



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

*In the name of Allah, the most gracious, the most merciful*



Save Water   
Save Earth  
before its too late 



# TIPS TO MINIMISE WATER WASTAGE IN YOUR HOME.



# **ABSORPTION OF LIPID**

**Dr. Nabila Sher  
KGMC (2021)**



**BY THE END OF THIS LESSON THE  
STUDENT WILL BE ABLE TO...**



# KNOW

- Products of lipids digestion
- How these dietary lipids are absorbed.
- The defects in digestion /and absorption of lipid





# Products of Lipid Digestion

# Products of Lipid Digestion

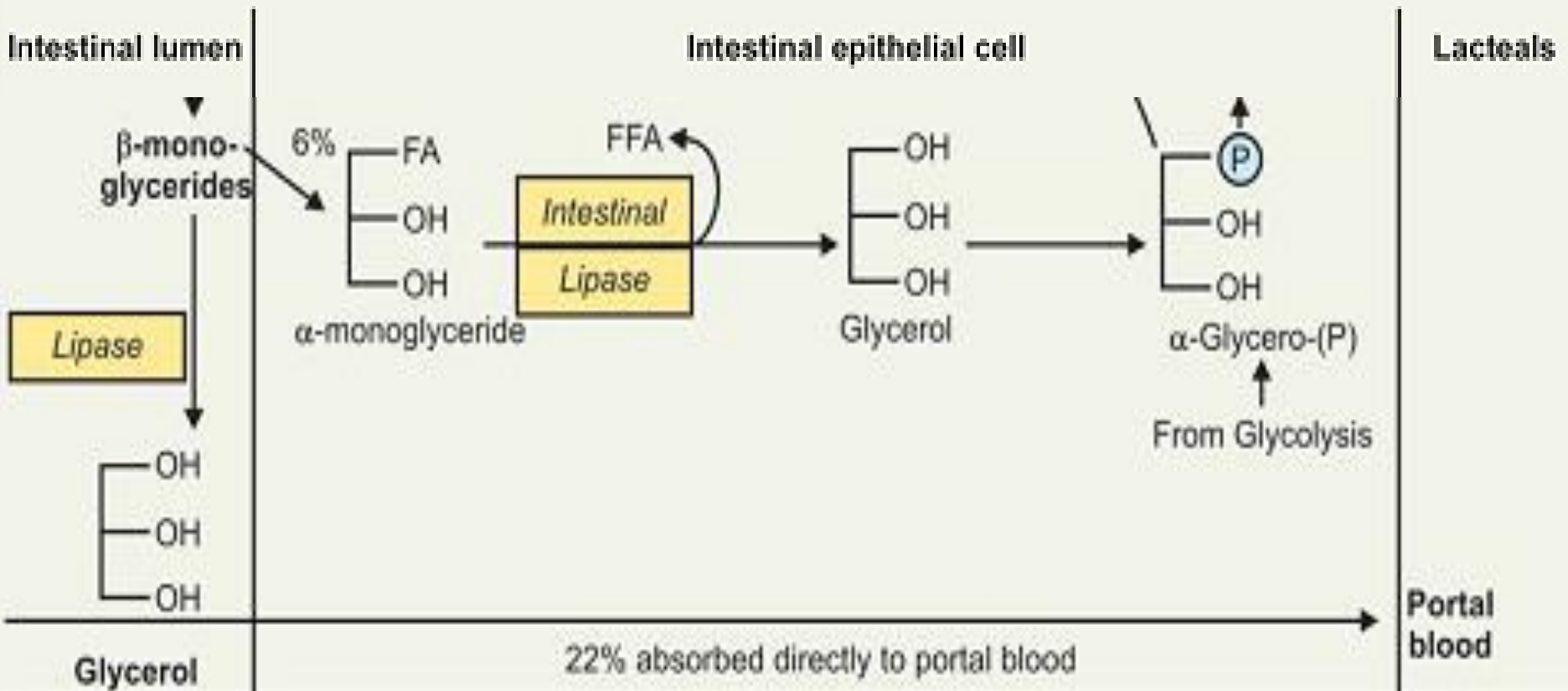
- Following are the end products of lipid digestion
- Free Fatty acids
- Triacylglycerol
- Diacylglycerol
- Monoacylglycerol
- Cholesterol esters
- Cholesterol
- Phospholipid
- Lysophospholipid
- glycerol
- vitamins (A, D, E and K)

# ABSORPTION OF LIPID

- 1. Glycerol
- 2. Fatty acid
- 3. TG
- 4. Cholesterol
- 5. Phospholipids

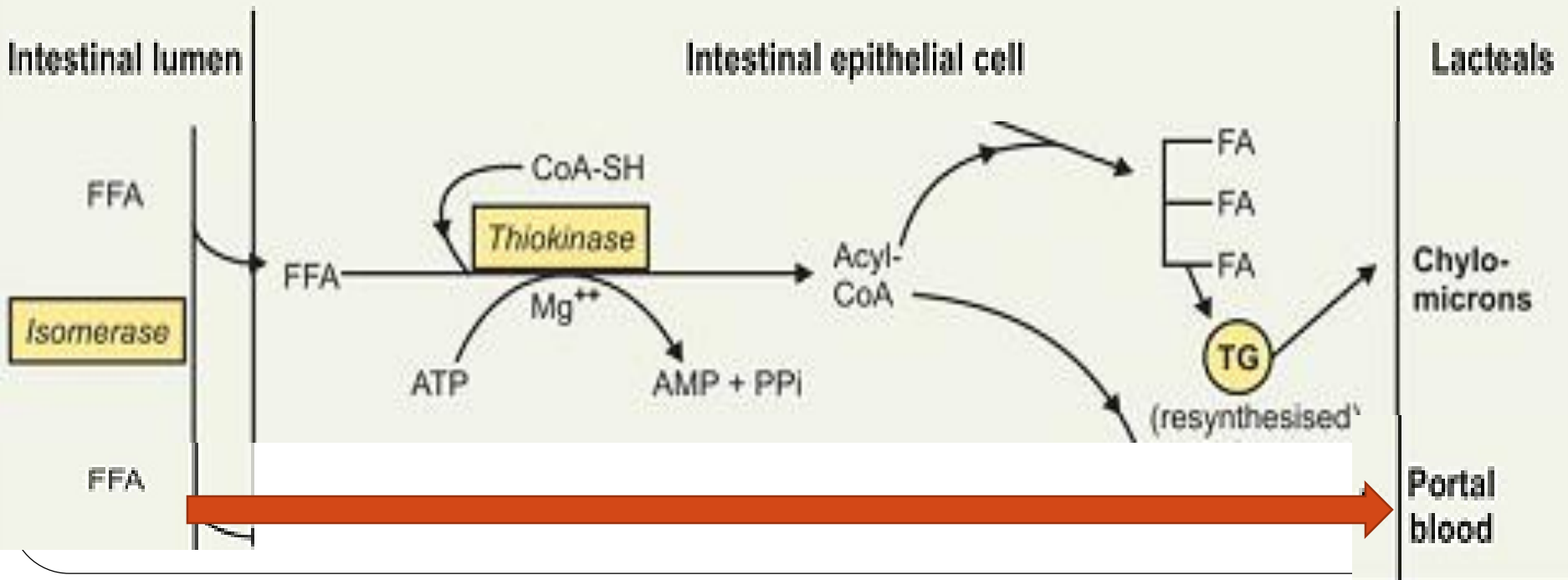
# Absorption of Glycerol

- Free glycerol (22%) liberated from the triacylglycerol (TG) by the enzyme lipase are released in intestinal lumen absorbed by the epithelial cells and enter directly into the portal vein and taken to liver for further utilization.
- Rest of glycerol are used in the re-synthesis of TGs.



# Absorption of Fatty acids

- Short , medium chain and unsaturated FA are absorbed to the blood directly by portal vein and taken to liver.
- FA in intestinal wall cells are activated and used for the re-synthesis of TGs.
- Some in the form of esterified FA passes through the thoracic duct and enter in the systemic circulation.



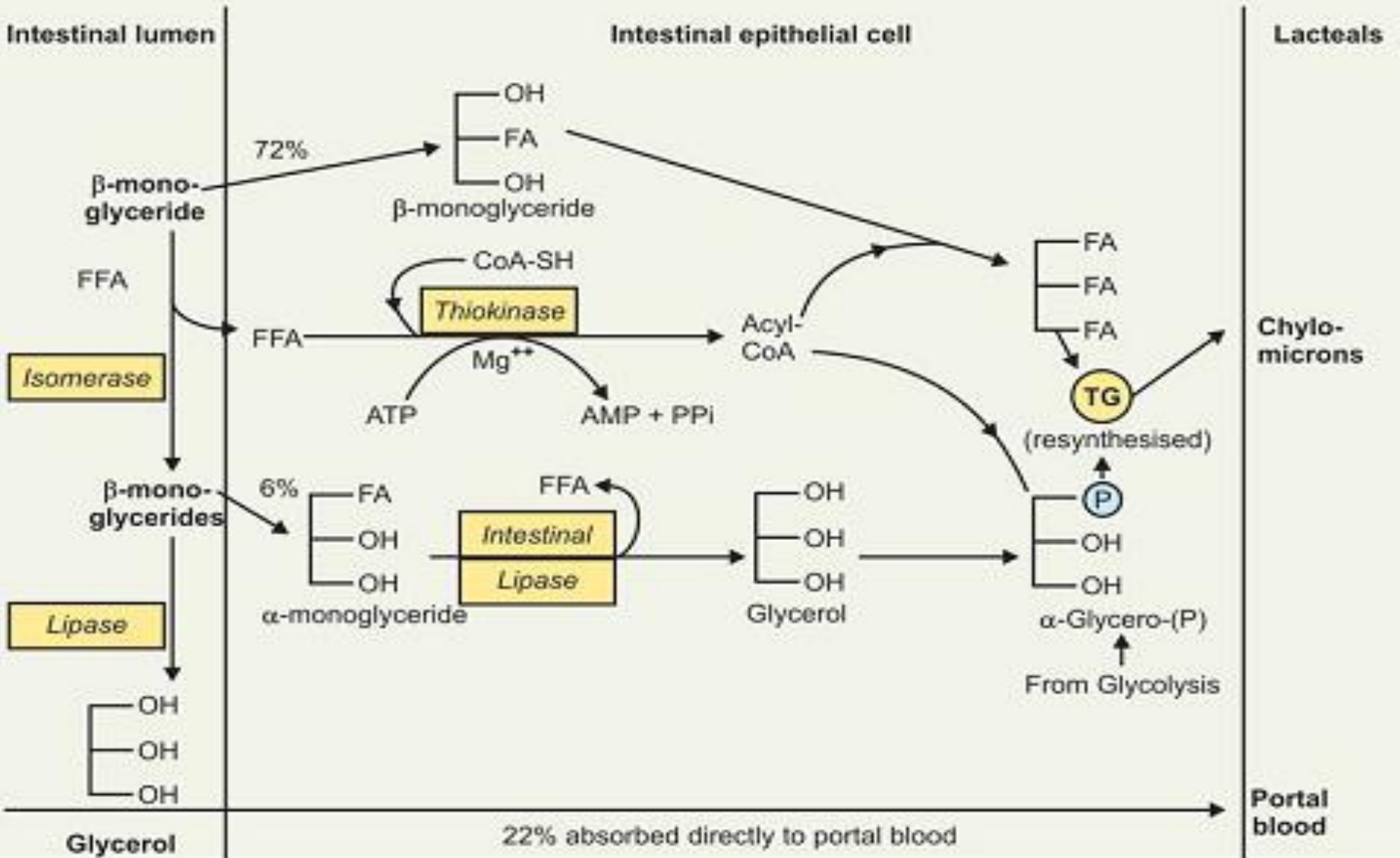
# Absorption of Cholesterol

- Dietary cholesterol is mainly present in the free (Non esterified) form so absorbed from intestine directly.
- Esterification of these free cholesterol takes place in mucosal cell because 90% of lymph cholesterol are in esterified form. Only 10-15% is present in the non-esterified form.
- The absorption is greatly increased in the presence of unsaturated FA and bile salts.
- Cholesterol esterase of pancreatic juice hydrolysis cholesterol ester in intestinal lumen.

# Absorption of Phospholipids

- Due to polar structure and hydrophilic property phospholipids are absorbed from intestine without digestion directly to portal blood to liver.
- Phospholipase A2 of pancreatic juice in the presence of bile salts and  $\text{Ca}^{++}$  hydrolyzes phospholipids into FFA and lysophospholipid and are absorbed.
- Some lysophospholipid resynthesis PL in mucosal cell.
- Some incorporated in Chylomicrons synthesis.
- Some in VLDL synthesis in mucosal cell and carried in lymphatic vessels.

# TG



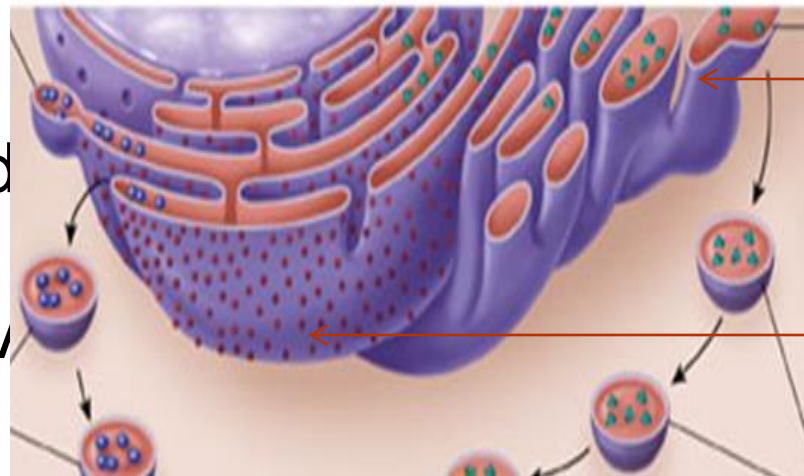


# Re-synthesis of Triacylglycerols and Cholesterol esters

- ❑ Monoacylglycerol are re-acylated to triacylglycerols
- ❑ Lysophospholipid are re-acylated to form phospholipids.
- ❑ Cholesterol is re acylated to form Cholesterol esters
- ❑ Long chain fatty acids are used for esterification to form TGs, phospholipids and cholesterol esters.
- ❑ Short and medium chain fatty acid are released in to the portal circulation and are carried by serum albumin to liver.

# Absorption of re-synthesized TG

- Monoglycerid and fatty acids re-synthesized TAG in the rough endoplasmic reticulum of mucosal cells.
- TGs, cholesterol ,PL , fat soluble vitamins and B48 from smooth endoplasmic reticulum converted to lipo-protein complex Chylomicrons.



Rough  
(TGs , CH, PL ,

Smooth

B48

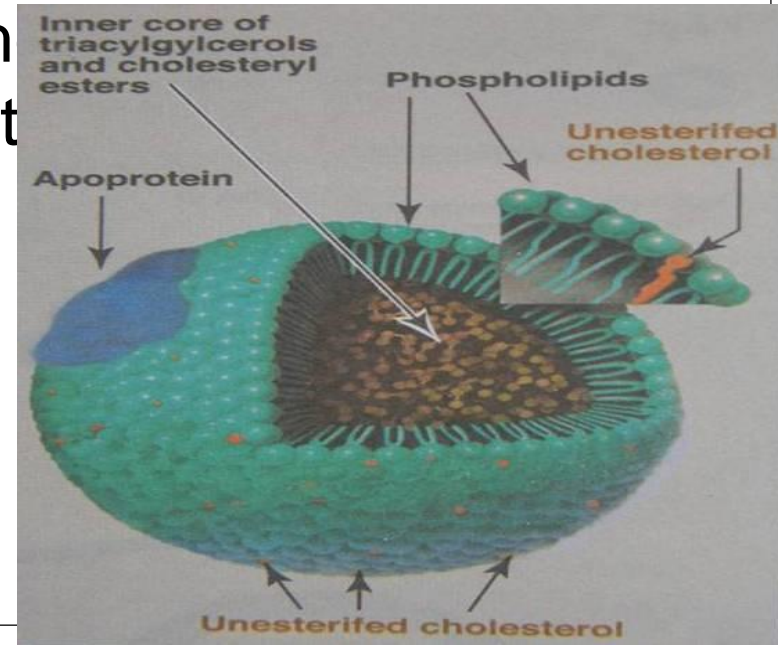
end

Vit /

endoplasmic reticulum

# CHYLOMICRONS

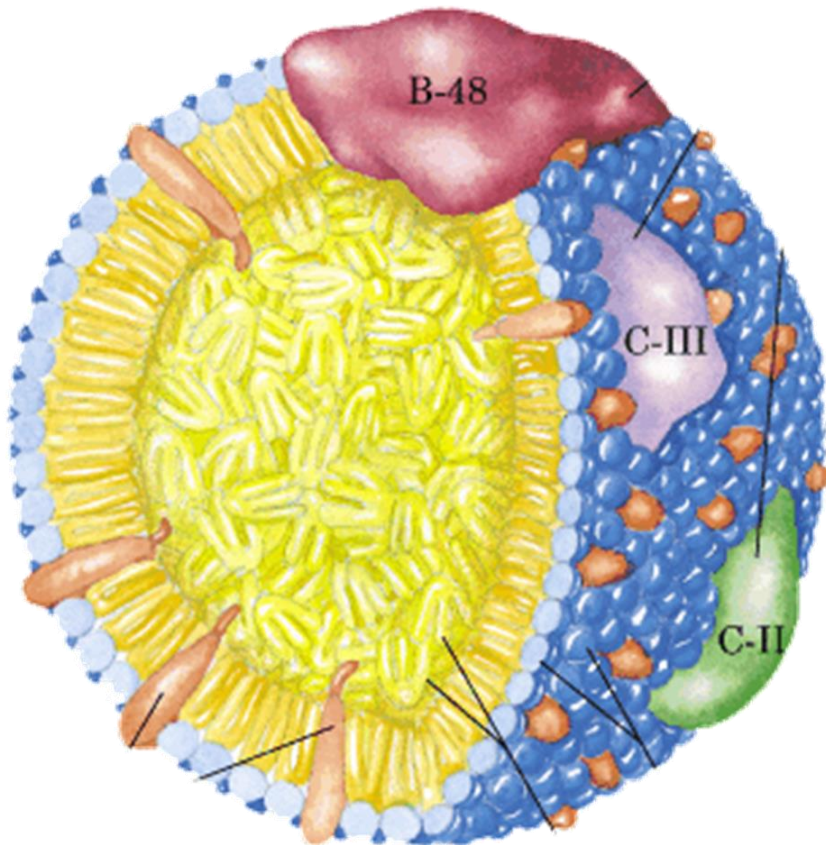
- Chylomicrons are **lipoproteins**, special particles that are designed for the transport of lipids in the circulation
- They are synthesized in the intestinal wall and transport exogenous (DIETARY) Lipids to various tissues. They consist of highest (99%) lipid and lowest (1%) concentration of protein.
- Chylomicrons pass through cell membrane of epithelial cells in extra cellular spaces into the lymphatics and from there get enter in the system



# Chylomicrons

- It is composed of central hydrophobic TG covered by layer of hydrophilic PL, cholesterol/ cholesterol ester and apolipoprotein (Apo- B-48, A-I, A-II, A-IV, CI, CII, CIII,E).
- Synthesized in intestinal wall and through the lymphatic vessels enter in the systemic circulation.
- Chylomicrons are released by exocytosis at the basal surface of the enterocytes. Because they are too large to enter capillaries so via lymphatic vessels they enter into the circulation.
- Chylomicrons after meal in blood is causes post prandial lipaema which disappears after 2-3 hours after meal.
- Rich in: TGs so deliver them to body cells as fuel.

# Structure of Chylomicron

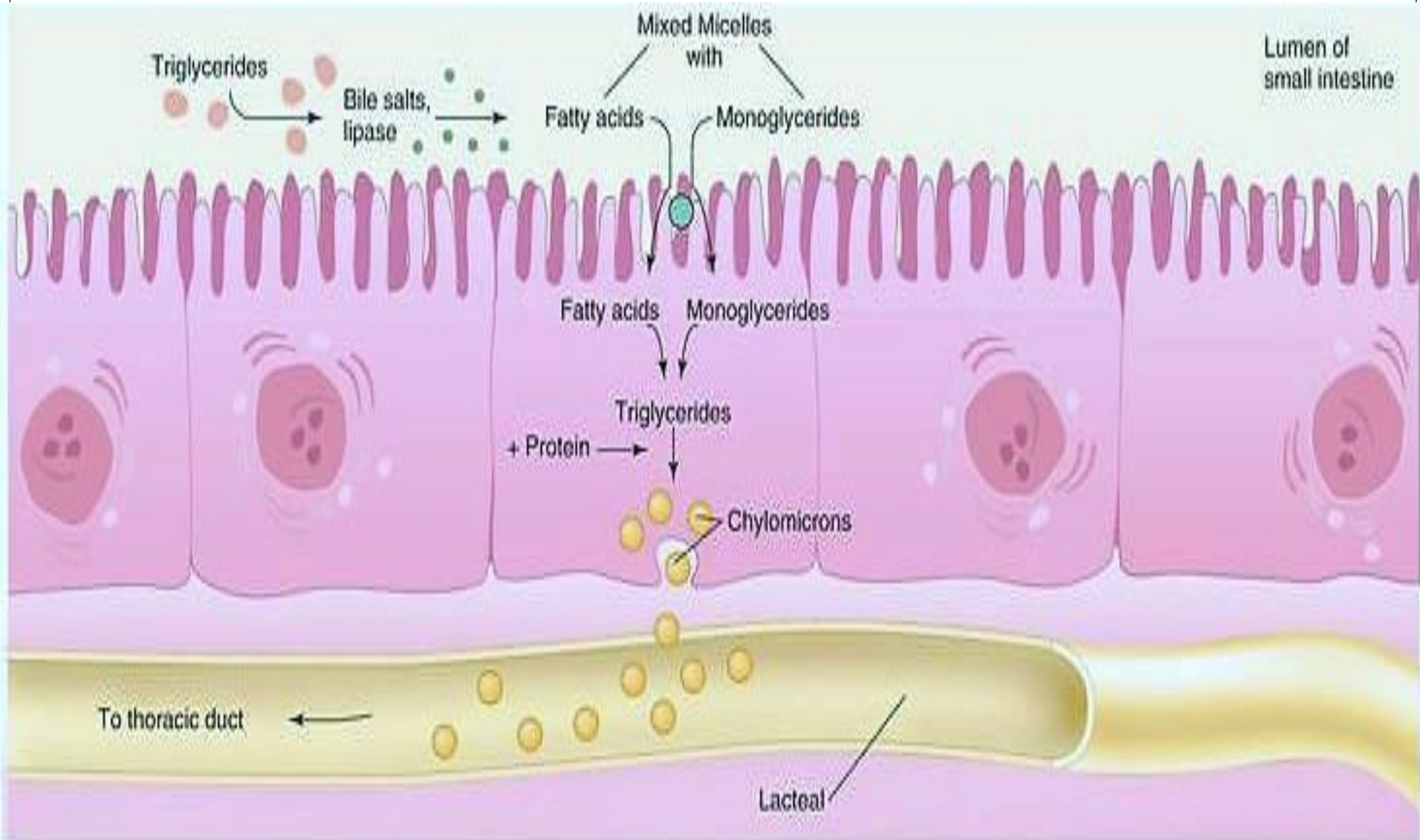


- *Size: 0.75–1 m $\mu$*
- TG (84%)
- Cholesterol(2%)
- Ester Cholesterol (4%)
- Phospholipid (8%)
- Apo lipoproteins B48 (2%)

have density  
( $<0.95\text{g/mL}$ ).

Size 0.5m $\mu$  in diameter.

# Formation and Transportation of Chylomicrons



# Fate of undigested Fat

- A combination of bile salt + FA + mono/ diglycerides can be absorbed into lymphatic channels.

# Fate of digested and absorbed Lipids

- Metabolized
- Store
- Secreted
- excreted



<b>LIPID FRACTIONS</b>	<b>VALUES mg/dl</b>
<b>Total lipid</b>	<b>400-600</b>
<b>Total cholesterol</b>	<b>150-200</b>
<b>LDL Cholesterol</b>	<b>80-150</b>
<b>HDL</b>	<b>30-60</b>
<b>VLDL</b>	<b>20-40</b>
<b>Triglycerides</b>	<b>75-150</b>
<b>Phospholipids</b>	<b>150-200</b>
<b>Free fatty acids</b>	<b>5-15</b>

# Clinical significance

## Lipid Malabsorption

- Steatorrhoeas
- Chylous abdomen
- Chylothorax
- Chyluria
- Defect in Chylomicrons synthesis.

# Steatorrhoeas

- Abnormality in the first two phases (preparatory and transport phases) of digestion of the lipid.
- It is due to the obstruction of flow of bile by billiary obstruction, disease of pancreas ,cystic fibrosis or surgical removal of pancreas duct, gall stones, tumor of head of pancreas, enlarged lymph nodes.

# Steatorrhea

- ❑ Lipid malabsorption results in increased lipids including fat soluble vitamins A, D, E and K in the feces.
- So the faeces contents of fat increased causing Steatorrheas.
- Normally 5% of total fat is excreted in faeces.
- Milk and coconut oil are used therapeutically since they contain medium chain fatty acids.

# Chylous abdomen

Obstruction to transportation phase leads

- Chylous abdomen
- Chylouria
- Chylothorax

# Chylothorax

- Due to an abnormal connection between pleural space and the lymphatic drainage of small intestine resulting in accumulation of lymph in pleural cavity giving Milky pleural effusion

# Chyluria

- Due to an abnormal connection between urinary tract and lymphatic drainage system of the intestine, forming Chylous fistula. Characterized by passage of Milky urine.

# Clinical significance of Chylomicron synthesis and utilization

- ❑ **Defective synthesis-** Due to deficiency of Apo-B 48 protein. The triglyceride may accumulate in intestinal cells.



# Physiologically important lipases

Lipase	Site of action	Preferred substrate	Product(s)
Lingual / acid stable lipase	Mouth , stomach	TAGS with medium chain FAS	FFA+DAG
Pancreatic lipase + co-lipase	Small intestine	TAGS with long chain FAS	FFA+ $2$ MAG
Intestinal lipase with bile acids	Small intestine	TAGS with medium chain FAS	$2$ FFA+glycerol
Phospholipase A $2$ + bile acids	Small intestine	PLs with unsat. FA at position $2$	Unsat FFA lysolecithin

**ANY QUESTION**



- **CHATTERJEA BIOCHEMISTRY**
- **LIPPINCOTT BIOCHEMISTRY**
- **HARPERS BIOCHEMISTRY**
- **SATYANARAYANA BIOCHEMISTRY**
- **INTERNET**



**Thank you**