–87. Molecular Biology of the Cell, 4th Edition.

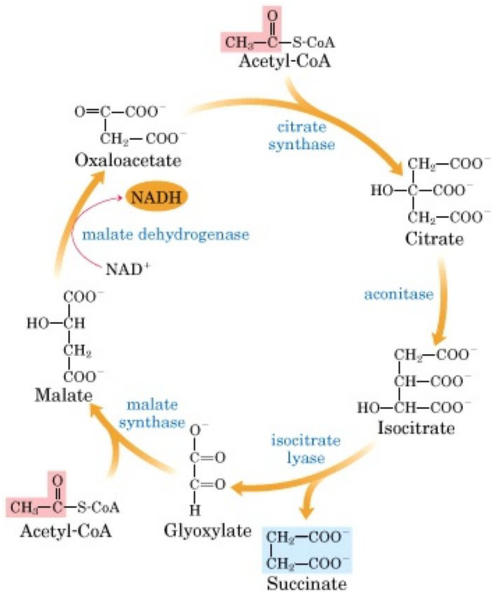
TCA intermediates and metabolism



Anaplerotic Reactions

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

The Glyoxylate Cycle



Coupling TCA and glyoxylate shunt