

# **Metabolism of lipoproteins and its disorders**

8<sup>th</sup> - 9<sup>th</sup> week

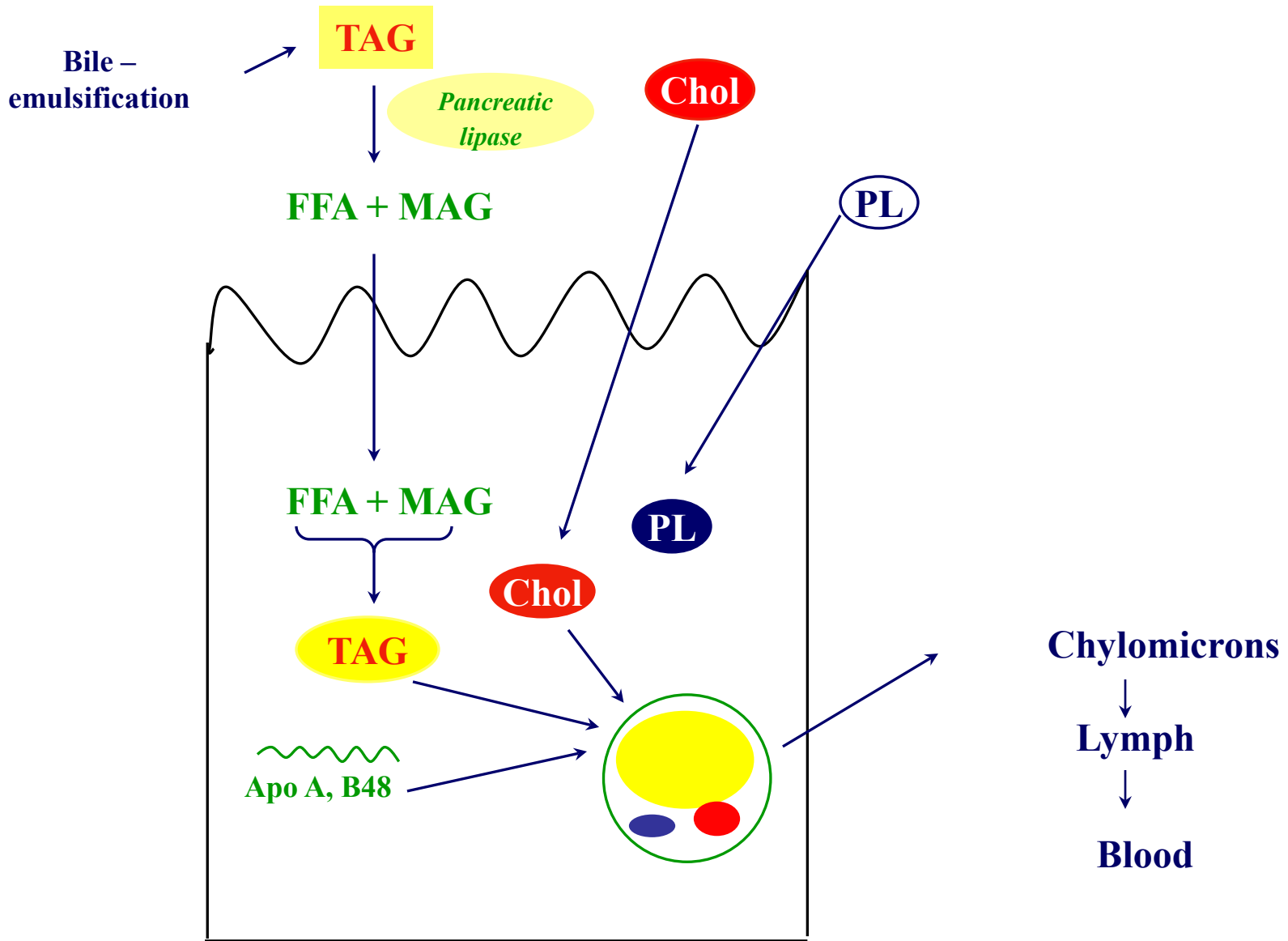
# Classification of lipoproteins

- According to
- density
  - ratio *lipids/proteins*
  - lipids composition

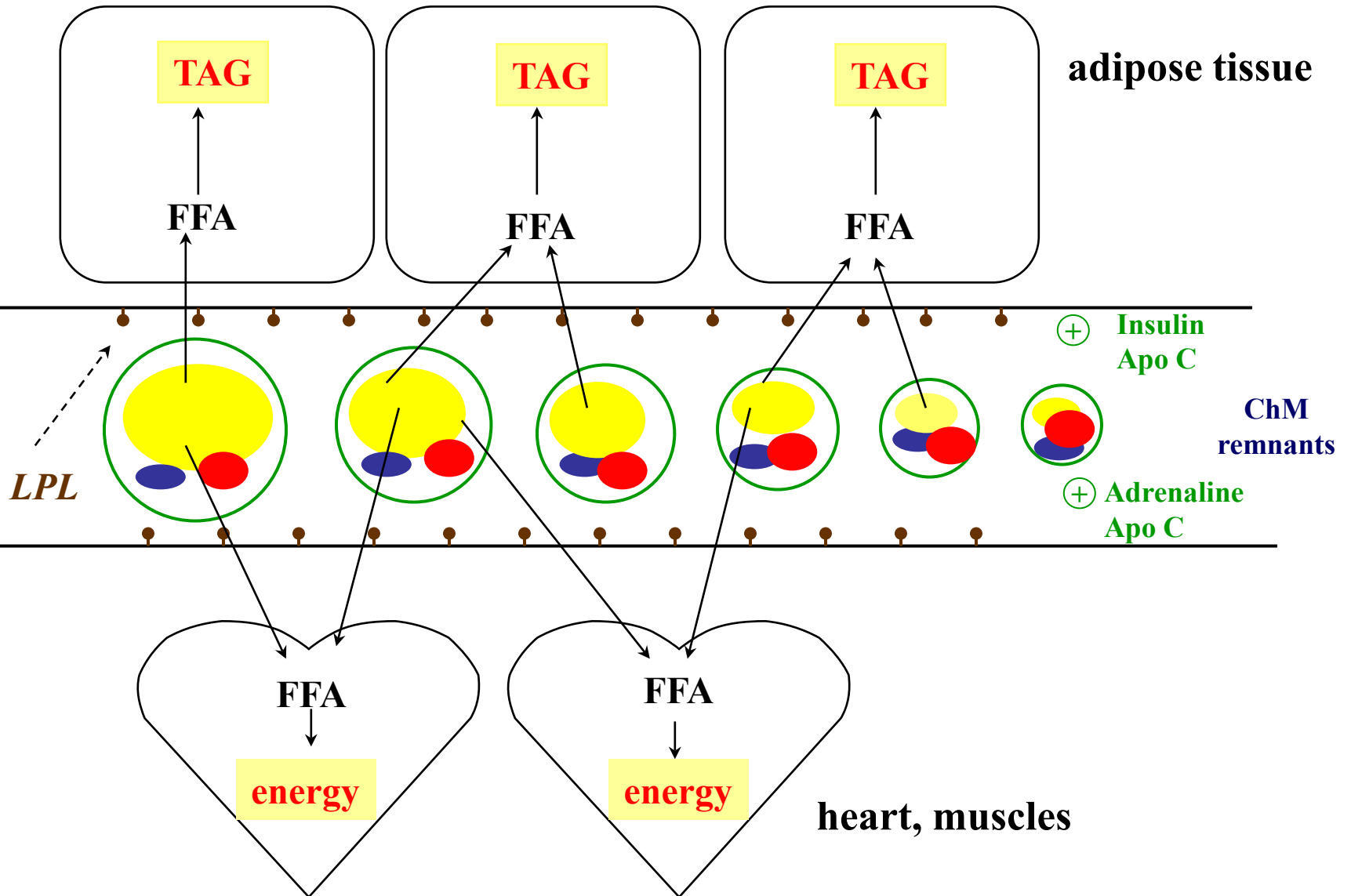
	<b>ChM</b>	<b>VLDL</b>	<b>LDL</b>	<b>HDL</b>
Proteins (%)	1	10	21	<b>50</b>
Phospholipids (%)	4	18	23	<b>30</b>
Cholesterol (%)	6	12	<b>45</b>	18
TAG (%)	<b>89</b>	<b>60</b>	11	2
Density (kg/L)	< 0.9	1.0	1.06	1.2

<b>Apoprotein</b>	<b>M<sub>r</sub></b>	<b>Location of synthesis</b>	<b>Function</b>
A-I	28.000	intestine, liver	structural apoprotein, activation of LCAT
A-II	17.400	intestine, liver	structural apoprotein
B-48	264.000	intestine	structural apoprotein, TAG transport, interaction with receptors
B-100	549.000	liver	as B-48
C-I	6.300	liver	activation of LCAT
C-II	8.800	liver	activation of LPL
D	250.000	?	structural apoprotein
E	37.000	liver	structural apoprotein

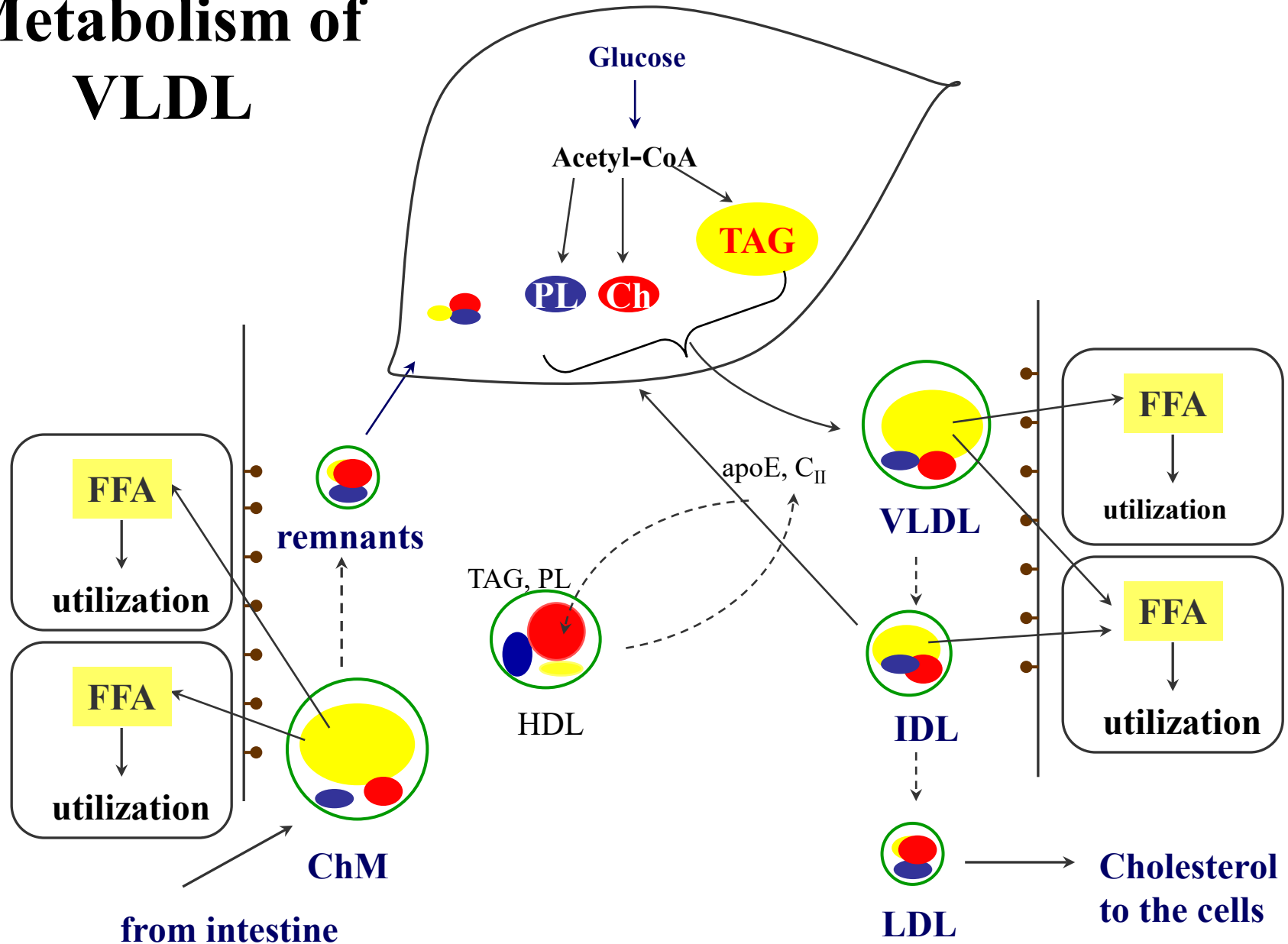
# Digestion and absorption of TAG



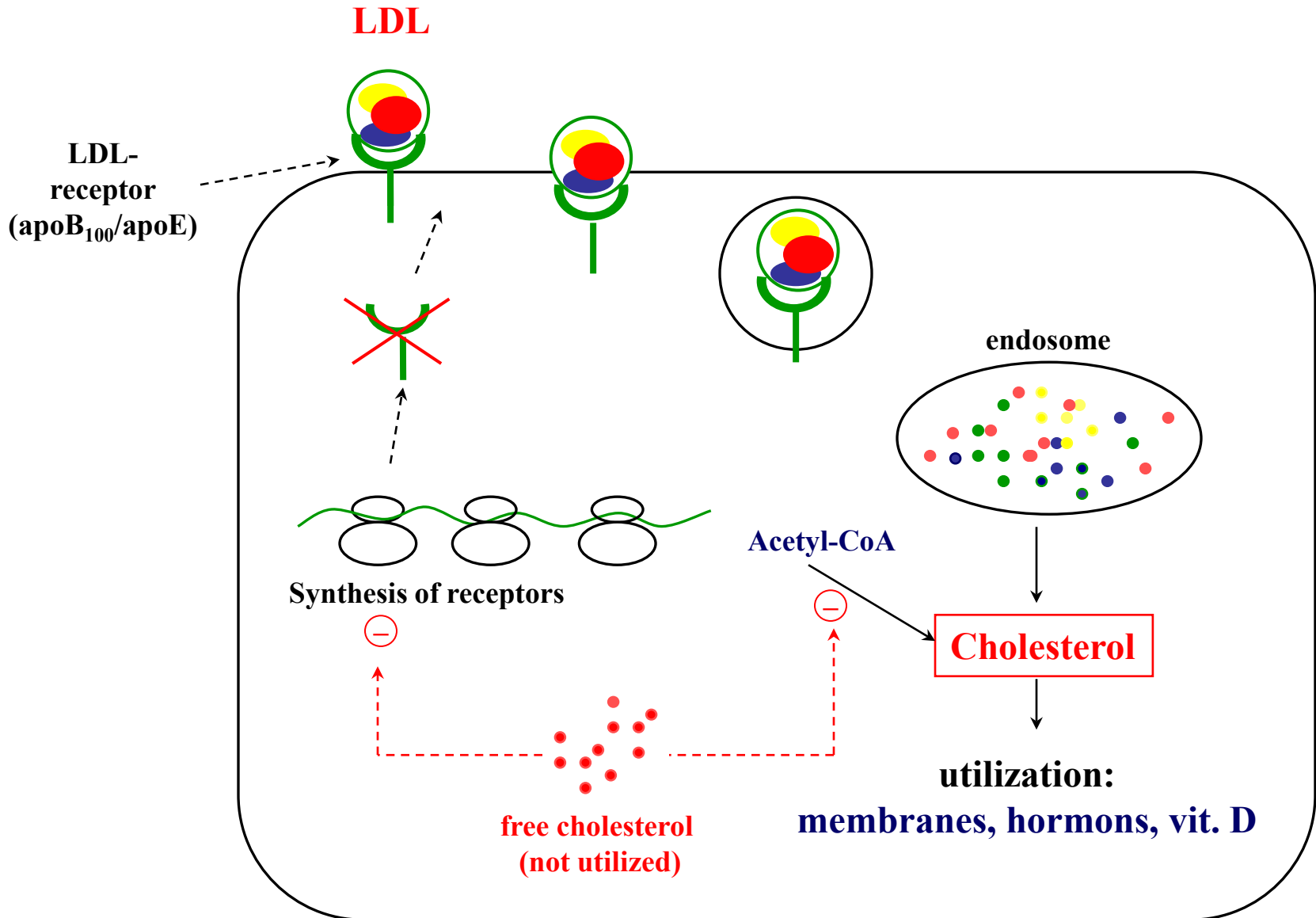
# Metabolism of chylomicrons



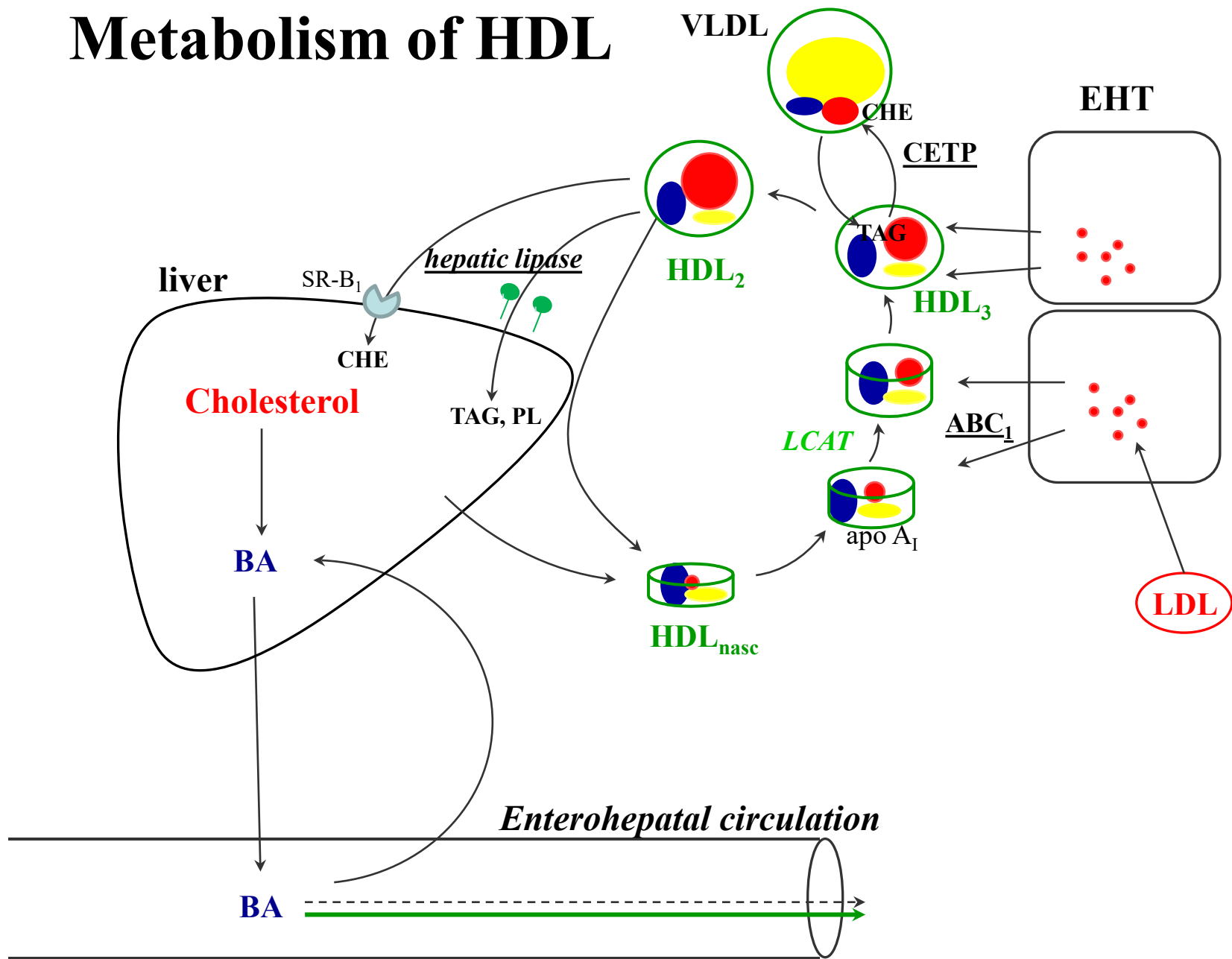
# Metabolism of VLDL



# Transport of LDL into the cells

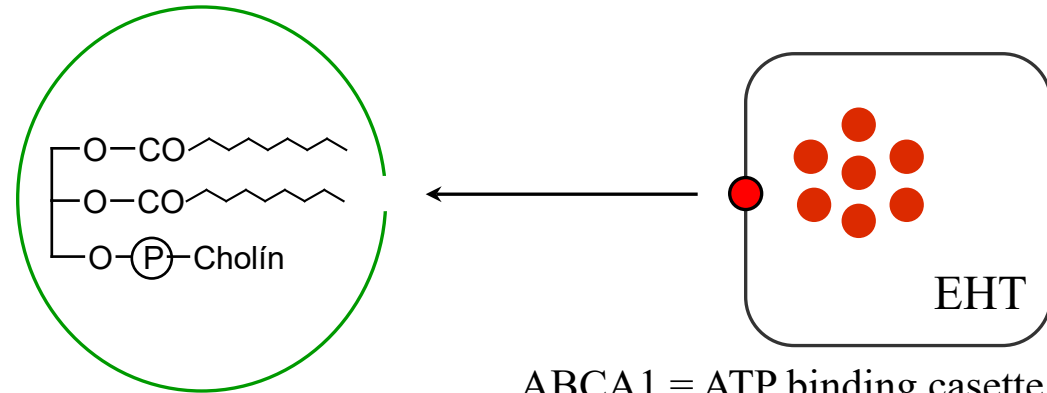


# Metabolism of HDL

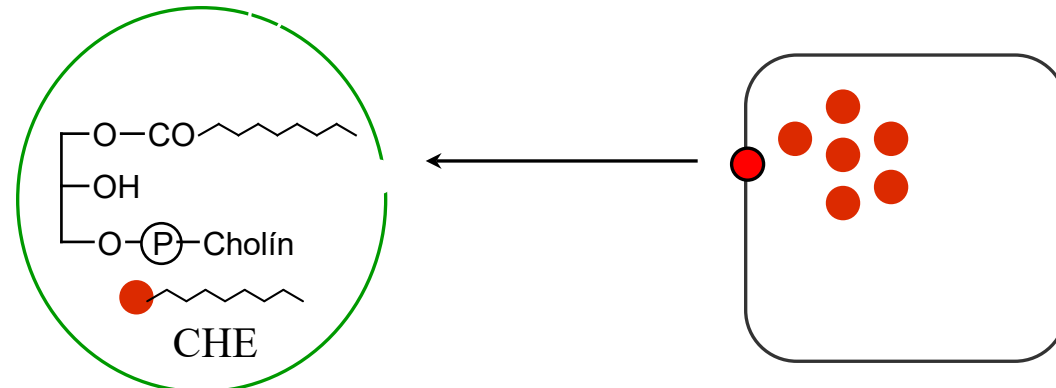
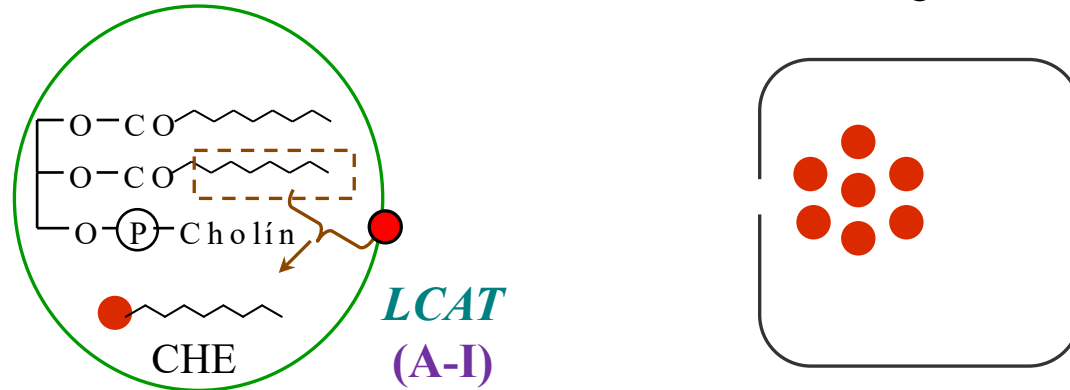




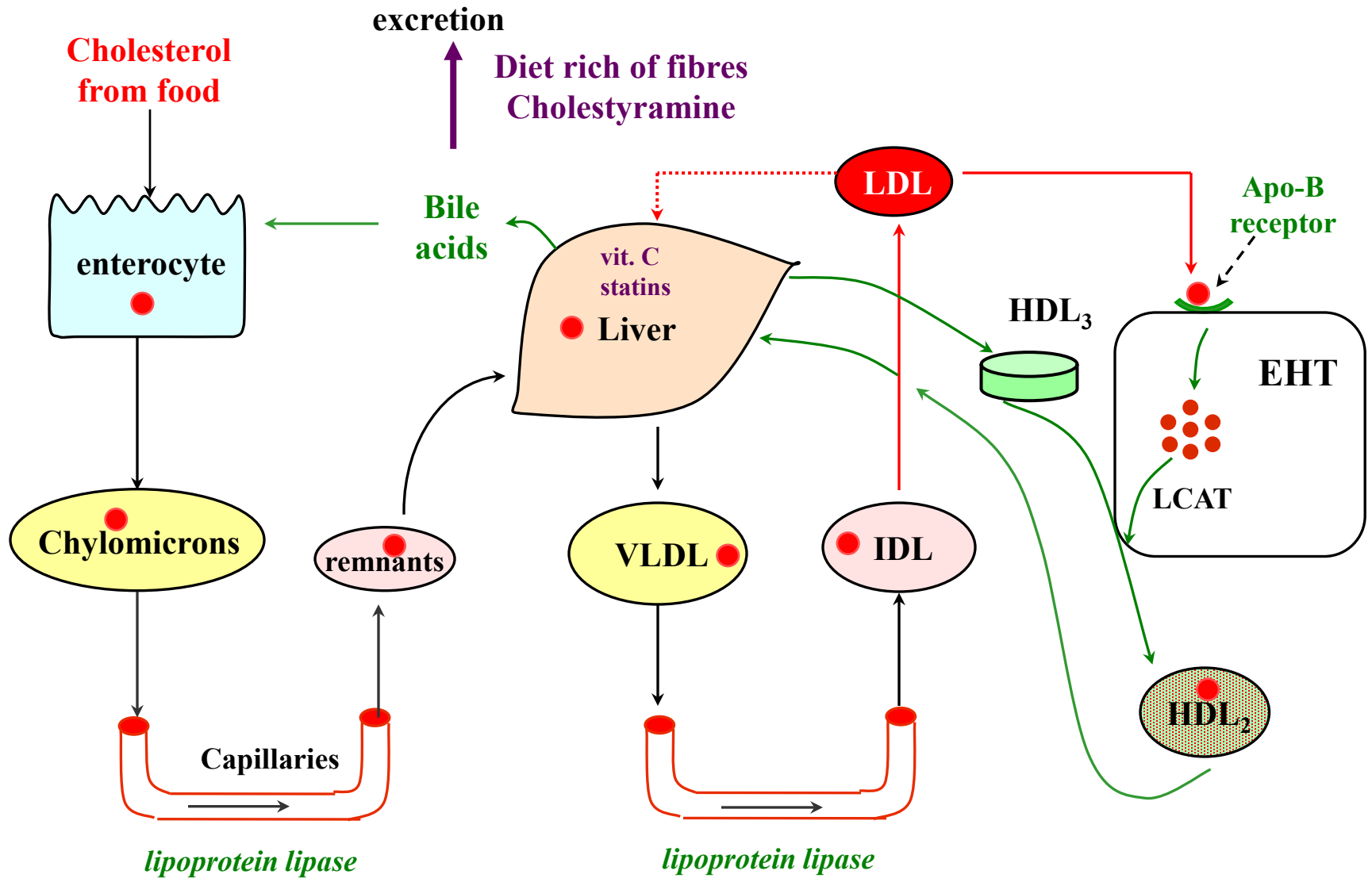
# Mechanism of esterification of cholesterol in HDL



ABCA1 = ATP binding cassette transporter A1



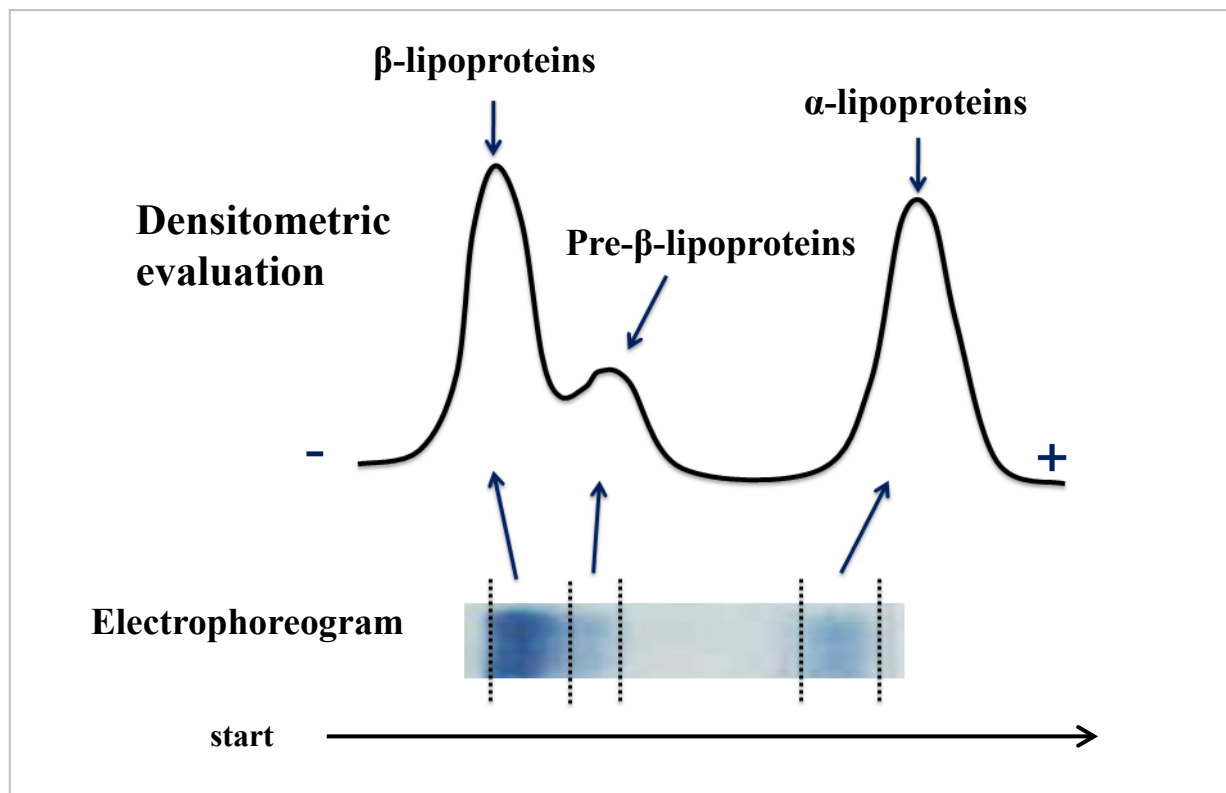
# Transport of cholesterol in organism



# Dyslipoproteinemias

(according to **Frederickson - fenotypic classification**)

- serum TAG levels
- Chol level
- cool test (Chylomicron) – serum appearance
- electrophoretic separation of lipoproteins



# Dyslipoproteinemias

(according to Frederickson - fenotypic classification)

clear



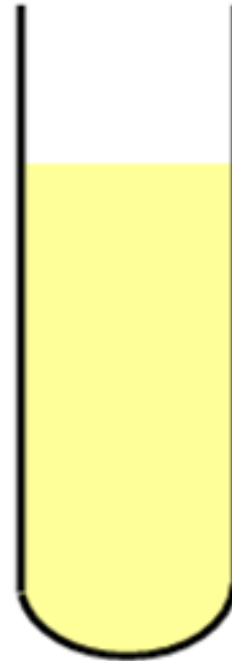
Normal  
or ↑ Chol (LDL)

creamy top layer  
down - clear  
serum



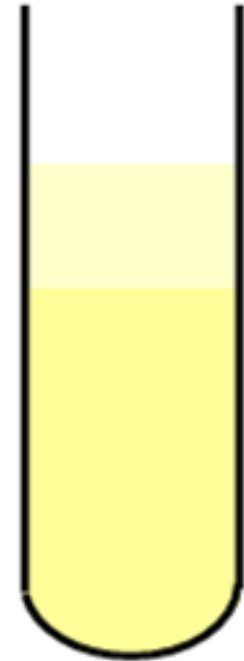
↑ chylomicrons

cloudy



↑ TAG (VLDL)

creamy top layer  
down - cloudy serum



↑ Chylomicrons  
and VLDL

# Dyslipoproteinemias according to Frederickson

Type of hyperlipoproteinemia	Serum appearance	TAG	CHOL	Failure	LIPOPROTEINS (electrophoresis)
healthy individual	clear	Norm (N)	Norm (N)	-	Norm (N)
<b>TYPE I</b> hypertriacylglycerolemia	clear + creamy top layer	↑ Exo	N	- deficiency of LPL - abnormal LPL - deficiency of apo C	↑ Chylomicrones
<b>TYPE II a</b> hypercholesterolemia	clear	N	↑↑	defect LDL receptors	↑ LDL
<b>TYPE II b</b> combined hyperlipidemia	turbid	↑ Endo	↑	defect LDL rec., +increase in VLDL	↑ VLDL + ↑ LDL
<b>TYPE III</b> combined hyperlipidemia	turbid	↑↑	↑↑	only one isoform of apo E (E <sub>2</sub> ) = remnants	↑↑ VLDL + ↑↑ LDL
<b>TYPE IV</b> hypertriacylglycerolemia	turbid	↑ Endo	N	↑ VLDL often associated with glucose intolerance	↑ VLDL
<b>TYPE V</b> hypertriacylglycerolemia	turbid bottom + creamy top layer	↑↑	N	unknown ethiology, relative deficiency of apo C	↑ VLDL + Chylomicrones

# Determination of lipid parameters

## Basic examinations:

- Determination of TAG and total serum cholesterol ( $\text{Chol}_{\text{total}}$ )
- Determination of lipoproteins LDL-chol a HDL-chol

Parameter	gender effect	Reference values ( $\text{mmol.L}^{-1}$ )
TAG	F	0.6 – 2.0
	M	0.6 – 2.5
Total cholesterol		3.3 – 5.2
LDL-chol		$\leq 3.4$
HDL-chol	F	0.9 – 2.0
	M	0.8 – 1.7

# HDL-cholesterol and prognosis of atherosclerosis risk

HDL- chol	Risk		
	Good prognosis	Standard	High
Males	$\geq 1.4$	<b>0.9 – 1.4</b>	$\leq 0.9$
Females	$\geq 1.6$	<b>1.1 – 1.6</b>	$\leq 1.1$

## Atherogenic index (AI)

higher AI  $\Rightarrow$  higher risk of atherosclerosis

$$AI = \frac{\text{Chol}_{\text{total}} - \text{HDL-chol}}{\text{HDL-chol}}$$

## Calculation of LDL in practice = Friedewald's formula

$$\text{LDL-chol} = \text{Chol}_{\text{total}} - \frac{\text{TAG}}{2.2} - \text{HDL-chol}$$