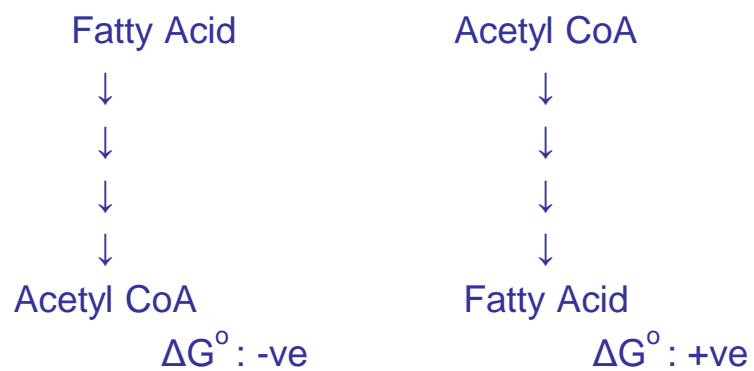


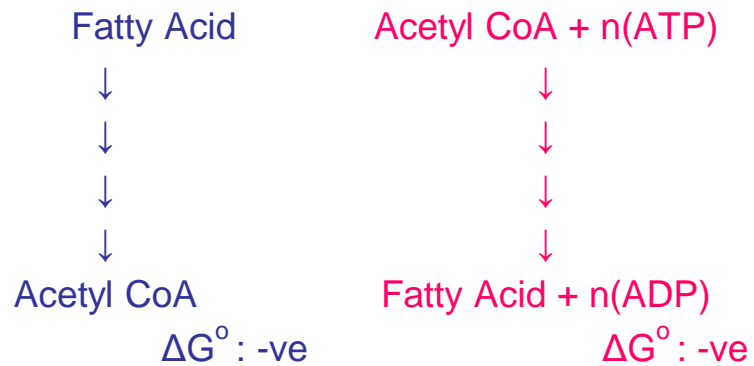
Fatty Acid Synthesis

- Requires
 - Carbon Source: Acetyl CoA
 - Reducing Power: NADPH
 - Energy Input: ATP

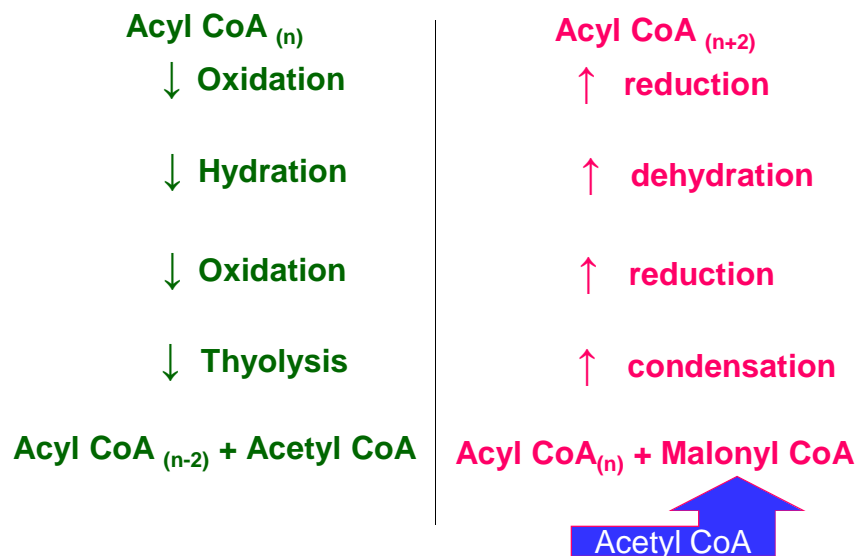
Why Energy ?



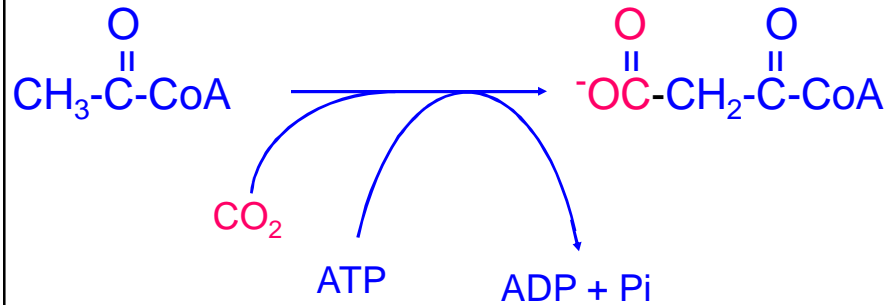
Why Energy ?



FA Degradation and Synthesis



Carboxylation of Acetyl CoA Produces Malonyl CoA

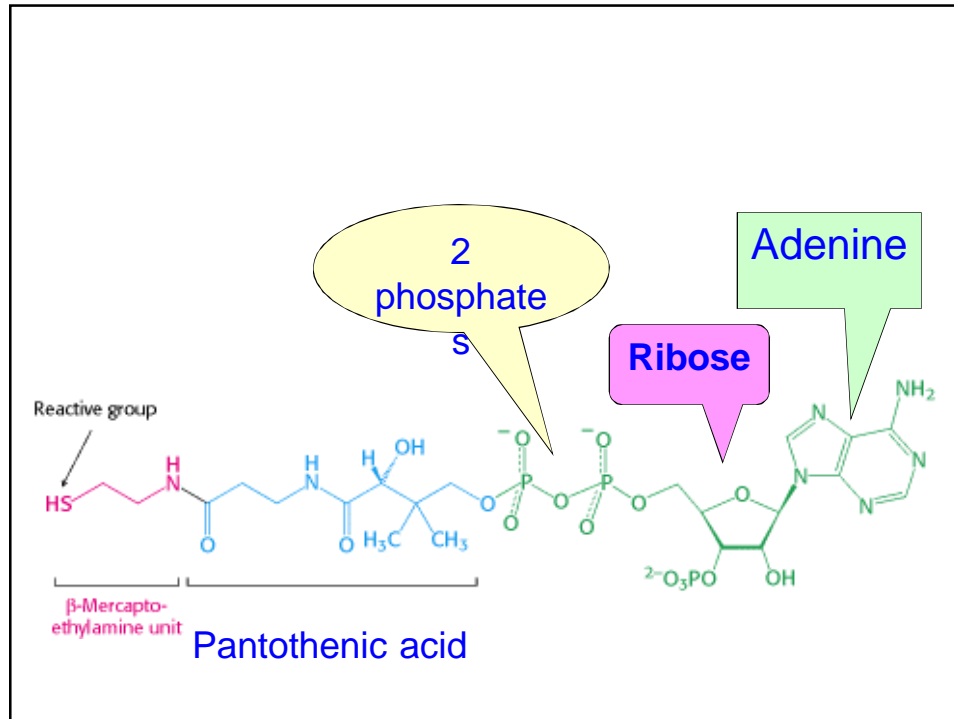


Acetyl CoA Carboxylase

Biotin-Containing Enzyme

Fatty Acid Synthase Catalyzes the remaining steps

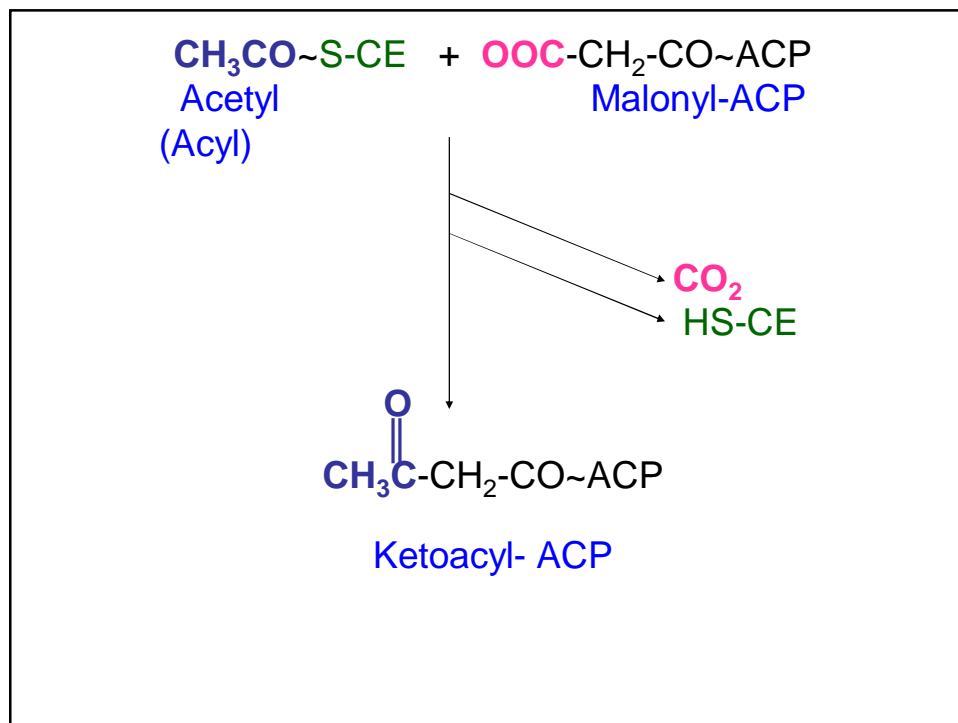
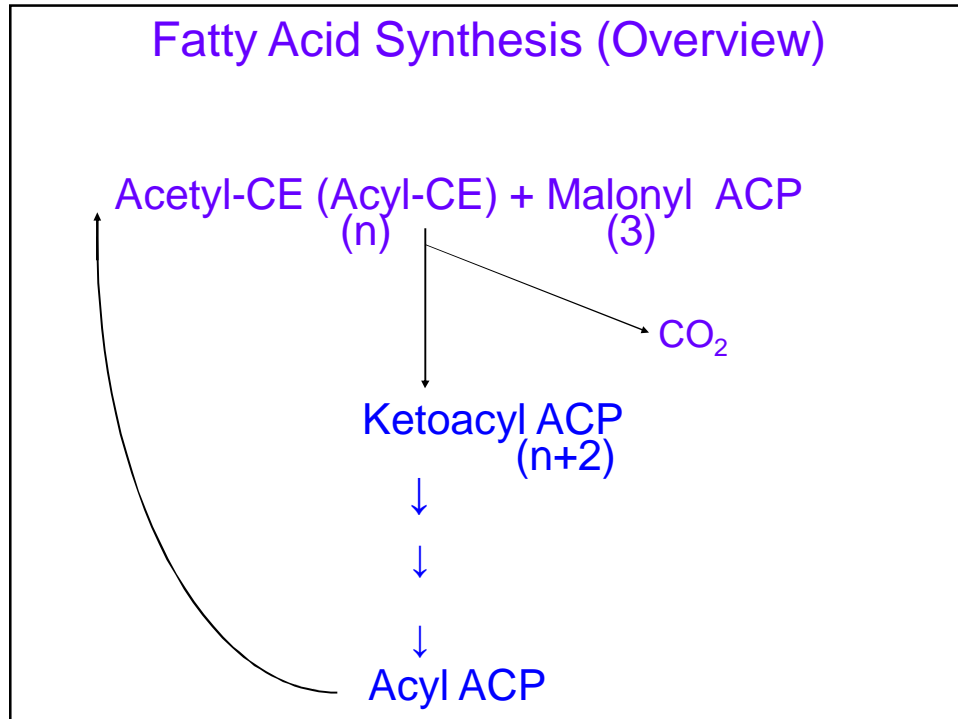
- Multifunctional Enzyme Complex
- **Dimer of two Identical Chains**
- **Each has Seven Catalytic Activities**
 - One activity is Condensing Enzyme with **-SH**
- **One Domain is Linked to Phosphopantetheine**
 - With Reactive **-SH**

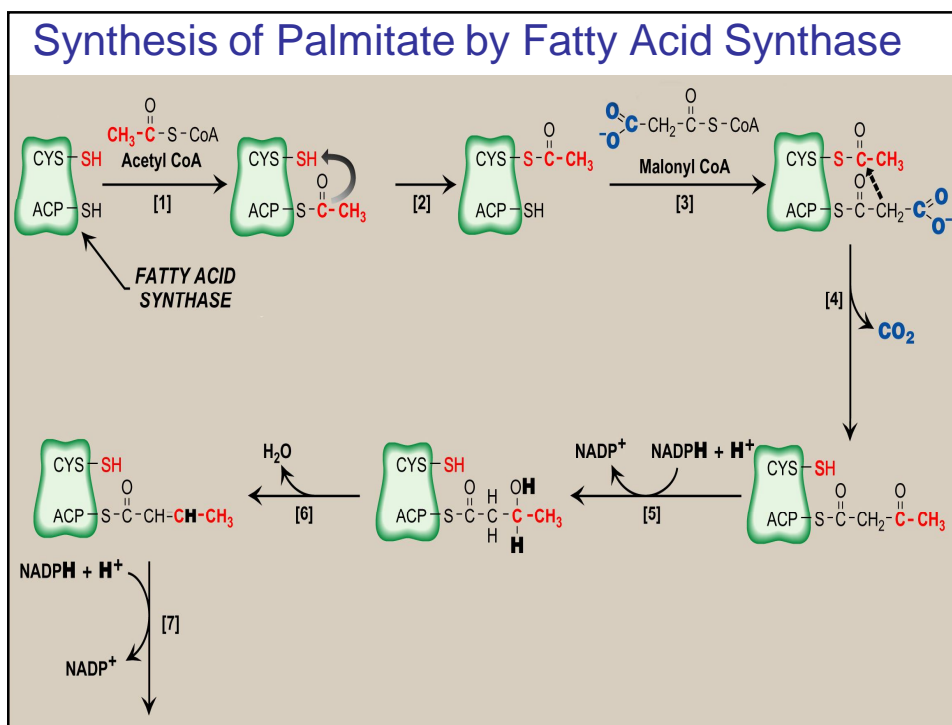
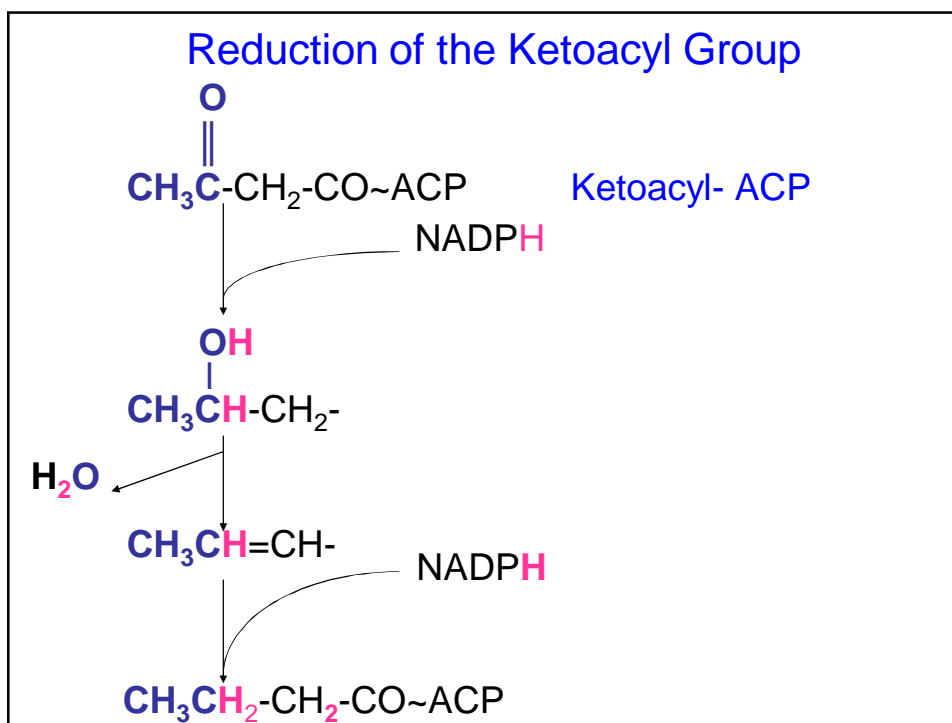


Fatty Acid Synthase Catalyzes the remaining steps

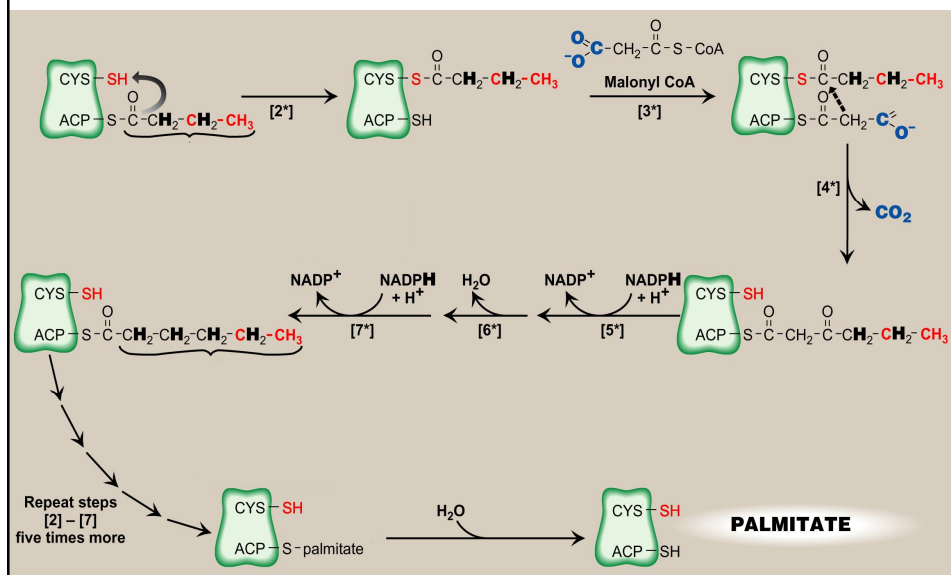
- **Multifunctional Enzyme Complex**
- **Dimer of two Identical Chains**
- **Each has Seven Catalytic Activities**
 - One activity is Condensing Enzyme with $-\text{SH}$
- **One Domain is Linked to Phosphopantetheine**
 - With Reactive $-\text{SH}$
 - Carries Intermediates during Catalysis
 - (Acyl, Acetyl and Malonyl Groups)
 - Known as **Acyl Carrier Protein (ACP)**

Fatty Acid Synthesis (Overview)





Synthesis of Palmitate by Fatty Acid Synthase (Cont.)



Synthesis of Palmitate (net reaction)

How many cycles of synthesis (Condensation)?

* 7

How many Malonyl CoA?

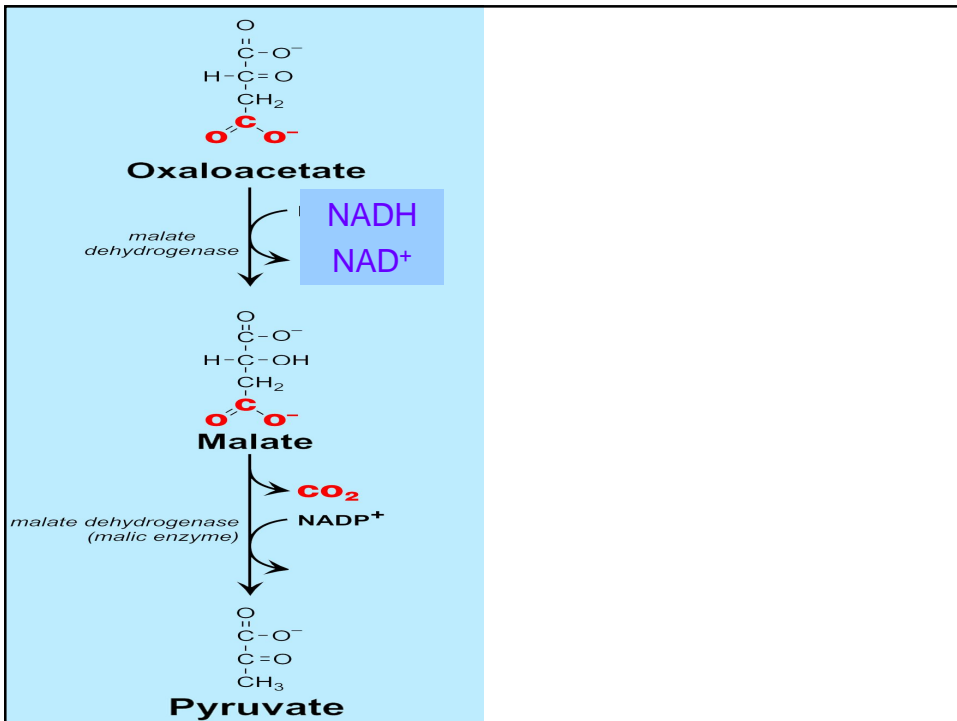
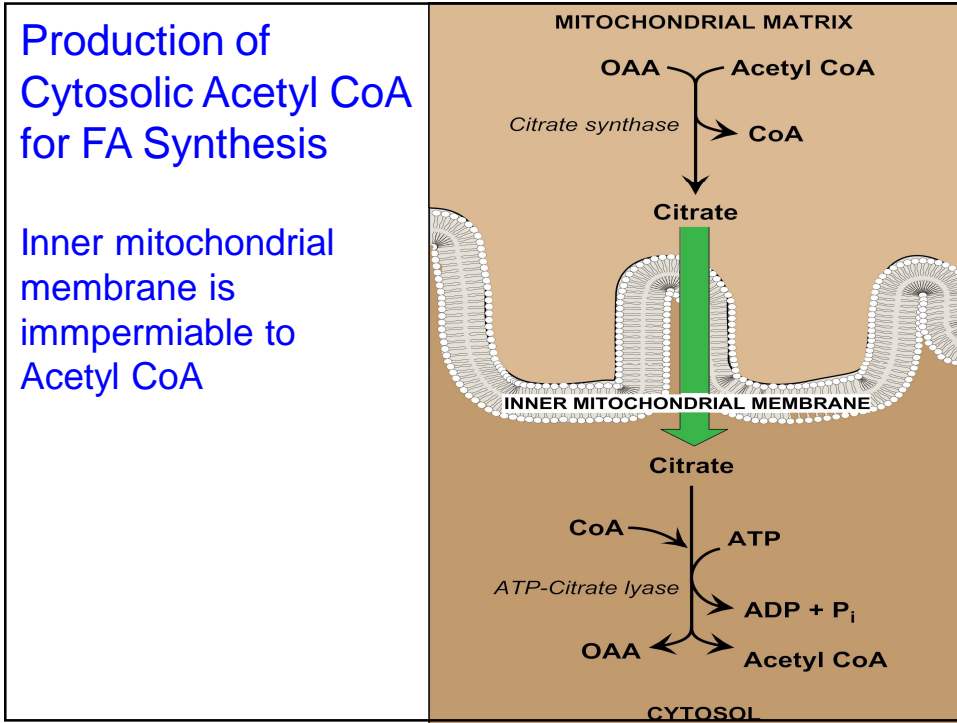
* 7

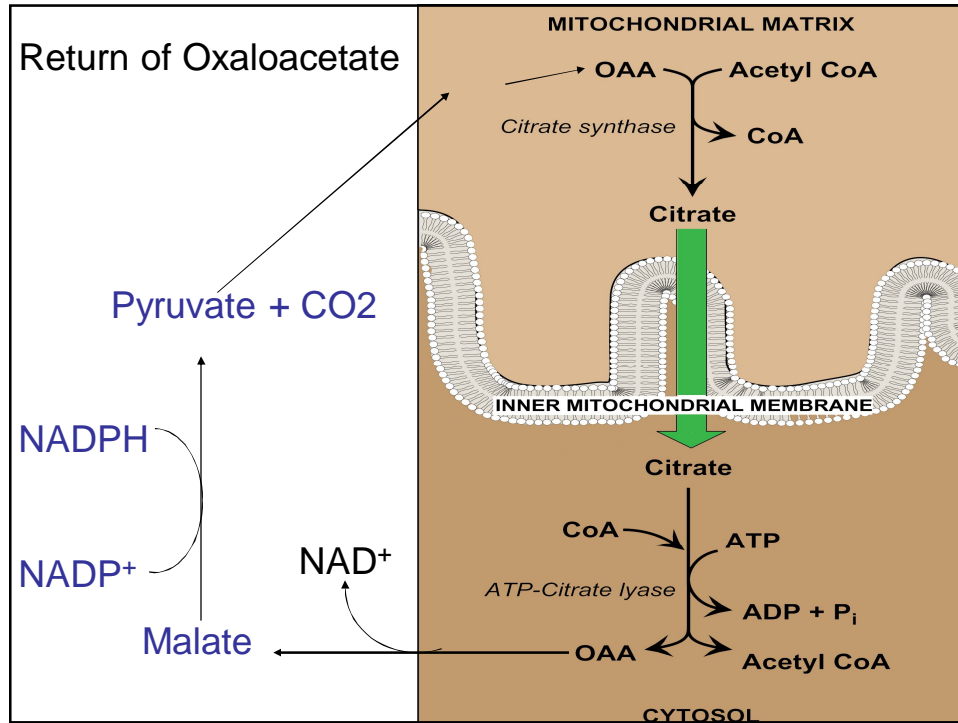
How many Acetyl CoA?

* 1

How Many NADPH?

* 14





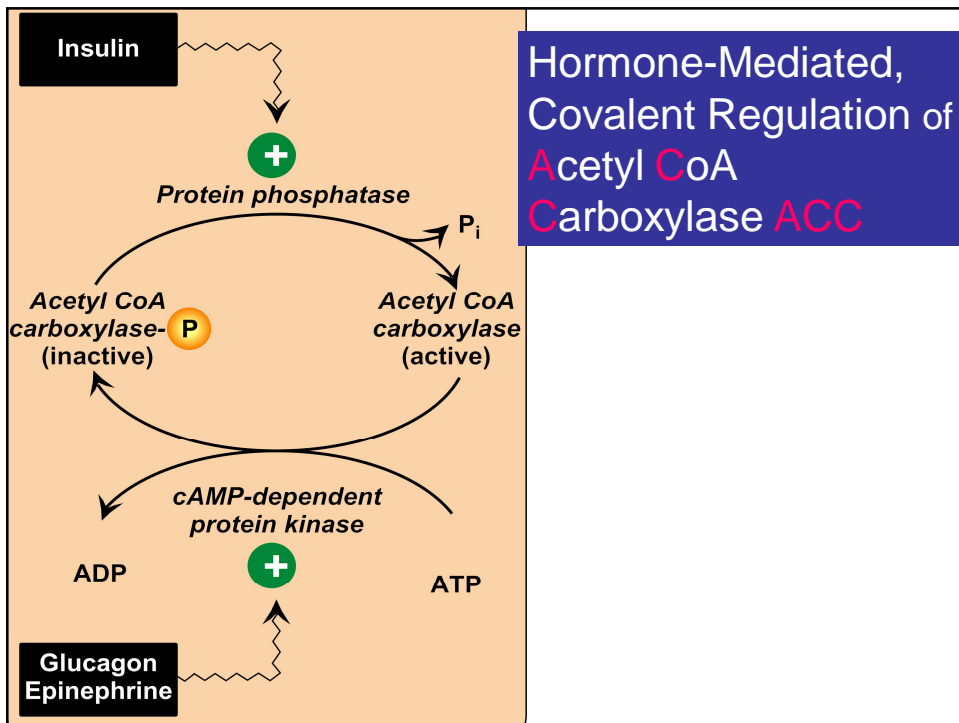
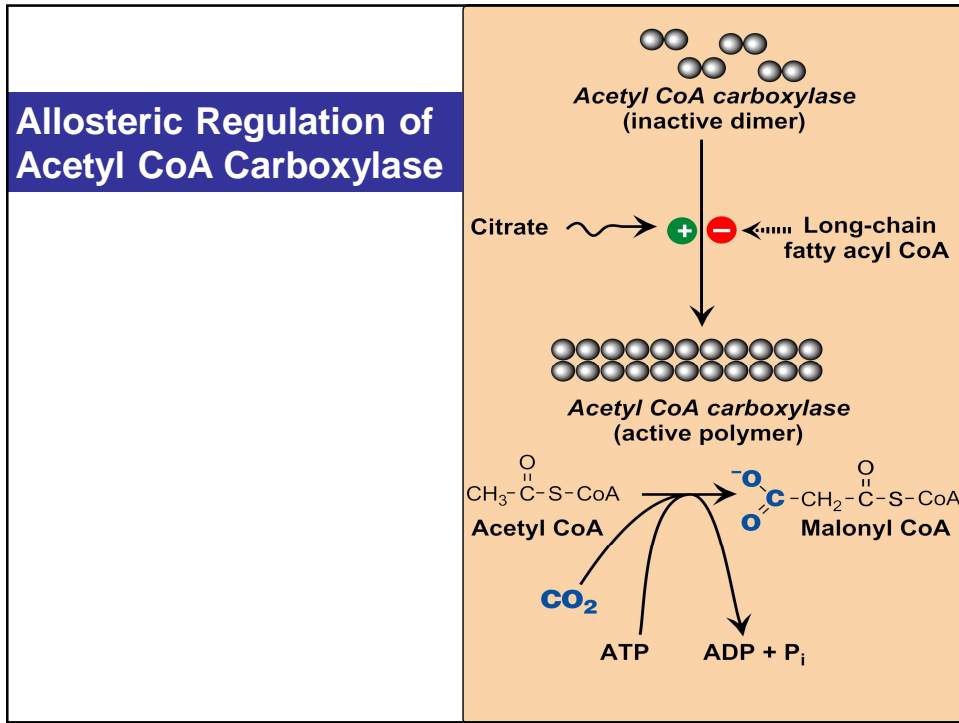
Regulation of FA Oxidation & Synthesis

OXIDATION

- Supply of Fatty Acids
-Hormonal Control
- Entry into Mitochondria
- Availability of NAD⁺

SYNTHESIS

- Regulation of AcCoA Carboxylase
-Allosteric Mechanism
- Phosphorylation
- Amounts of Enzymes



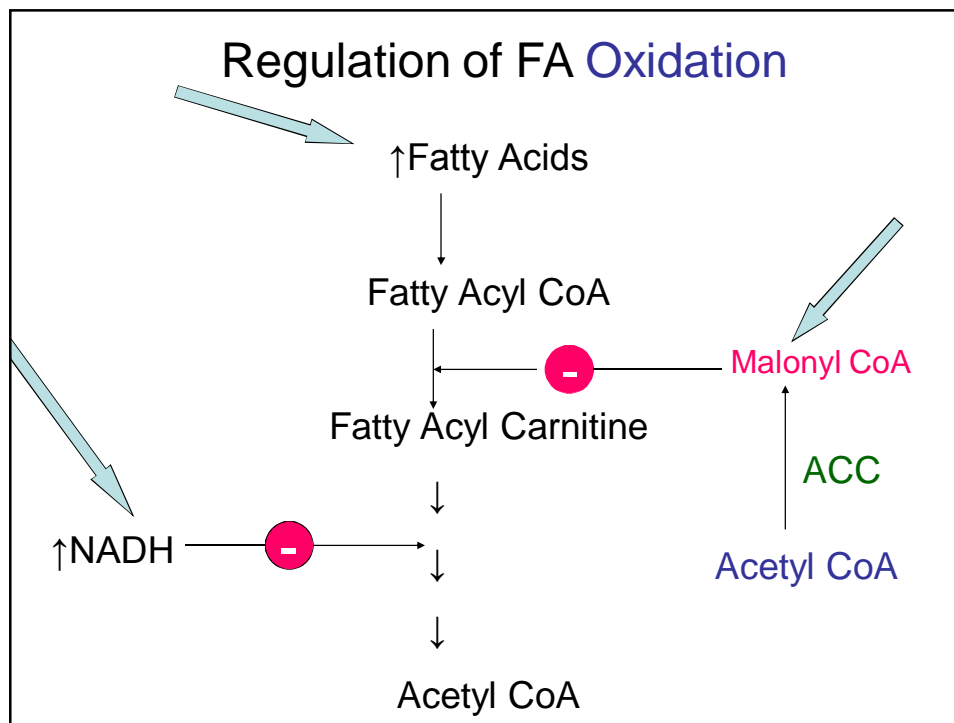
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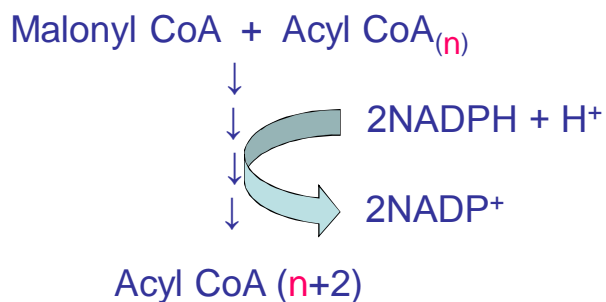
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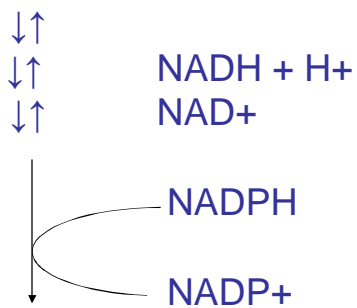
Elongation of Fatty Acids

- in Endoplasmic Reticulum
- Similar Sequence of Reactions
- Different Enzymes



$n = 16$ or more carbons

Elongation of Fatty Acids in Mitochondria

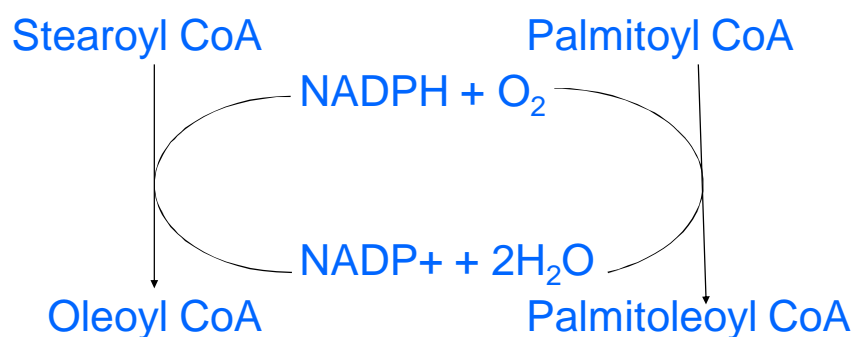


$n = \text{less than } 16$ carbons

Introduction of Double Bonds

- Synthesis of Monounsaturated FA
 - Oleic Acid 18: Δ^9
 - Palmitoleic 16: Δ^9
- In endoplasmic reticulum
- No double bond can be introduced beyond carbon 9 in human

Introduction of Double Bonds (Cont.)



Δ^9 Desaturase; Cytochrome b_5

Introduction of Double Bonds (Cont.)

Formation and Modification of Polyunsaturated FA

-Elongation

- Desaturation

Additional double bonds can be introduced by:

Δ^4 Desaturase

Δ^5 Desaturase

Δ^6 Desaturase

Modification of Polyunsaturated FA

Linoleic 18:2 $\Delta^{9,12}$



Desaturation

18:3 $\Delta^{6,9,12}$

ω ?



Elongation

20:3 $\Delta^{8,11,14}$

ω ?



Desaturation

20:4 $\Delta^{5,8,11,14}$

ω ?

Arachidonic