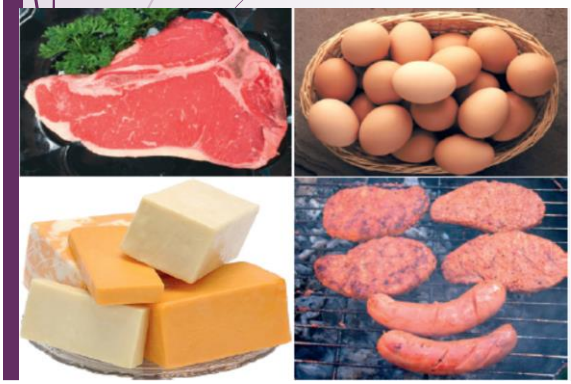
Nutrition & Diet Therapy
Third Stage
First Semester 2022-2023



Lecture Three : Lipids

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Lipids or Fats

Fats are greasy substances that are not soluble in water. They are soluble in some solvents such as ether, benzene, and chloroform. They provide a more concentrated source of energy; each gram of fat contains 9 Kcalories. Fat-rich foods are generally more expensive than carbohydrate-rich foods. Like carbohydrates, fats are composed of carbon, hydrogen, and oxygen but with a substantially lower proportion of oxygen. The word lipid is derived from lipos, a Greek word for fat

However, carbohydrates and lipids have two important structural differences:

1. Lipids are more complex, with more carbon (C) and hydrogen (H) atoms and fewer oxygen (O) atoms.
2. The common structural units of lipids are fatty acids, whereas the common structural units of carbohydrates are simple sugars.

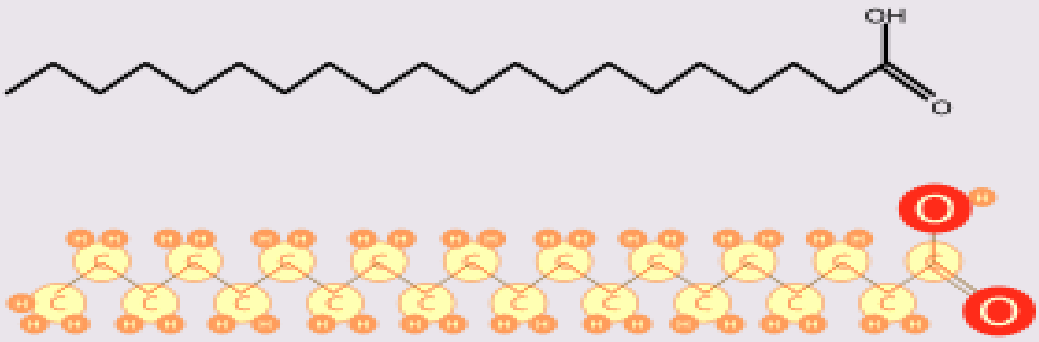
Food Sources

- Fats are present in both animal and plant foods. The animal foods that provide the richest sources of fats are meats, especially fatty meats, fatty fish such as tuna and salmon; whole milk; cream; butter; cheeses made with cream; egg yolk.
- The plant foods containing the richest sources of fats are olives, sunflower, safflower, sesame seeds, corn, peanuts, soybeans, margarine, nuts, avocados, coconut, and cocoa butter.

Fatty acids:

are organic compounds consist of short or long hydrocarbon chain. The first carbon atom in the molecule has three hydrogen atoms attached (methyl group). Chemists call the terminal chain that ending with methyl group is omega (ω). The last carbon atom in the fatty acid molecule forms an acid group (carboxyl group).

Structure of fatty acid



In nature, common fatty acids have **even numbers** of carbon atoms. Short-chain fatty acids have **2 to 4** carbons; medium-chain fatty acids have **6 to 12** carbons; and long chain fatty acids have **14 to 24** carbons.

They are classified into two methods:

1- According to the degree of saturation into:

a- Saturated fatty acids: each of its carbon atoms carries all the hydrogen atoms possible. In general, animal foods contain more saturated fatty acids than unsaturated.

b- Monounsaturated fatty acids: fatty acids with a pair of hydrogen atoms missing, creating one double bond. These lipids are generally from plant sources.

c- Polyunsaturated fatty acids: When fatty acids have two or more spaces unfilled with hydrogen atoms, creating two or more double bonds.

Hydrogenation: **Process producing a more saturated (or solid) fat. This process turns polyunsaturated vegetable oils into saturated fats (margarine is made in this way).**

2- According to their necessity for the body into:

a- Essential fatty acids (EFAs):

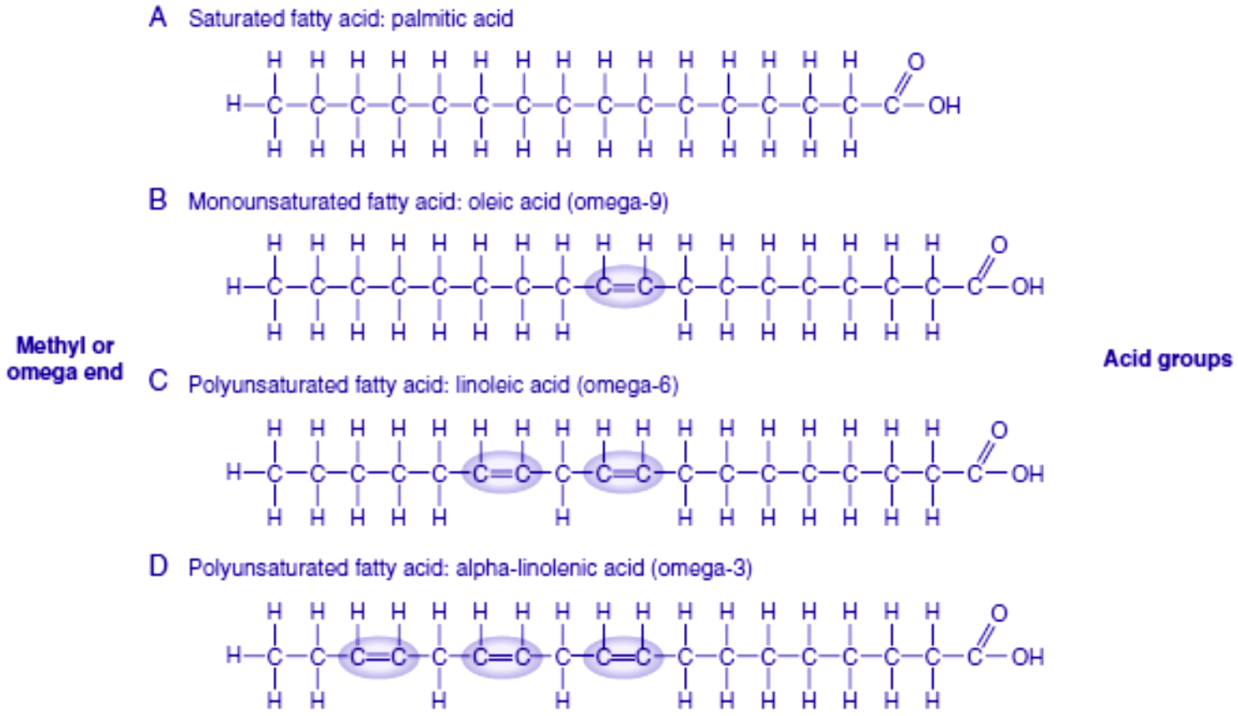
are necessary fats that humans cannot synthesize; EFAs must be obtained through diet. The body cannot synthesize two polyunsaturated fatty acids, alpha-linolenic acid (ALA) and linoleic acid. Alpha-linolenic acid is an omega-3 fatty acid. The "3" refers to the position of the first double bond that appears in the fatty acid's carbon chain, when you start counting carbons at the omega end of the molecule.

Cells use alpha-linolenic acid to synthesize two other omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Linoleic acid is an omega-6 fatty acid. Cells can convert linoleic acid to arachidonic acid (AA). The body uses EPA, DHA, and AA to make several compounds that have hormone like functions, including prostaglandins. (fatty compounds similar to hormones derived from arachidonic acid).

- **Prostaglandins** produce a variety of important effects on the body, such as stimulating uterine contractions, regulating blood pressure, and promoting the immune system's inflammatory response. **Essential fatty acids are necessary in small amounts for good health.**
- Infants require DHA and EPA for **nervous system development**, and babies **do not grow properly** when their diets lack essential fatty acids. Other signs of essential fatty acid deficiency include **scaly skin, hair loss, and poor wound healing.**

b- Nonessential fatty acids (NEFAs):

are fatty acids that body can manufacturing it in a modest amount that include omega-9 fatty acids such as oleic acid.



Classification

1-Simple lipids which include:

- **Oils:** unsaturated fatty acids, liquid at room temperature.
- **Fats:** saturated fatty acids, solid at room temperature.
- **Waxes**

2-Compound lipids which include:

- **Phospholipids:** compounds of fatty acids, phosphoric acid and nitrogenous base (lecithins, cephalins, sphingomyelins). Phospholipids are naturally found in plant and animal foods. Lecithin is the major phospholipid in food; egg yolk, liver, wheat germ, peanut butter, and soybeans are rich sources of lecithin.

Classification

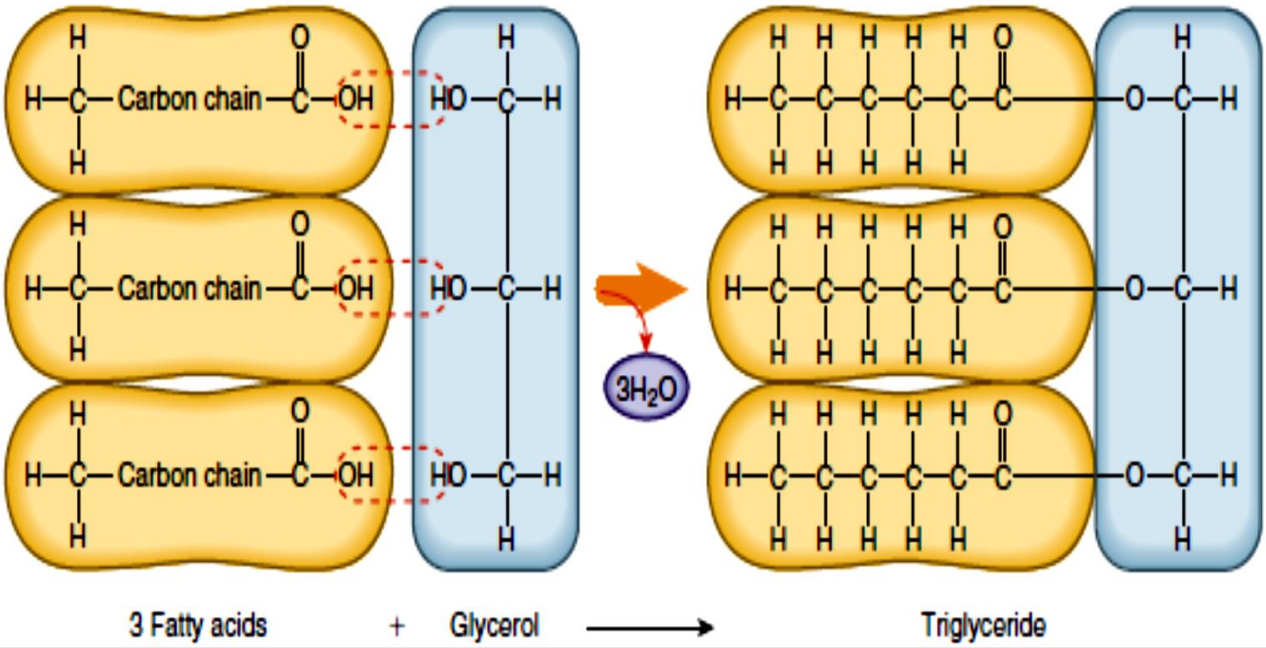
- **Glycolipids:** compounds of fatty acids combined with carbohydrates and nitrogenous base (cerebrosides, gangliosides).
- **Lipoproteins:** lipids in combination with protein (apolipoprotein).

3-Derived lipids which include:

- (Free fatty acids, Glycerol, and Fat soluble vitamins (A, D, E, K)).

- **Triglycerides:**

Consist of three fatty acids attached to glycerol, a three-carbon compound that is often referred to as the "backbone" of the triglyceride. Triglycerides comprise about 95% of lipids in your body and food. Triglycerides are often referred to as fats and oils. The body stores energy as triglycerides (fat). Most triglycerides contain mixtures of unsaturated and saturated fatty acids.



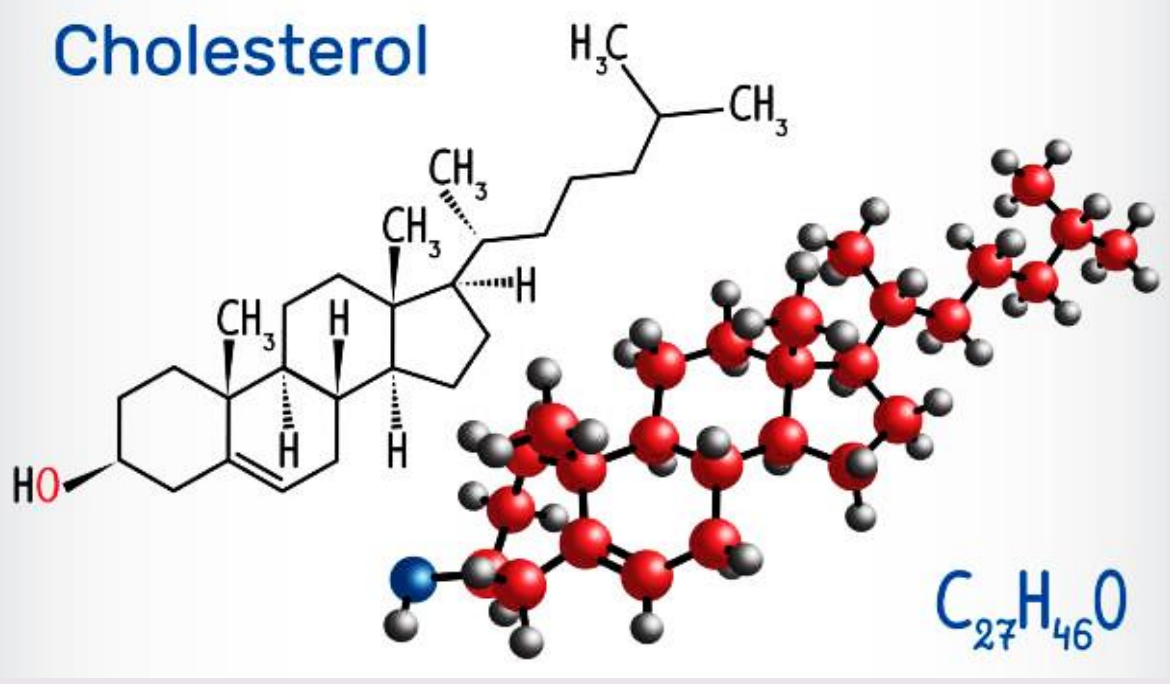
Triglycerides

Cholesterol

is a sterol, a more chemically complex type of lipid that exists in animal foods and body cells and does not exist in plant foods. Cholesterol is essential for the synthesis of bile, sex hormones, cortisone, and vitamin D. The body manufactures 800 to 1,000 mg of cholesterol a day in the liver. Cholesterol is a common constituent (part) of one's daily diet because it is found so abundantly in egg yolk, fatty meats, shellfish, butter, cream, cheese, whole milk.

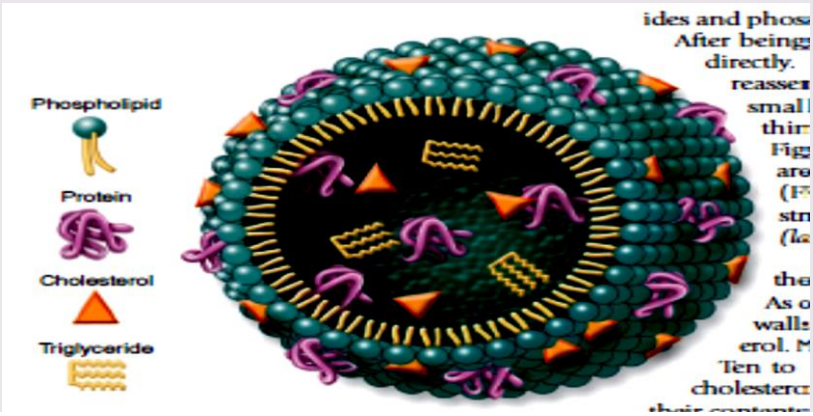
Cholesterol

Cholesterol is a component of every cell membrane in your body. The liver uses cholesterol to make bile, an emulsifier (a substance that keeps water-soluble and water-insoluble compounds mixed together) that facilitates lipid digestion. Cholesterol is considered as a contributing factor in heart disease causing high serum cholesterol, which is also called hypercholesterolemia (unusually high levels of cholesterol in blood).



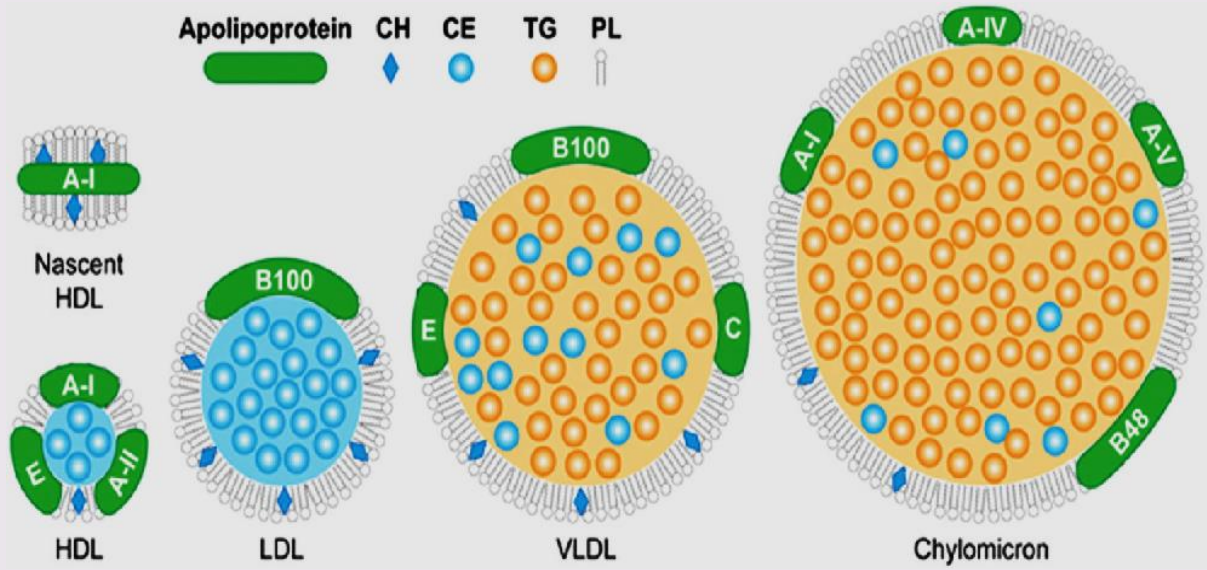
Lipoproteins

Fats are insoluble in water, which is the main component of blood. Therefore, special carriers must be provided for the fats to be absorbed and transported by the blood to body cells which is called lipoproteins (carriers of fat in the blood).



Lipoproteins are classified according to their mobility and density to:

- **Chylomicrons (the largest lipoprotein; transport the lipids after digestion into the body).**
- **Very-Low-Density Lipoproteins (VLDLs). lipoproteins made by the liver to transport lipids throughout the body.**
- **Low-Density Lipoproteins (LDLs). carry blood cholesterol from liver to the cells.**
- **High-Density Lipoproteins (HDLs). lipoproteins that carry cholesterol from cells to the liver for eventual excretion**



	Total Cholestrol (mg/dL)	LDL Cholesterol (mg/dL)	HDL Cholesterol (mg/dL)	Triglycerides
Good	Less than 200	Less than 100. Below 70 if coronary artery disease is present	60 (risk decreased)	Less than 150
Borderline	200-239	130-159	41-59	150-199
Bad	240 or higher	160 or higher; 190 and above is very high	Less than 40 is very low (risk increased)	200-499; 500 or higher is very high

Functions

- Providing energy, lipids yield 9 kcal/g.
- Supply essential fatty acids.
- Add to food palatability, lipids add flavor to food.
- Promote satiety after meals which delays hunger.
- Thermal insulation from cold, the layer of lipid helps maintain body temperature.

- Adipose (fatty) tissue protects vital organs and bones from injury by serving as protective padding and support.
- lipids are structural components of cell membranes.
- Carrier of fat-soluble vitamins A, D, E, and K.

Case in point: FRANCESCA: LOSING WEIGHT

- Francesca is a 40-year-old Italian schoolteacher who has been heavy most of her life. She is active and loves playing handball and racquetball. She was always active during school and does not know why she cannot lose her weight. She has about 100 pounds to lose. She has an Italian mother who loves to cook, and she brings Francesca a lot of traditional Italian meals. Francesca loves her mom and does not want to offend her by not eating the food. Francesca wants to lose weight and is now ready to forge ahead. She knows that the diet programs offered on TV, "lose weight fast and drop a dress size in a week," are not for her. Francesca asked her doctor for a referral to a dietitian to discuss the best way to lose weight.

ASSESSMENT

1. What data do you currently have about Francesca?
2. What has contributed to her current problem?
3. Is this an unusual problem for a woman of 40?
4. What do you know about Francesca's personality?
5. What do you know about her knowledge of weight reduction strategies?

DIAGNOSIS

1. Write a nursing diagnosis for Francesca.