

LIPID METABOLISM & Beta-Oxidation of Fatty Acids

By

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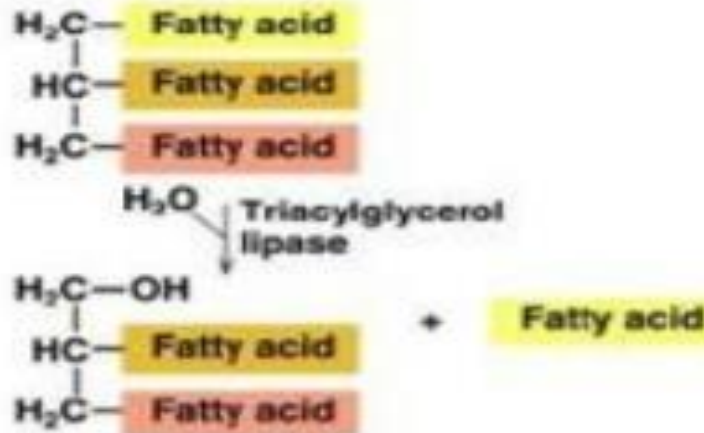
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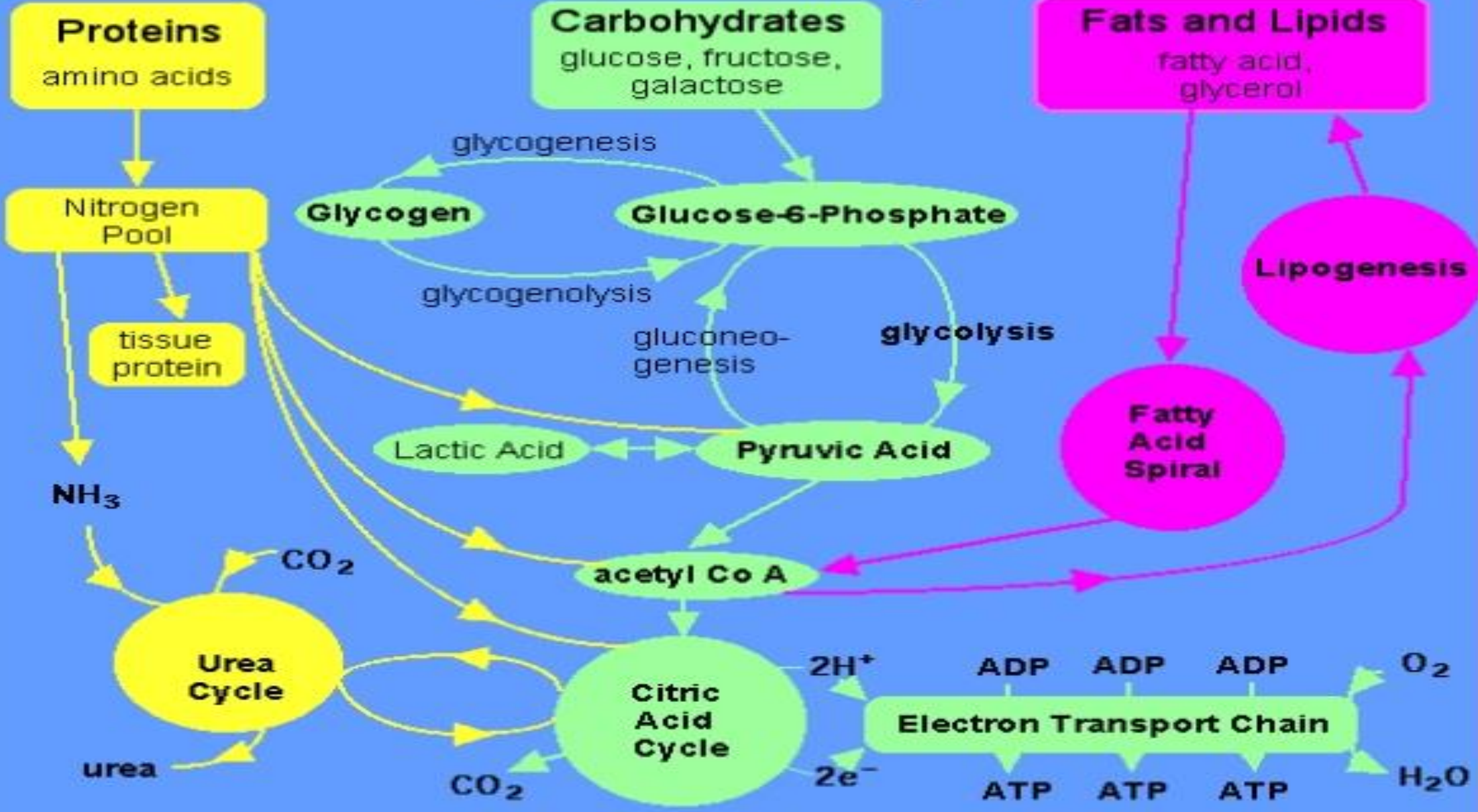
Stream: M.Sc. Organic Chemistry (Sem. –II)

Lipid Metabolism

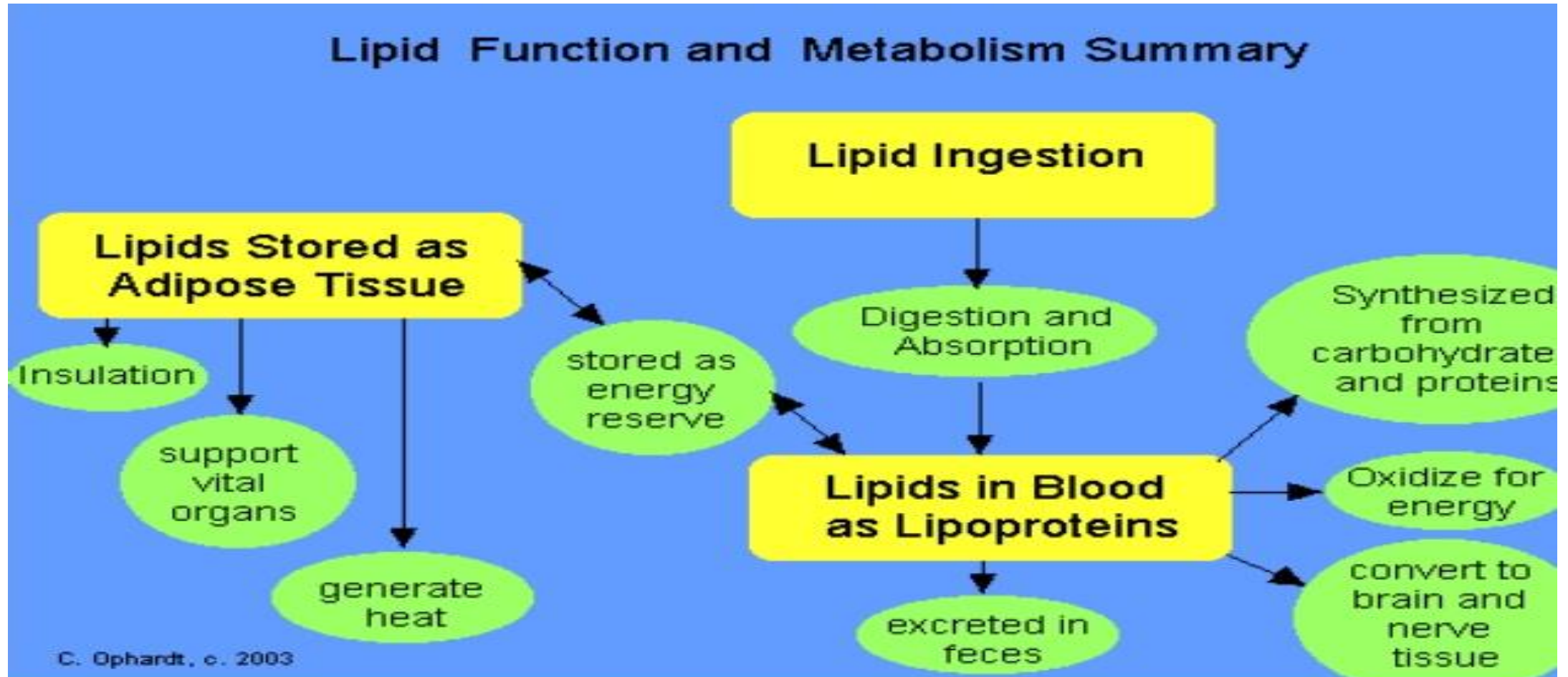
- 1 Digestion of Triacylglycerols
- 2 Oxidation of Fatty Acids
- 3 ATP and Fatty Acid Oxidation



Metabolism Summary



Lipid Metabolism



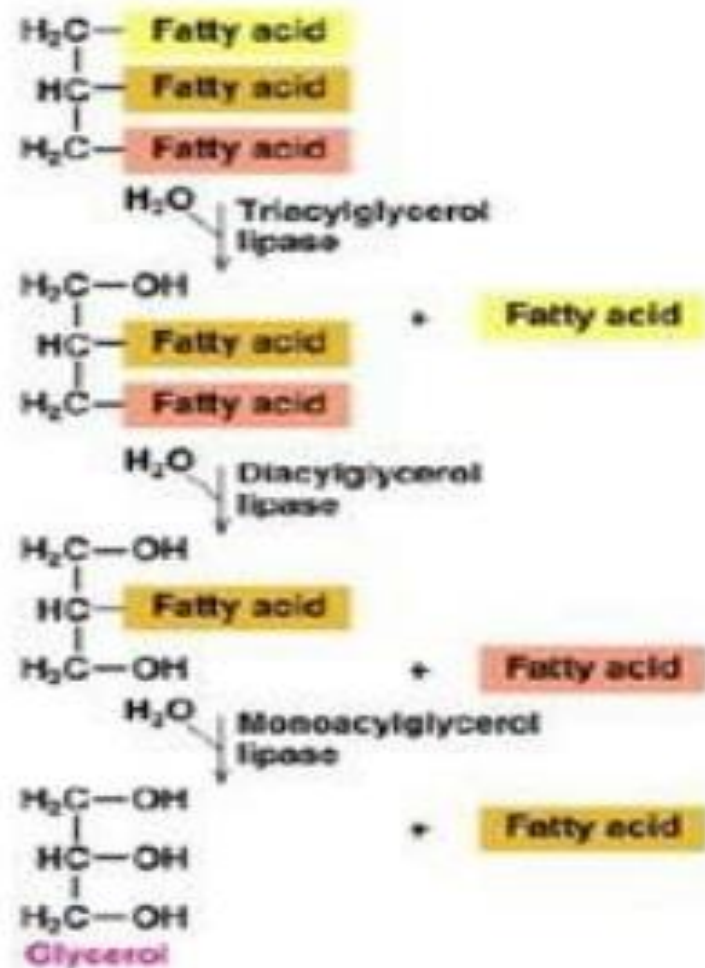
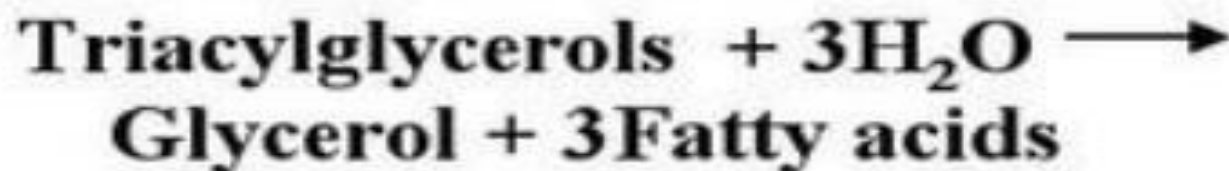
Lipid Metabolism



Fat Mobilization

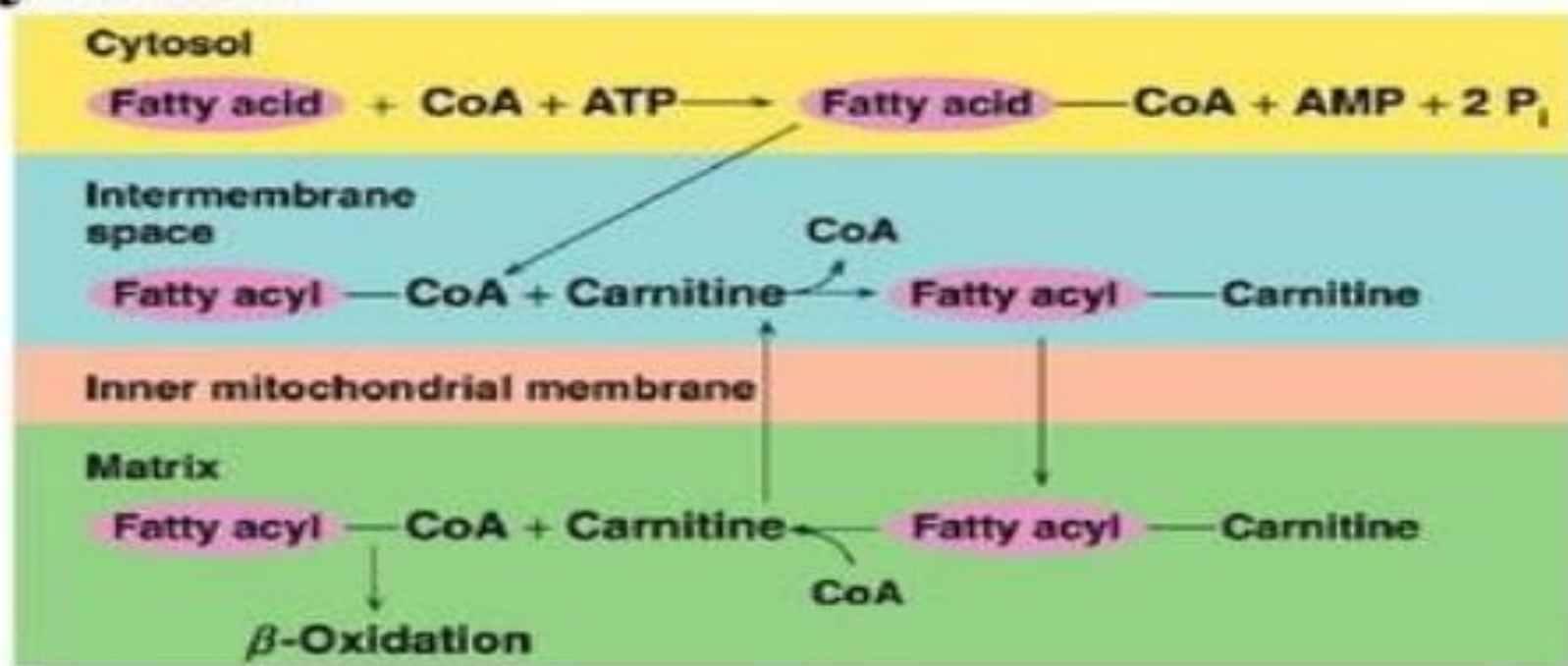
Fat mobilization:

- Breaks down triacylglycerols in adipose tissue to fatty acids and glycerol.
- Fatty acids are hydrolyzed initially from C1 or C3 of the fat.



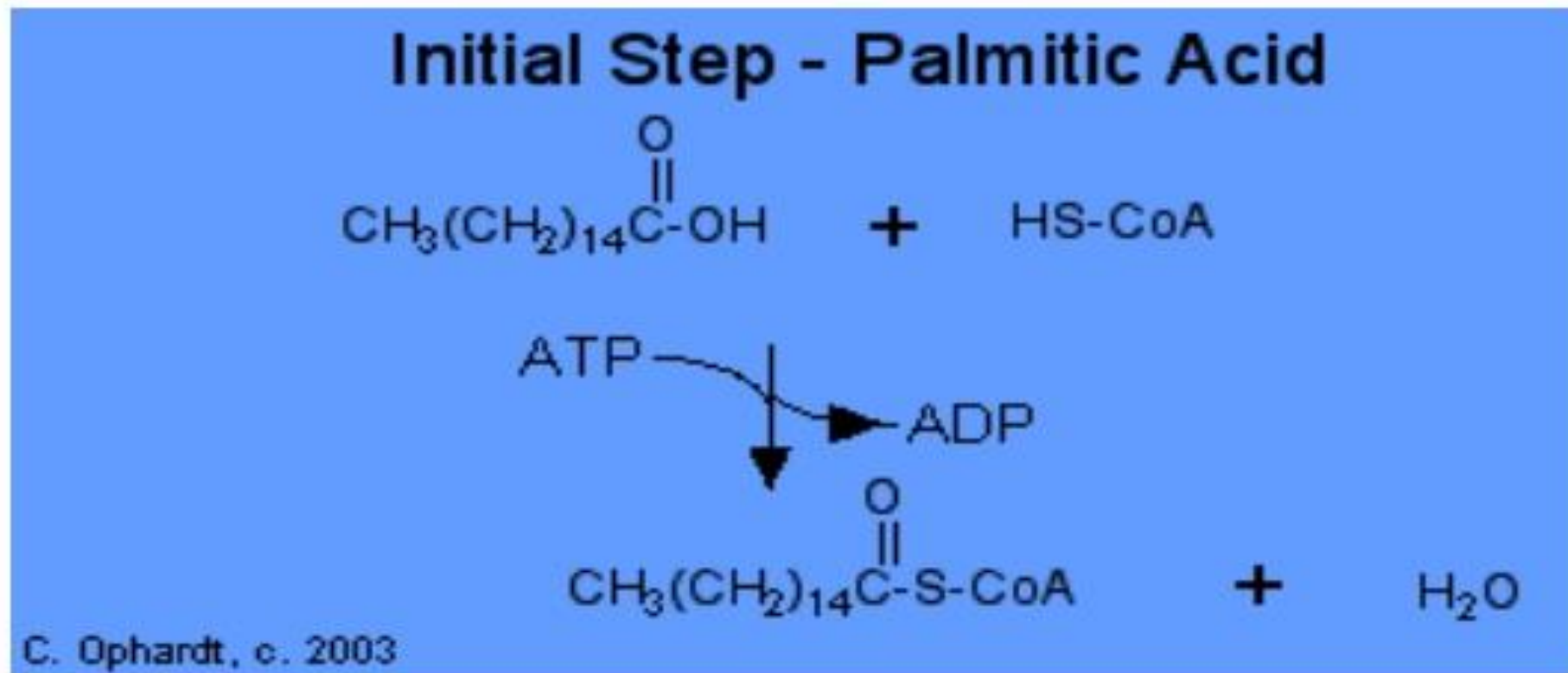
Fatty Acid Activation

- Fatty acid activation is complex, but it regulates the degradation and synthesis of fatty acids.



Oxidation of Fatty Acids

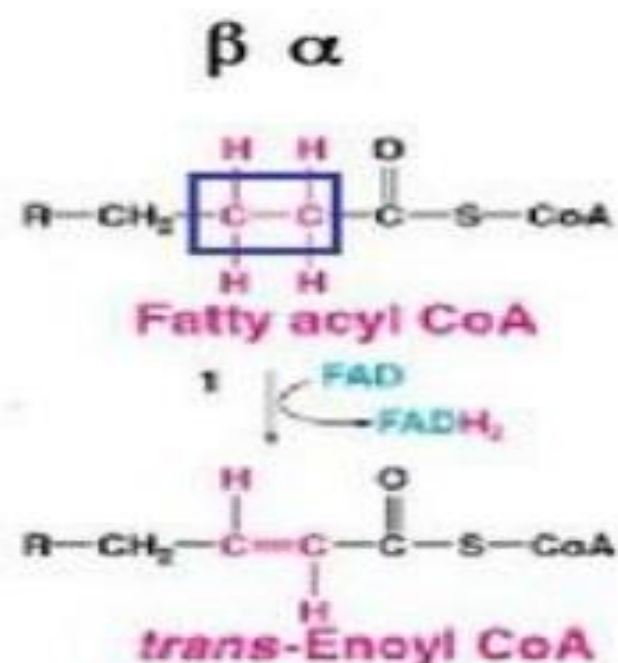
Initial Step: Requires an ATP to synthesize acetyl CoA with the fatty acid.



Beta-Oxidation of Fatty Acids

In **reaction 1, oxidation:**

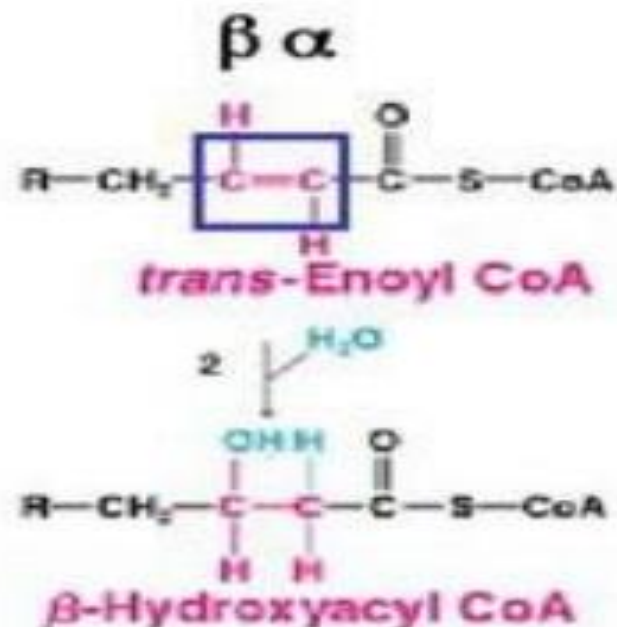
- Removes H atoms from the α and β carbons.
- Forms a trans C=C bond.
- Reduces FAD to FADH₂.



Beta-Oxidation of Fatty Acids

In **reaction 2**, hydration:

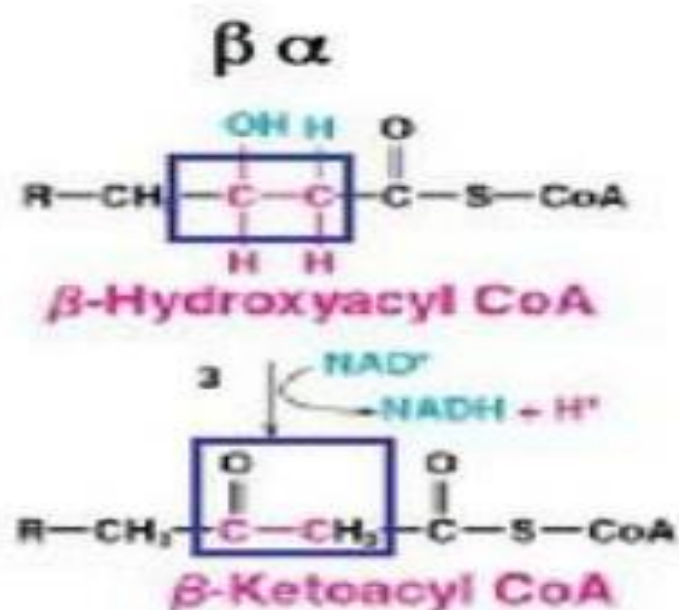
- Adds water across the trans C=C bond.
- Forms a hydroxyl group (—OH) on the β carbon.



Beta (β)-Oxidation of Fatty Acids

In reaction 3, a second oxidation:

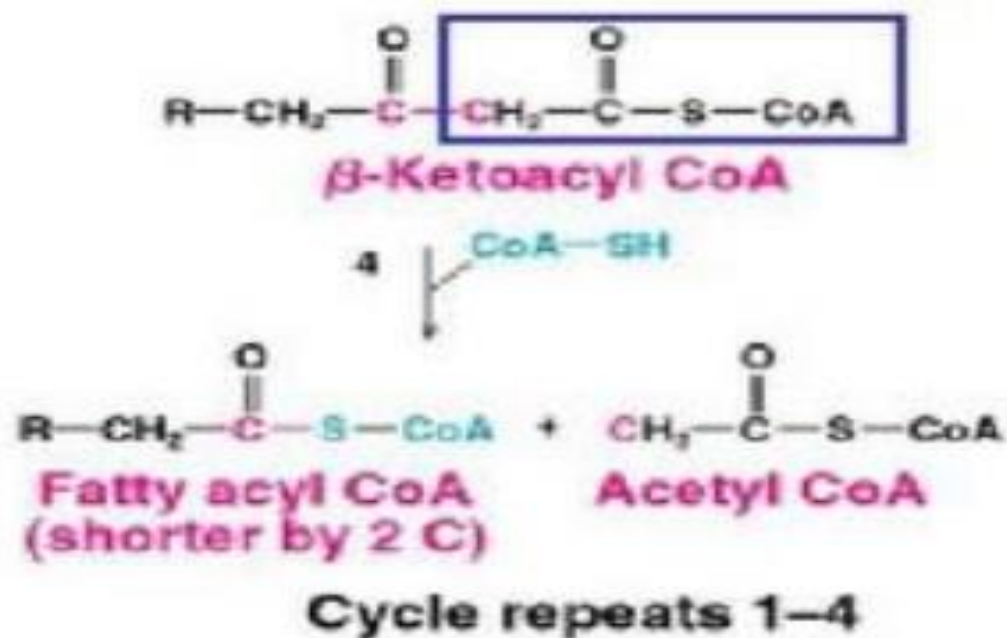
- Oxidizes the hydroxyl group.
- Forms a keto group on the β carbon.



Beta (β)-Oxidation of Fatty Acids

In **Reaction 4**, acetyl CoA is cleaved:

- By splitting the bond between the α and β carbons.
- To form a shortened fatty acyl CoA that repeats steps 1 - 4 of β -oxidation.

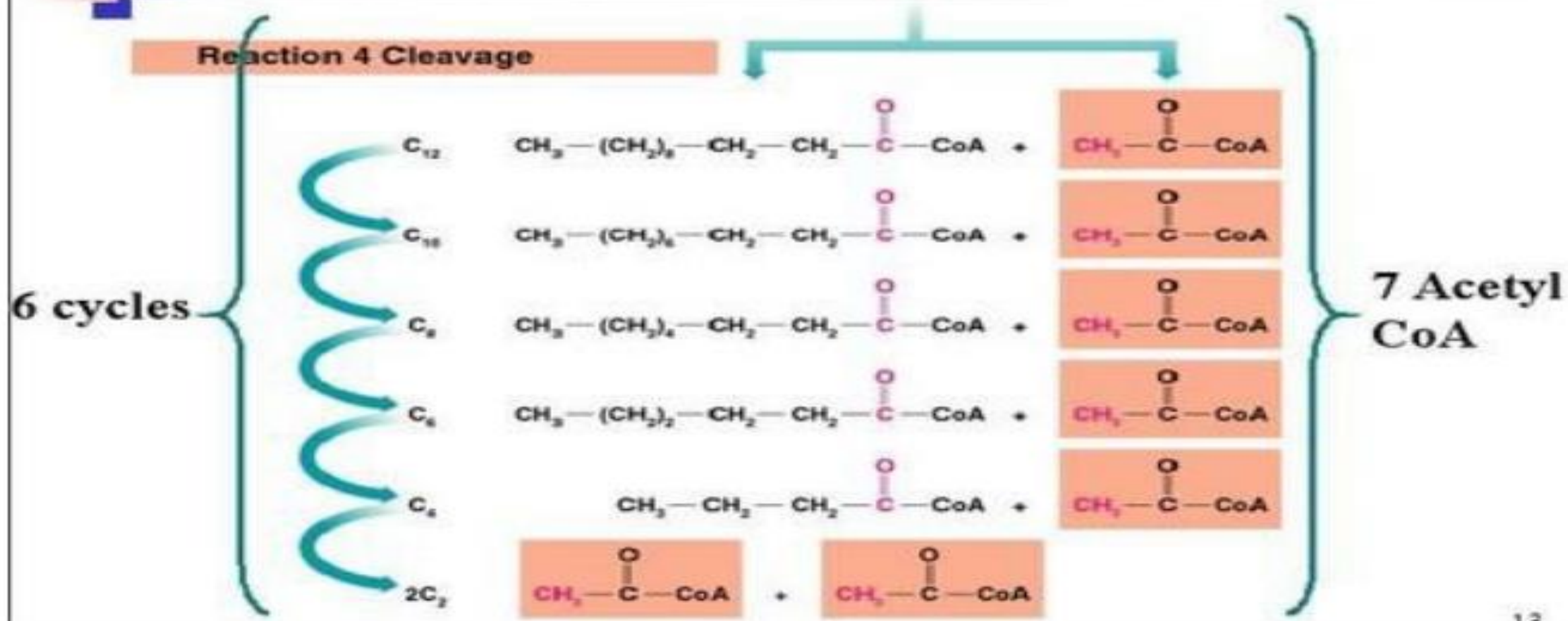


Beta (β)-Oxidation of Myristic (C_{14}) Acid

Matrix



Beta (β)-Oxidation of Myristic (C14) Acid (continued)





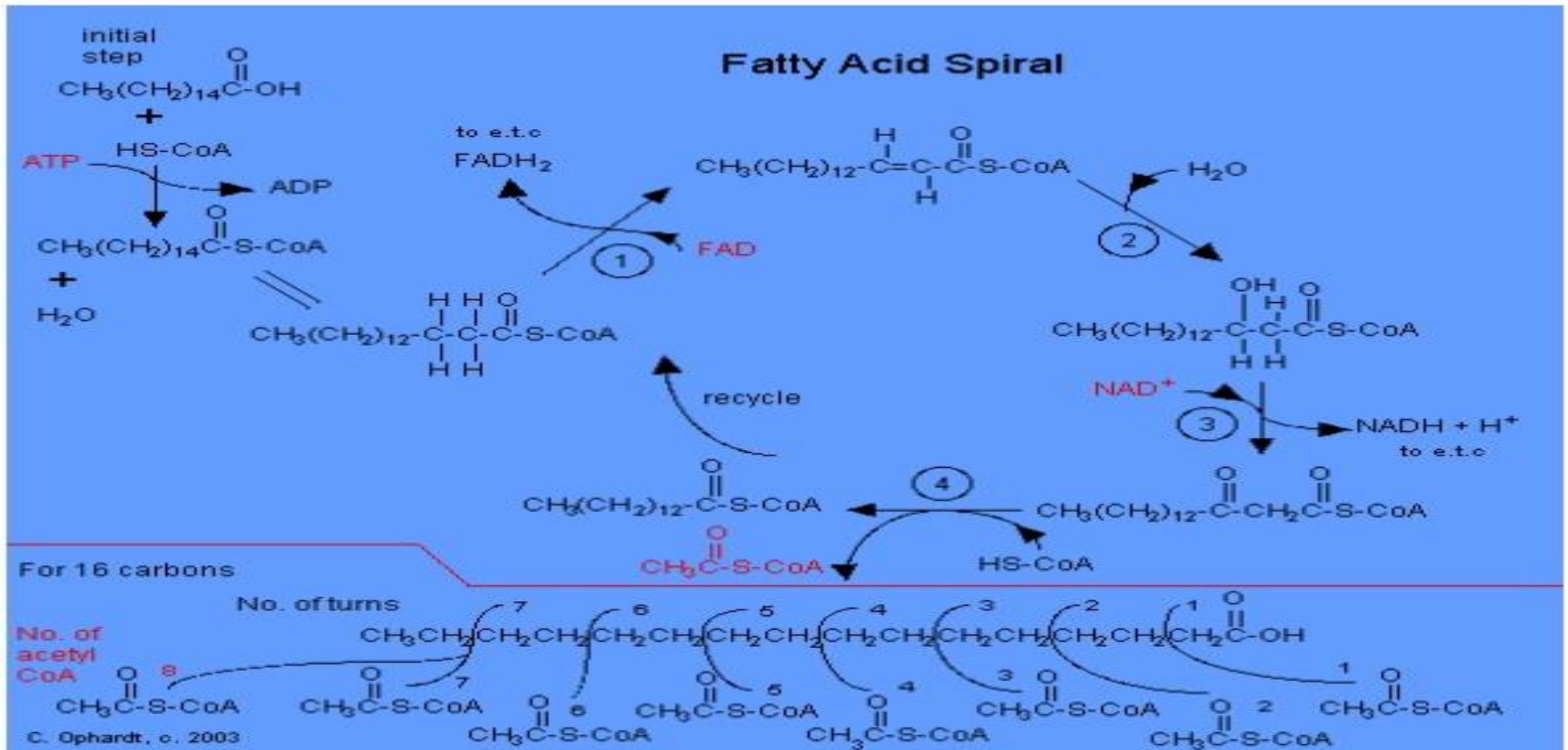
Cycles of β -Oxidation

The length of a fatty acid:

- **Determines the number of oxidations and**
- **The total number of acetyl CoA groups.**

Carbons in Fatty Acid	Acetyl CoA (C/2)	β-Oxidation Cycles (C/2 - 1)
12	6	5
14	7	6
16	8	7
18	9	8

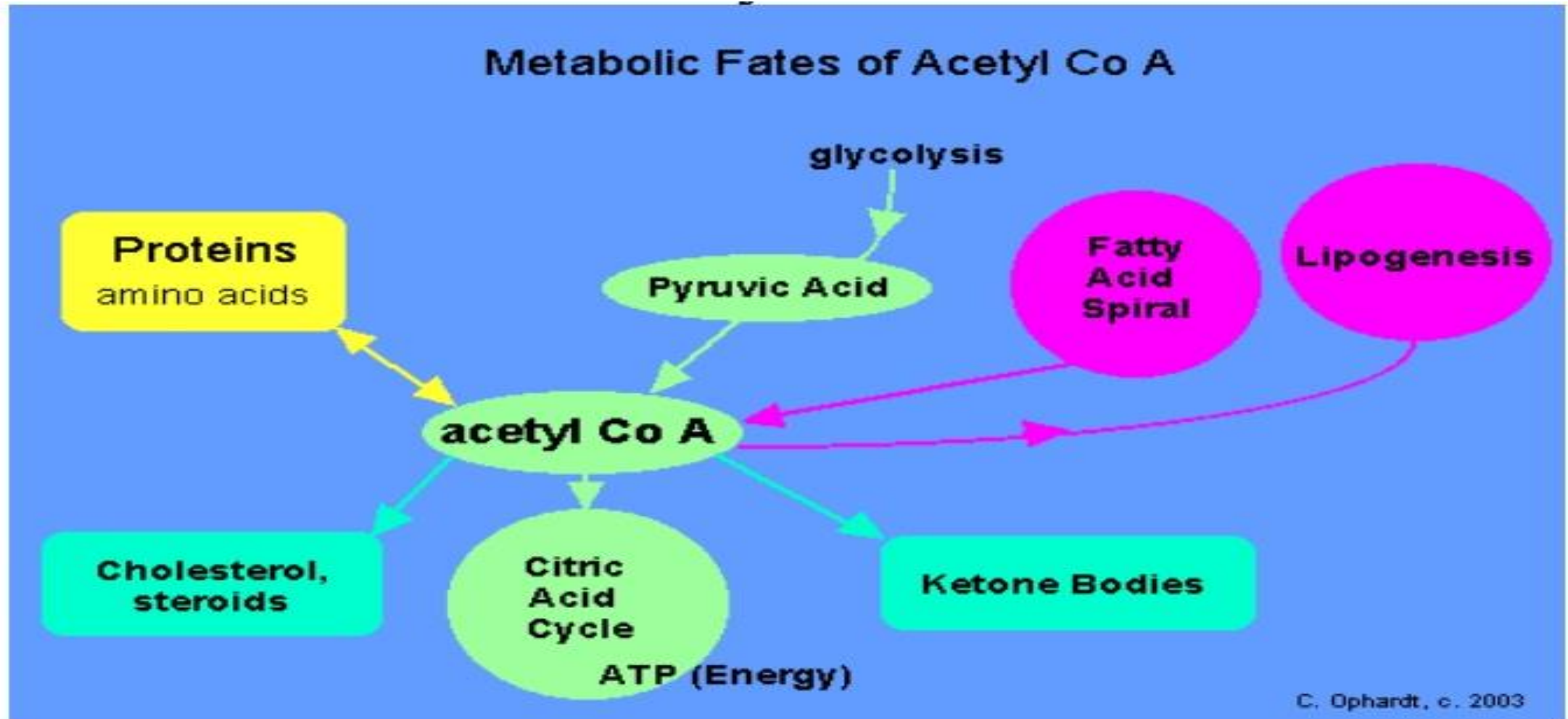
Complete Path Of Beta-Oxidation Of Fatty Acids



Palmitic Acid -ATP Synthesis

- Palmitic Acid is C-16
- Initiating Step - requires 1 ATP (text says 2)
- Step 1 - FAD into e.t.c. = 2 ATP
- Step 3 - NAD⁺ into e.t.c. = 3 ATP
- **Total ATP per turn of spiral = 5 ATP**
- Example with Palmitic Acid = 16 carbons = 8 acetyl groups
- Number of turns of fatty acid spiral = $8 - 1 = 7$ turns
- ATP from fatty acid spiral = 7 turns and 5 per turn = 35 ATP.
- **NET ATP from Fatty Acid Spiral = $35 - 1 = 34$ ATP**

Different Ways To Get Acetyl CoA



A rustic 'Thank You' card is centered on a white-painted wooden plank background. The card is made of brown kraft paper and features the words 'Thank You' in a dark brown, elegant cursive font. The card is decorated with three autumn leaves in shades of yellow, orange, and red, and a small cluster of orange berries at the top right corner.

Thank
You

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