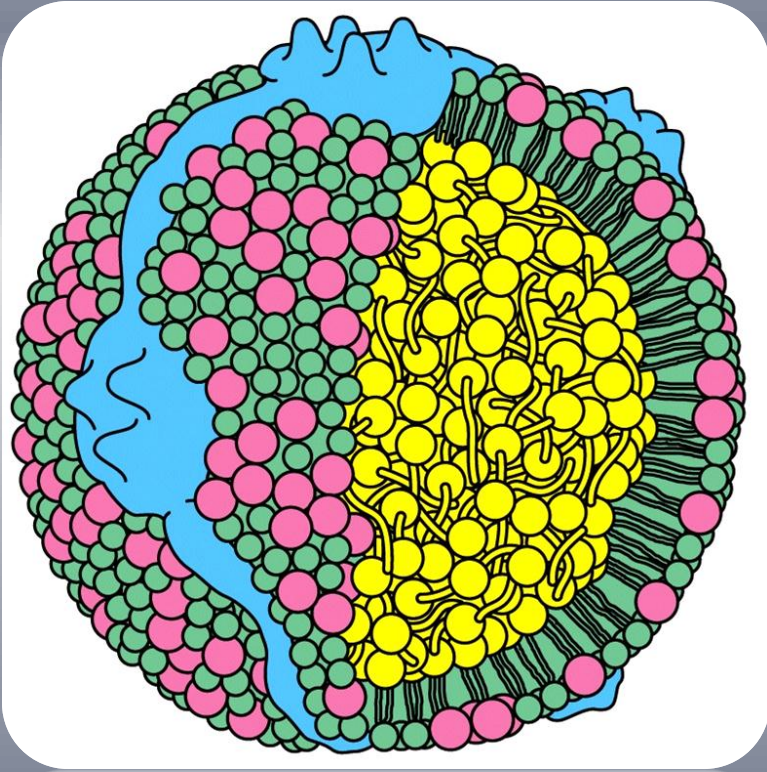


Lipid metabolism



BY

DR: HUSSEIN ABDELAZIZ

Objectives

- By the end of lecture the student should:**
 - ✓ Identify importance of lipids in food.**
 - ✓ Describe digestion of different types of lipids.**
 - ✓ Illustrate absorption of lipids from intestine.**
 - ✓ Summarize transport of dietary lipids from intestine.**

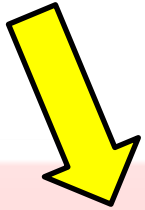


- **Source of energy: 1 gm supplies 9.1 calories**
- **Minimal amount of fat is essential in our food to:**
 - **Essential fatty acids**
 - **Help Fat-soluble vitamins absorption**

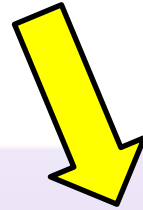
Lipids



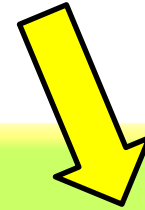
Digestion of lipids



**1-
Triglycerides**

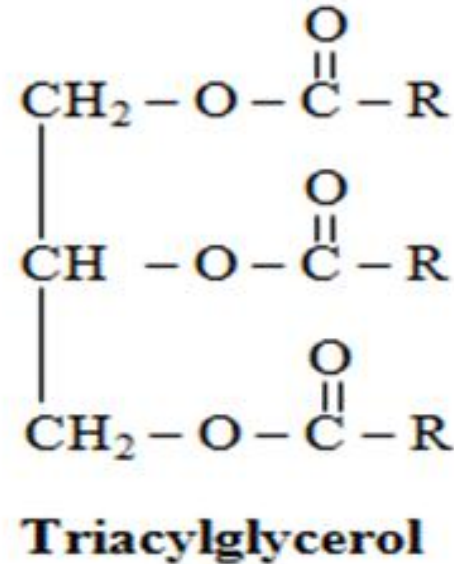
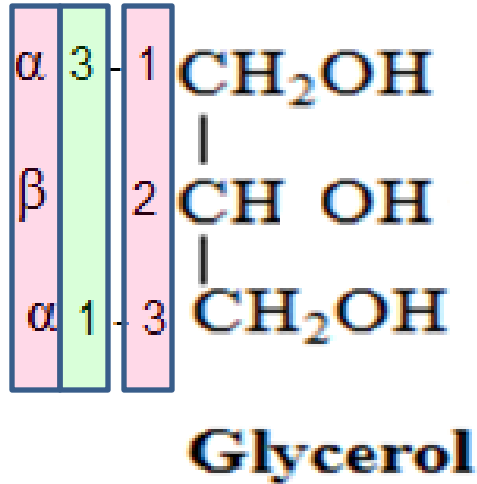
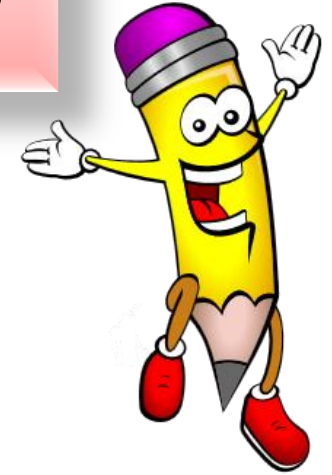


**2-
Phospholipids**



**3-
Cholesterol
esters**

1- Digestion of triglycerides



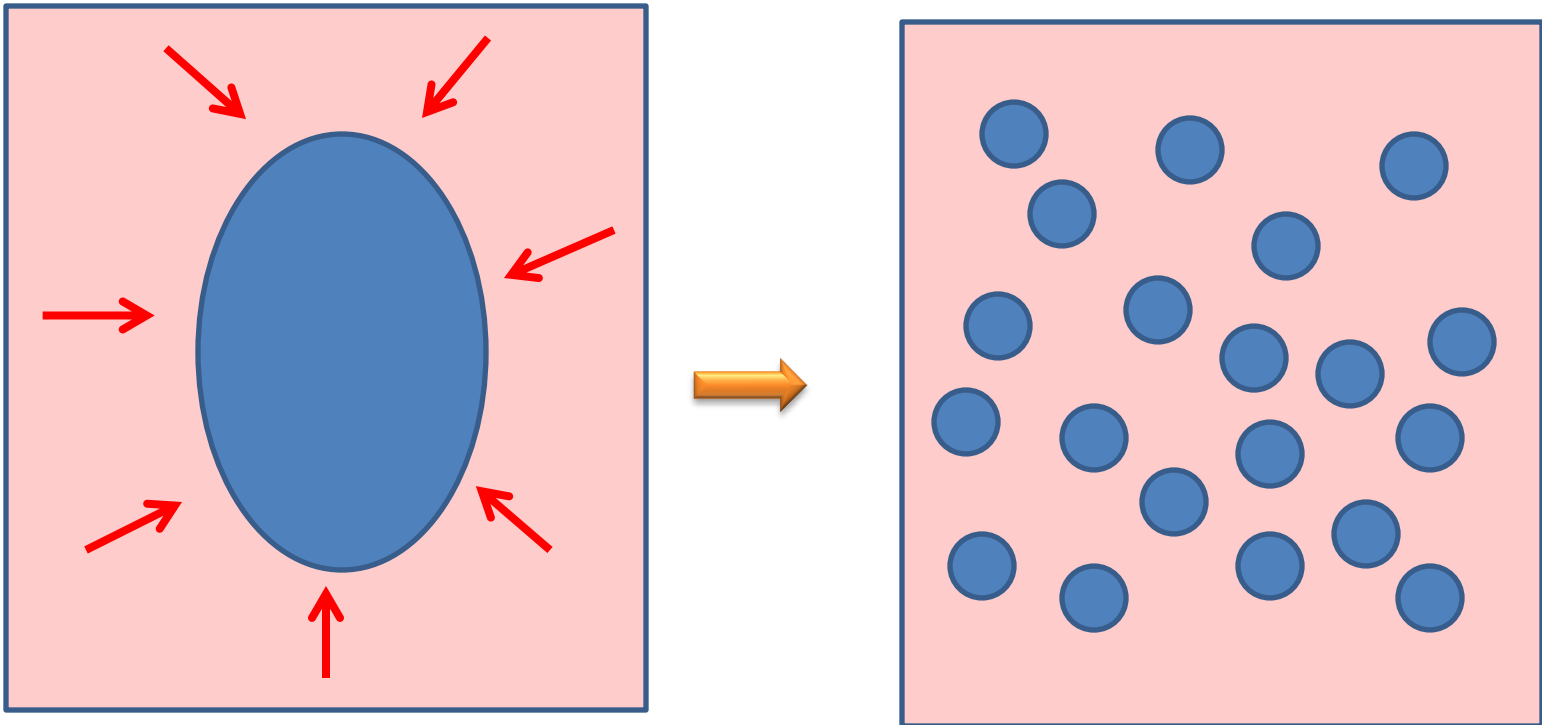
A- Emulsification

B- Enzymatic hydrolysis by lipase enzymes

A-Emulsification



- Breakdown of large fat globule → small ones



A-Emulsification

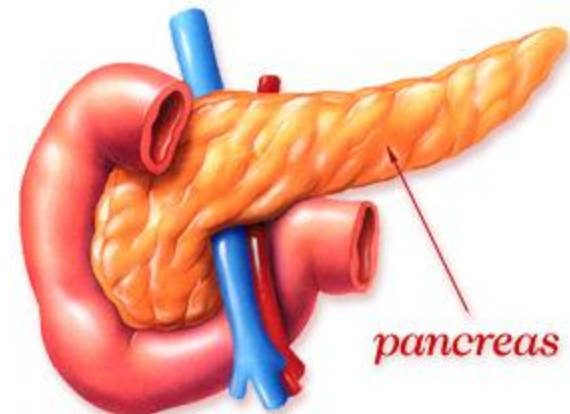
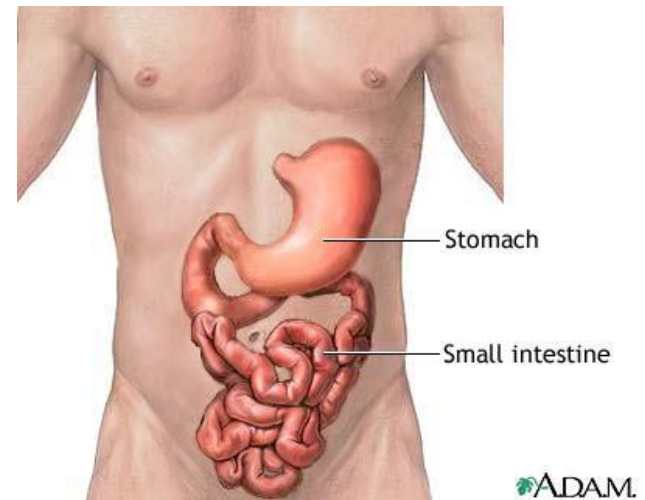


- Breakdown of large fat globule → small ones
- Occurs in:
 - Mouth** by chewing
 - Stomach** by peristaltic contractions
 - Intestine** by peristaltic movement,
bile salts
lysophospholipids

B- Lipase enzymes

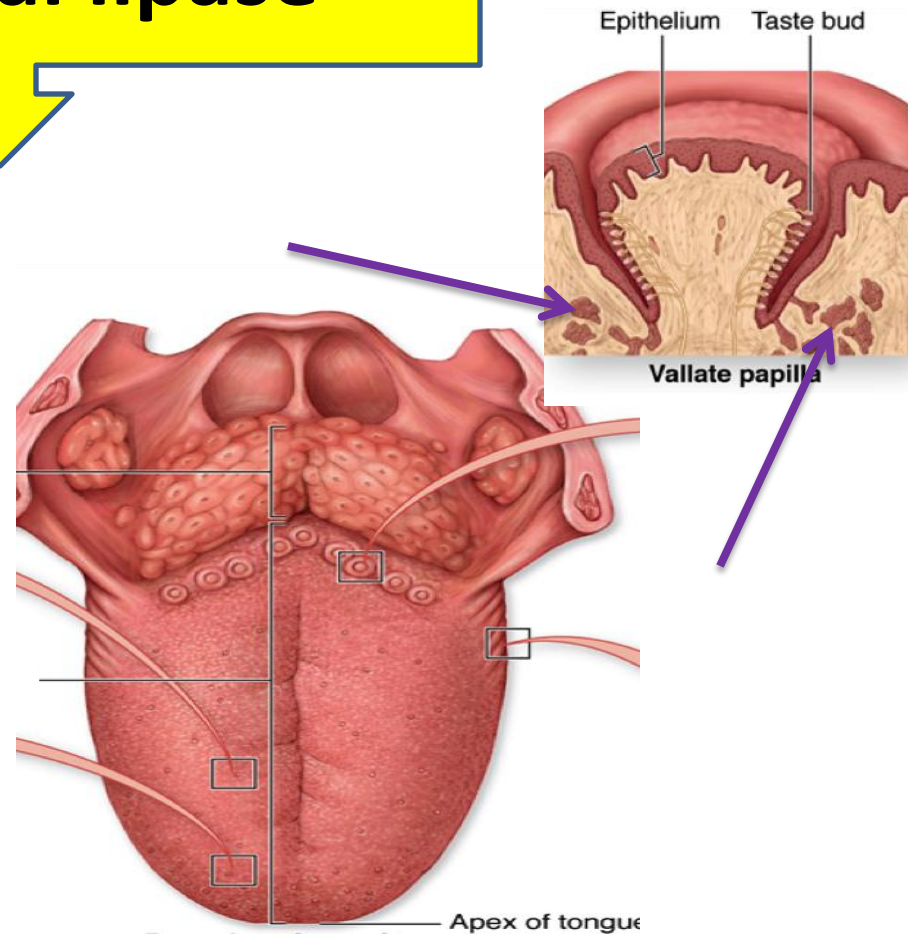
Types:

- 1- lingual lipase
 - 2- gastric lipase
 - 3- pancreatic lipase
 - 4- intestinal lipase
- the most active is pancreatic lipase.**



1- Lingual lipase

- secreted by the dorsal surface of the tongue (Von-Ebner's glands)
- Is not of much significance in humans compared to rat or mouse



2- Gastric lipase (pH 3-6)

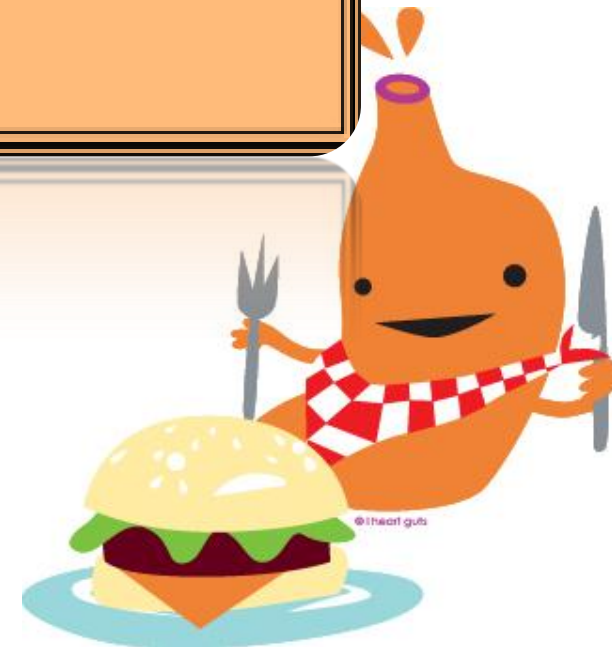
Triacylglycerols
Short & medium
chain unsaturated
fatty acids

Gastric lipase
→
(infants)

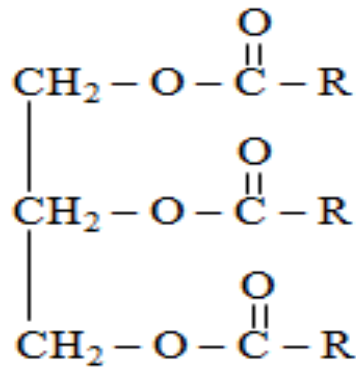
Short & medium
free fatty acids
& 1,2 diacylglycerols

physiological significance in :

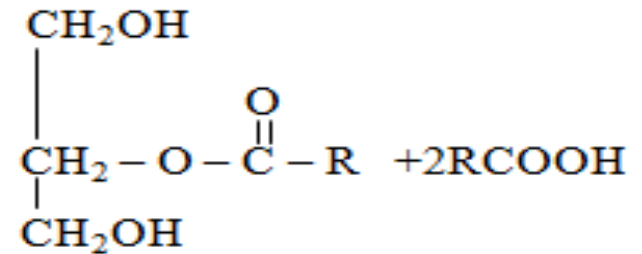
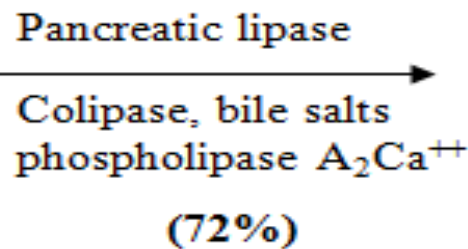
- **Infants:**
- **adults:**



3- Pancreatic lipase



Triacylglycerol

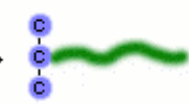


β -monoglyceride 2FA



Triglyceride

Pancreatic Lipase

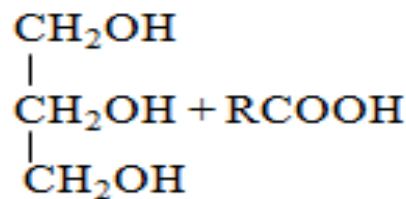


Monoglyceride

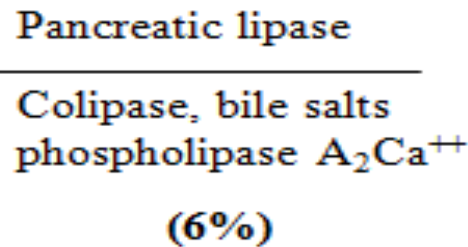


Free fatty acids

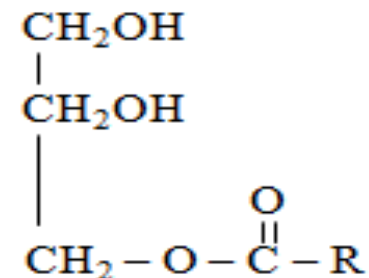
(22%)



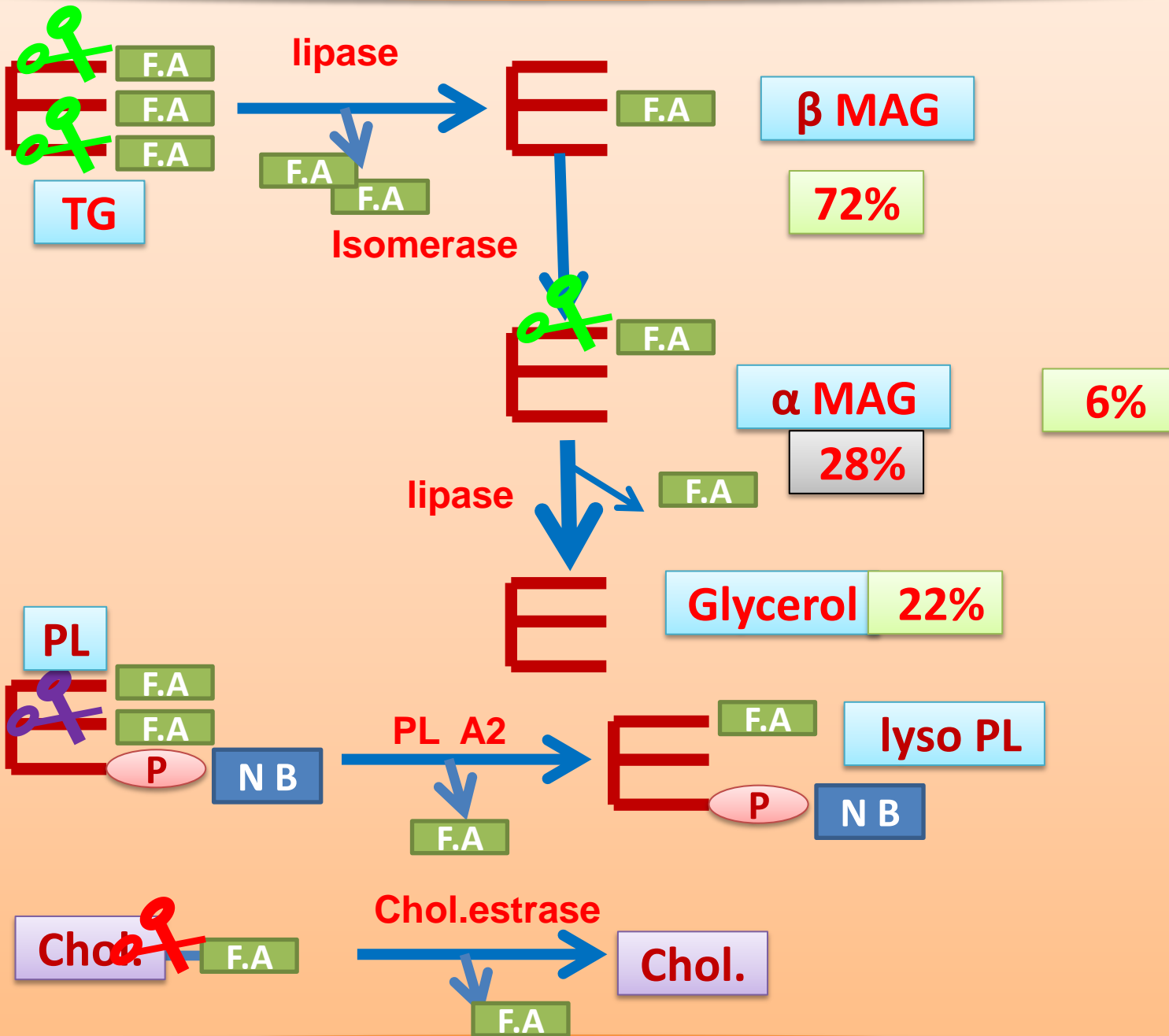
Glycerol FA



Isomerase



α -monoglyceride



4- Intestinal lipase



- ✓ Act within intestinal mucosal cells → hydrolyse the absorbed primary (α) monoglycerides forming glycerol and FFA

2- Digestion of phospholipids

- ❑ **Phospholipids → lysophospholipids**
- ❑ **Intestinal phospholipase may complete the hydrolysis of lysophospholipids**
- ❑ **Phospholipase A₂ activated by trypsin & requires bile salts for activity**

3- Digestion of cholesterol esters

- Cholesterol esters by cholesterol esterase → FA & free cholesterol

Absorption of lipids

- The end products of lipid digestion are :
monoglycerides, FA, glycerol, cholesterol
& lysophospholipids



1- Glycerol and short chain FA :

water soluble → carried through portal circulation

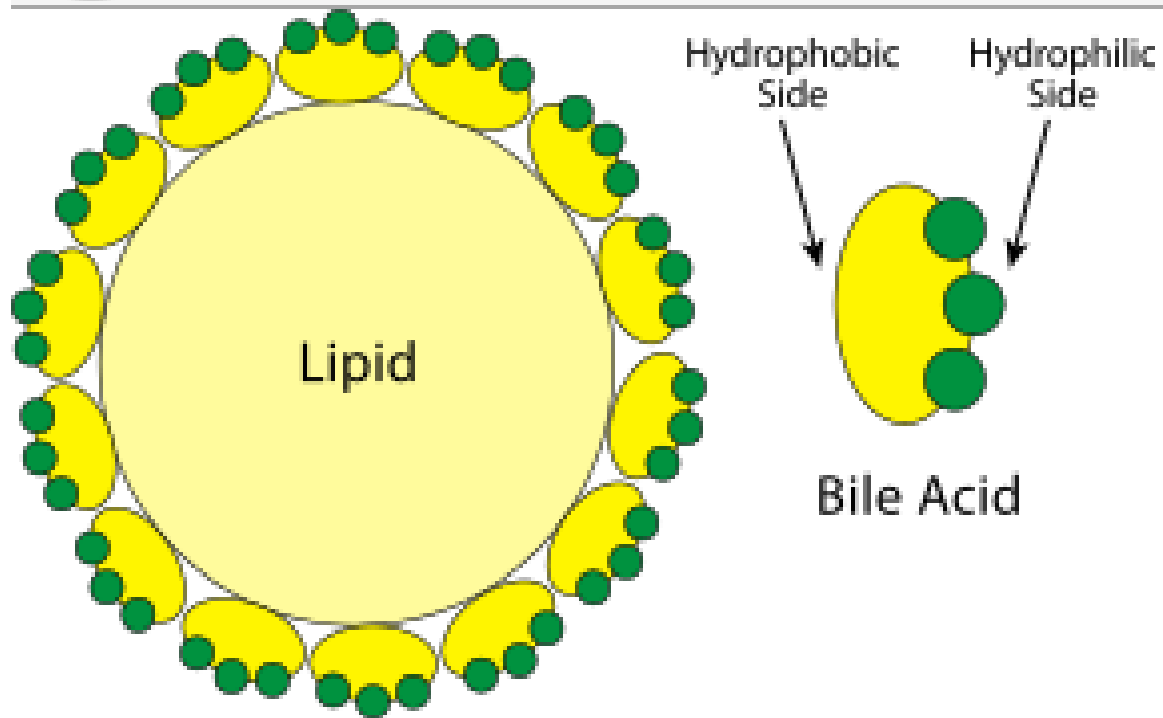
2- Long chain FA, monoglycerides, cholesterol & lysophospholipids :

need bile salts to be absorbed

How



- **Bile salts surround these component (by their unpolar end while their polar endings directing outward) → water soluble micelles (0.1 –0.5 μ in diameter)**



How



- **Micelles soluble in water, enter microvilli of mucosal cells by **endocytosis** where fat digestion may be completed through action of intestinal lipase:**

Lipid absorption

Lumen

Blood

Passive diffusion

F.A

Gly

TG

Chol.E

Resynthesis

TG

Ch

.E

PL

Ph.L

Chylomicrons

F.A

MG

LPh.L

Chol

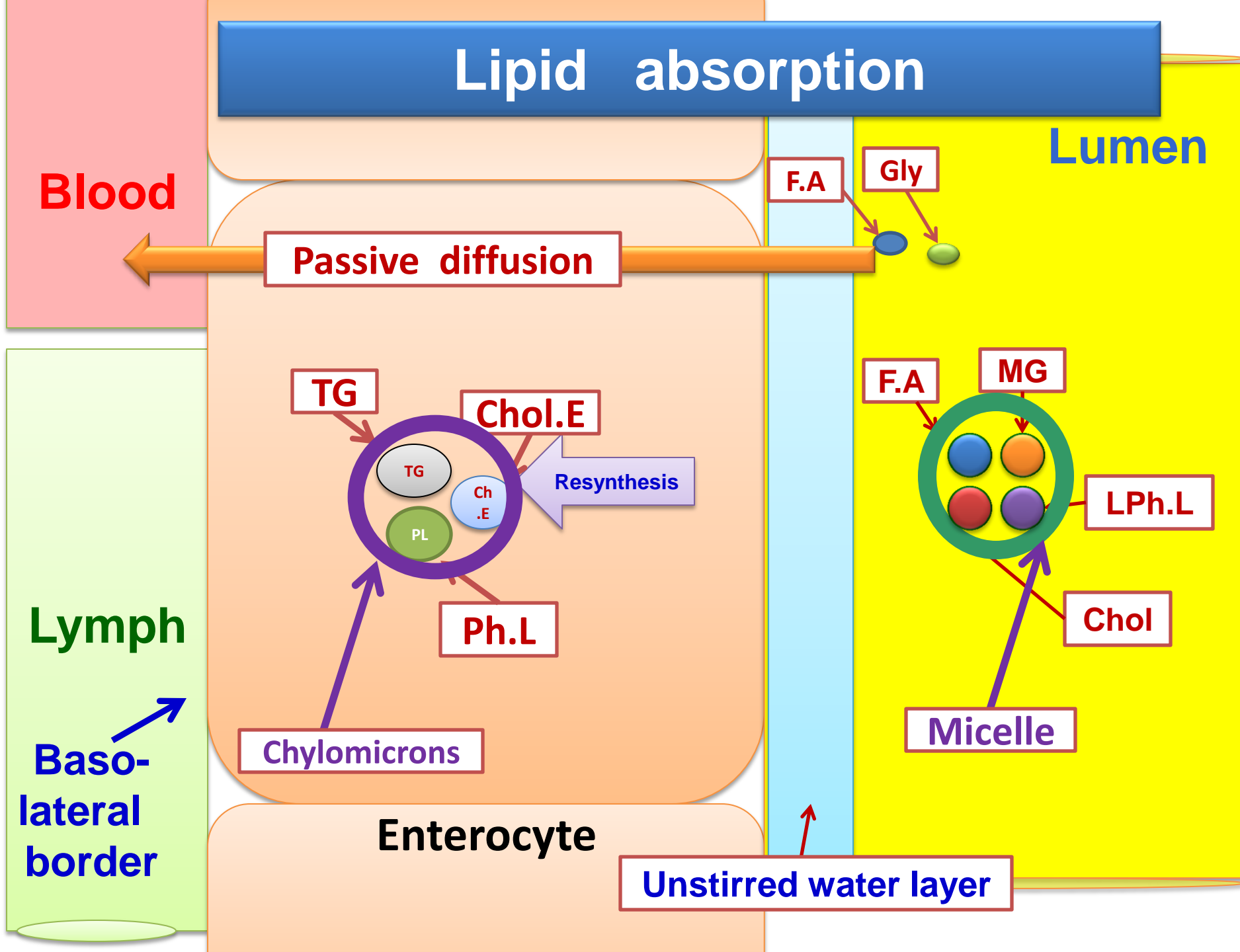
Micelle

Lymph

Baso-
lateral
border

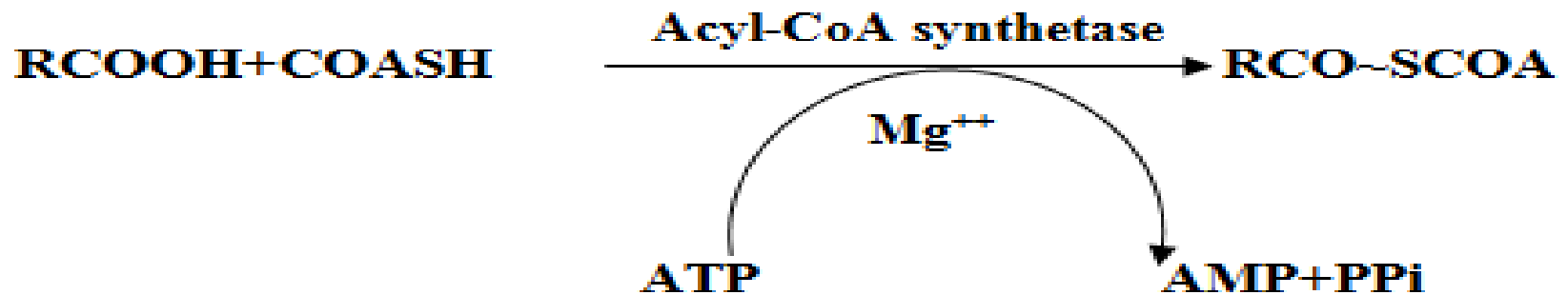
Enterocyte

Unstirred water layer



- In the mucosal cells triglycerides and other lipids are resynthesized once again as follow:

1- FA activated to acyl-CoA



2- Reesterification of absorbed β -monoglyceride with 2 Acyl-CoA \rightarrow triglycerides

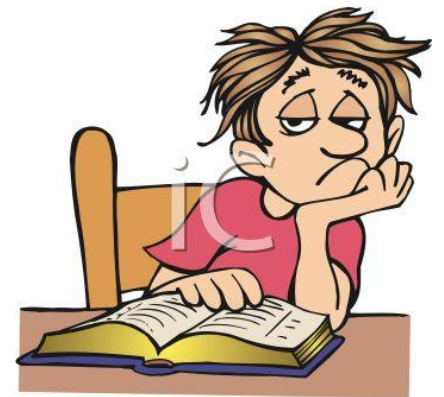
3- Re-esterification of **glycerol 3p** with 3 Acyl-CoA \rightarrow triglycerides

Glycerol 3p is derived from:

- Glycerol by Glycerokinase, present in liver, kidney & **to small degree in small intestine** but deficient in adipose tissue
- DHAP derived from glucose by glycolysis.

- Resynthesis of **phospholipids & cholesterol esters** by combination of **cholesterol and lysophospholipids** absorbed with **acyl-CoA**

- The triglycerides, phospholipids & cholesterol bind with a protein (**Apolipoprotein B₄₈**) forming **chylomicrons** → lacteals & pass with lymphatic drainage → the thoracic duct → systemic circulation.

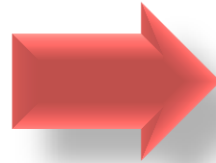


Fate of absorbed lipids

- Immediately after absorption of lipids there is turbidity of plasma due to circulating chylomicrons (appear in plasma 2 hours after meals)
- This turbidity is soon cleared by lipoprotein lipase enzyme (clearing factor)



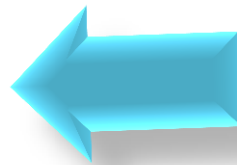
**Lipoprotein
lipase**



**Chylomicrons
(TG)**



Glycerol → liver
FFA → adipose
CT, liver



Glycerol

FFA

Summary

Questions

Thank
You

