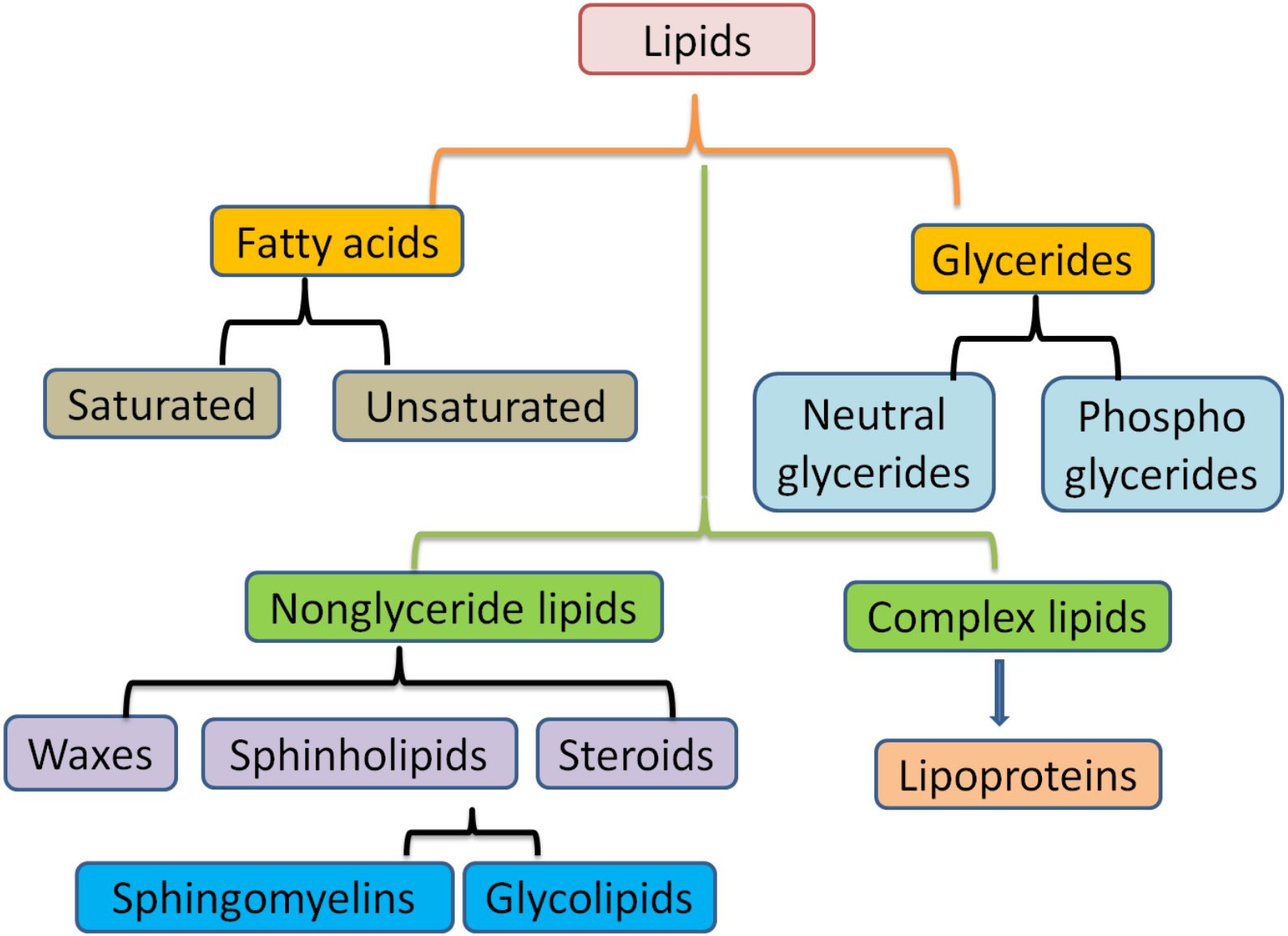
Lipids metabolism disorders


Lipids
Fatty acids
Glycerides
Saturated
Unsaturated
Neutral glycerides
Phospho glycerides
Nonglyceride lipids
Complex lipids
Waxes
Sphinholipids
Steroids
Lipoproteins
Sphingomyelins
Glycolipids

Type of fatty acids

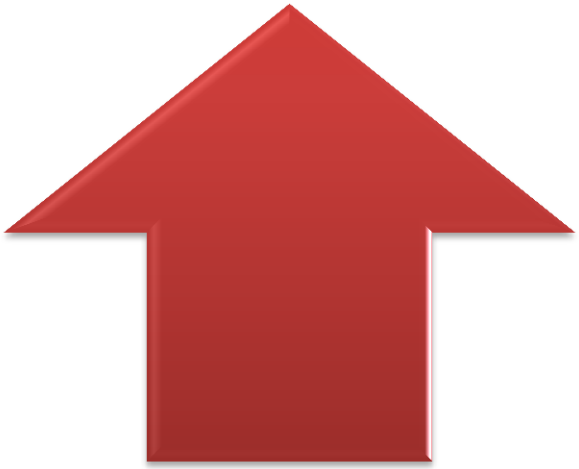
- **Saturated fat**
  - **Animal oil like meat, milk, butter**
  - **Vegetable oil like coconut and palm kernel oil**
- **Polyunsaturated fat**
  - **Plan source like safflower, corn, cottonseed, sunflower oil and soybean oil**
- **Monounsaturated fat**
  - **Plant and animal product like olive oil, canola oil, avocado and peanut oil**

Lipids Functions

- Excellent energy reserves
- Structure of cell membranes
- Organ padding
- Body thermal insulation
- Essential fatty acids (EFA)
- Hormone synthesis
- Fat soluble vitamin absorption

Lipids Disorder

- **Lipids deficiency (Shortage in Lipids intake)**
- **Lipids exceeding (Overtaking in Lipids intake)**



Hyperlipoproteinaemia

Hypolipoproteinaemia

Lipids Deficiency

- Fat should comprise of 3% of total calories to prevent fatty acid deficiency
- Fatty acid deficiency syndromes
  - Dry scaly skin, dermatitis (Linoleic acid deficiency)
  - Hand tremors (Prostaglandin deficiency)
  - Inability to control blood pressure

Lipids Exceeding

- Fat should comprise not more than 30% of total calories to prevent lipids exceeding
- To prevent overtaking, we should consume fat breakdown (% total calories)
  - <8% from saturated fat
  - 10% from polyunsaturated fat
  - 10-15% from monounsaturated fat

Body Mass Index

- Current best single gauge for body fat
- BMI =(Weight in Kg)/((Height in cm)(Height in cm)) X 10,000

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Healthy Weight
25.0 – 29.9	Overweight
30.0 and Above	Obese

Lipoproteins

- **Low Density Lipoproteins (LDL) – is made by the liver and is comprised of cholesterol that is delivered to the cells in the body**
  - **High levels of LDL is strongly correlated with heart disease**
- **High Density Lipoproteins (HDL) - made by the liver and picks up cholesterol from the cells fro recycling or excretion**
  - **High levels of HDL is inversely correlated with heart disease**
  - **It is protective**

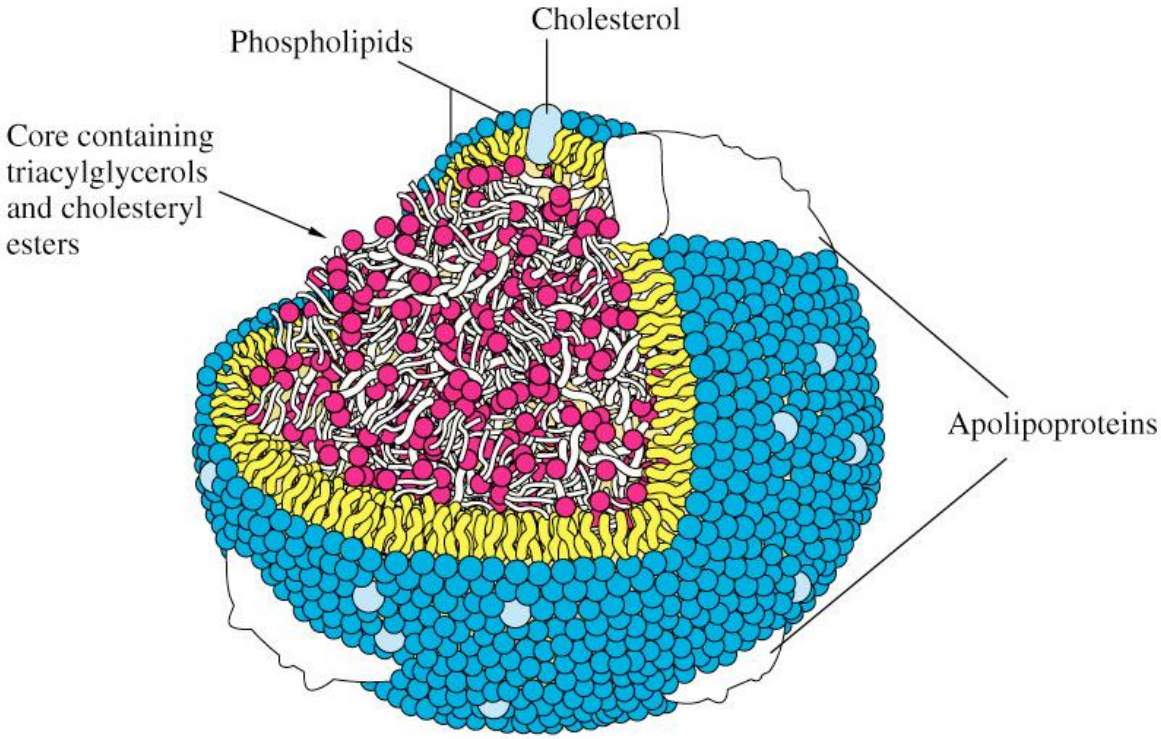
Apolipoproteins

- **Apolipoproteins** are proteins that bind lipids (oil-soluble substances such as fat and cholesterol) to form lipoproteins. They transport the lipids through the lymphatic and circulatory systems. Apolipoproteins also serve as enzyme cofactors, receptor ligands, and lipid transfer carriers that regulate the metabolism of lipoproteins and their uptake in tissues.

Apolipoproteins

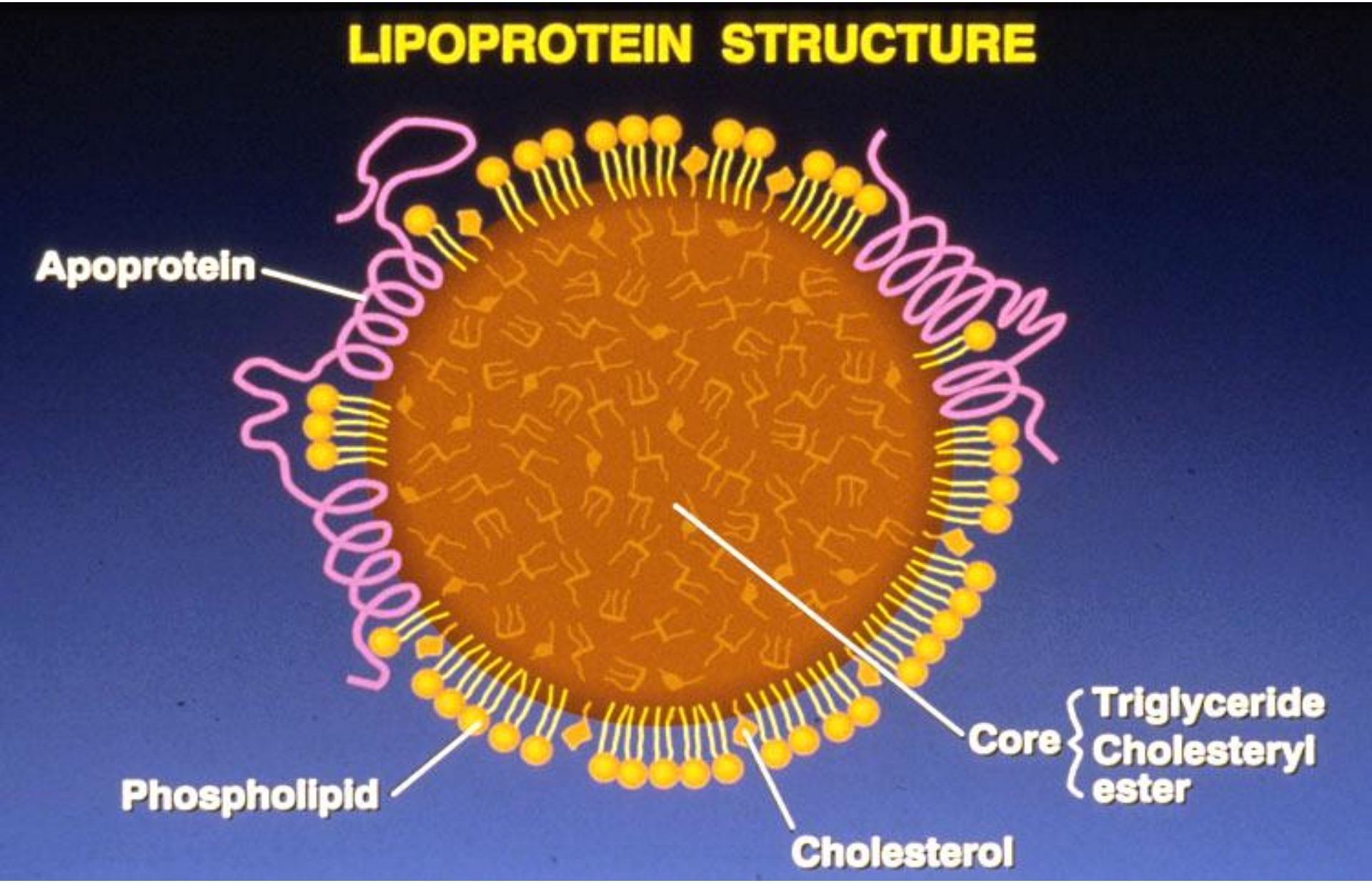
There are six classes of apolipoproteins and several sub-classes:

- A (apo A-I, apo A-II, apo A-IV, apo A-V)
- B (apo B48 and apo B100)
- C(apo C-I, apo C-II, apo C-III, apo C-IV)
- D
- E
- H



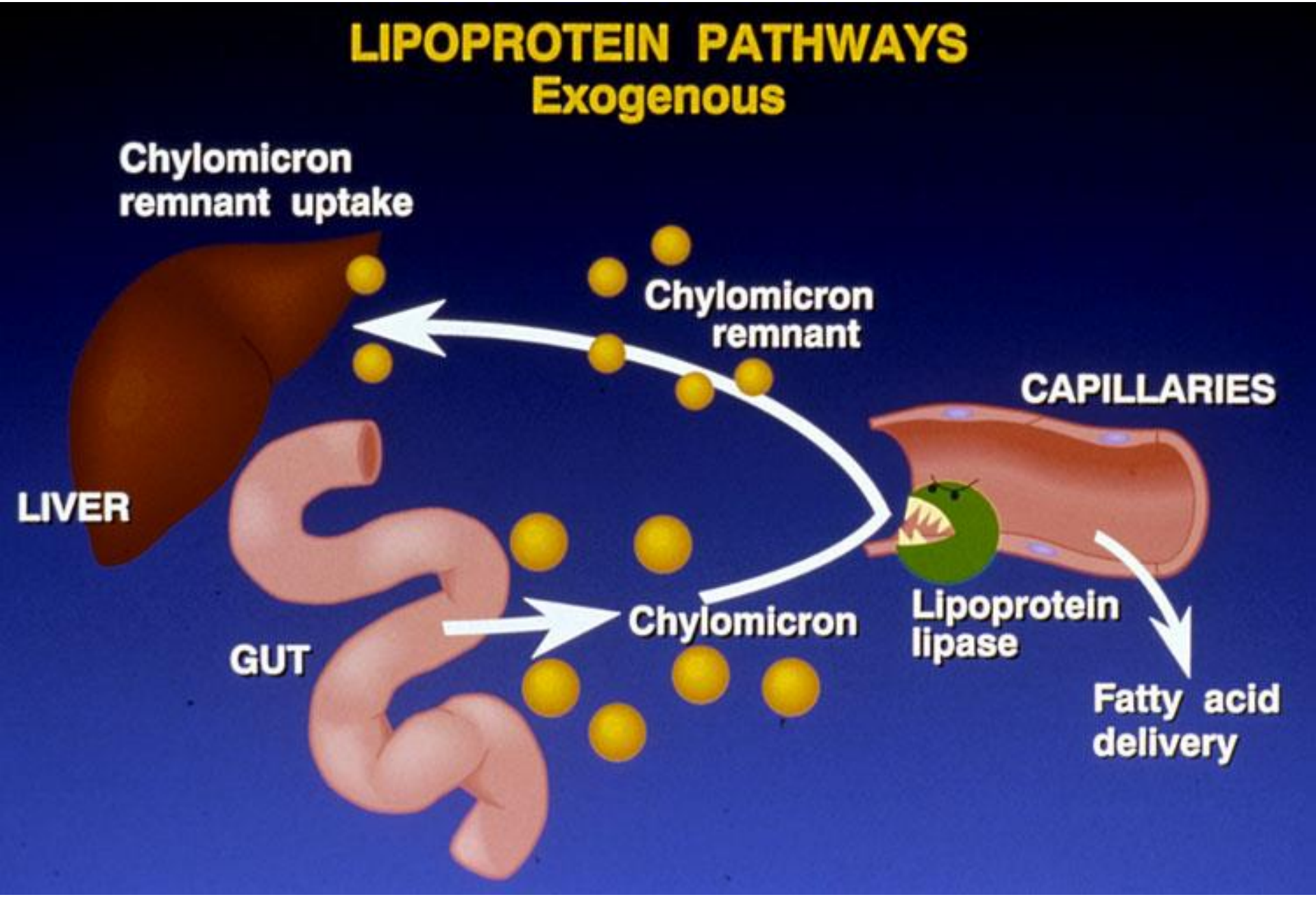
Blood levels for Lipids

- **Total Cholesterol:**
  - **<200 mg/dl = desirable**
  - **200-239 mg/dl = borderline hyperlipidemia**
  - **>240 mg/dl = hyperlipidemia**
- **LDL < 130 mg/dl is favorable**
- **HDL > 35 mg/dl is favorable**

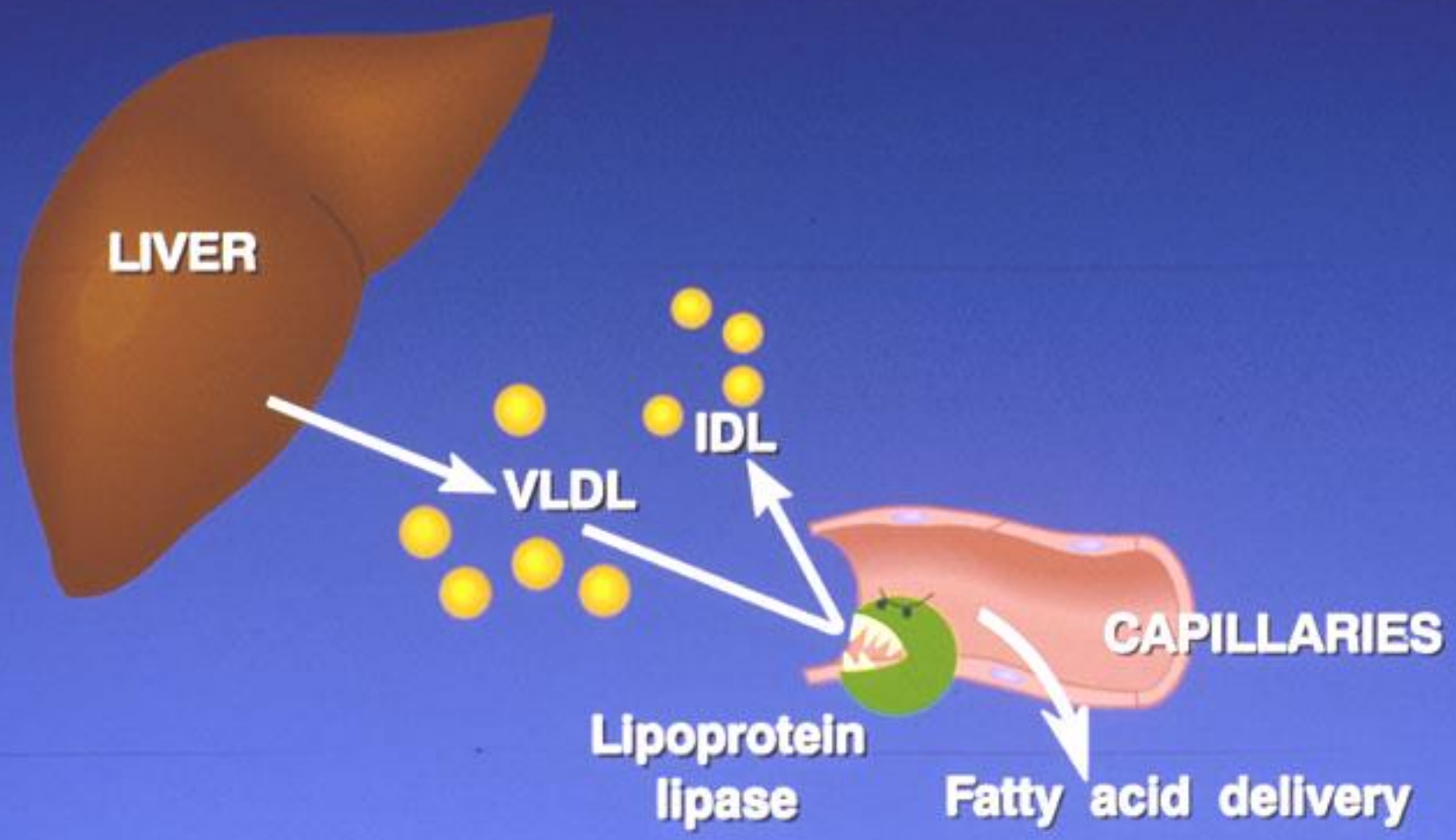

LIPOPROTEIN STRUCTURE
Apoprotein
Phospholipid
Cholesterol
Core
Triglyceride
Cholesteryl
ester

FOUR MAJOR LIPOPROTEIN CLASSES

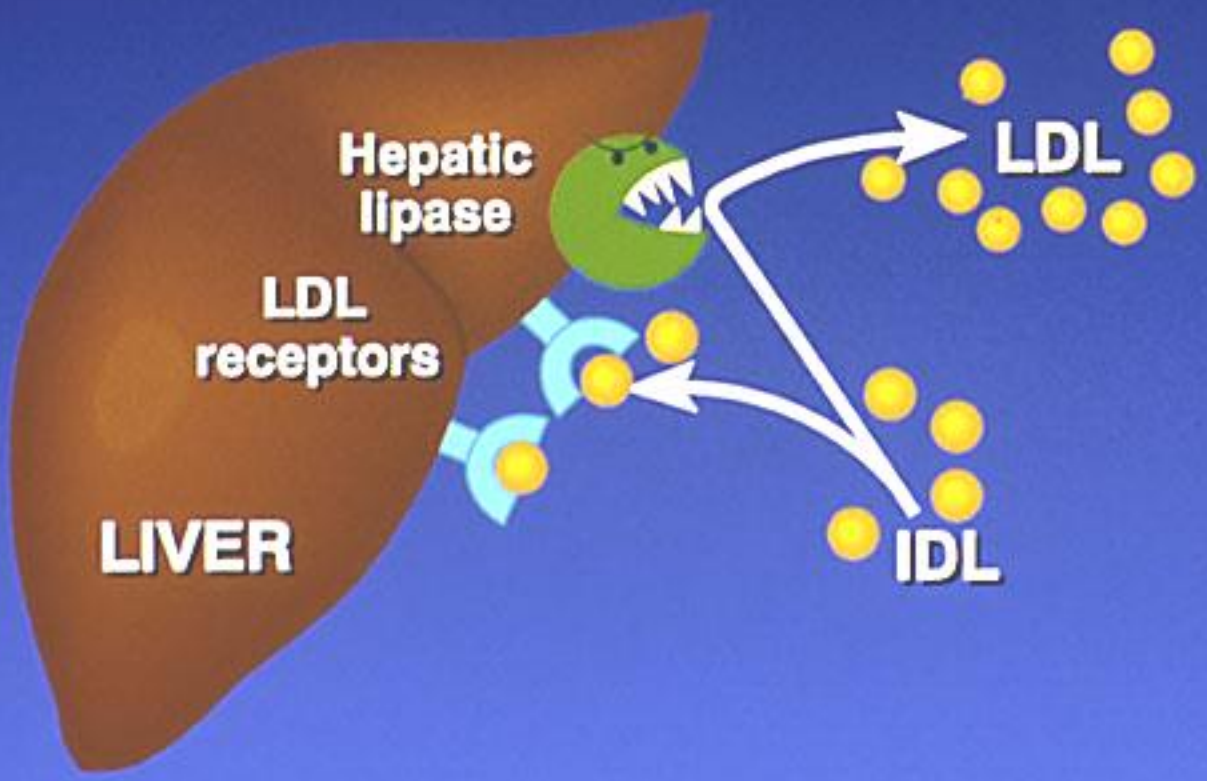
	High Density	Low Density	Very Low Density	Chylo-microns
Apolipo-proteins	A-I, A-II E, Cs	B-100	B-100, Cs, E	B-48, Cs, E, A-I, A-II
Major core lipids	Cholesteryl ester	Cholesteryl ester	Triglyceride	Triglyceride
Relative sizes	HDL_2 HDL_3			


LIPOPROTEIN PATHWAYS
Exogenous
Chylomicron remnant uptake
Chylomicron remnant
CAPILLARIES
LIVER
GUT
Chylomicron
Lipoprotein lipase
Fatty acid delivery

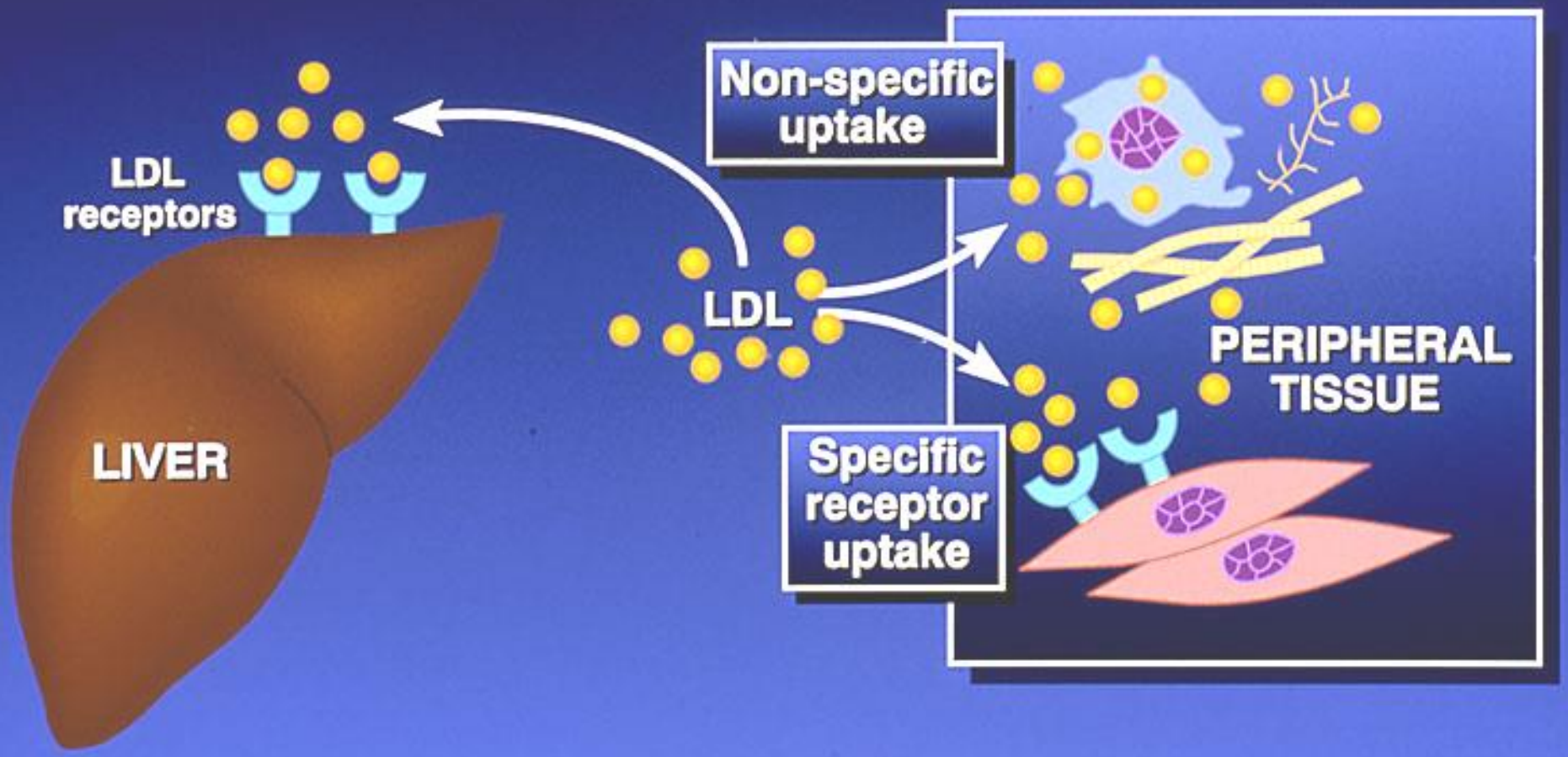
LIPOPROTEIN PATHWAYS
Endogenous
(VLDL-IDL)

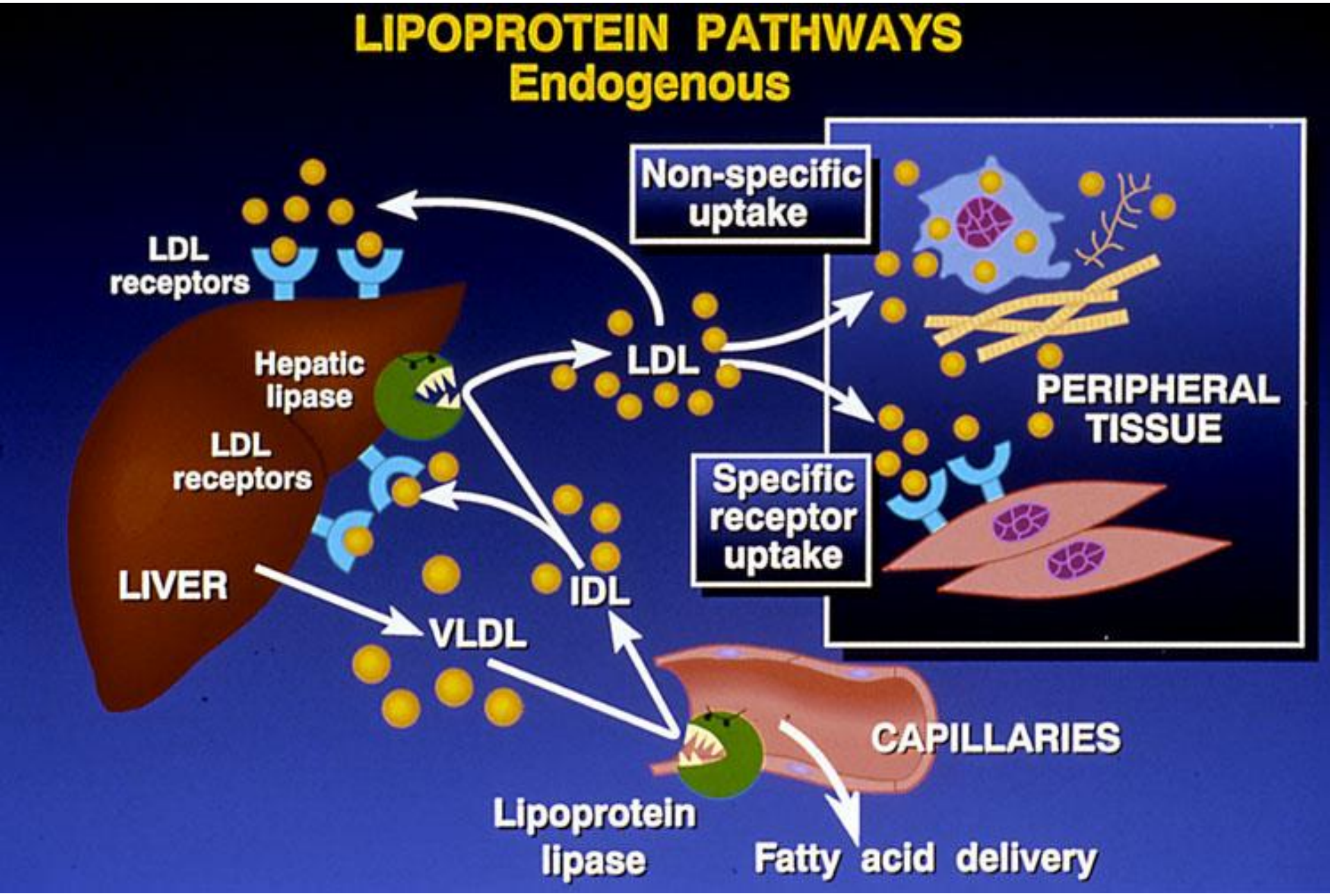


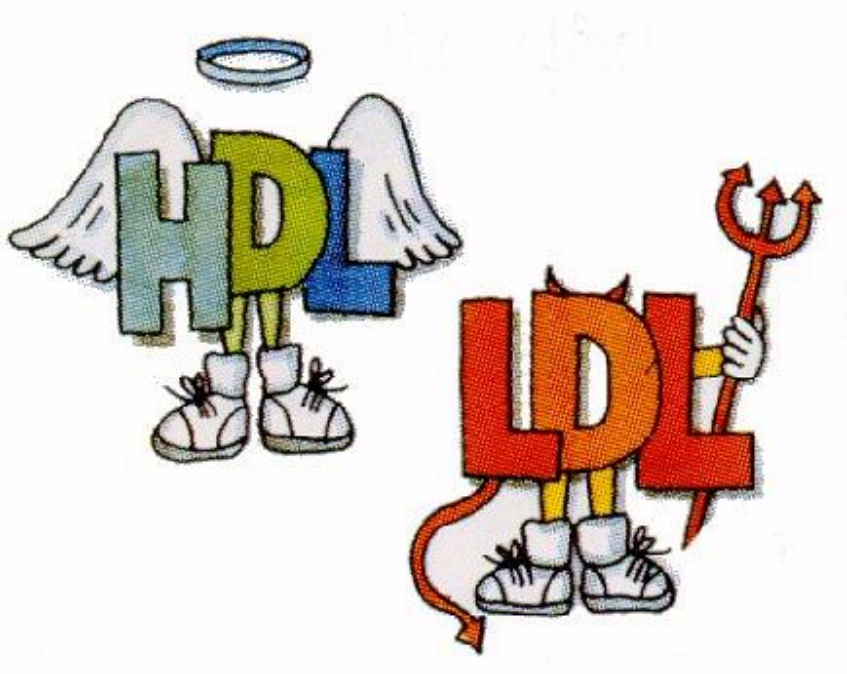
LIPOPROTEIN PATHWAYS
Endogenous
(IDL-LDL)



LIPOPROTEIN PATHWAYS
Endogenous
(LDL Uptake)




LIPOPROTEIN PATHWAYS
Endogenous
Non-specific uptake
LDL receptors
Hepatic lipase
LDL
LDL receptors
PERIPHERAL TISSUE
Specific receptor uptake
LIVER
IDL
VLDL
CAPILLARIES
Lipoprotein lipase
Fatty acid delivery

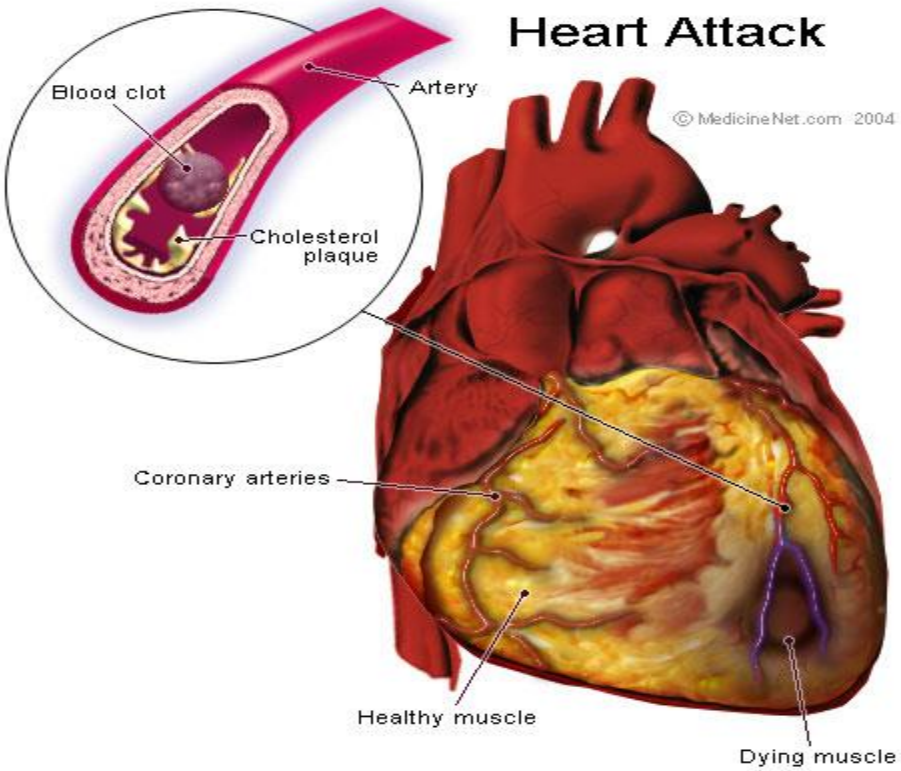


High serum levels of cholesterol cause disease and death by contributing to development of **atherosclerosis**

Cholesterol which is present in the form of the **LDL** is so-called **"bad cholesterol."**

Cholesterol in the form of **HDL** is referred to as **"good cholesterol"**

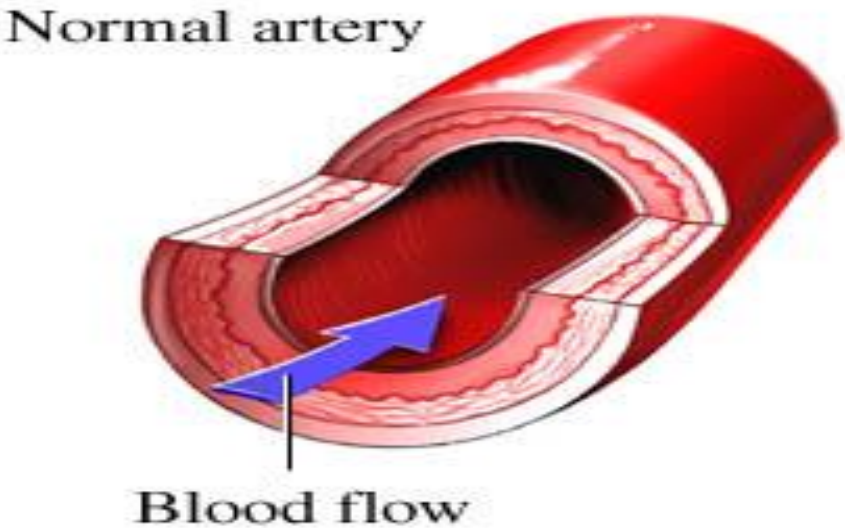
HDL functions as a shuttle that moves cholesterol throughout the body

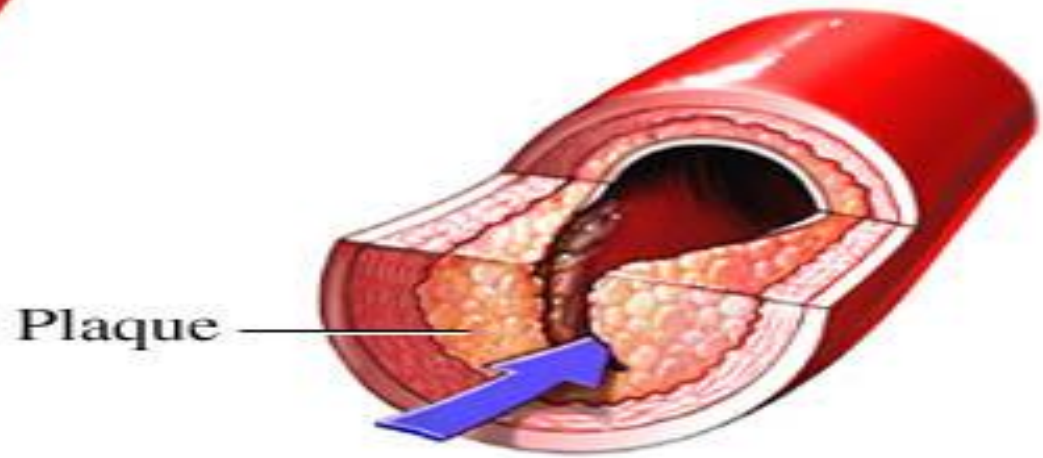


LDL/HDL Ratio

The ratio of cholesterol in the form of LDL to that in the form of HDL can be used to evaluate susceptibility to the development of atherosclerosis

For a healthy person, the LDL/HDL ratio is 3.5





For a healthy person, the **LDL/HDL ratio** is 3.5


OBESITY
Sex hormone imbalance
Increased free fatty acids
Mechanical stress
Metabolic syndrom
Insulin resistance
Hypertension
Dyslipidemia
Sleep apnea
Hormone dependent tumors
Osteoarthritis
Type 2 diabetes mellitus
Low back pain
Shortness of breath
DISABILITY
Cardiovascular disease
MORTALITY
© 2006 www.ObesityModel.com

Prevention of Lipid Disorder

- Reduce fat
  - Cut down on high fat foods
  - E.g. butter, margarine, oil, mayonnaise
- Consume small amounts of unsaturated fats
  - Do not eliminate fat completely since it is high in calories

Prevention of Lipid Disorder

- Limit added sugar and alcohol
  - Added sugar and alcohol are ‘empty calories’
- Watch portions of all food
  - ‘fat free’ ≠ ‘calorie-free’
- Drink at least 8 glasses of water everyday
  - Water is calorie-free, refreshing, and filling

Prevention of Lipid Disorder

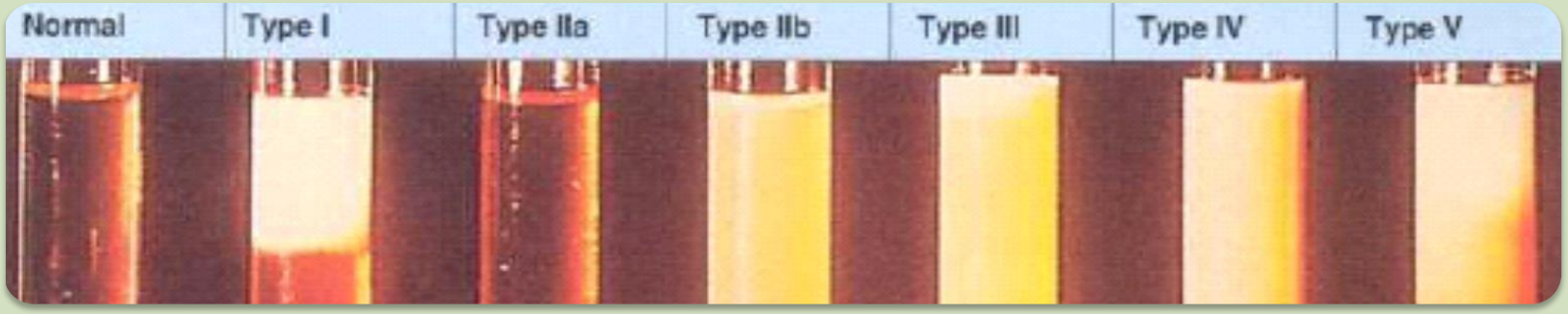
- Increase intake of vegetables, fruits, and whole grains
  - Loaded with fiber
  - Contain high amounts of vitamins, minerals, and phytonutrients
- Include low-fat protein-rich food with every meal
  - E.g. tofu, beans, eggs, and fish

Prevention of Lipid Disorder

- **Slow down when eating**
  - **Too fast eating will exceed calorie needs before realizing we are full**

Hyperlipoproteinaemia

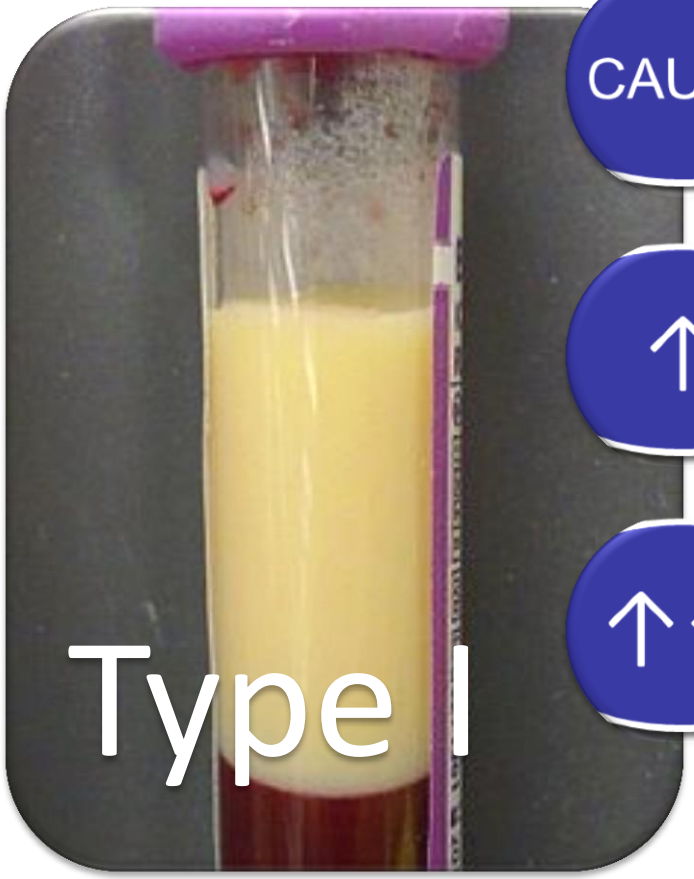
Hyperlipoproteinaemia



Fredrickson(WHO) classification

Fredrickson Classification	
Type I	High chylomicrons
Type II Type IIa Type IIb	 High LDL High LDL and VLDL
Type III	High chylomicrons and Intermediate Density Lipoprotein (IDL)
Type IV	High Triglycerides
Type V	Very similar to Type I, but with high VLDL
Non-classified forms: Hypo-alpha lipoproteinemia Hypo-beta lipoproteinemia	

Type I Hyperlipoproteinemia



CAUSE — Lipoprotein lipase deficency

↑ — Chylomicron

↑↑ — Triacylglycerol

Type IIa Hyperlipoproteinemia

- Most common
- Familial hypercholesterolemia
- Defective LDL receptors
- Plasma LDL & cholesterol level are elevated

Type IIb Hyperlipoproteinemia

Excess of apo-B

↑Pre-beta & beta (VLDL & LDL)

↑Total cholesterol, LDL, VLDL & TG

Type III Hyperlipoproteinemia

Abnormal apo-E

‘Broad beta' band (IDL)

↑Total cholesterol & TG

Type IV Hyperlipoproteinemia

Overproduction of VLDL

Pre-beta (VLDL)

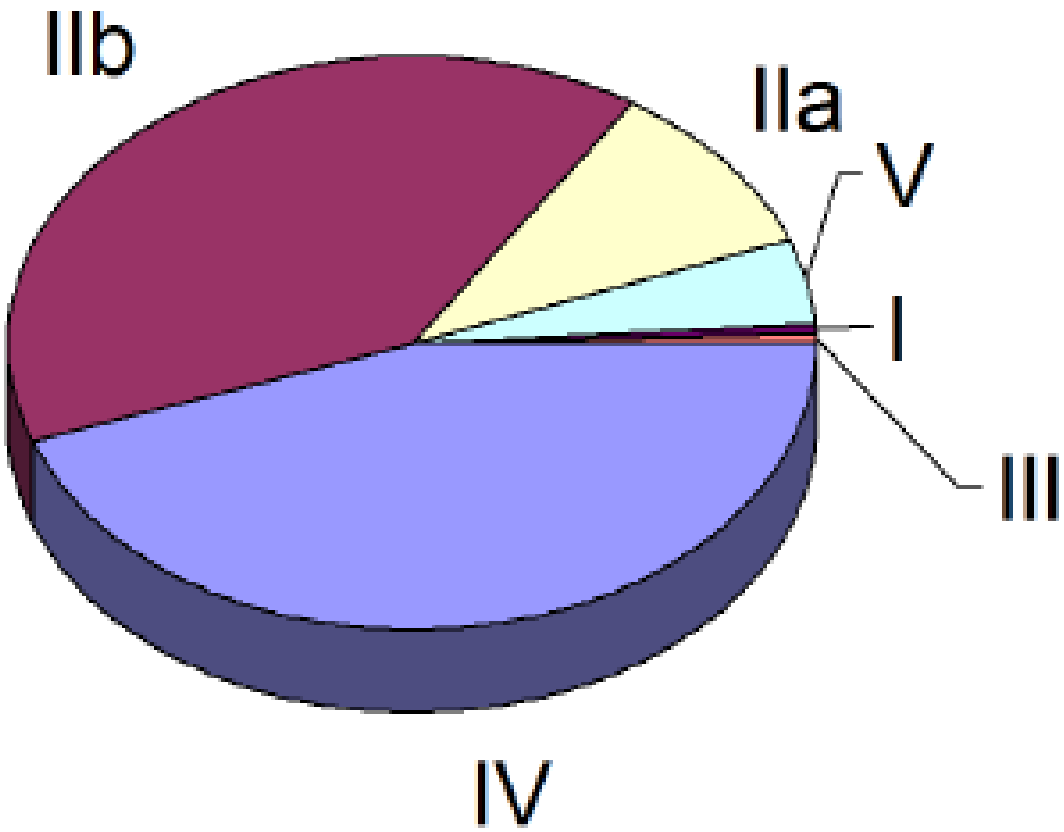
↑Triacylglycerol

Type V Hyperlipoproteinemia

Secondary to other causes

Pre-beta (VLDL) plus chylomicrons

↑Total cholesterol & TG



Relative prevalence of familial forms of hyperlipoproteinemia[20]

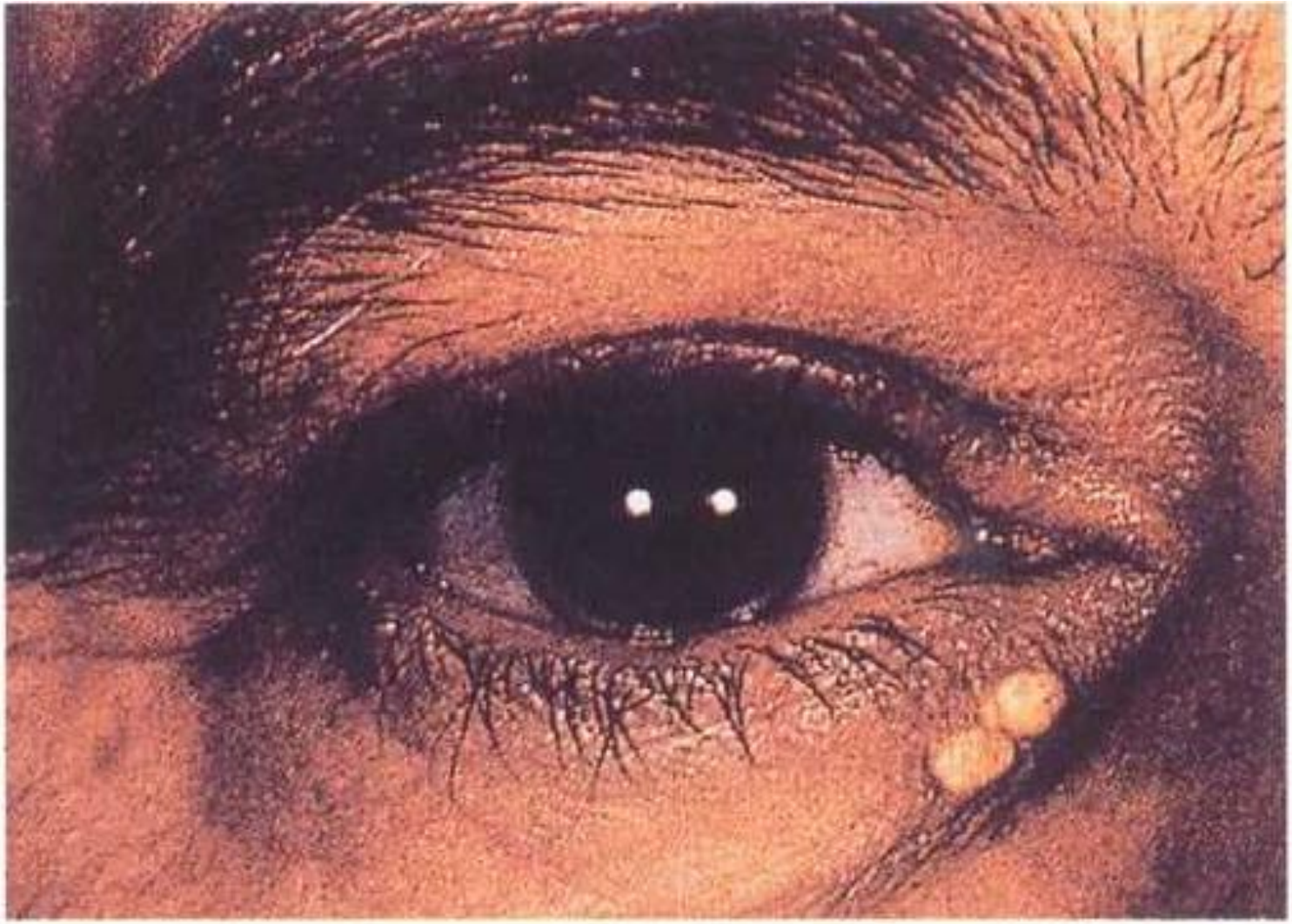


Fig. 1 **Xanthelasmas in younger individuals (age <40 years) usually indicate hypercholesterolaemia.** In the elderly they do not carry the same significance.

Palmar xanthoma

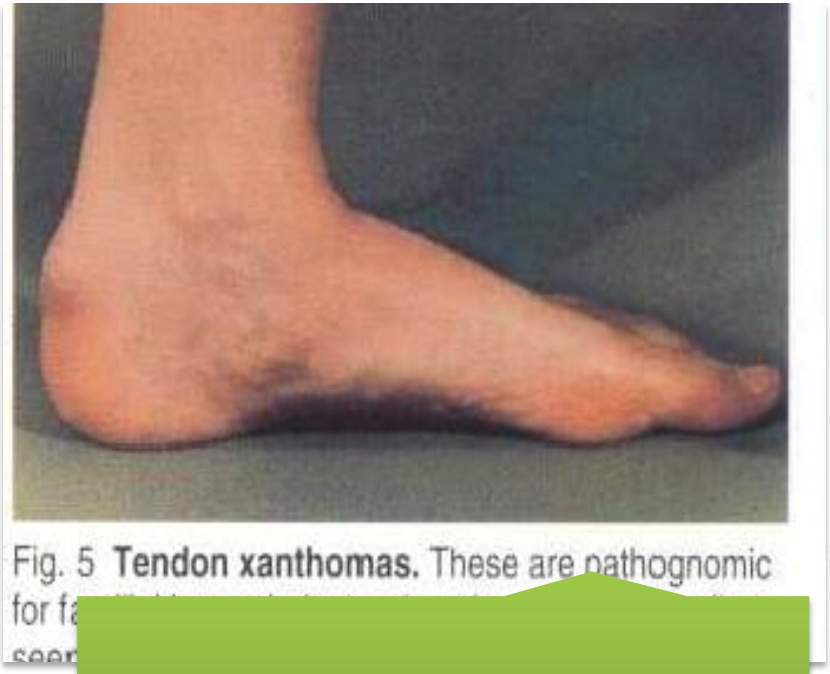


Fig. 5 **Tendon xanthomas.** These are pathognomic for fa

Tendon xanthoma

Hypolipoproteinemia

Hypolipoproteinemia

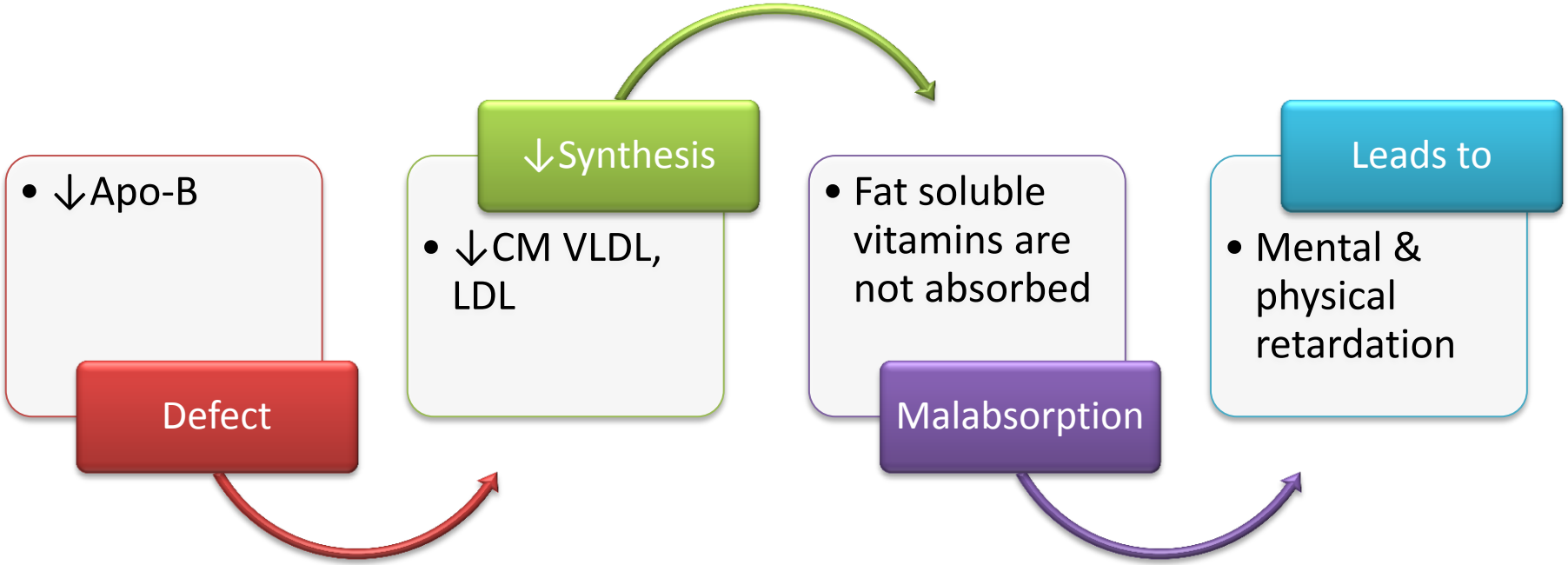
Abetalipoproteinemia

- Defect in synthesis of apo-B

Familial lipoprotein deficiency[Tangier disease]

- Defect in synthesis of apo-A

Abetalipoproteinemia



Fatty liver

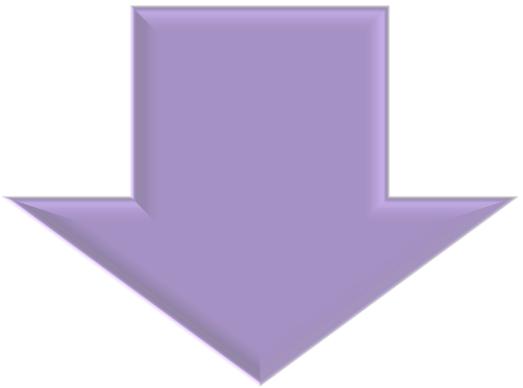
Excessive accumulation of fat in the liver parenchymal cells

- Liver is not a storage organ for fat
- Liver contains about 5% fat

Fatty liver


Accumulation of fat in the liver
Fibrotic changes
Cirrhosis

FATTY LIVER: CAUSES



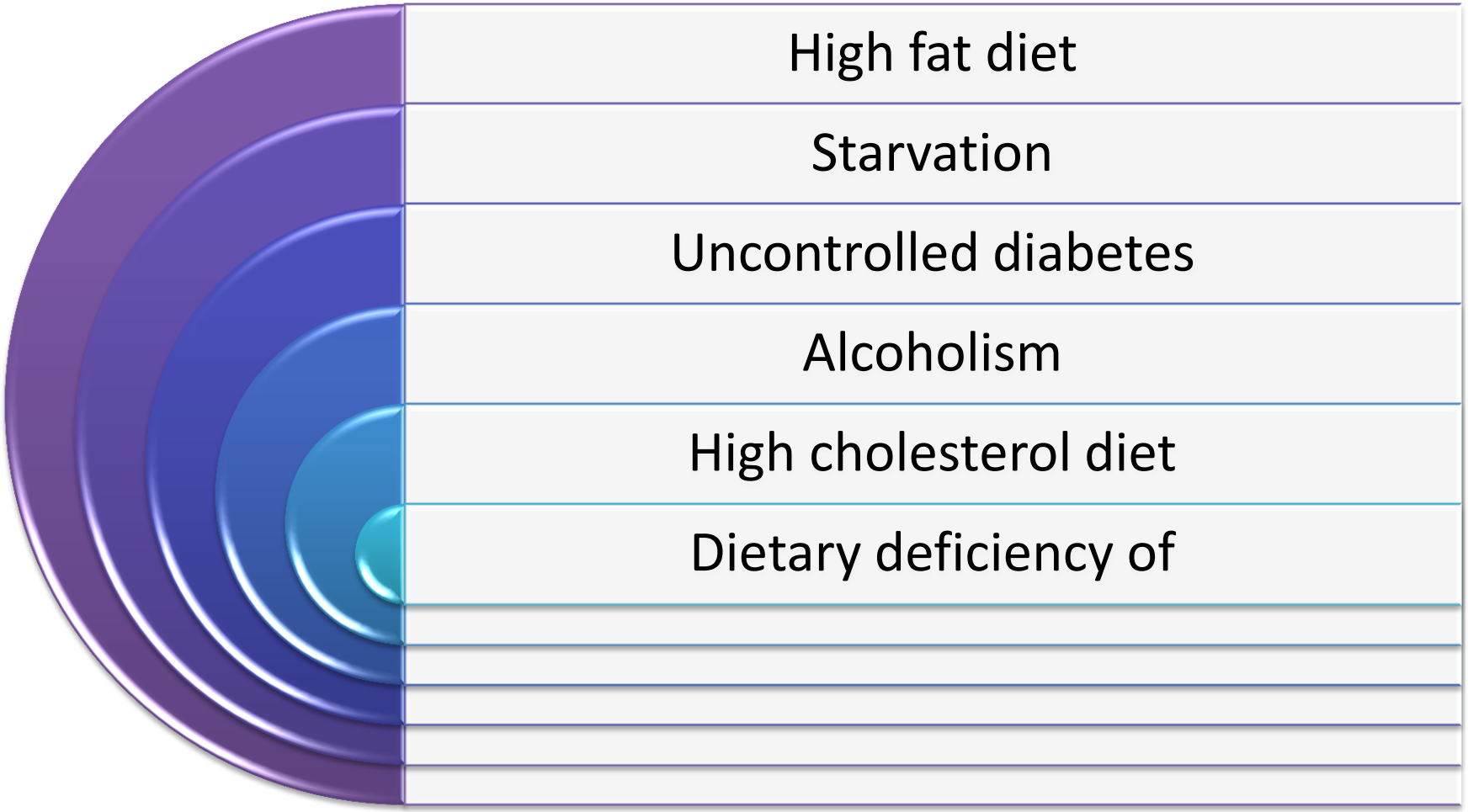
DECREASED

Secretion of VLDL

INCREASED

Hepatic TG synthesis

Conditions that cause FATTY LIVER



Conditions that cause FATTY LIVER