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Programs of Pharmacy

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LIPID

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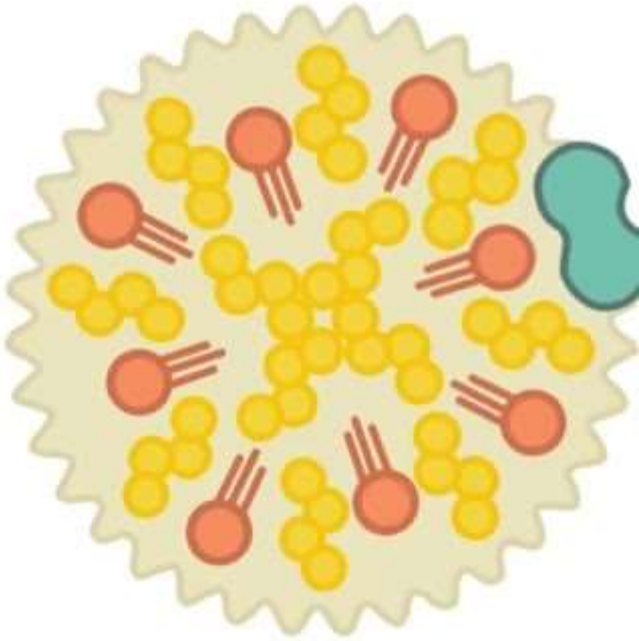
Introduction

- Lipids are a group of organic compounds that are water-insoluble but soluble in organic solvents such as alcohol and ether.
- They primarily consist of carbon, hydrogen, and oxygen, with a lower proportion of oxygen compared to carbohydrates.



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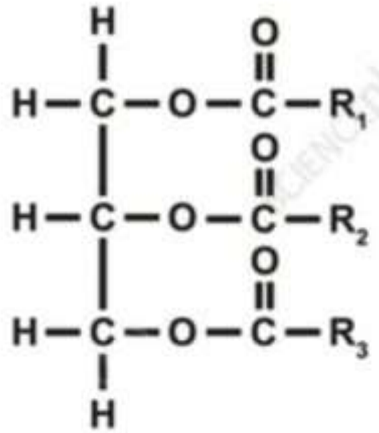
Classification of Lipids

- **Simple lipids**
  - Fatty Acid + Glycerol
    - **Triglycerides**



- **Complex lipids**
- **Derived lipids**

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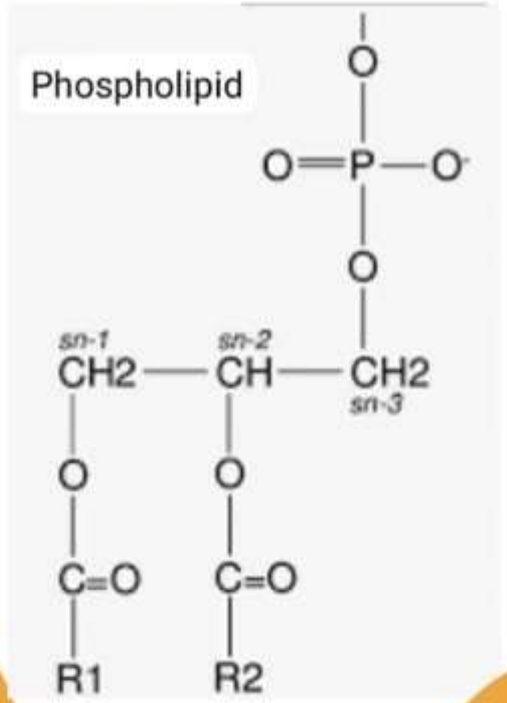
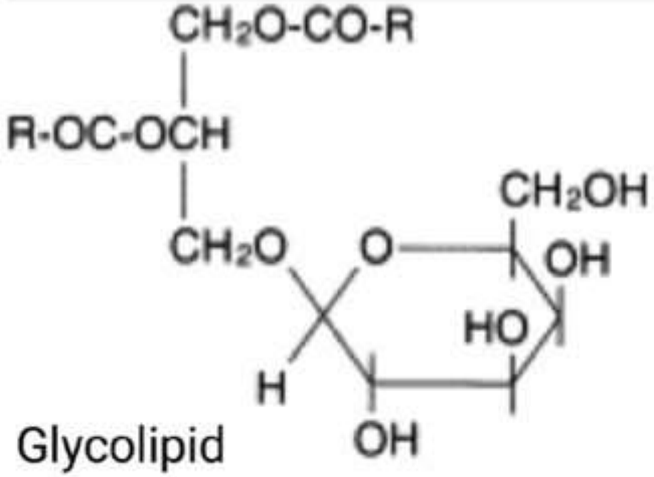
Classification of Lipids

Simple lipids

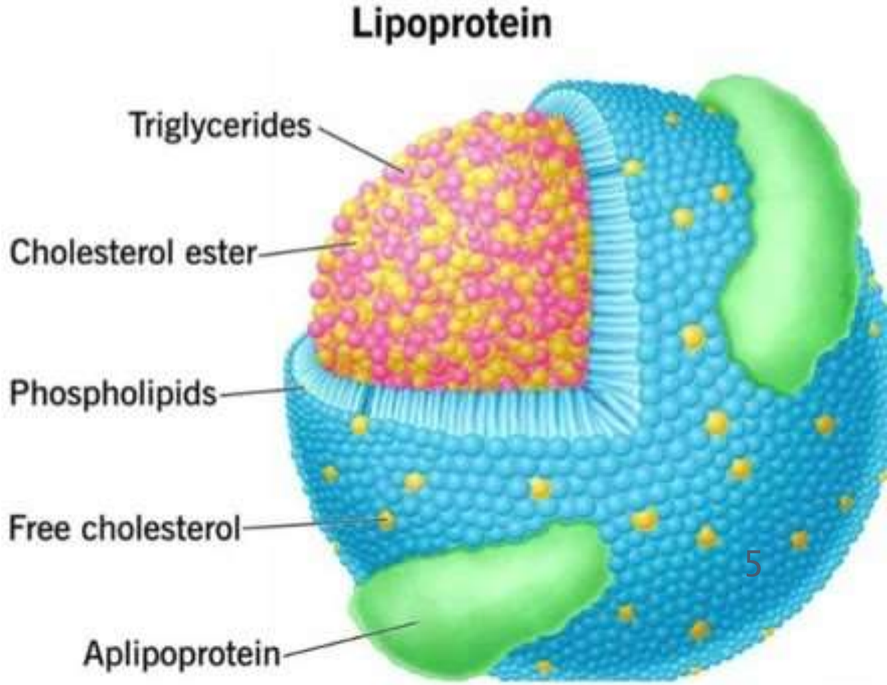


Complex lipids

Fatty Acid + Glycerol+ Groups



Derived lipids

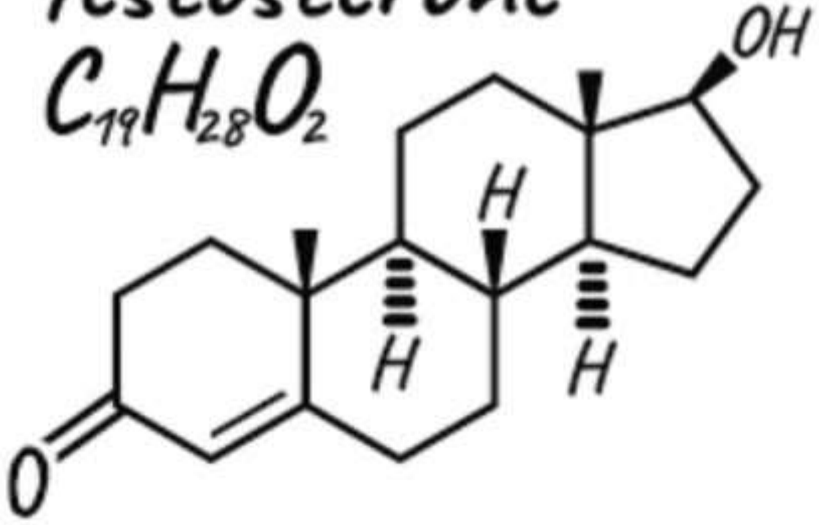


Classification of Lipids

Simple lipids

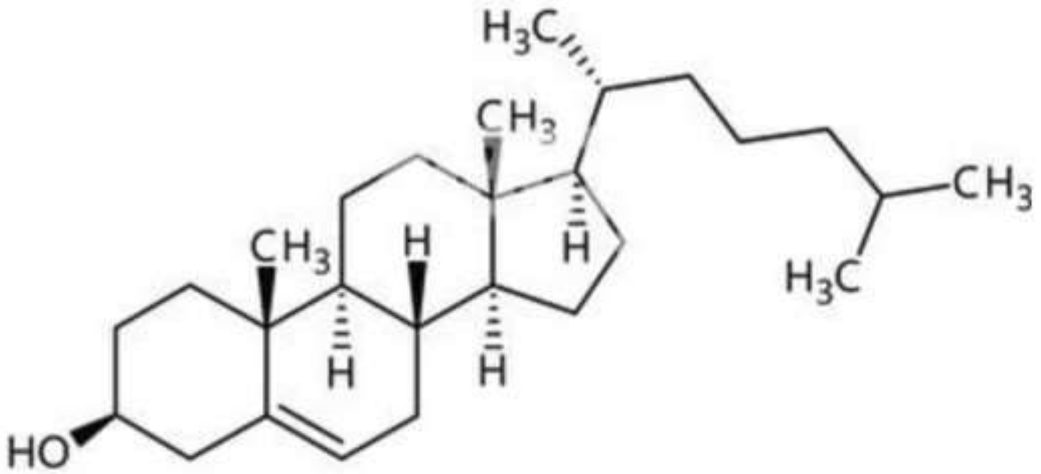
Testosterone

$C_{19}H_{28}O_2$



Complex lipids

CHOLESTEROL



Derived lipids

Drived from simple and complex lipids

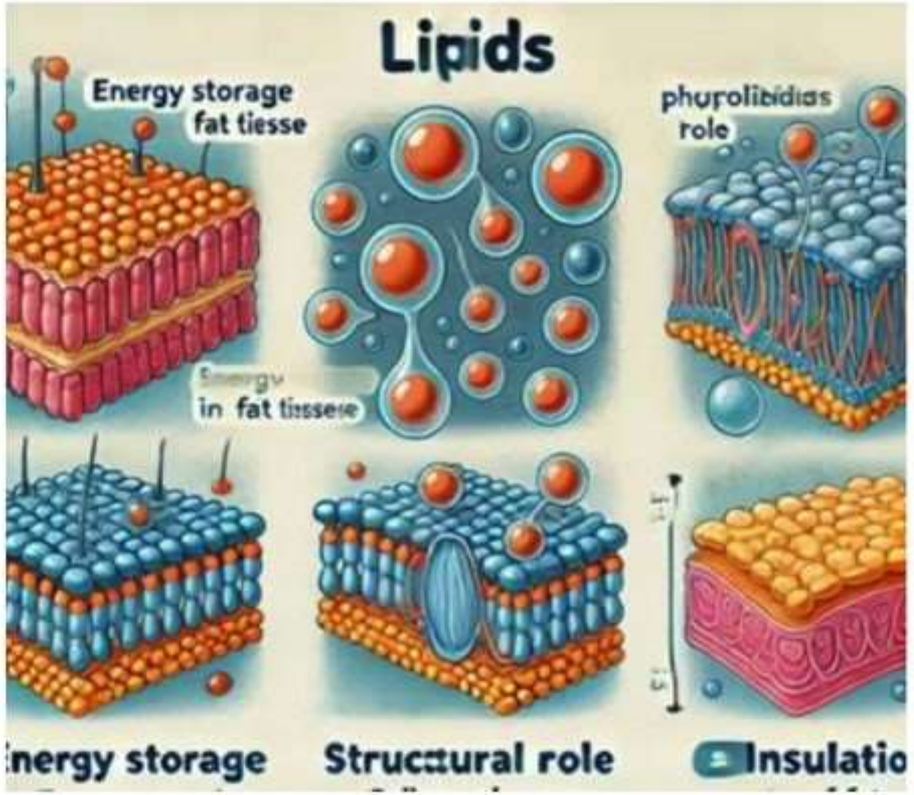
- Steroids
- Cholesterol

Function of Lipids

1. **Energy Storage:** Triglycerides provide long-term energy storage.
2. **Structural Role:** Phospholipids and cholesterol are critical for maintaining the integrity of cell membranes.

A. Phospholipids form the lipid bilayer in cell membranes.

B. Cholesterol maintains membrane fluidity.

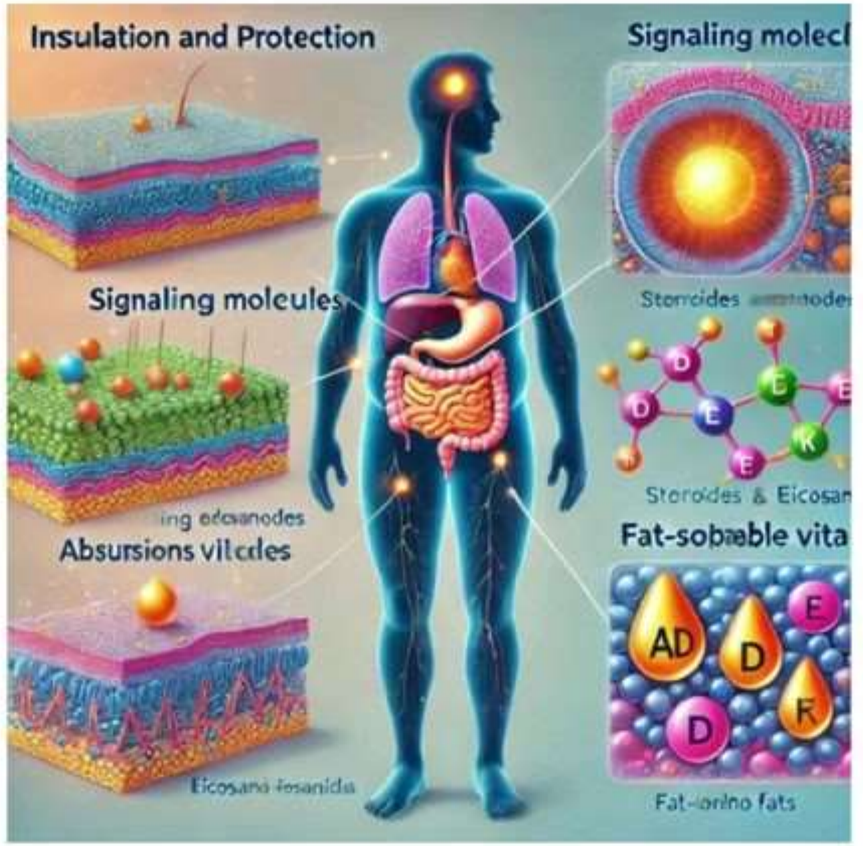


Function of Lipids

3. **Insulation and Protection:** Fat layers act as thermal insulation and protect organs.

4. **Signaling Molecules:** Steroids and eicosanoids act as hormones and mediators

5. **Absorption of fat-soluble vitamins:** Lipids help in the absorption of vitamins A, D, E, and K.



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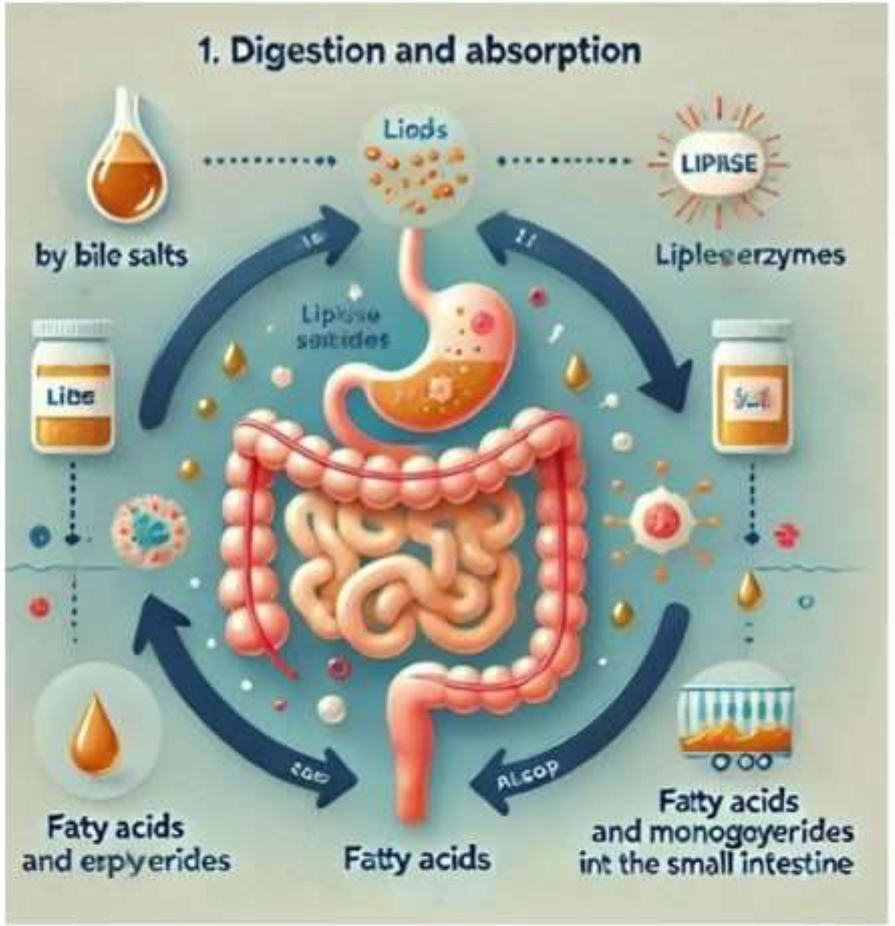
Transport of Lipids

- Lipids are transported in the body through the blood, but since they are hydrophobic, they need special mechanisms to move efficiently

1. Digestion and Absorption

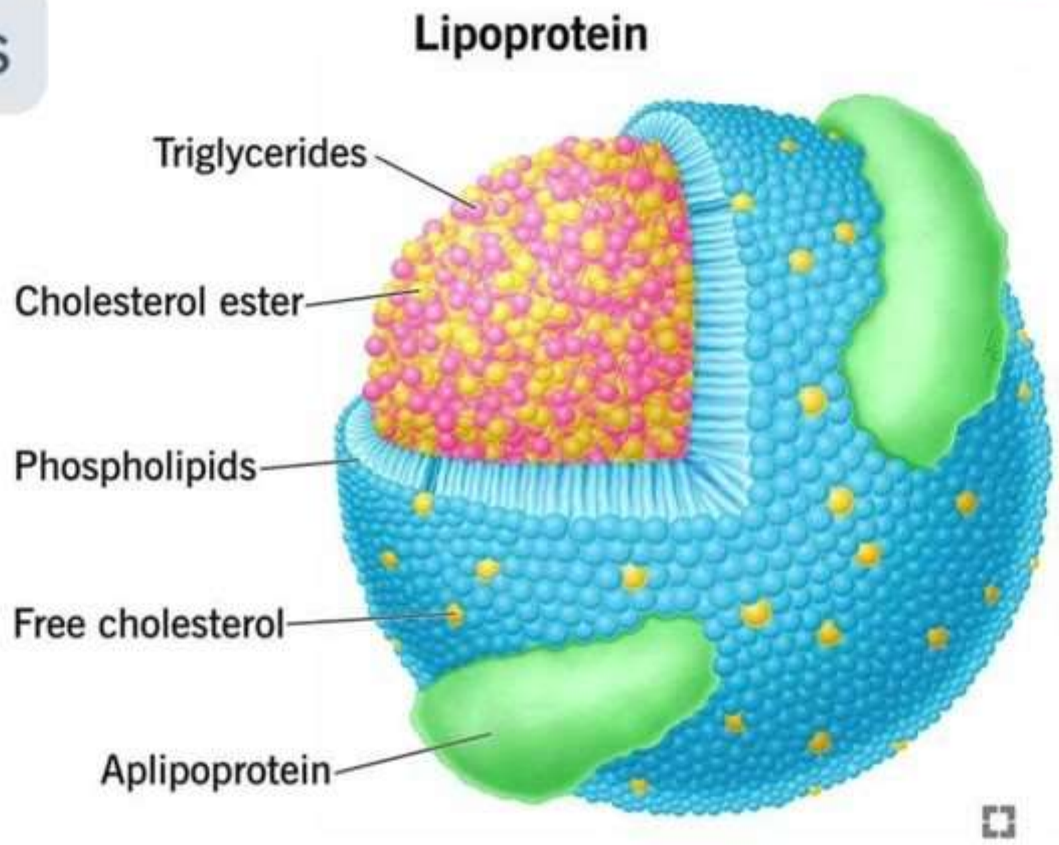
- Lipids are broken down in the digestive system by bile salts and enzymes like lipase.
- The products (fatty acids, monoglycerides) are absorbed in the small intestine.



Transport of Lipids

2. Formation of Chylomicrons

- Inside the intestinal cells, digested lipids are reassembled into triglycerides.
- These triglycerides are packed with proteins into structures called chylomicrons.
- Chylomicrons are transported through the lymphatic system into the bloodstream.



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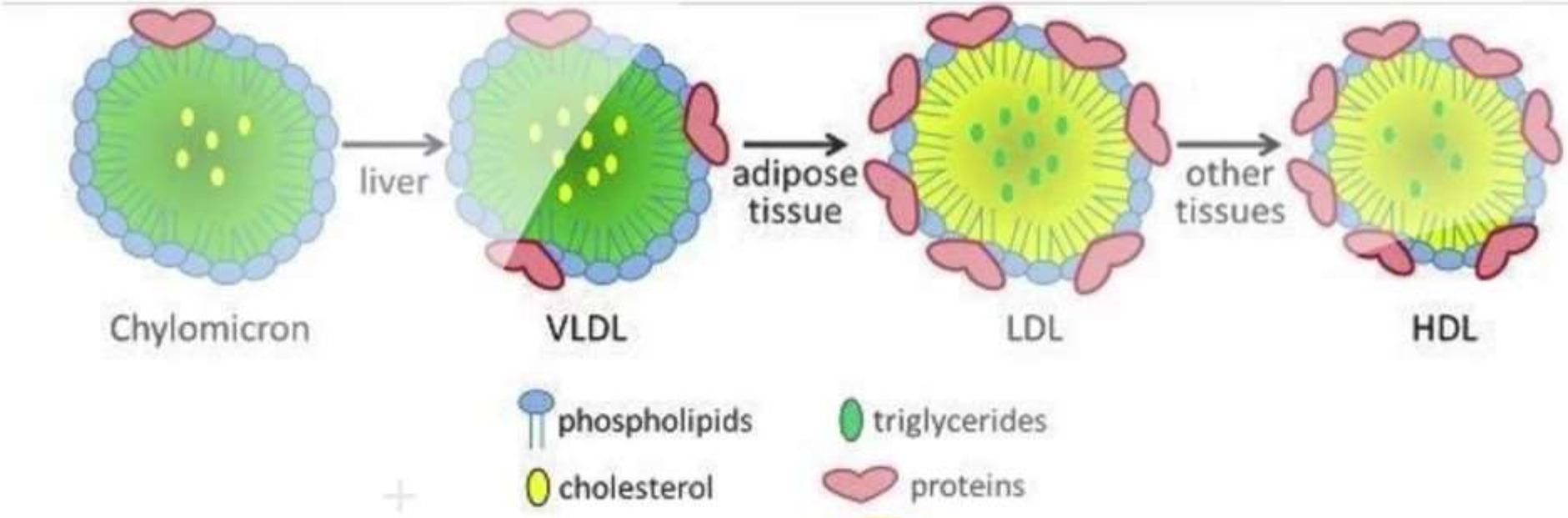
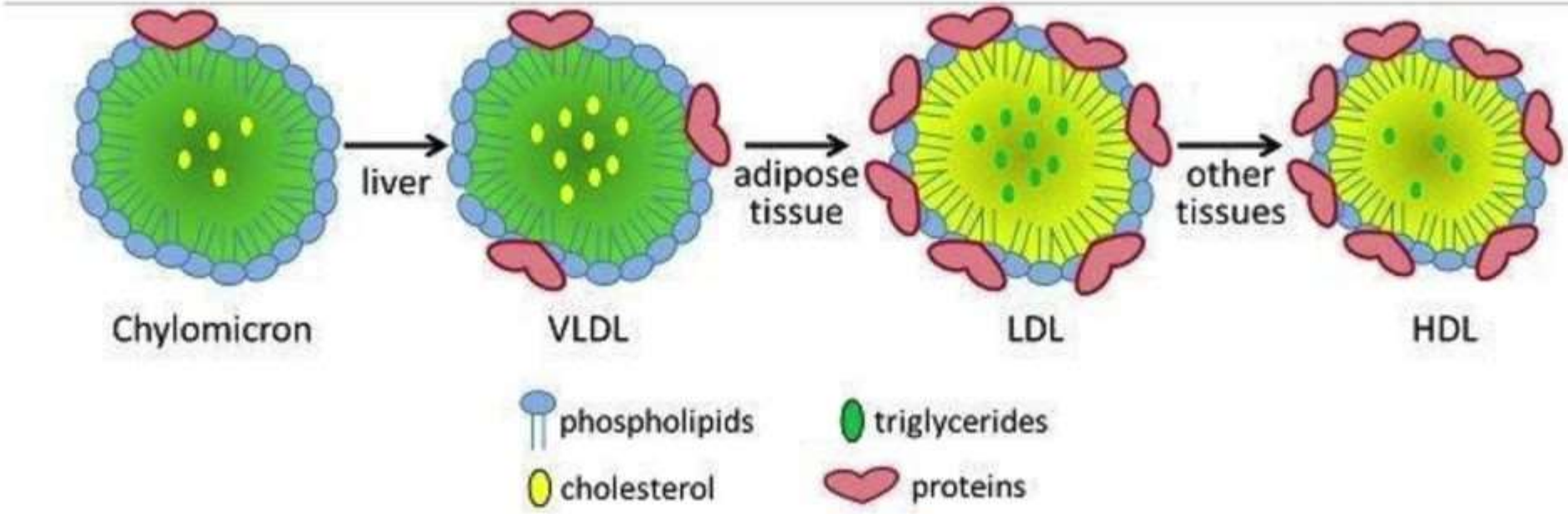
Types of Lipoproteins

- **Chylomicrons:** These transport dietary lipids from the intestines to the rest of the body.
- **LDL:** Transport cholesterol to cells. Known as "bad cholesterol" because they can accumulate in blood vessels, leading to health issues.



Types of Lipoproteins

- **VLDL:** Responsible for carrying triglycerides from the liver to various tissues.
- **HDL:** Collect excess cholesterol from tissues and return it to the liver. Referred to as "good cholesterol" because they help remove excess cholesterol



2. Uptake by Cells:

- Lipoproteins interact with receptors on the cell surface.
- They deliver lipids to cells for energy, storage, or to build cell structures.

3. Storage and Usage:

- Lipids are stored in adipose tissue as an energy source.
- Some lipids are used to build cell membranes or produce hormones and signaling molecules.

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Catabolism

Definition:

A process of breaking down fatty acids to produce energy within the mitochondria

Main Steps:

1. **Activation:** Fatty acids are converted to Fatty Acyl-CoA using ATP.
2. **Transport:** Fatty Acyl-CoA enters the mitochondria through the Carnitine Shuttle.
3. **Breakdown (β-Oxidation):** Fatty acids are broken down by removing 2-carbon units at a time, producing:
   - **Acetyl-CoA** (enters the Krebs Cycle).
   - **$FADH_2$** and **NADH** (generate ATP in the electron transport chain).

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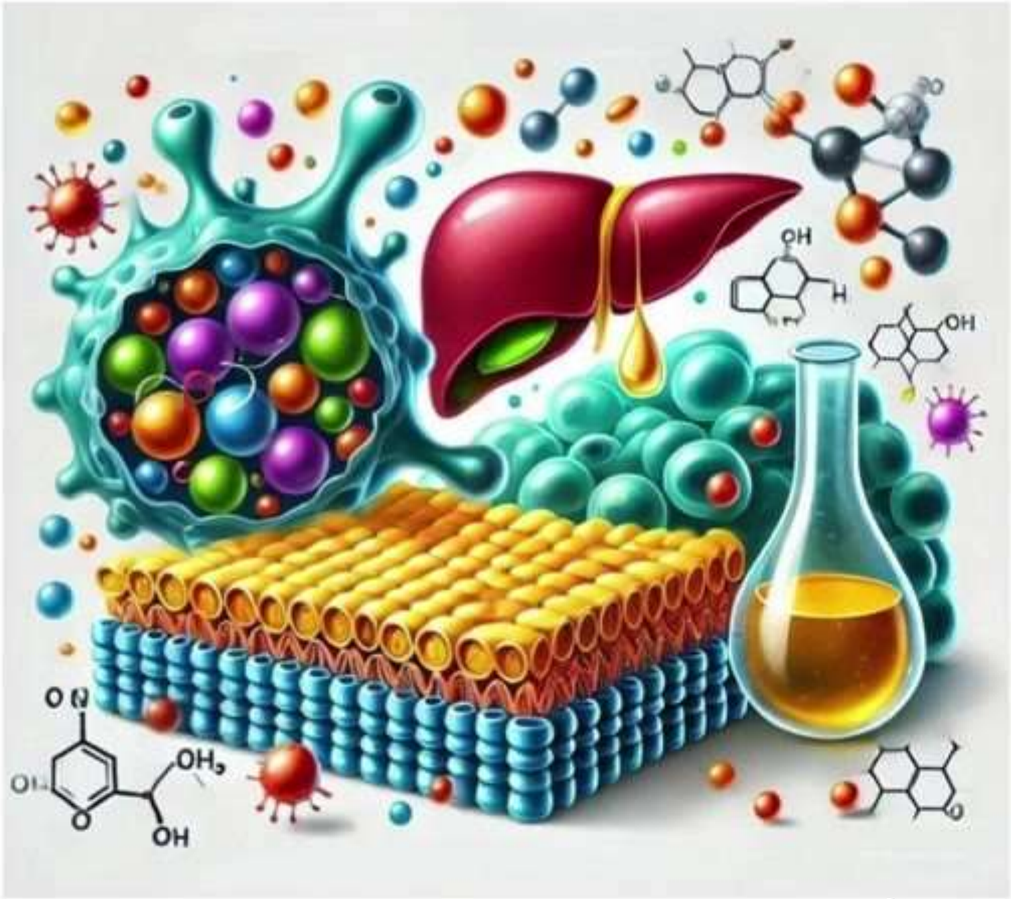
Lipid anabolism (lipogenesis)

is synthesis of lipids on liver cells from amino acids which are converted to acetyl-CoA and from glucose into glyceraldehyde 3-phosphate.

Both of acetyl-CoA and glyceraldehyde 3-phosphate converted into triglycerides.



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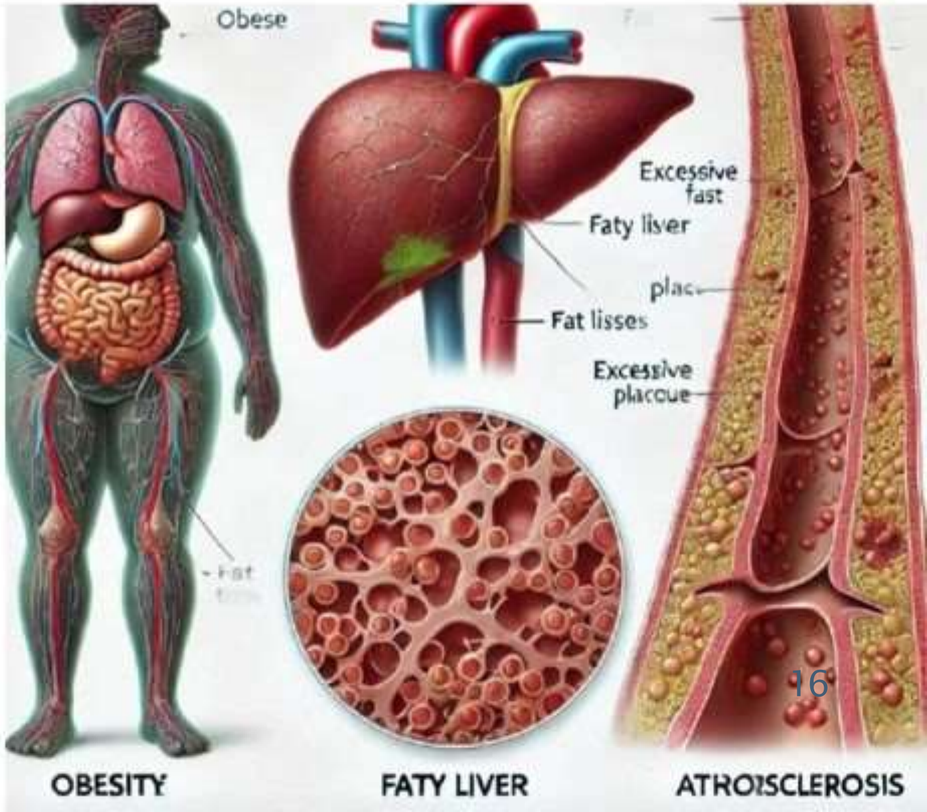
CONDITIONS OF LIPID DISORDERS

- **Definition:**

These disorders occur when necessary, enzyme do not work correctly or lost.

- **Disorders:**

1. Obesity
2. Fatty Liver
3. Atherosclerosis



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OBESITY

- **Definition:**

Is accumulation of fat in the body.

- **Metabolic change in obesity:**

1. Dyslipidemias:
2. Glucose intolerance:

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FATTY LIVER

- **Definition:**

is a reversible condition where in large vacuoles of triglyceride fat accumulate in liver cells.

- **Causes:**

1. Decreased Phospholipid Synthesis:
2. Reduced Secretion of VLDL:
   - Ethanol (alcohol) metabolism produces a substance called acetaldehyde.

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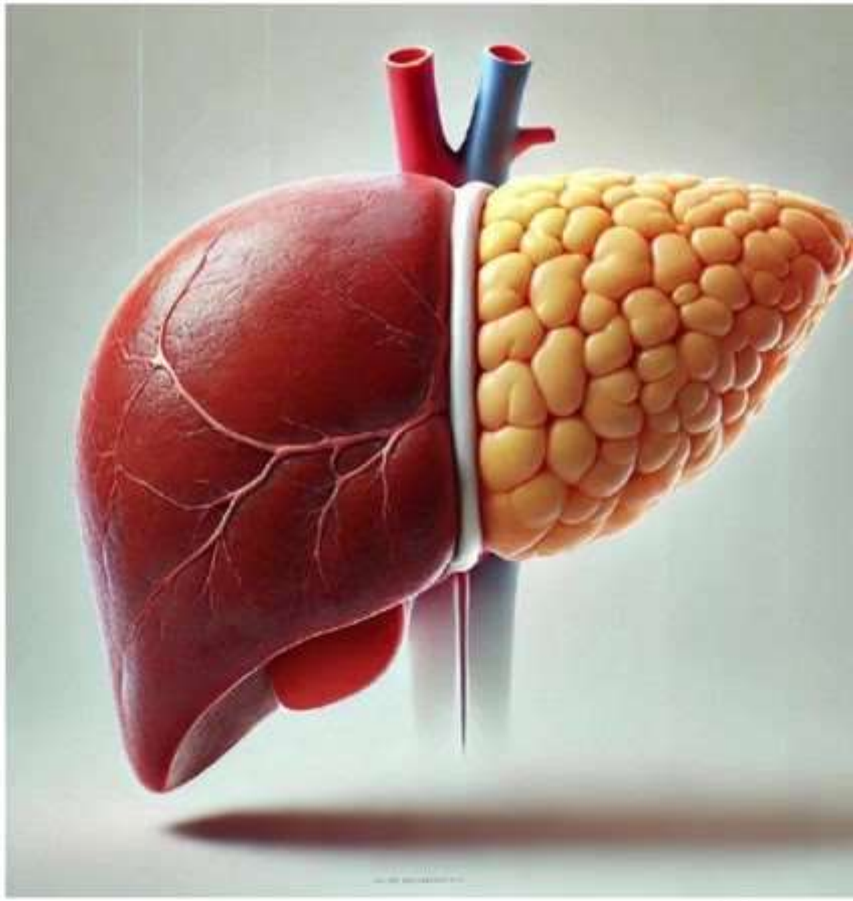
FATTY LIVER

3. **Activation of Ito Cells (Hepatic Stellate Cells):**
Alcohol stimulates these liver cells to produce more extracellular matrix (ECM) proteins, resulting in:

Fibrosis: Increased fibrous tissue.

Cirrhosis: Permanent liver damage.



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ATHEROSCLEROSIS

Atherosclerosis is the thickening of artery walls due to the accumulation of white blood cells (foam cells) and smooth muscle cells, forming fatty plaques that narrow the arteries and reduce blood flow.

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SUMMARY

- Lipids are essential compounds for energy storage, cell membrane structure, and hormone production.
- They include fatty acids, triglycerides, phospholipids, and sterols.
- Lipid digestion involves bile and enzymes, with absorption as chylomicrons.
- Excess glucose is stored as fat through lipogenesis, while beta-oxidation breaks fatty acids into energy.
- Disorders like obesity, fatty liver, and atherosclerosis arise from lipid imbalances.

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Which of these disorders can result from the accumulation of fat in the liver?

1. Type 1 diabetes
2. Fatty liver disease
3. High blood pressure

Correct answer:
Fatty liver disease

REFRENCE

- Lippincott's Illustrated Reviews: Biochemistry
- Guyton and Hall Textbook of Medical Physiology

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Thank you!