Lipids

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Lipids are one of the types of biomolecules in the body.
Other names include:

- Macromolecules (emphasizing their large size)
- organic molecules (emphasizing their carbon structure).

Biomolecules include

- Lipids
- Carbohydrates
- Protein
- Nucleic acids

Lipids contain carbon, hydrogen, and oxygen, like carbohydrates, but the ratios of these atoms are different, so that lipids are typically nonpolar (another word for hydrophobic).

Roles of Lipids:

- ENERGY - Adipose tissue stores lipids as **triglycerides**. These lipids have a glycerol head and three fatty acid tails. This provides vast amounts of efficient energy storage in our bodies. They have a glycerol head and 3 fatty acid tails. Saturated fatty acids have all single-bonded carbon chains so they are able to saturate the carbon chain with hydrogens. Saturated fatty acids are safely stable for ATP production and long-term storage.
    - **Lipogenesis** is the process by which fatty acids and glycerol are connected together into triglycerides. **Lipolysis** is the breakdown of triglycerides into fatty acids and glycerol. Insulin is the primary hormone that stimulates lipogenesis. Multiple hormones stimulate fat breakdown, such as catecholamines like adrenaline and dopamine, thyroxine, and cortisol.
    - Ketogenesis is the process by which fatty acids are partially broken down into short carbon chains called ketones. Both fatty acids and ketones can be utilized by the mitochondria to make ATP.

- PHOSPHOLIPIDS - Cell membranes
    - Biological membranes are made from a phospholipid bilayer. Like the energy storage form of triglycerides, phospholipids have a glycerol head. But they only have two fatty acid tails. Fatty acids can be single bond chains or double-bonds.
        - 1 double-bond in a fatty acid is called monounsaturated (examples of foods rich in these are olives and avocados, but all natural foods contain mixes of various types of fatty acids).
        - If there are two or more double bonds in a fatty acid, it is called polyunsaturated (sometimes just called PUFA). Famous omega-3 fatty acids are named for having their first double bond at the third carbon, and have names you've heard of such as DHA and EPA. Fish is an excellent source for these kinds of fatty acids - we must eat these essential fats because we cannot make them on our own.
    - Unsaturated fatty acids are carbon chains with one or more double bonds. As the number of double bonds in the molecule increases, they are increasingly unstable, reactive, and easily

oxidized (broken down and rancid). These delicate molecules are important for membrane fluidity and all kinds of complex signaling, especially with regard to inflammatory responses (e.g prostaglandins are omega-6 polyunsaturated fatty acids).
    - So, the fatty acid chains on a phospholipid vary, but they will always have this phosphate group attached to the glycerol, and then usually an electronegative Nitrogen atom, causing this to be a polar, or hydrophilic, head. In the phospholipid bilayer, the polar heads stick out toward the water environment on both sides of the membrane, and the nonpolar tails that are hydrophobic point toward the middle since they are repelled by the water.

- CHOLESTEROL - cell membrane, cell signaling, and steroid hormone production
    - is a ring-based lipid that is an important component in the cell membrane. As much as 25% of the cell membrane may be cholesterol! Its cell membrane roles include decreasing membrane permeability and stabilizing the membrane even when there are minor temperature changes. It's also important in determining where membrane proteins and channels are located.
    - Cholesterol serves as the building block of all steroid hormones in the body.
        - Without cholesterol, we can't make the adrenal gland hormones aldosterone, cortisol, or testosterone. In males, the testes require cholesterol to produce testosterone. In females, cholesterol is essential for the ovarian production of estrogen and progesterone.
        - In the skin, cholesterol is converted into Vitamin D only in the presence of UV light from the sun.
    - Lastly, cholesterol is the main ingredient in bile, which is made in the liver, stored in the gall bladder, and then released into the intestine to emulsify dietary fats.

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