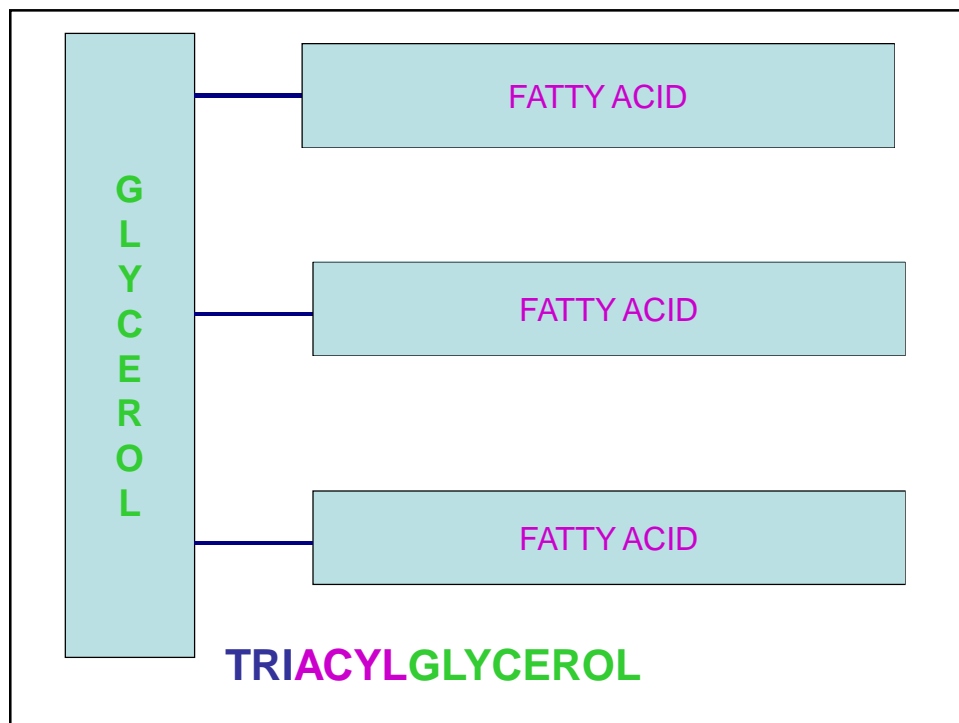


Fatty Acid and Triacylglycerol Metabolism 1

Mobilization of stored fats and
oxidation of fatty acids

Lippincott's Chapter 16

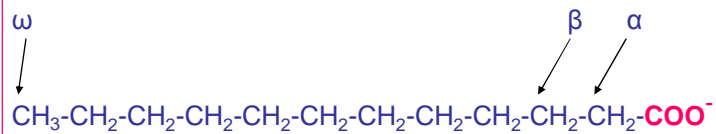




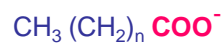
Fatty acid

The pK_a of carboxyl group in fatty acid ≈ 4.8

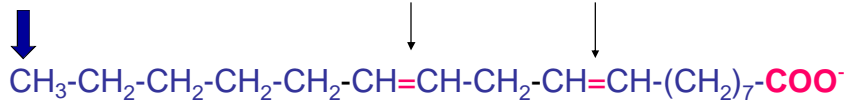
So, at physiological pH fatty acid exists as anion



Or



The hydrocarbon chain can be saturated or it may contain one or more double bonds



Unsaturated Fatty Acid

18:2 $\Delta^{9,12}$ or 18:(9,12)

Linoleic Acid

$\omega 6$

Some fatty acids of physiological importance

COMMON NAME	STRUCTURE
Formic acid	1
Acetic acid	2:0
Propionic acid	3:0
Butyric acid	4:0
Capric acid	10:0
Palmitic acid	16:0
Palmitoleic acid	16:1(9)
Stearic acid	18:0
Oleic acid	18:1(9)
Linoleic acid	18:2(9,12)
Linolenic acid	18:3(9,12,15)
Arachidonic acid	20:4(5, 8, 11, 14)
Lignoceric acid	24:0
Nervonic acid	24:1(15)

Triacylglycerol (TAG) or FAT is the major energy reserve in the body

It is more efficient to store energy in the form of TAG

Why FAT not Carbohydrates?

- * More reduced:
9 kcal per gram compared with
4 kcal per gram of carbohydrates
- * Hydrophobic:
can be stored without H₂O
carbohydrates are hydrophilic
1 gram carbohydrates: 2 grams H₂O

Why FAT not Carbohydrates? (Continued)

Average adult has 10 Kg of Fat
How many calories?
90,000 kcal

What is the mass of carbohydrates that
produces 90,000 kcal ?
 $90,000 / 4 = 22.5 \text{ Kg}$

How much water with it?

FATTY ACID as FUELS

- The major fuel used by tissues but Glucose is the major circulating Fuel

<u>Fuel type</u>	<u>Amount used/ kcal/12 hours (gram)</u>	<u>Amount in Fluids</u>
FA	540 (60)	3 (0.4)
Glucose	280 (70)	80 (20)

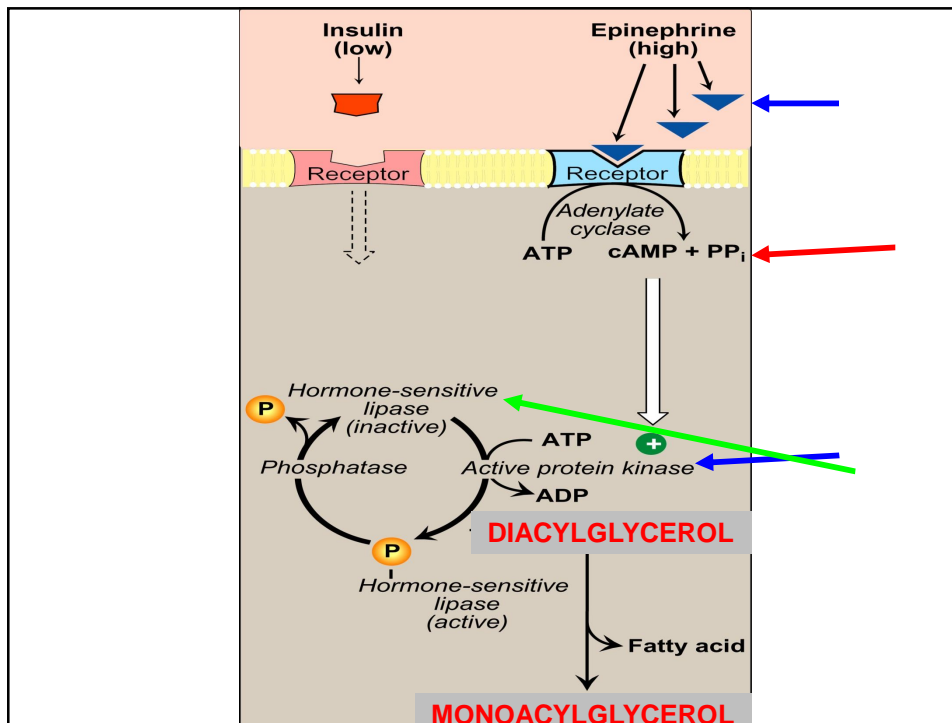
Mobilization of stored fats The need for hormonal signal

- Fat is stored in Adipose tissue
- When needed a hormonal signal must reach the adipocytes.
- Hydrolysis of TAG

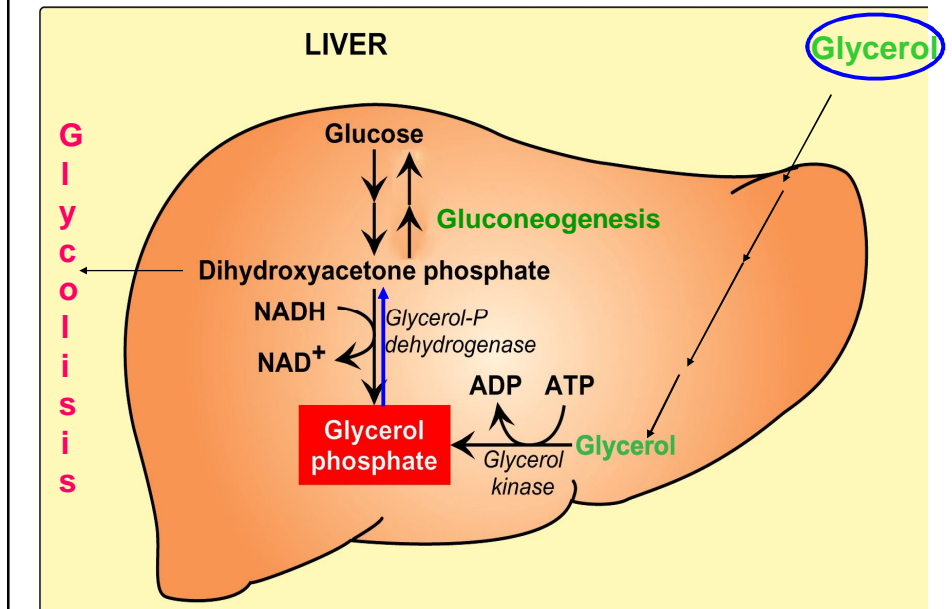


Hormones that activate the Hormone Sensitive Lipase

- Glucagon
- Epinephrine
- Norepinephrine
- ACTH

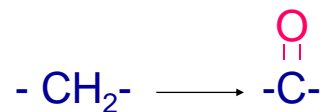


Fate of Glycerol

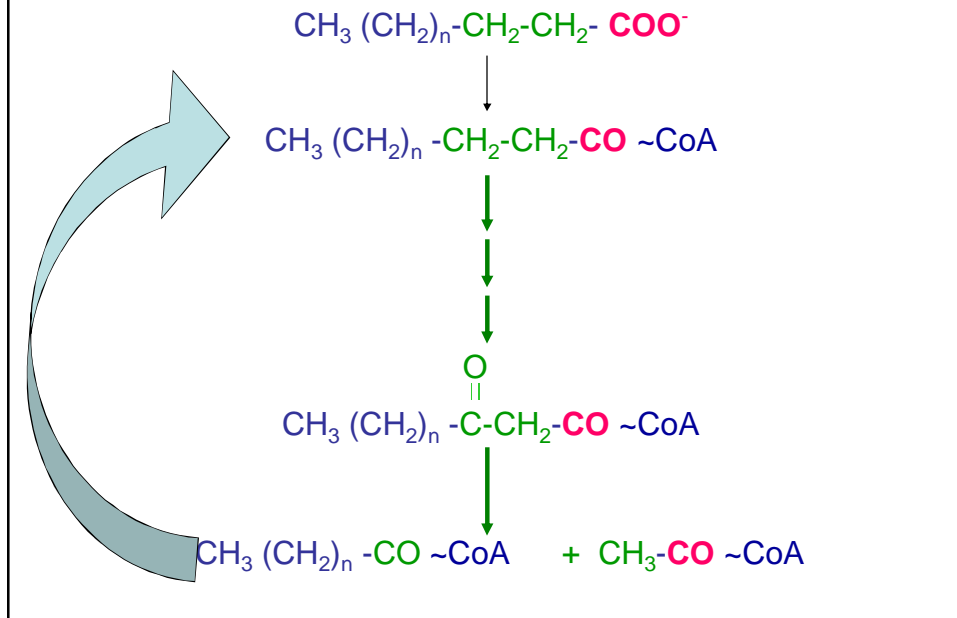


β Oxidation of Fatty Acids

- Fatty Acids are transported to tissues bound to albumin
- Degraded by oxidation at β carbon followed by cleavage of two carbon units



β Oxidation of Fatty Acids (overview)



Activation of Fatty Acids

- Joining F.A with Coenzyme A
- RCO~SCoA (Thioester bond)



Activation of Fatty Acids (cont.)

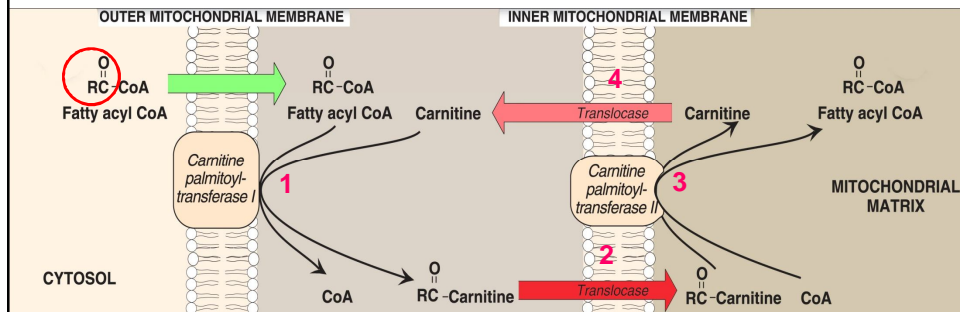
- ATP conversion to AMP + 2 P_i is equivalent to hydrolysis of 2 ATP to 2ADP
- Enzyme: thiokinase (Acyl CoA Synthetase)
- Location: - outer mitochondrial membrane

- mitochondrial matrix (for short and medium chain FA)

Transport of long chain Acyl CoA across inner mitochondrial membrane

- Inner mitochondrial membrane is impermeable to Acyl CoA
- Carrier system is required (Carnitine Shuttle)
- It consists of:
 - Carrier molecule
 - Two enzymes
 - Membrane transport protein

CARNITINE SHUTTLE



For Long chain fatty acids
 Inhibited during fatty acid synthesis
 Not required for medium and short chain fatty acids

β Oxidation of Fatty Acids (overview)

