TOPIC: INTRODUCTION TO LIPIDS

Introduction to Lipids

- **Lipids**: a structurally & functionally *diverse* class of molecules that are hydro*phobic* (do _____ mix in H_2O).
  - May be **amphipathic:** having _____ hydro*phobic* ("H_2O-fearing") & hydro*philic* ("H_2O-loving") parts.
- Recall: 1) _____ (solids) & 2) _____ (liquids).
  - The term "fats" is often used *loosely*.
- Common sources of lipids include butter, oils, fatty meats, fish, dairy products, nuts/seeds, & processed foods.

NOTE: Structurally, there are ____ main types of lipids in our diet: triglycerides, phospholipids, & sterols.

EXAMPLE

Indicate which of the following characteristics about lipids are true (T) or false (F).

- All lipids are amphipathic _____
- All lipids have a hydrophobic component _____
- All lipids have a very similar structure to each other _____
- Lipids can be either solid, liquid, or gaseous at room temperature _____
- Lipids are a very diverse class of molecule with many different chemical structures _____
- The term "lipids" is synonymous with the term "fats" _____

PRACTICE

The 3 major structural classes of dietary lipids are:

a) Lipids, Oils, Sterols.

b) Triglycerides, Phospholipids, Sterols.

c) Triacylglycerides, Phospholipids, Cholesterol.

d) Lipids, Oils, Triglycerides.

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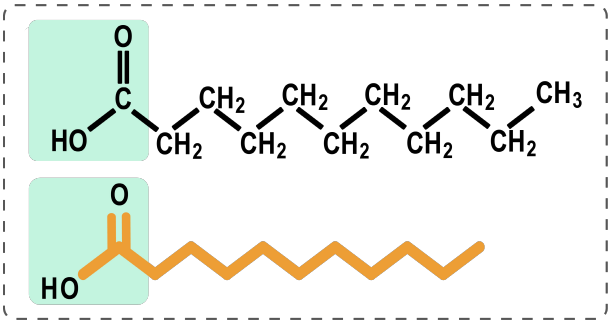
Triglycerides

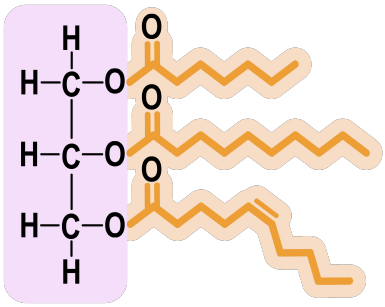
◆ Triglycerides are the most _____ lipid in our body & diet (accounts for ~95% of lipids we consume).

- **Triglyceride:** molecule consisting of _____ *fatty* acids attached to a _____ molecule.
  - **Fatty Acid (FA):** *hydrocarbon* chain with a carboxylic _____ group (-COOH) at one end.
  - **Glycerol:** a 3-carbon molecule that forms the triglyceride backbone.

◆ Triglycerides can be stored in _____ tissue to provide energy at a later time.



Fatty Acid Representations



Triglyceride = Glycerol + _____ Fatty Acids

EXAMPLE

Which of the following statements about triglycerides is true?

a) Triglycerides consist of a single fatty acid attached to a 3-carbon glycerol molecule.

b) Triglycerides are composed of 3 glycerol molecules attached to a fatty acid backbone.

c) Triglycerides can be stored in adipose tissue to provide energy at a later time.

d) Triglycerides only account for 20-35% of our total fat intake.

PRACTICE

Which of the following statements is false?

a) A hydrocarbon chain is just a linear molecule composed of only hydrogen and carbon atoms.

b) Fatty acids are hydrocarbon chains with a carboxyl group at one end.

c) Triglycerides consist of a 3-carbon glycerol backbone & 3 fatty acids.

d) Triglycerides always have 3 identical fatty acids in terms of their length and number of double bonds.

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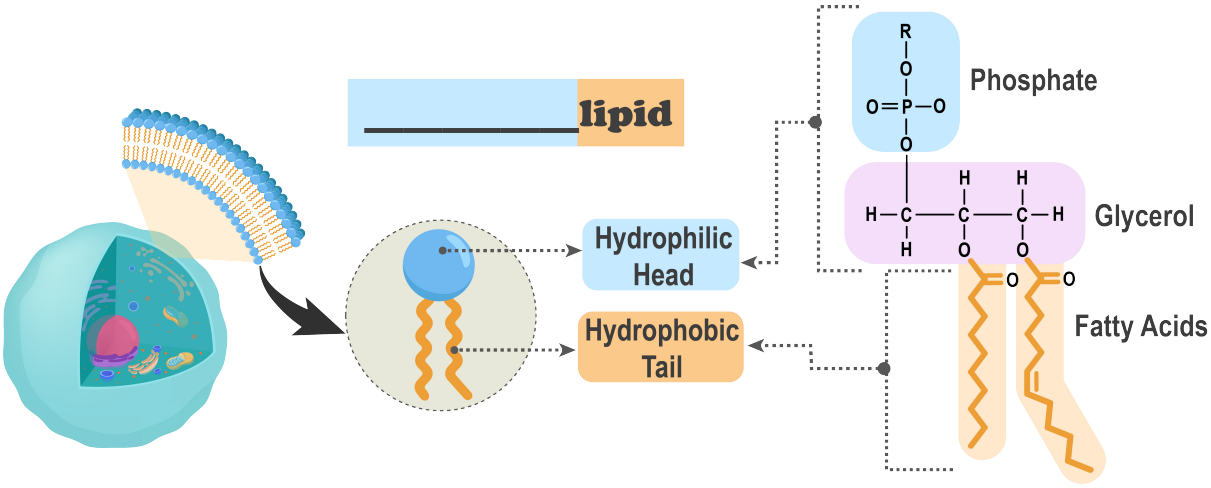
Phospholipids

- **Phospholipids:** molecules made of _____ fatty acids attached to a (_____)-containing glycerol.
  - Are *amphipathic*, allowing them to form _____ & help _____ lipids in the blood.



NOTE: Phospholipids are _____ essential in our diet, but phosphorus (P) is.

EXAMPLE

Lecithin is a major phospholipid in your cell membranes and is also used by the liver to produce bile since lecithin can act as an emulsifier. Which of the following statements about lecithin is false?

a) Lecithin plays a crucial role in fat metabolism/digestion and transport.

b) Lecithin is amphipathic, allowing it to help mix fats and water.

c) Lecithin is an essential nutrient that must be obtained through the diet, as the body cannot produce it.

d) Lecithin can be added to salad dressings to prevent the fat from separating/rising to the top of the dressing.

PRACTICE

Which of the following best explains why phospholipids are important in biological systems?

a) Phospholipids can be stored in adipose tissue for energy storage.

b) Phospholipids are amphipathic, allowing them to form membranes & be used as emulsifiers.

c) Phospholipids are entirely hydrophobic, meaning they can protect cell membranes.

d) Phospholipids are precursors to vitamin D & sex hormones.

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PRACTICE

Given that phospholipids are crucial for cell membrane structure, biosignaling, and other vital functions, why are they not considered essential dietary nutrients?

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a) Because phospholipids are completely degraded during digestion and cannot be absorbed intact.

b) Because phospholipids have no specific role in metabolism and are only structural components.

c) Because the human body can synthesize/manufacture phospholipids endogenously from dietary fatty acids, phosphorous, choline, and other precursors, making direct dietary intake unnecessary.

d) Because phospholipids are not present in any foods, so they do not contribute to dietary intake.

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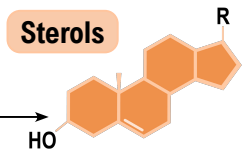
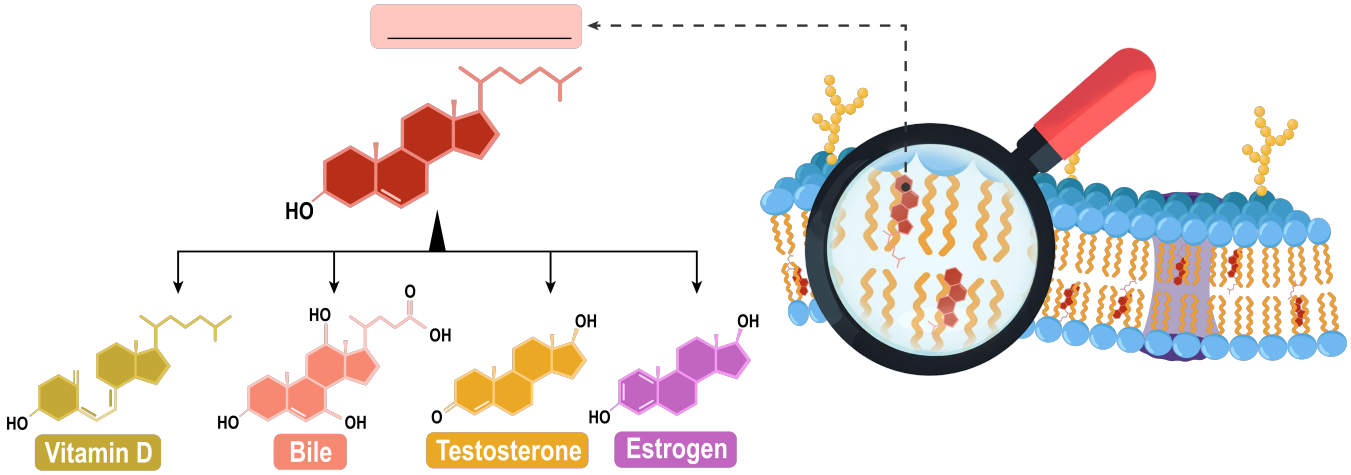
Sterols



- **Sterols:** lipids with a multi-_____ structure (usually 4 rings).
  - **Cholesterol:** the most common sterol in our diet only found in _____-based foods/membranes.
    - It is _____ essential in our diet (liver can synthesize it).
    - Serves as a _____ to make other vital compounds (e.g. vitamin D, bile, testosterone & estrogen).
    - Too much cholesterol in the blood (particularly LDL) is associated with cardiovascular disease.



EXAMPLE

Which of the following statements about sterols is true?

a) Sterols have a multiple-ring structure and always have at least one carboxylic acid group (-COOH).

b) Cholesterol helps regulate blood glucose levels.

c) Sterols are structurally different than other dietary lipids because they do not have fatty acids.

d) Cholesterol is a precursor to Vitamins A, B, & K.

PRACTICE

Luca has decided to start a vegan diet, excluding all animal-based products. He should:

a) Not worry about his cholesterol intake because his body can synthesize it naturally.

b) Take cholesterol supplements so that he has enough in his diet.

c) Take vitamin D & testosterone supplements because cholesterol is a precursor to these molecules.

d) Ensure he eats enough cholesterol from plant-based products.