

Lipoproteins

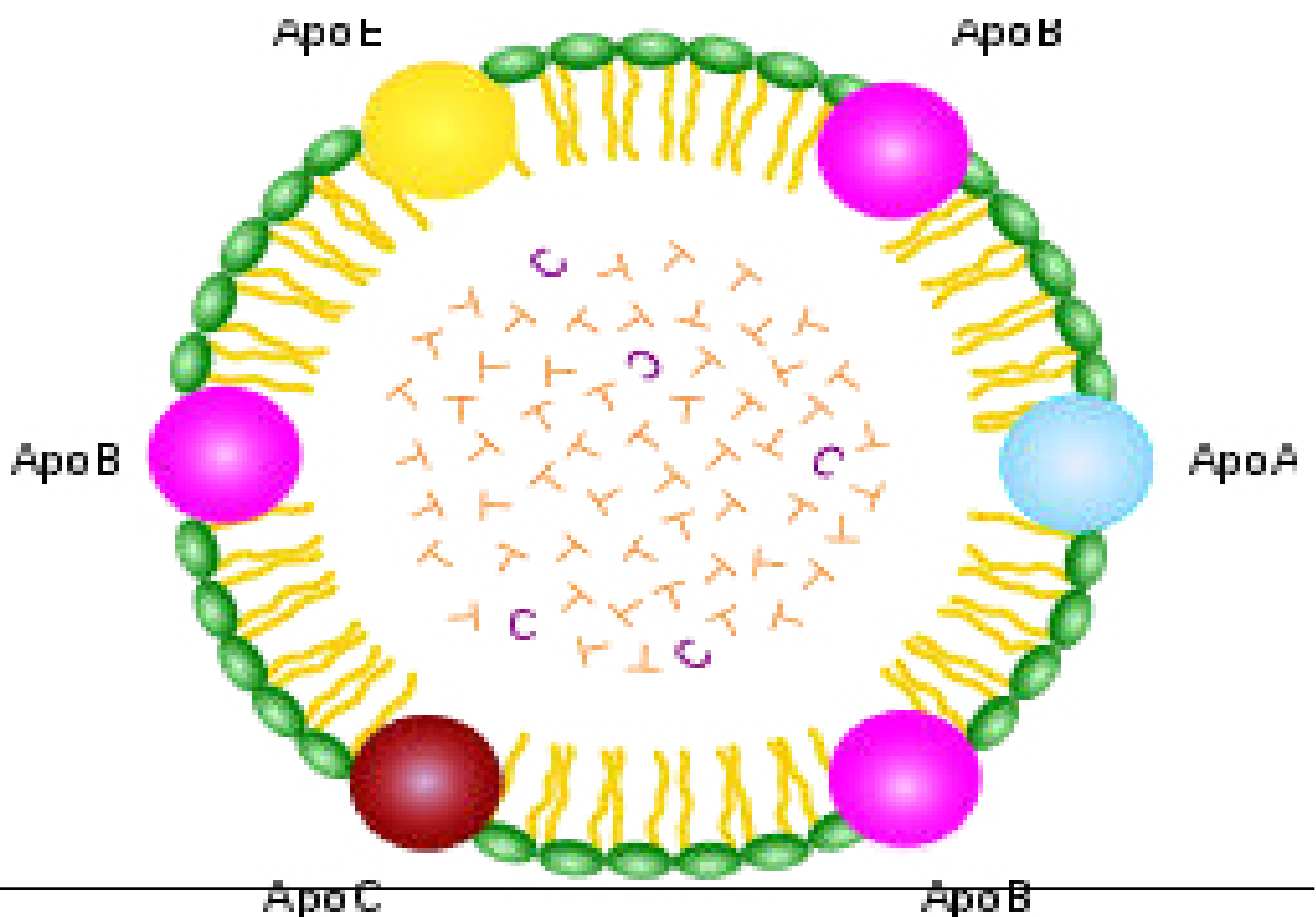
Lipoproteins

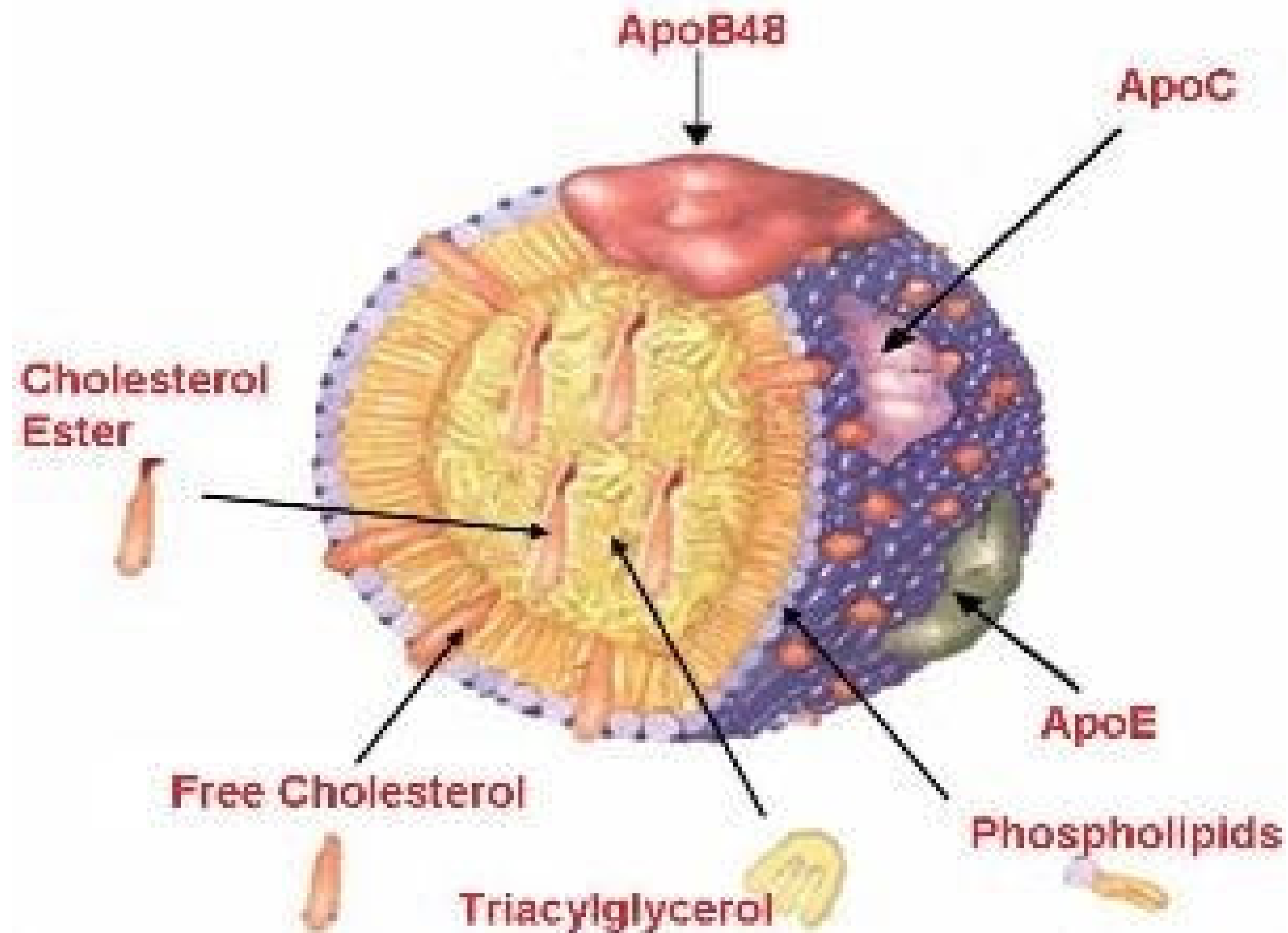
- **Lipoproteins** are types of **Compound Lipids / Conjugated Proteins.**

- www.FirstRanker.com**

- **Lipoprotein** serve as **vehicles** for transportation of **Neutral and Amphipathic Lipids** through aqueous media **blood and lymph**.
- Lipoproteins are **biosynthesized within the cells of tissues**.
- By aggregation of various forms of **Lipids and Apoproteins**.

Structure Of Lipoproteins

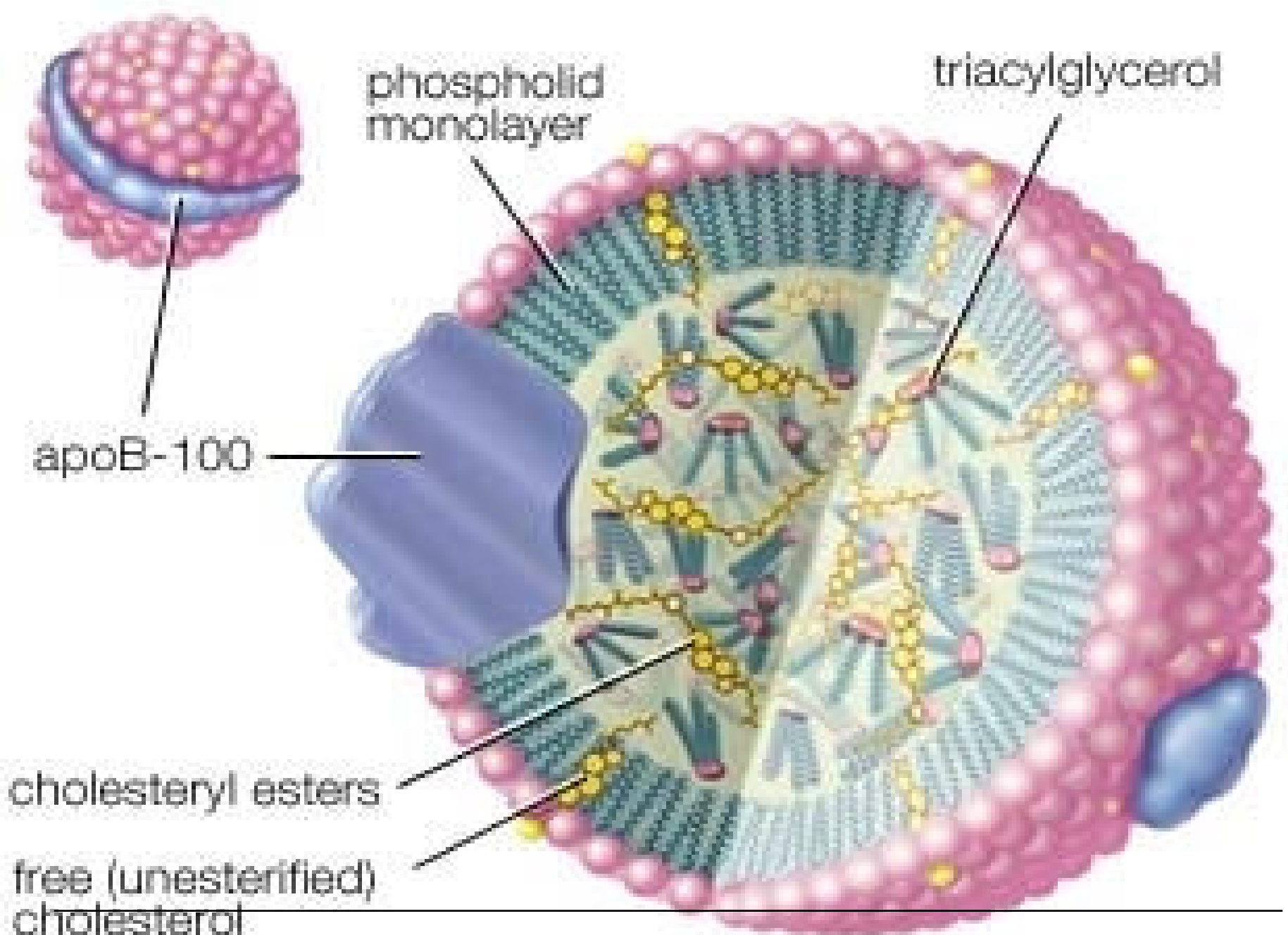


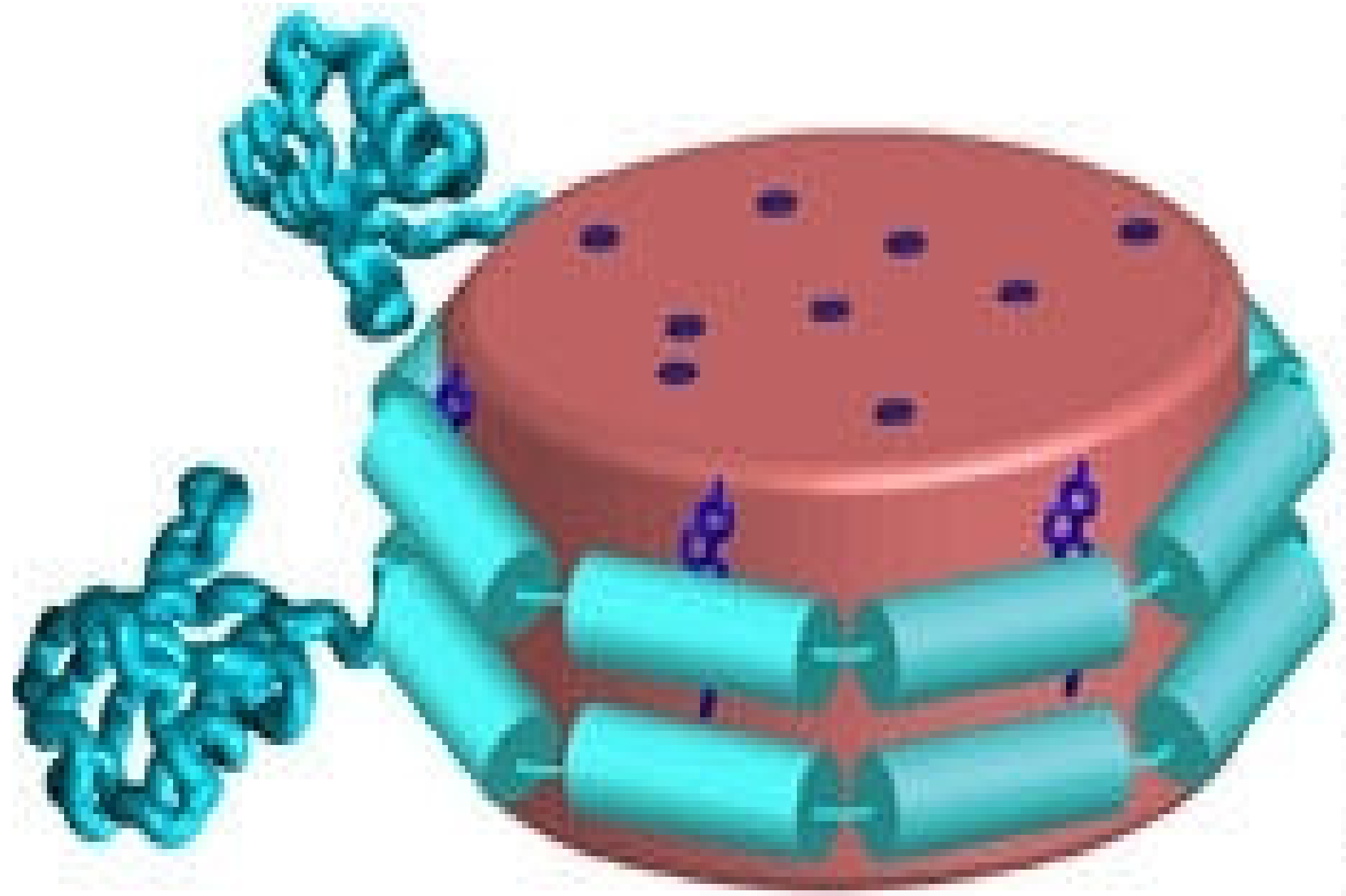


Structure of Lipoproteins

- The non polar /hydrophobic Lipids **TAG and Cholesterol Ester** are gathered centrally to form the core of LipoProtein particle.
- At the periphery of Lipoprotein are **Apoprotein and Amphipathic Lipids** viz **Phospholipids and Cholesterol**.

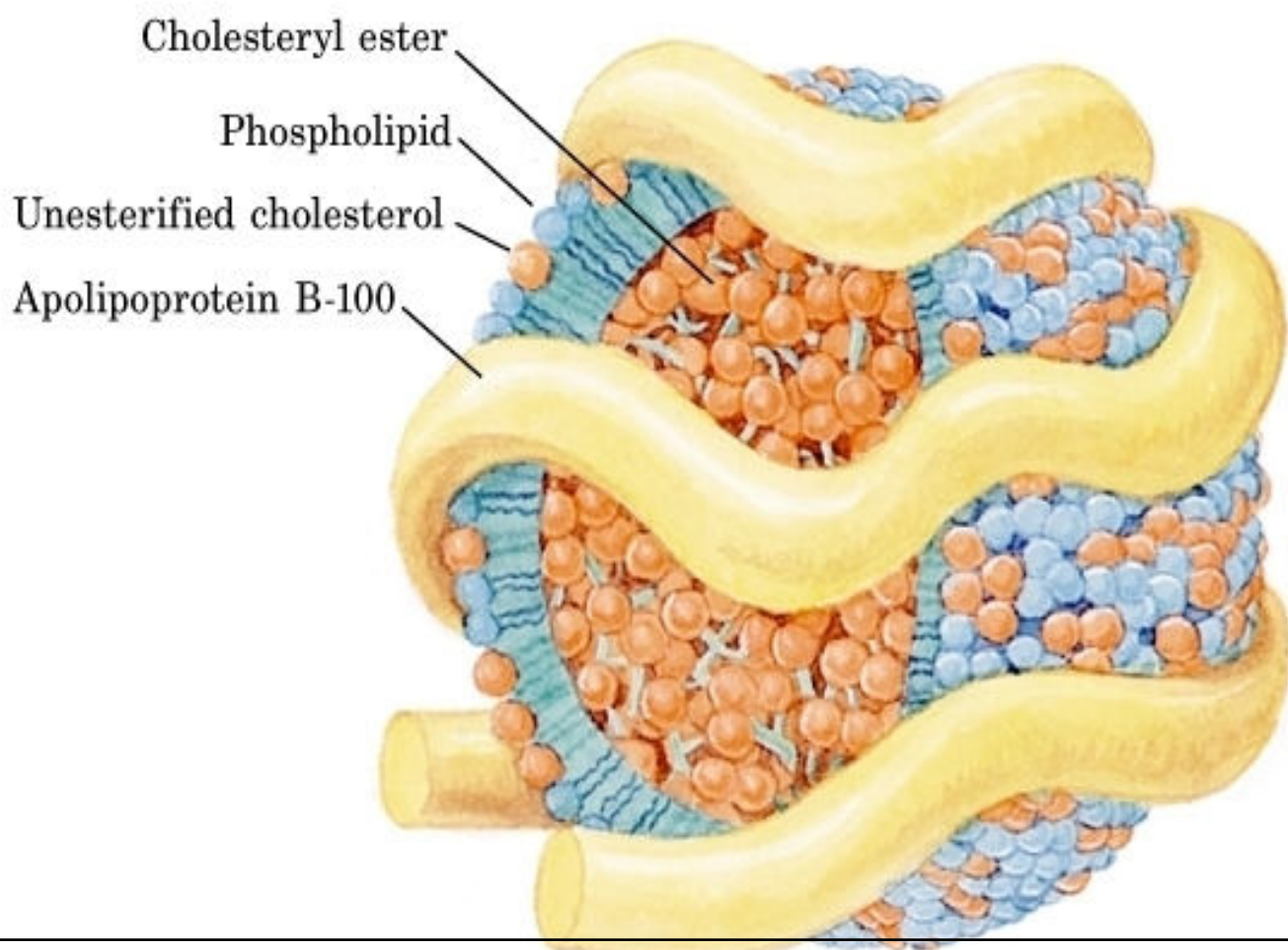
- The Apoprotein and polar groups of Amphipathic Lipids **impart hydrophilic property** to Lipoprotein molecules
- This **helps in transportation of Lipids**
- **From site of origin to site of utilization through blood.**





Discoidal HDL

Cholesterol Transported as Lipoprotein Complex (LDL)



Functions Of Lipoproteins

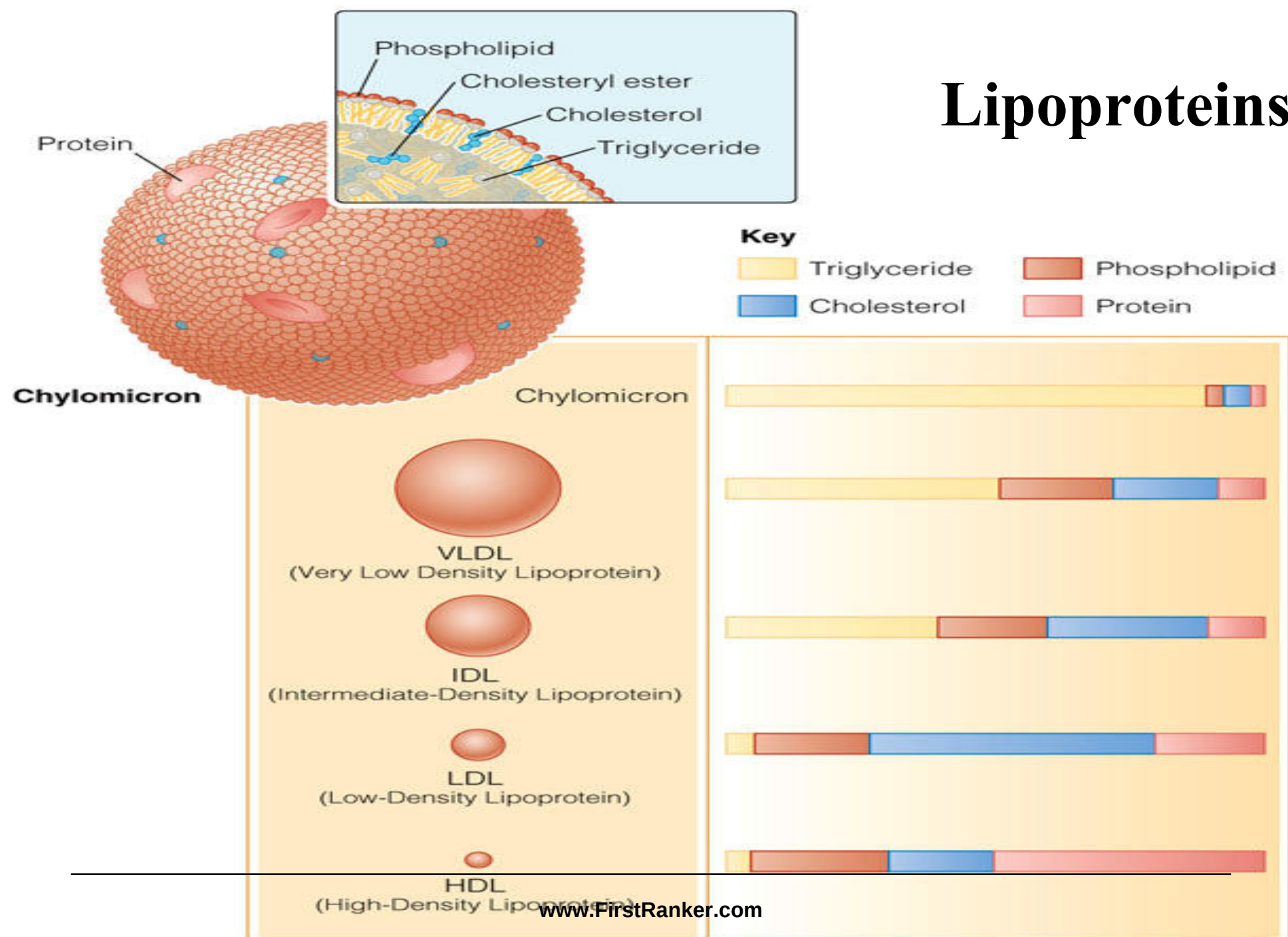
- Lipoproteins serve as a **vehicle in transportation** of non polar Lipids
- From the **site of its biosynthesis to the site of utilization** through **aqueous media of blood or lymph.**

Types Of Lipoproteins

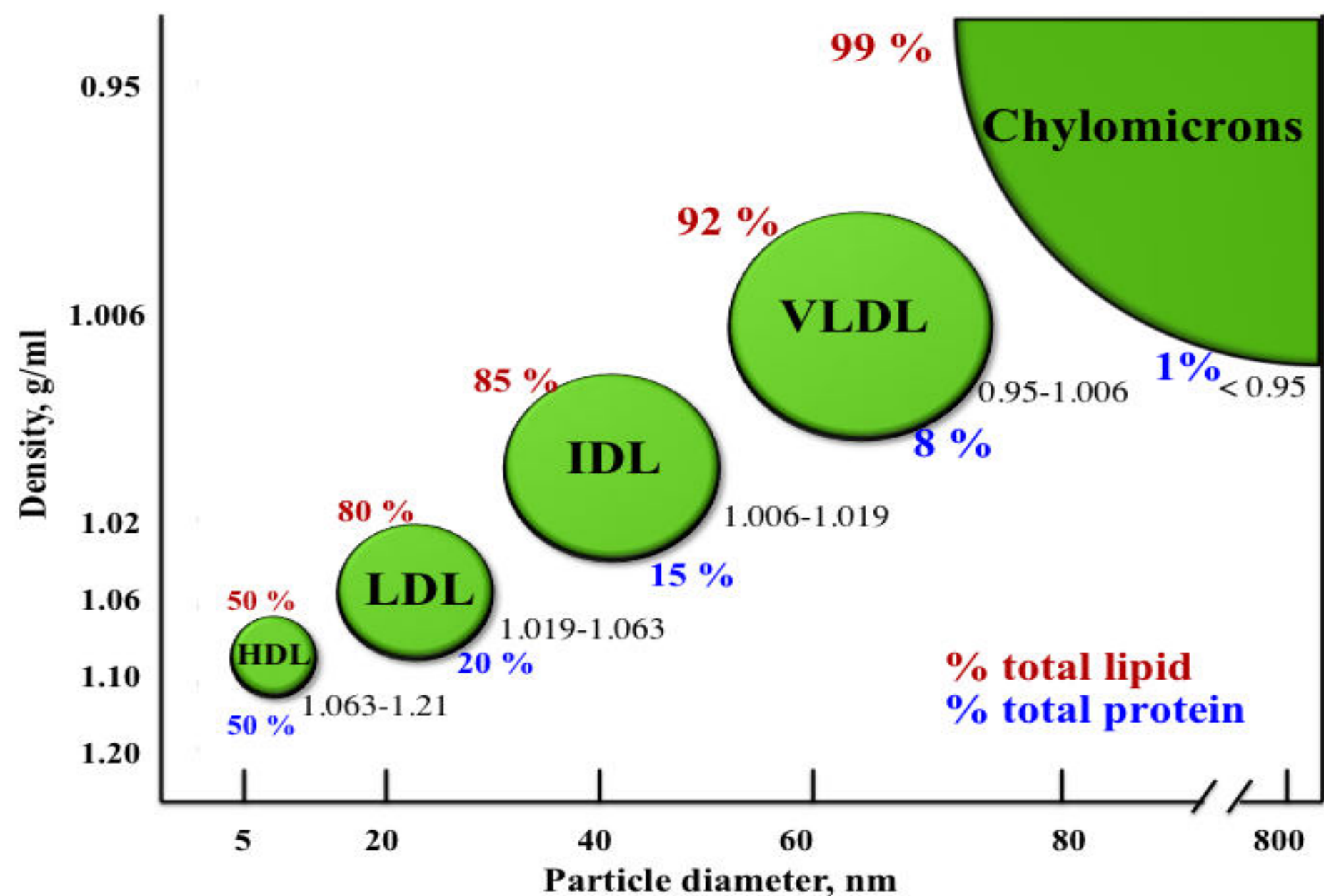
- Depending upon the **composition** and other **properties** following are **the types of Lipoproteins**:

- Chylomicrons (CM)
- Very Low Density Lipoprotein (VLDL)
- Low Density Lipoproteins (LDL)
- High Density Lipoproteins (HDL)
- Free Fatty acid -Albumin

Lipoproteins



Lipoproteins



Types of Lipoprotein

(all contain characteristic amounts TAG, cholesterol, cholesterol esters, phospholipids and Apoproteins - NMR Spectroscopy)

Increasing density ↓	Class	Diameter (nm)	Source and Function	Major Apolipoproteins
	Chylomicrons (CM)	500 Largest	Intestine. Transport of <u>dietary</u> TAG	A, B48, C(I,II,III) E
	Very low density lipoproteins (VLDL)	43	Liver. Transport of <u>endogenously</u> synthesised TAG	B100, C(I,II,III) , E
	Low density lipoproteins (LDL)	22	Formed in circulation by partial breakdown of IDL. Delivers cholesterol to peripheral tissues	B100
	High density lipoproteins (HDL)	8 Smallest	Liver. Removes "used" cholesterol from tissues and takes it to liver.	A, C(I,II,III), D, E
			Donates apolipoproteins to CM and VLDL	

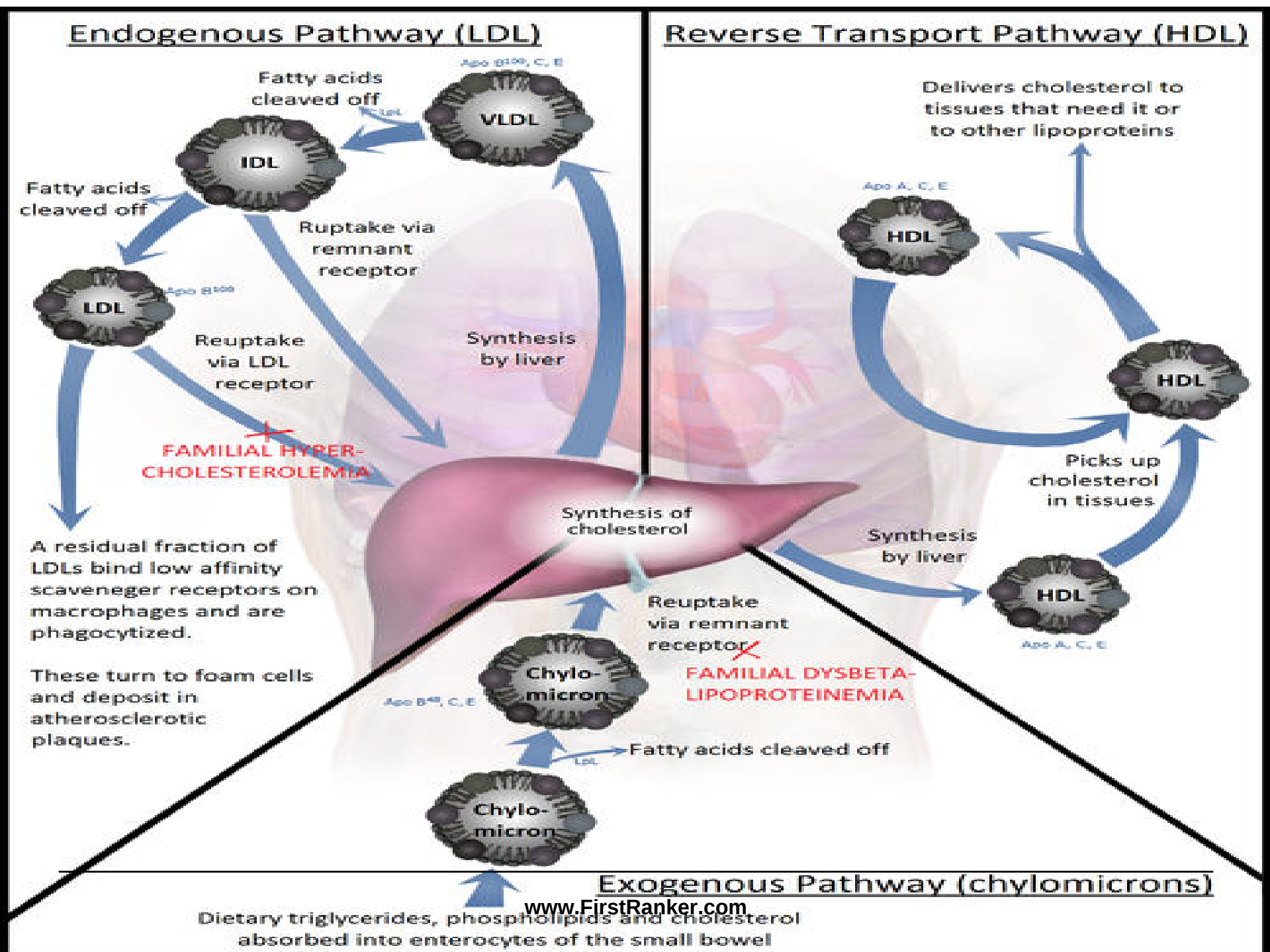
Features	Chylomicrons	VLDL	LDL	HDL
Site of Synthesis	Small Intestine	Hepatocytes Liver -80% Intestine -20%	Blood Circulation From VLDL	Nascent HDL Liver
Lipids %	99%	92%	80%	50%
Protein %	1%	8%	20%	50%
Rich Lipid Form	TAG Exogenous	TAG Endogenous	Cholesterol	Phospholipids
Associated Apoprotein	Apo B48, Apo CII ,Apo E	Apo B100,Apo CI,Apo CII,Apo E	Apo B100, Apo CI, Apo CII and Apo E	Apo A I,Apo A II Apo C I, Apo C II Apo D & Apo E
Transport From	Dietary Lipids Intestine	Liver	Liver	Extrahepatic Tissues
Transport To	Liver	Extrahepatic Tissues	Extrahepatic Tissues	Liver

HDL Has Scavenging Role

OR

Reverse Transport of Cholesterol

HDL Is Associated With Enzyme LCAT Responsible For Cholesterol Esterification And Its Excretion



- **HDL** has scavenging role with protective mechanism.
- HDL Transports Cholesterol from Extrahepatic tissues back to Liver for its excretion.
- HDL reduces risk of Atherosclerosis.
- HDL clears the body Lipids and do not allow accumulation of Lipids in blood.

- Thus when the levels of HDL are **within normal range**
- **Cholesterol associated with HDL is termed as Good Cholesterol**
- **Based on Electrophoretic pattern the Lipoproteins are termed as:**
 - **LDL:** Beta Lipoproteins
 - **VLDL:** Pre Beta Lipoproteins
 - **HDL:** Alpha Lipoproteins

Classification of plasma Lipoproteins according to their electrophoretic mobility

Electrophoretic Pattern of Serum Lipoproteins



α -lipoprotein (HDL)

Pre- β -Lipoprotein (VLDL)

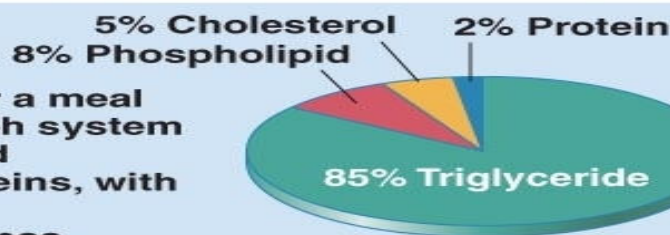
β -lipoprotein (LDL)

CM

Lipoprotein class	Density (g/mL)	Diameter (nm)	Protein % of dry wt	Phospholipids %	Triacylglycerols % of dry wt
HDL	1.063-1.21	5 - 15	50	29	8
LDL	1.019 - 1.063	18 - 28	25	21	4
IDL	1.006-1.019	25 - 50	18	22	31
VLDL	0.95 - 1.006	30 - 80	10	18	50
Chylomicrons	< 0.95	100 - 500	1 - 2	7	84

Chylomicron

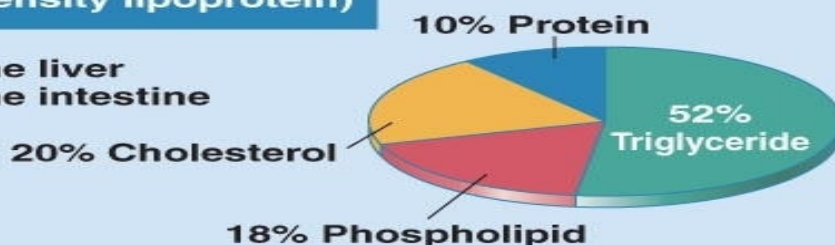
- Formed in the gut after a meal
- Released into the lymph system and then into the blood
- Largest of the lipoproteins, with the lowest density
- Taken up by the liver once triglycerides are removed



Transports dietary fat into the blood and to the tissues of the body

VLDL (Very-low-density lipoprotein)

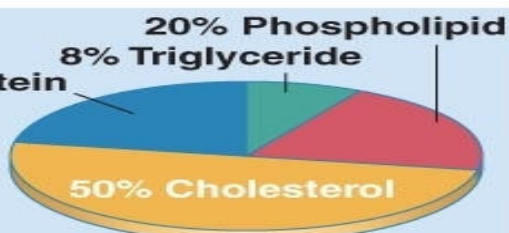
- 80% formed in the liver
- 20% formed in the intestine



Transports endogenous lipids, especially triglycerides, to the various tissues of the body

LDL (Low-density lipoprotein)

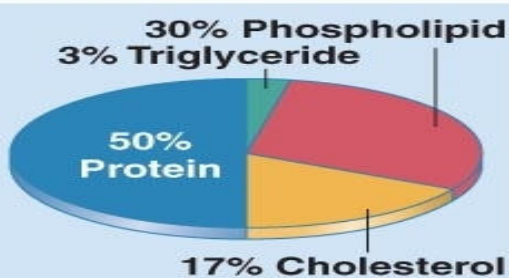
- Formed in blood from VLDL (transformation from VLDL to LDL occurs as the triglycerides are removed from the VLDL)



Transports cholesterol to the cells of the body

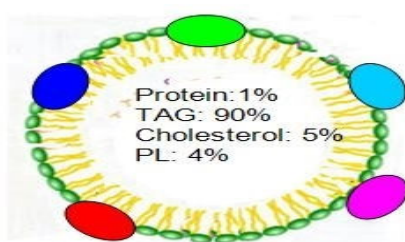
HDL (High-density lipoprotein)

- Synthesized in liver and released into the blood
- Transported by the blood throughout the body, picking up free cholesterol



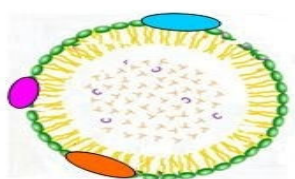
Transports cholesterol from tissues back to the liver

© 2011 Pearson Education, Inc.



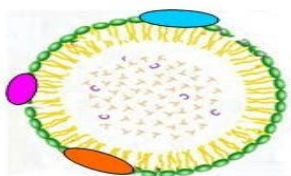
Lipoprotein type: Chylomicron
Density: <0.950 g/mL
Diameter: 80-1000 nm
Major lipids: dietary triacylglycerols
Apolipoproteins: B48, A1, A2, C, E

Protein: ~1%
Triglyceride: ~90%
Cholesterol: ~5%
Phospholipids: ~4%



Lipoprotein type: VLDL
Density: 0.950-1.006 g/mL
Diameter: 30-80 nm
Major lipids: endogenous triacylglycerols
Apolipoproteins: B100, C, E

Protein: ~10%
Triglyceride: ~65%
Cholesterol: ~13%
Phospholipids: ~13%



Lipoprotein type: IDL
Density: 1.006-1.019 g/mL
Diameter: 25-30 nm
Major lipids: endogenous triacylglycerols and cholesterol
Apolipoproteins: B100, C, E

Protein: ~18%
Triglyceride: ~34%
Cholesterol: ~22%
Phospholipids: ~22%



Lipoprotein type: LDL
Density: 1.019-1.063 g/mL
Diameter: 20-22 nm
Major lipids: cholesterol and cholesteryl ester
Apolipoproteins: B100

Protein: ~20%
Triglyceride: ~10%
Cholesterol: ~45%
Phospholipids: ~23%



Lipoprotein type: HDL
Density: 1.063-1.090 g/mL
Diameter: 9-15 nm
Major lipids: cholesteryl ester and phospholipids
Apolipoproteins: A1, A2, C, E

Protein: ~50%
Triglyceride: ~20%
Cholesterol: ~18%
Phospholipids: ~30%

	CM	VLDL	LDL	HDL
Density (g/ml)	< 0.94	0.94-1.006	1.006-1.063	1.063-1.210
Diameter (Å)	6000-2000	600	250	70-120
Total lipid (wt%) *	99	91	80	50
Triacylglycerol	85	55	10	6
Cholesterol esters	3	18	50	40
Cholesterol	2	7	11	7
Phospholipid	8	20	29	46
Apoprotein %	1	9	20	50

Fatty acid compositions (wt% of the total) in the main lipids of human Lipoprotein

	Triacylglycerols			Cholesterol Esters			Phospholipids		
Fatty acid	VLDL	LDL	HDL	VLDL	LDL	HDL	VLDL	LDL	HDL
16:0	27	23	23	12	11	11	34	36	32
18:0	3	3	4	1	1	1	15	14	14
18:1	45	47	44	26	22	22	12	12	12
18:2	16	16	16	52	60	55	20	19	21
20:4 (n-6)	2	5	8	6	7	6	14	13	16

The main properties of the Apoproteins.*

Apoprotein	Molecular weight	Lipoprotein	Function
Apo A1	28,100	HDL	Lecithin:cholesterol acyltransferase (LCAT) activation. Main structural protein.
Apo A2	17,400	HDL	Enhances hepatic lipase activity
Apo A4	46,000	CHYLOMICRON(CM)	
Apo AV(5)	39,000	HDL	Enhances triacylglycerol uptake
Apo B48	241,000	CHYLOMICRON	Derived from Apo B100 – lacks the LDL receptor
Apo B100	512,000	LDL, VLDL	Binds to LDL receptor
Apo C1	7,600	VLDL, CM	Activates LCAT
Apo C2	8,900	VLDL, CM	Activates lipoprotein lipase
Apo C3	8,700	VLDL, CM	Inhibits lipoprotein lipase
Apo D	33,000	HDL	Associated with LCAT, progesterone binding
Apo E	34,000	HDL	At least 3 forms. Binds to LDL receptor
Apo(a)	300,000-800,000	LDL, Lp(a)	Linked by disulfide bond to apo B100 and similar to plasminogen

Disorders Of Lipoproteins

3) Disorders associated with Lipoprotein Metabolism

A Hyper-Lipoproteinaemias :-

- Type-I: familial lipoprotein lipase deficiency.
- Type-II: familial hypercholesterolaemia.
- Type-III: familial dys-beta Lipoproteinaemia.
- Type-IV: familial hypertriglyceridaemia.
- Type-V: Combined hyperlipidaemias.

B Hypolipo-proteinaemias:-

- A-beta- Lipoproteinaemia.
- Familial alpha-Lipoprotein deficiency (Tangier's disease).



Table I Lipid levels (mg/DL) in human beings with known heart disease

Test	Desirable	Borderline	Undesirable
Total cholesterol	<200	200-240	>240
HDL cholesterol	>45	35-45	<35
Triglycerides	<200	200-400	>400
LDL cholesterol	<130	130-160	>160
Cholesterol/HDL	<4.5	4.5-7.5	>5.5
LDL/HDL	<3.0	3.5	>5.0

- Defect in Lipoprotein metabolism leads to Lipoprotein disorders:
 - Hyperlipoproteinemias
 - Hypolipoproteinemias

TOTAL CHOLESTEROL			
2004	2006	2008	2011
390	Very High		
380			
370			
360			
350			
340			
330			
320			
310			
300			
290			
280	High		
270			
260			
250			
240			
230			
220			
210			
196	198		195
190	188 Good		
180			
170			
160			
150	Very Good		
140			
130			
120			
110			

LDL (bad) CHOLESTEROL			
2004	2006	2008	2011
320	Very High		
310			
300			
290			
280			
270			
260			
250			
240			
230			
220	Very High		
210			
200			
190	High		
180			
170			
160			
150			
140			
130	131		
120	119 Good		123
110			
100*			
90	Very Good		
80			
70*			
60			
50			
40			

HDL (good) CHOLESTEROL			
2004	2006	2008	2011
130			
125			
120			
115			
110			
105			
100			
95			
90			
85			
80	Protective		
75			
70			
65			
60			
55			
49			
45	44	46	45
40	High Risk		
35			
30			
25			
20			
15			
10			
5			
0			

TOTAL/HDL Cholesterol Ratio		
7.0	Very High	
6.5		
6.0		
5.5	High	
5.0		
4.5		
4.0	4.5	4.3
3.5	Good	
3.0		
2.5		
2.0		
1.5		
1.0		
0.5		
0.0		

- www.FirstRanker.com**

- The Cholesterol associated to high LDL levels is said to be **bad Cholesterol**.
- This increases the risk of Atherosclerosis ,Ischemia, MI and Stroke.
- Recently evidenced high levels of blood HDL are also **bad to body**.
- This increases the risk of Atherosclerosis ,Ischemia, MI and Stroke.

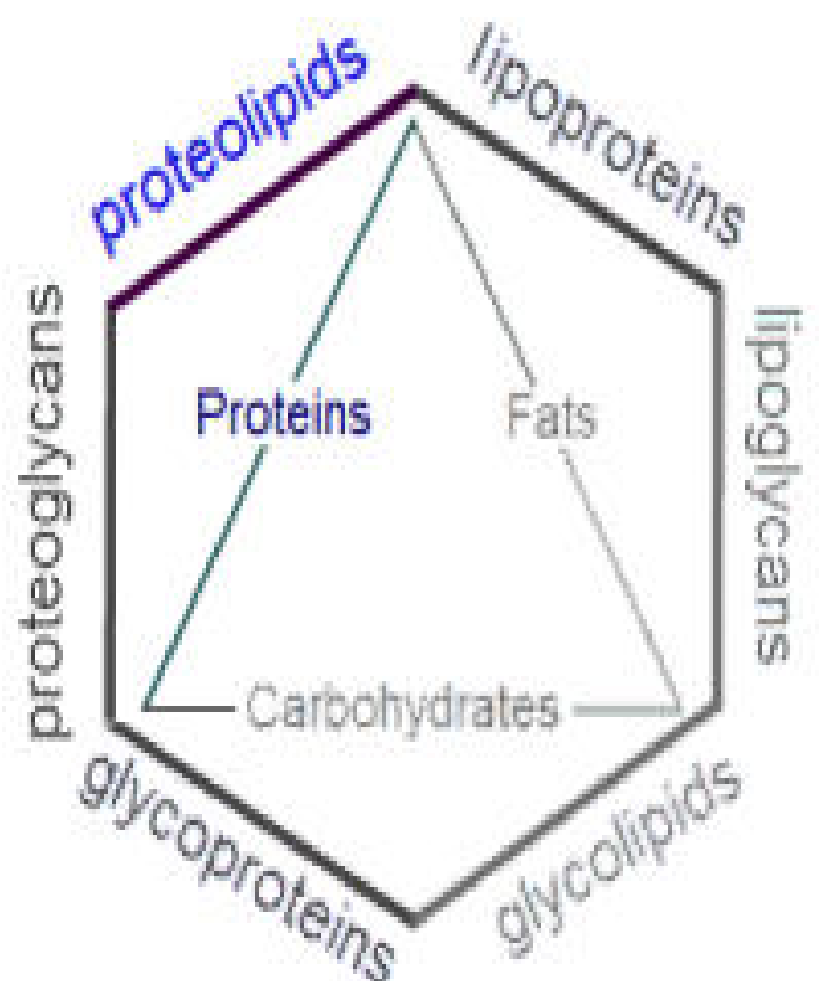
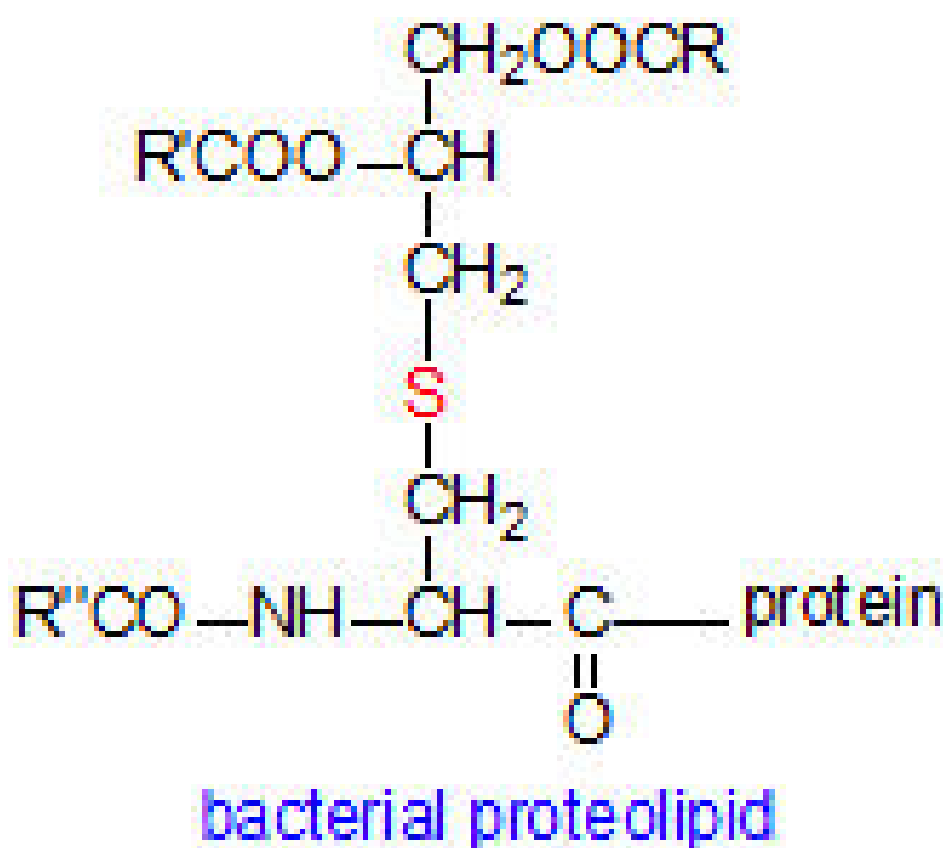
Proteolipids/ Lipophilin

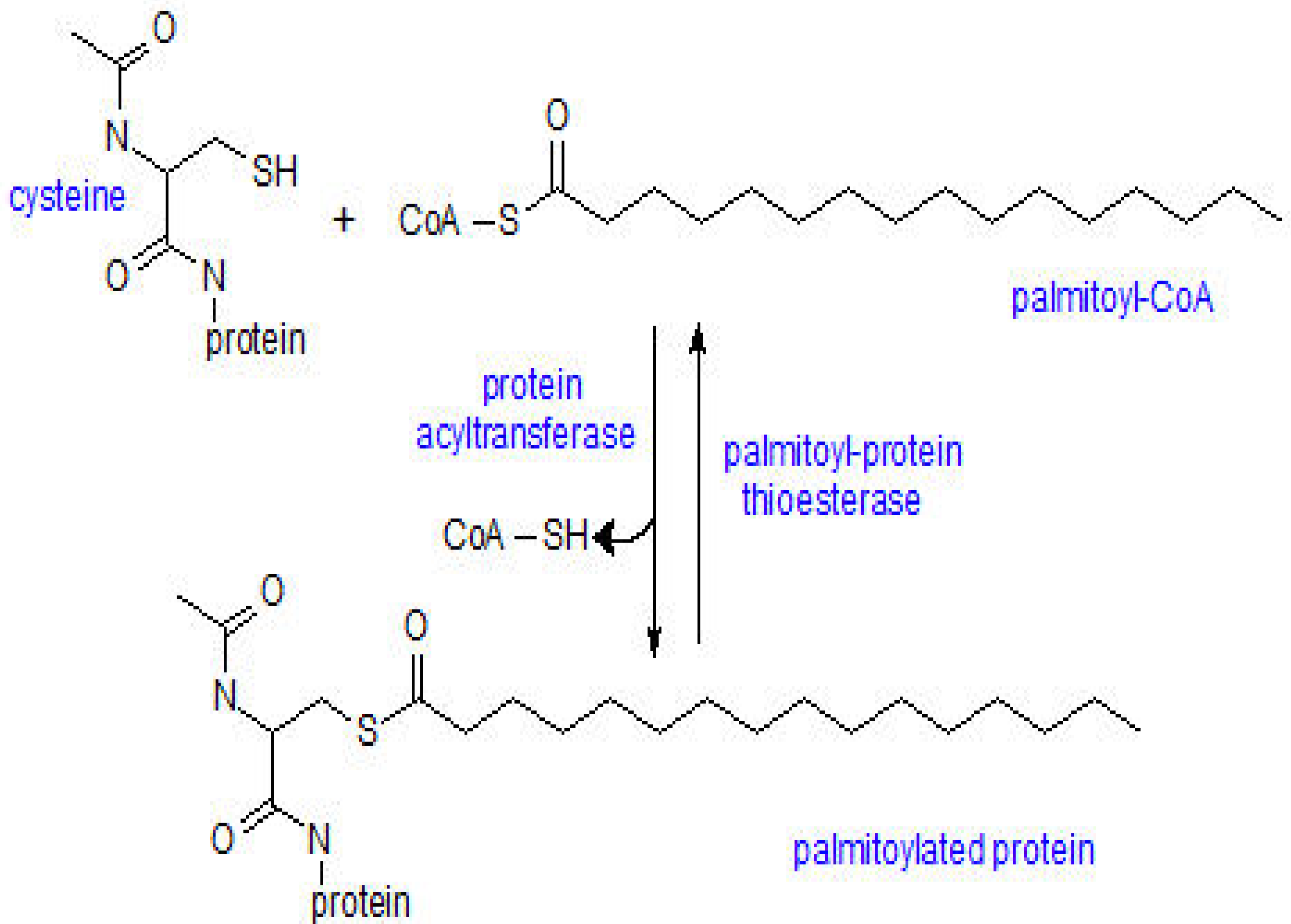
Proteolipids/ Lipophilin

- Proteolipids are compound lipids which have **more content of Proteins than Lipids.**
- Proteolipid is a **transmembrane domain protein** bound with **Lipids.**

Occurrence Of Proteolipids

- Proteolipids are structural Lipids
- Present on the **extracellular side of the membrane.**
- Proteolipids are also present in **Myelin Sheath.**





www.FirstRanker.com