β Oxidaton Take Place

Part of β oxidaton process

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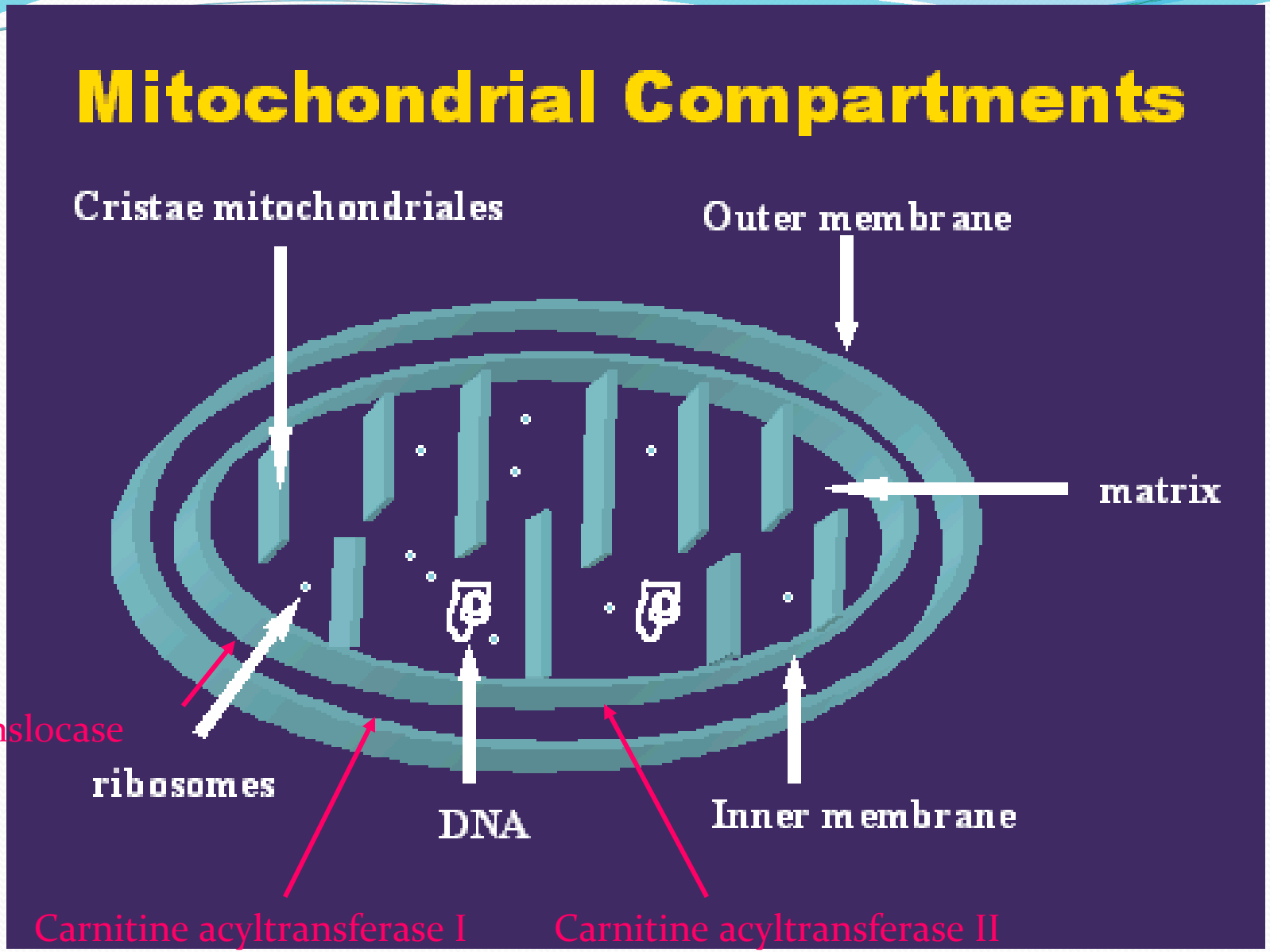
Mitochondrial Compartments

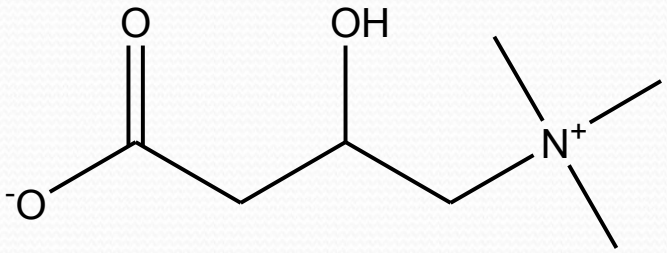


Source: http://cellbio.utmb.edu/cellbio/mitochondria_1.htm

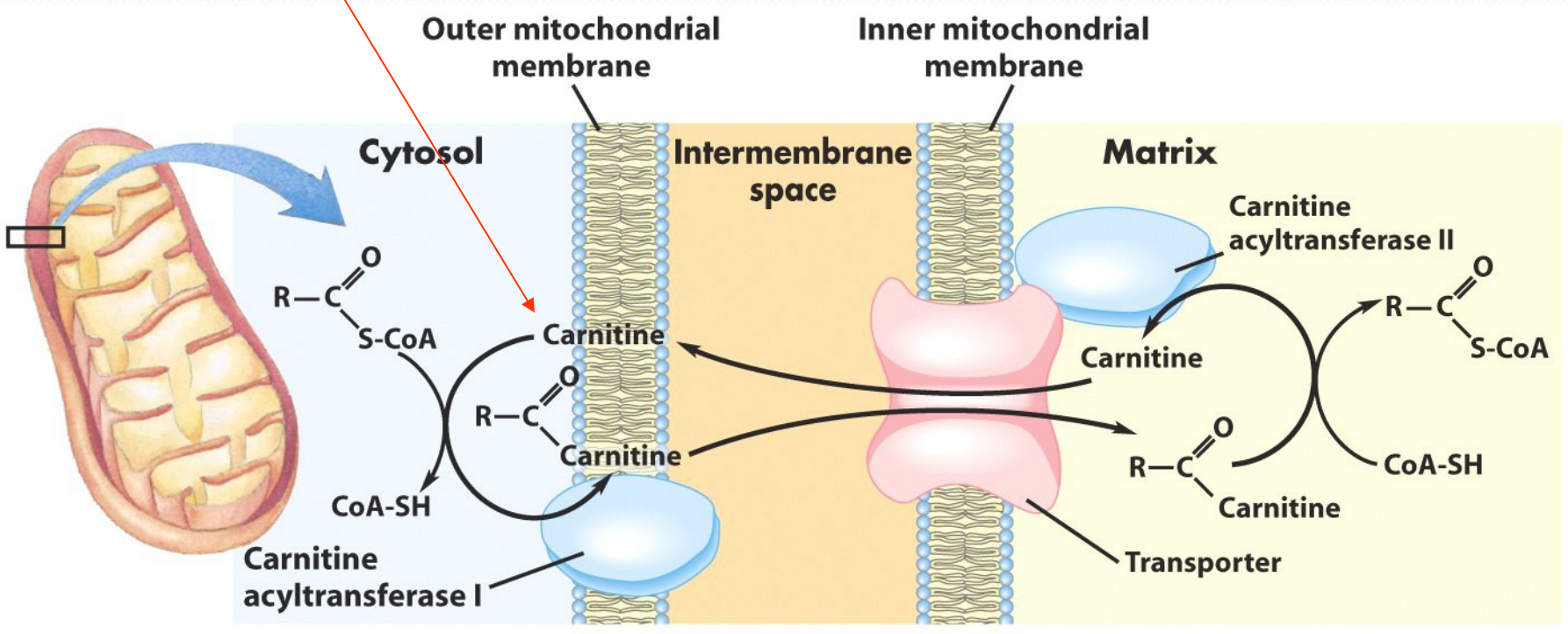
Membrane Transport of Fatty Acyl CoA Esters

- FA with ≤ 12 carbons enter mitochondrial matrix (MM)
- FA with ≥ 14 carbons use CARNITINE SHUTTLE

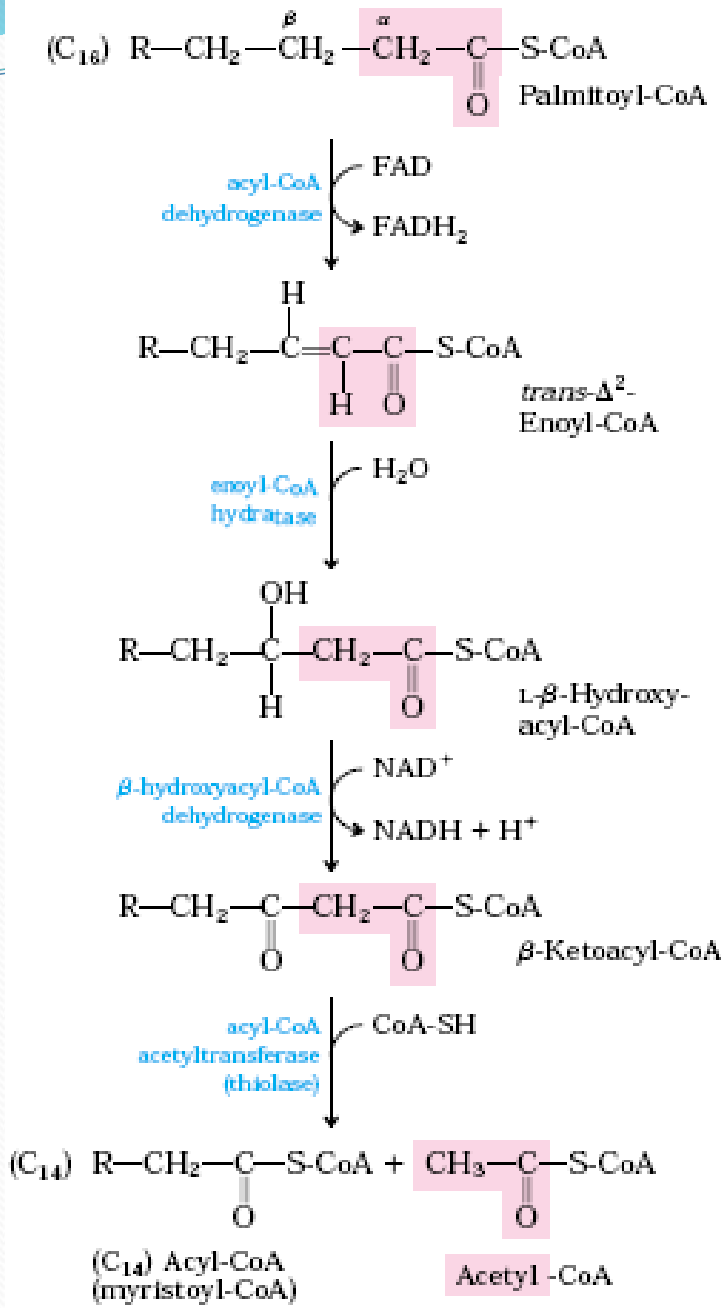
Rate-limiting step of FA oxidation

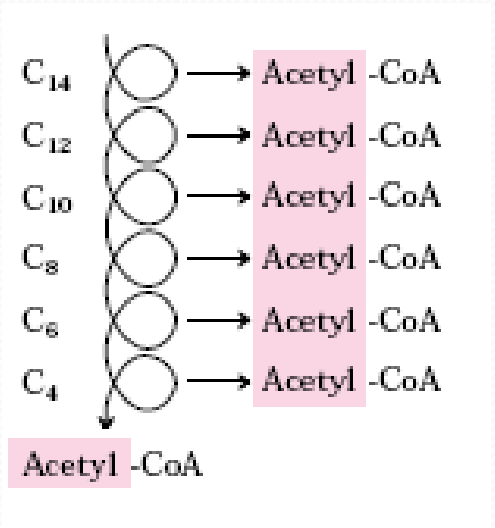


carnitine

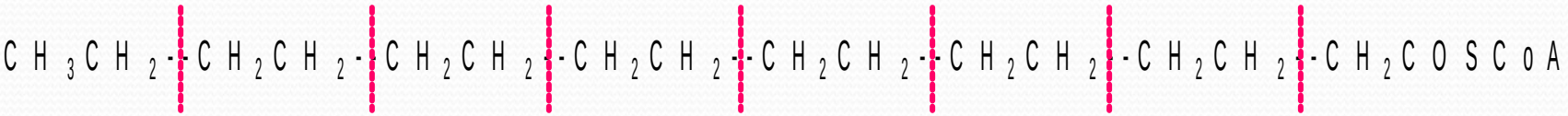


PALMITIC ACID OXIDATION


(C16) R—CH2—CH2—CH2—C—S-CoA
β
α
O
Palmitoyl-CoA
acyl-CoA dehydrogenase
FAD
FADH2
H
R—CH2—C=C—C—S-CoA
H O
trans-Δ2-Enoyl-CoA
enoyl-CoA hydratase
H2O
OH
R—CH2—C—CH2—C—S-CoA
H O
L-β-Hydroxy-acyl-CoA
β-hydroxyacyl-CoA dehydrogenase
NAD+
NADH + H+
R—CH2—C—CH2—C—S-CoA
O O
β-Ketoacyl-CoA
acyl-CoA acetyltransferase (thiolase)
CoA-SH
(C14) R—CH2—C—S-CoA + CH3—C—S-CoA
O O
(C14) Acyl-CoA (myristoyl-CoA)
Acetyl -CoA


C14 → Acetyl -CoA
C12 → Acetyl -CoA
C10 → Acetyl -CoA
C8 → Acetyl -CoA
C6 → Acetyl -CoA
C4 → Acetyl -CoA
Acetyl -CoA

Complete β oxidation of Palmitoyl CoA



7 Cycles

$$8\ CH_3COSCoA + 7\ FADH_2 + 7\ NADH + 7\ H^+$$

β Oxidation

$$\text{Palmitoyl-CoA} + 7\text{CoA} + 7\text{O}_2 + 28\text{P}_i + 28\text{ADP} \longrightarrow 8\ \text{acetyl-CoA} + 28\text{ATP} + 7\text{H}_2\text{O}$$

In TCA Cycle

$$8\ \text{Acetyl-CoA} + 16\text{O}_2 + 80\text{P}_i + 80\text{ADP} \longrightarrow 8\text{CoA} + 80\text{ATP} + 16\text{CO}_2 + 16\text{H}_2\text{O}$$

Total reaction

$$\text{Palmitoyl-CoA} + 23\text{O}_2 + 108\text{P}_i + 108\text{ADP} \longrightarrow \text{CoA} + 108\text{ATP} + 16\text{CO}_2 + 23\text{H}_2\text{O}$$

Yield of ATP during Oxidation of One Molecule of Palmitoyl-CoA to CO2 and H2O

TABLE 17–1 Yield of ATP during Oxidation of One Molecule of Palmitoyl-CoA to CO_2 and H_2O

Enzyme catalyzing the oxidation step	*Number of NADH or $FADH_2$ formed*	*Number of ATP ultimately formed**
Acyl-CoA dehydrogenase	7 $FADH_2$	10.5
β-Hydroxyacyl-CoA dehydrogenase	7 NADH	17.5
Isocitrate dehydrogenase	8 NADH	20
α-Ketoglutarate dehydrogenase	8 NADH	20
Succinyl-CoA synthetase		8†
Succinate dehydrogenase	8 $FADH_2$	12
Malate dehydrogenase	8 NADH	20
Total		108

*These calculations assume that mitochondrial oxidative phosphorylation produces 1.5 ATP per $FADH_2$ oxidized and 2.5 ATP per NADH oxidized.

†GTP produced directly in this step yields ATP in the reaction catalyzed by nucleoside diphosphate kinase (p. XXX).

Energetics of Complete Oxidation of Fatty Acids

			High Energy Phosphate Bonds Generated
Palmitic Acid	⇒	Palmitoyl CoA	-2
$CH_3COSCoA$	TCA Cycle ⟹	$CO_2 + H_2O$	108
		Net	106

References

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