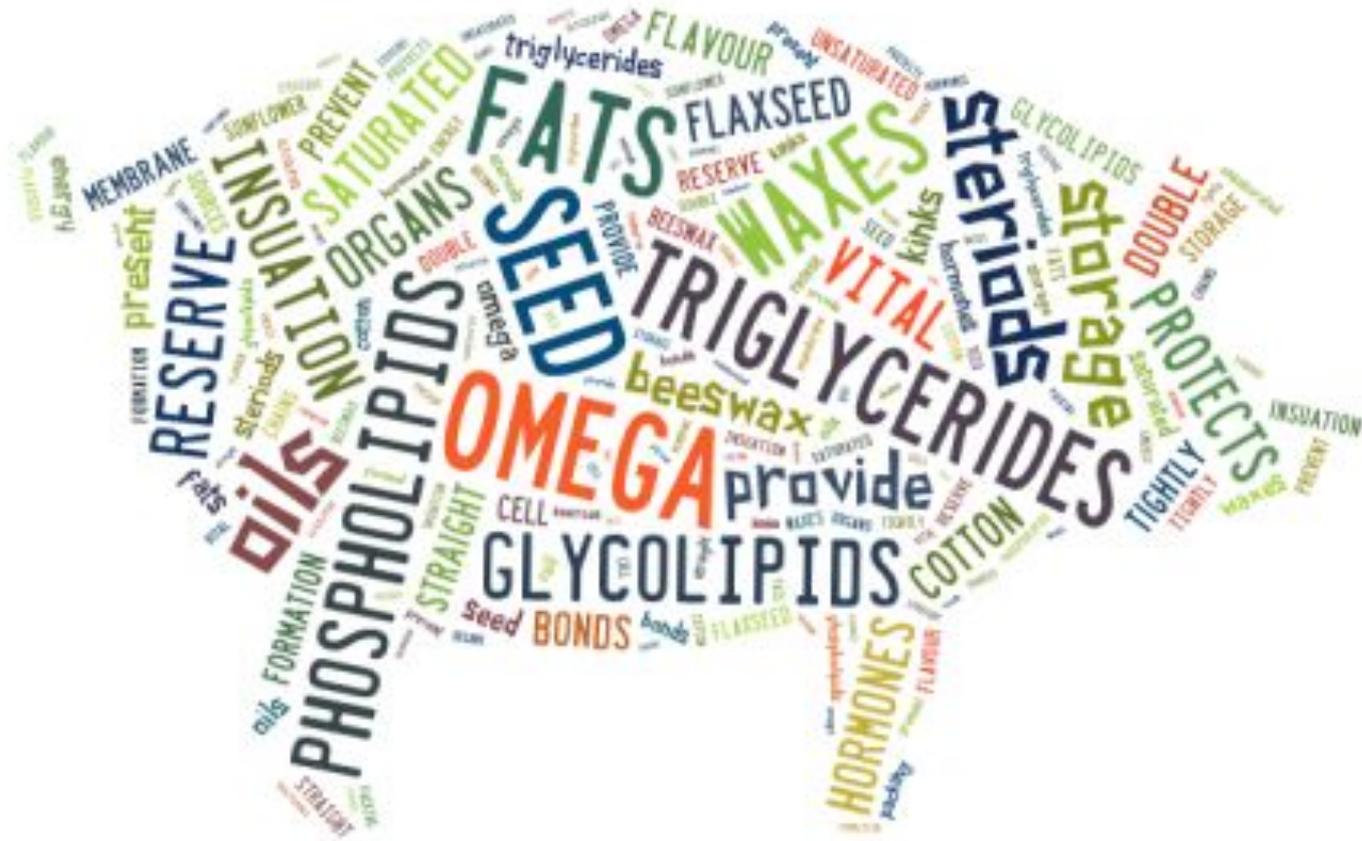


Lipids



Lipids – Biomolecule #2

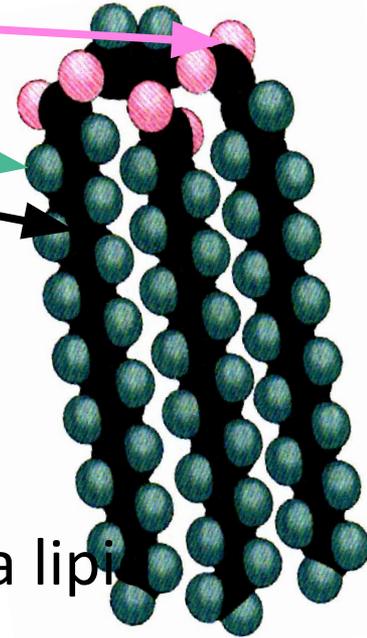
- Made up of C, H, and a little bit of O

Remember, carbohydrates always had twice as many H's to O's (like water).

Lipids don't have twice as many H's and O's.
They have way more H's than that.

This is one way you can tell a carbohydrate from a lipid.

- This group has fats and oils and **steroids**
 - [What is fat?](#) (watch this!)



Lipids – Biomolecule #2

Another difference between lipids and carbohydrates:

- Lipids are **not** water soluble (this is why oil and water do not mix).
- Carbohydrates are water soluble

***STOP AND THINK:** Write down your answers for the following in the notes

- Look up what soluble means
- How might not being water soluble be useful for something like a cell membrane?



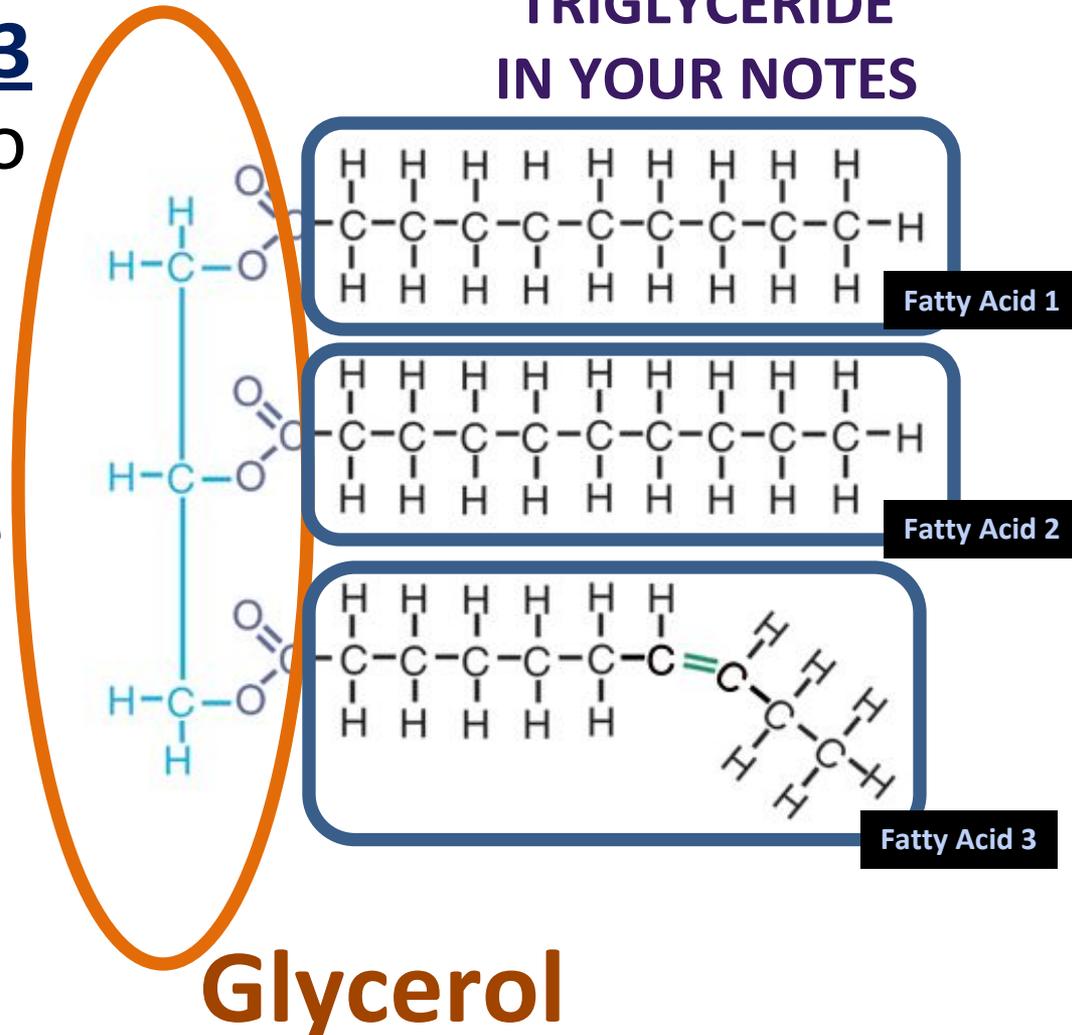
Lipid Type #1: Fats & Oils

- Structure:
 - **Glycerol** + fatty acids
 - Fatty acids are chains of carbon atoms bonded to hydrogen atoms
 - Saturated vs. Unsaturated (more on this later)
- Function:
 - **Store** large amounts of chemical energy
 - Main component in cell **membranes**
- E.g. Triglycerides (i.e. Olive Oil, Beef Fat)

Lipid Type #1: Fats & Oils Structure

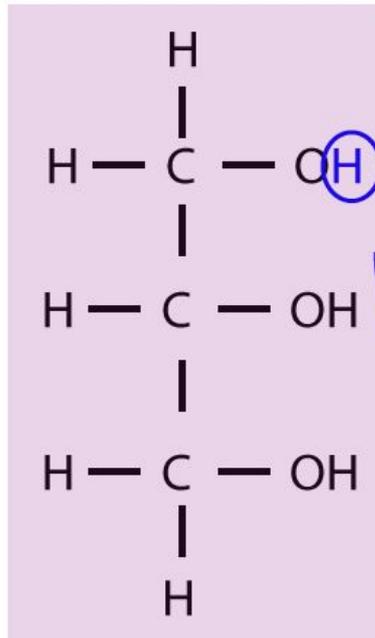
- Many lipids contain **3** fatty acids bonded to the glycerol
 - Called **triglycerides**
- These fatty acids are bonded to the glycerol via **dehydration synthesis**

NOW DRAW THIS TRIGLYCERIDE IN YOUR NOTES

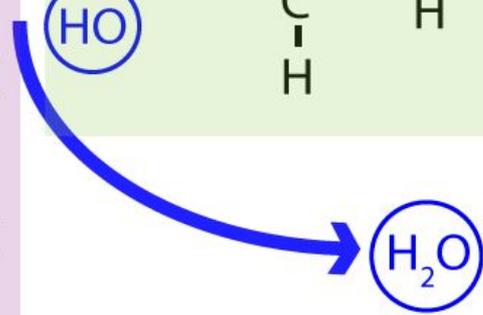
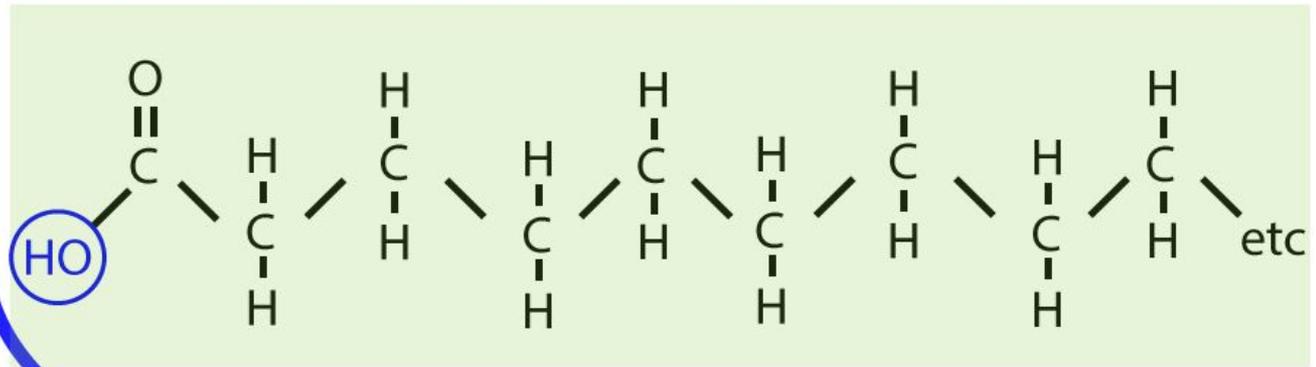


Dehydration Synthesis of a Triglyceride

Glycerol



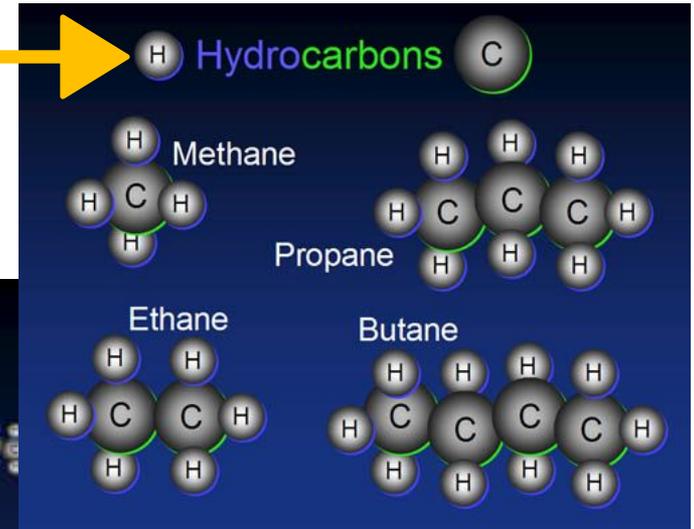
Fatty acid



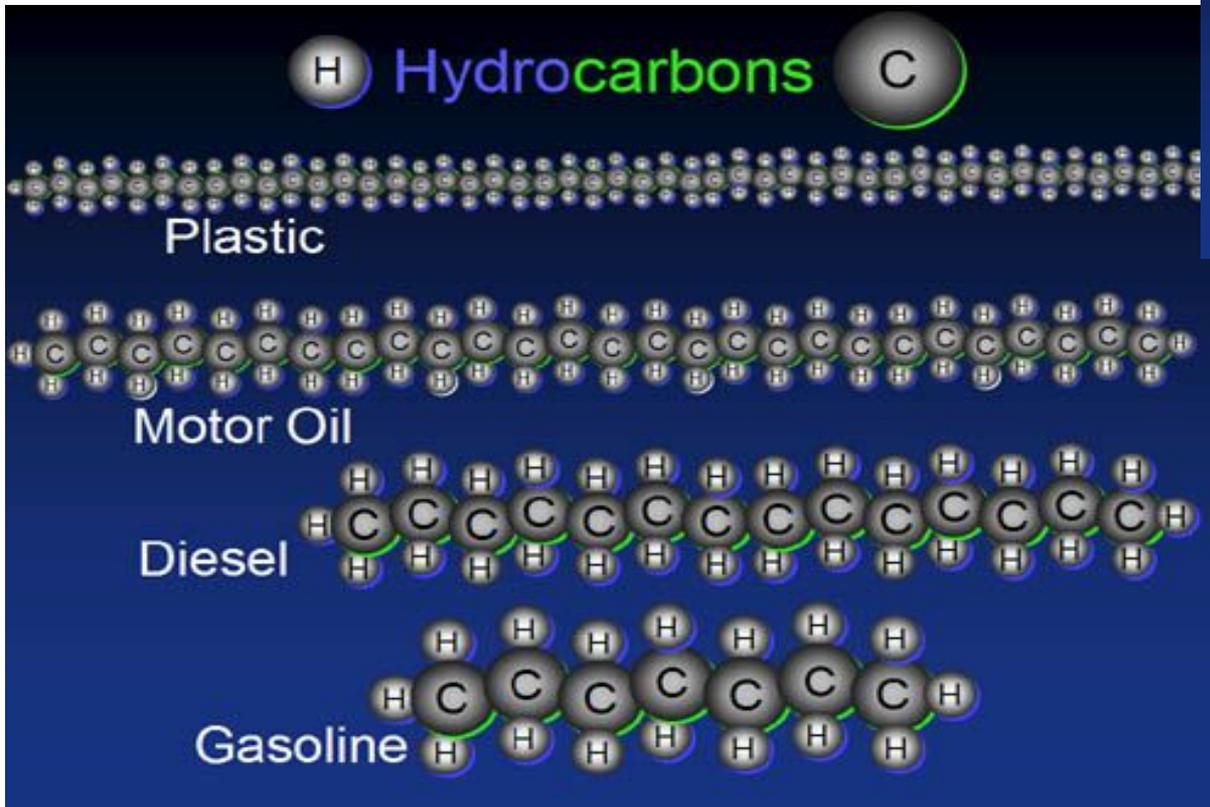
How many waters will have to come out to make a **triglyceride**?

Fatty Acids

- Fatty acids have long **hydrocarbon** chains

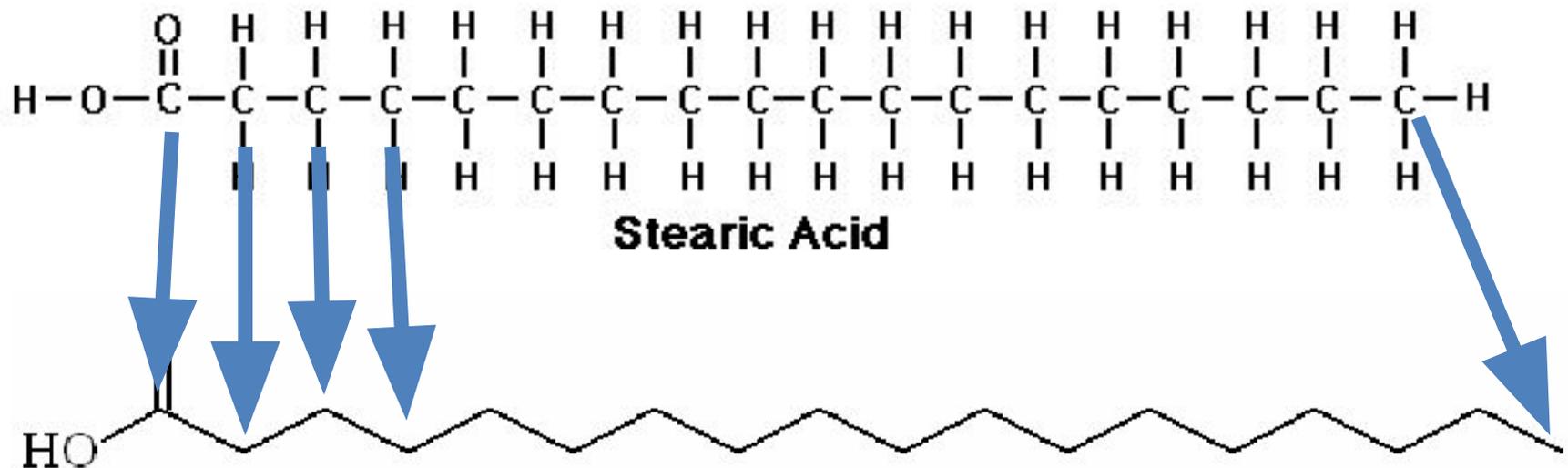


A hydrocarbon chain is a chain of carbons and hydrogens.



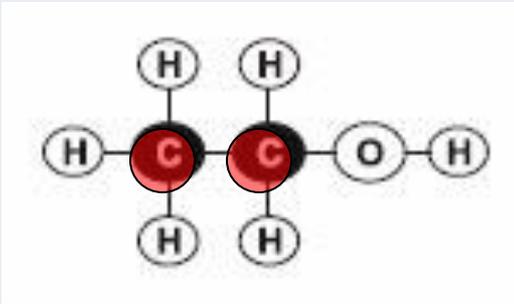
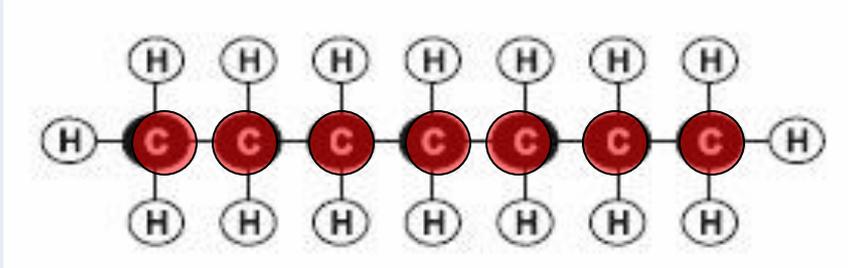
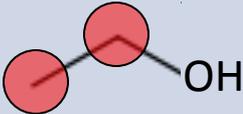
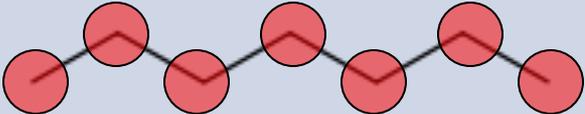
Hydrocarbons

- There is a shorthand for drawing this part of the fatty acid chains
 - To simplify a hydrocarbon, we draw a kinked line
 - Each bend or end of a line is a **carbon** atom



Practice Shorthand for Hydrocarbons

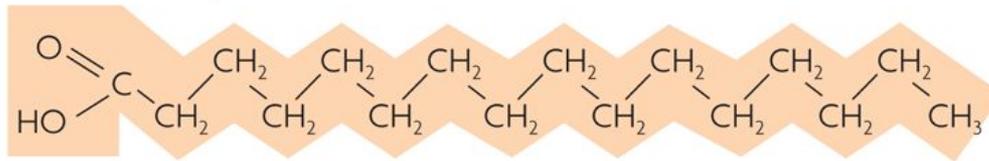
- Try drawing the two molecules below:

Chemical Name	Ethanol	Heptane
Chemical Formula	C_2H_5OH	C_7H_{16}
Ball & Stick Model	 A ball and stick model of ethanol. It consists of two carbon atoms (black) bonded together. The first carbon is bonded to three hydrogen atoms (white), and the second carbon is bonded to two hydrogen atoms and one oxygen atom (red). The oxygen atom is further bonded to a hydrogen atom.	 A ball and stick model of heptane. It consists of a straight chain of seven carbon atoms (black) bonded together. Each carbon atom is bonded to hydrogen atoms (white) to satisfy its four bonds. The two end carbons are each bonded to three hydrogens, and the five middle carbons are each bonded to two hydrogens.
Abbreviated (Shorthand) Model	 An abbreviated model of ethanol. It shows a zigzag line representing the carbon chain, with a red circle at the end representing the oxygen atom, and the letters "OH" next to it.	 An abbreviated model of heptane. It shows a zigzag line representing the carbon chain, with red circles at each vertex and end point representing carbon atoms.

Saturated vs. Unsaturated Fats

- A lipid's **function** can be affected by the **saturation** of the fatty acids. (To be saturated means full).
 - Saturated: it is “saturated” with hydrogen atoms (maximum number of hydrogens bonded to carbons).

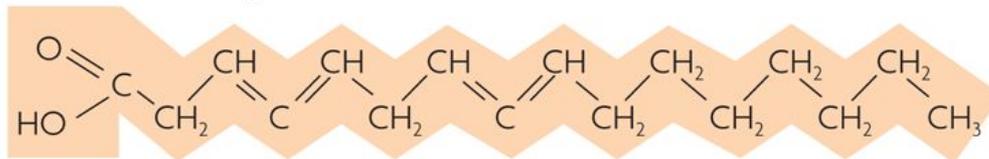
Saturated fatty acid



Saturated fats contain fatty acids in which all carbon-carbon bonds are single bonds.

- Unsaturated: at least one double bond between carbon atoms in the chain, so the chain has fewer hydrogens.

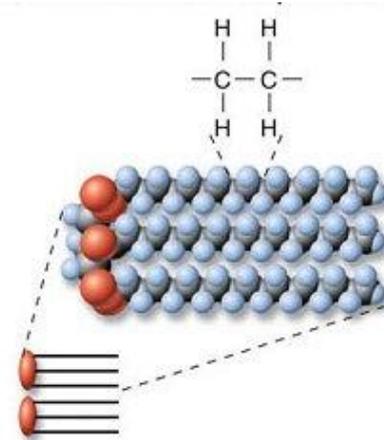
Unsaturated fatty acid



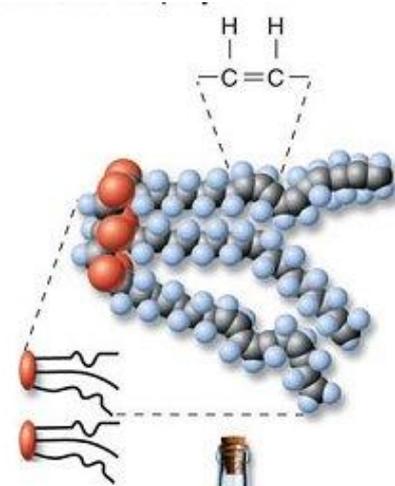
Unsaturated fats have fatty acids with at least one carbon-carbon double bond.

Saturated vs. Unsaturated Fats

- Saturated fats are **solid** at room temperature and unsaturated fats are **liquid**.
 - Saturated fats are typically found in animals
 - E.g. butter and meat.
 - Unsaturated fats are typically found in plants
 - E.g. olive or peanut oils.



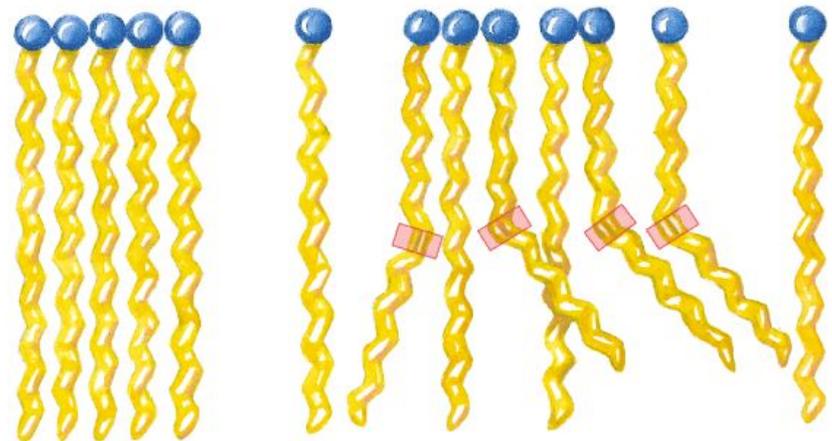
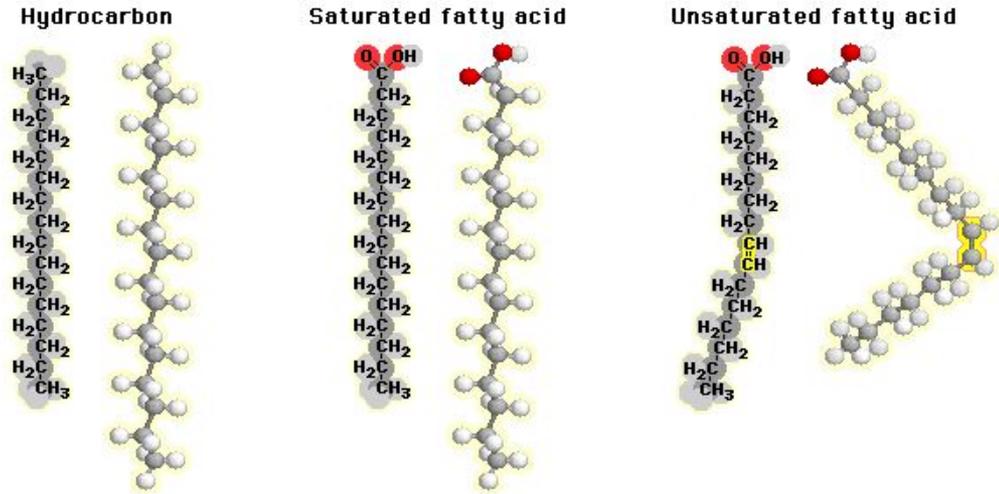
(b) Hard fat (saturated): Fatty acids with single bonds between all carbon pairs



(c) Oil (unsaturated): Fatty acids that contain double bonds between one or more pairs of carbon atoms

Saturated vs. Unsaturated Fats

Based on their structure (right) can you guess why saturated fats are solid and unsaturated are liquid at room temp?



Saturated fatty acids

Mixture of saturated and unsaturated fatty acids

(c)

(d)

“Butter Manatee and Diver”

sculpted by Jim Victor, Palmetto, FL
Manatee County Fair, Jan. 2012



Natural peanut butter can separate into both types!

Unsaturated

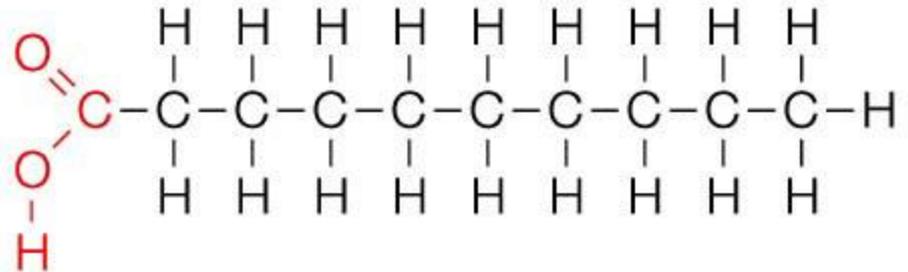
Saturated



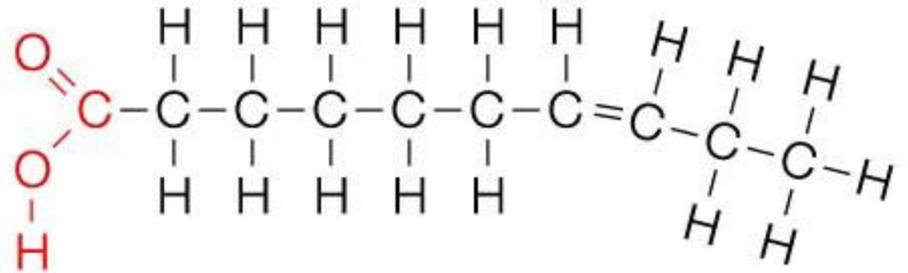
Saturated vs. Unsaturated Fats

- Saturated and unsaturated fats have different **properties** because of how the molecules pack together.
- Which molecule do you think would pack together more closely?

Saturated

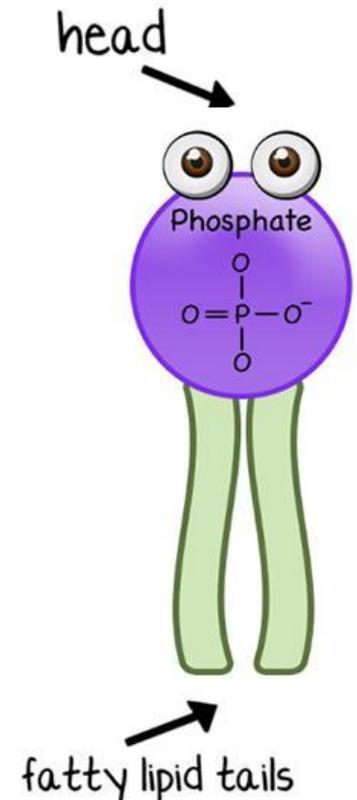


Unsaturated

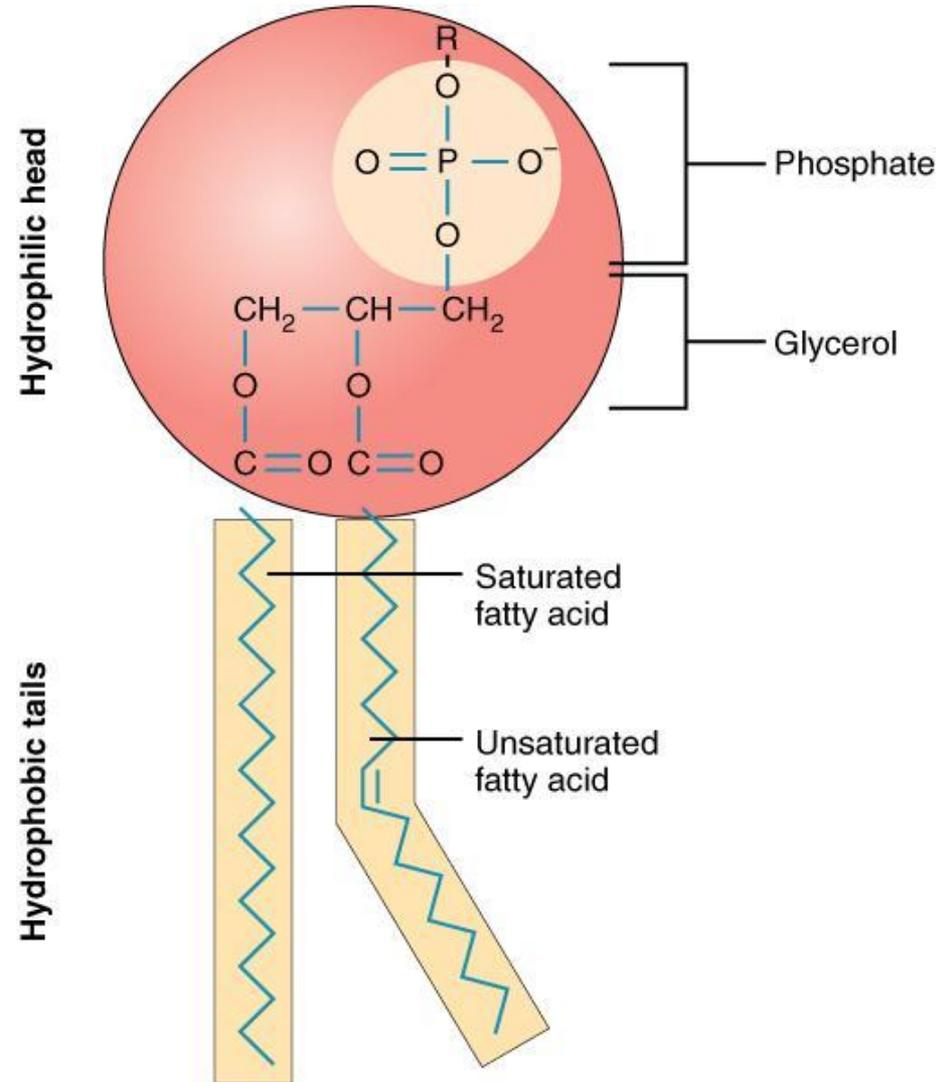
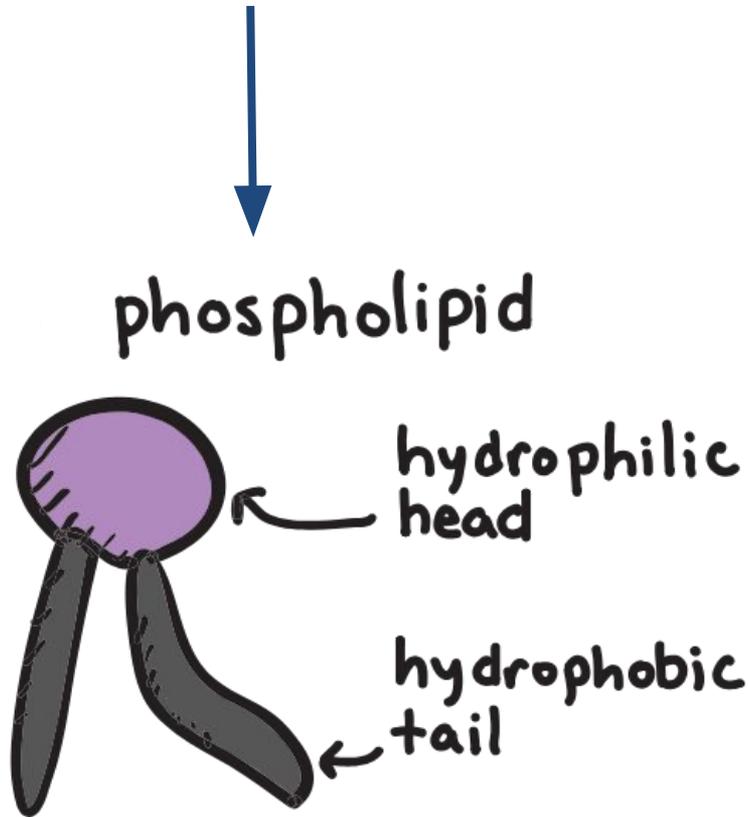


Phospholipids

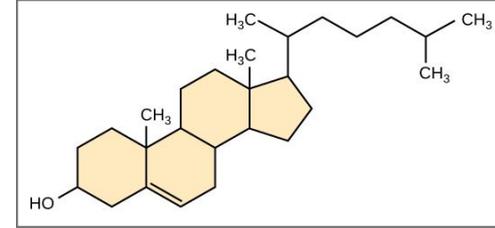
- Cell membranes are made up of a lipid similar to triglycerides; a **phospholipid**
- Structure: Glycerol backbone attached to a phosphate group “**head**” and 2 fatty acid “**tails**”
 - The fatty acid tails can be saturated or unsaturated
- Function: Provide a selective **barrier** between the inside and outside of the cell and cellular compartments.



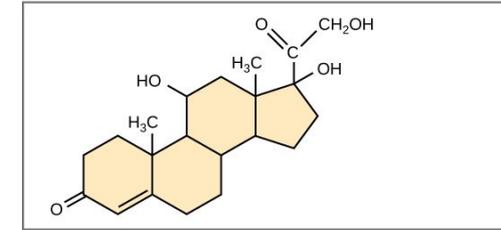
How we will picture a Phospholipid



Steroids

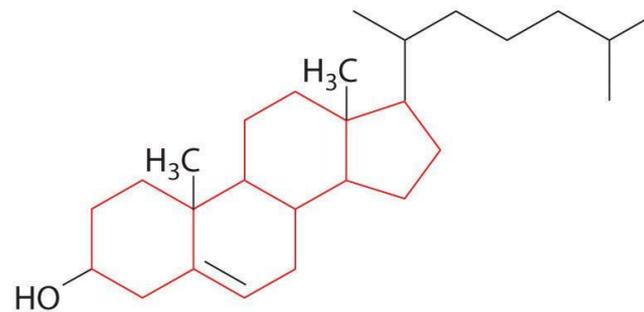
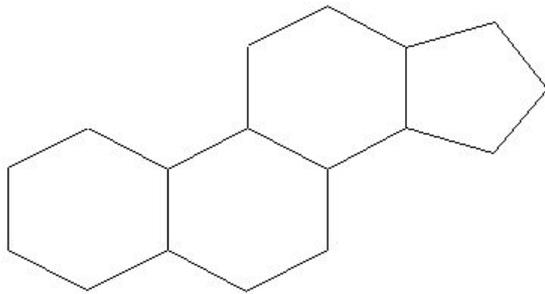


Cholesterol

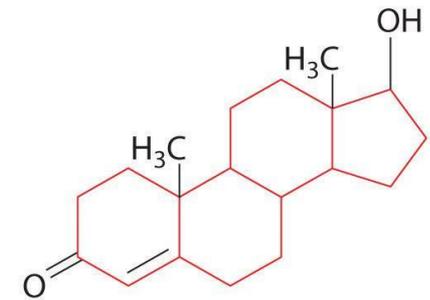


Cortisol

- Structure:
 - 4 interconnected carbon rings



Cholesterol



Testosterone

The structure in red is derived from cholesterol.

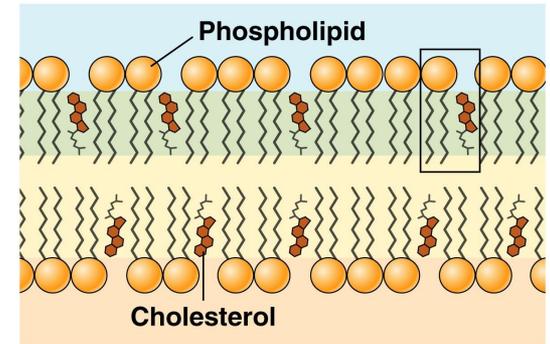
1 Type of Steroid: Cholesterol

- Cholesterol is one type of steroid.

It functions to keep the cell membrane flexible.

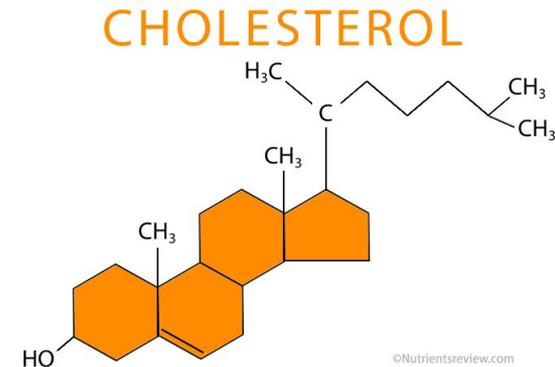
Cholesterol is added between phospholipids in the cell membrane, sort of as a spacer.

It prevents phospholipids from packing too tightly when temperatures get cold, or from spreading too far apart when temperatures get hot.



(a) Cholesterol in plasma membrane

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Another Type of Steroid: Hormones

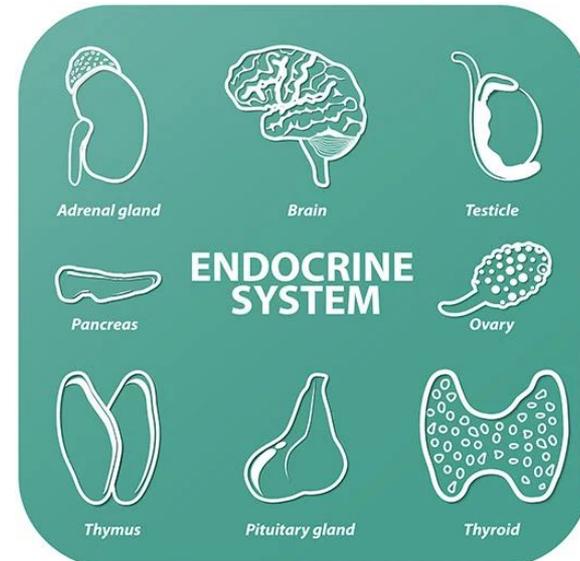
Hormones are signalling molecules within a cell.

A cell doesn't have a mouth or ears, so they communicate with other cells using chemicals known as hormones.

You have a whole body system that creates hormones, known as the Endocrine System!

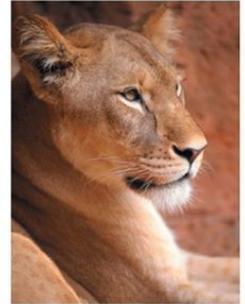
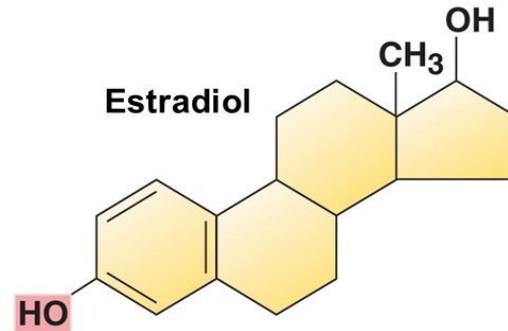


See the 4 carbon ring

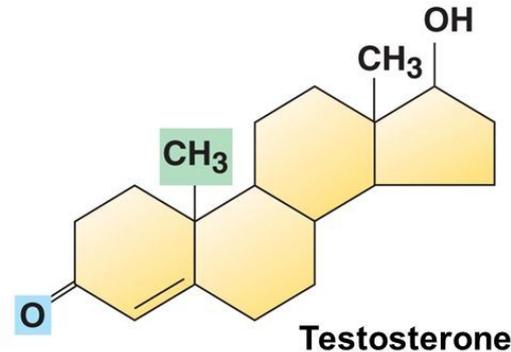


Hormones

For instance, what creates the physical differences seen in different genders is really just a result of what type of sex hormone they are producing.



Female lion



Male lion

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Let's Fill in Your Macromolecule Table for Lipids!

Macromolecule	Lipids
Types of Atoms	Carbon, Hydrogen and Oxygen
Monomers made of	N/A
Function(s)	Storing energy, making up cell membranes, cell communication
Examples	Triglycerides, Phospholipids, Steroids and Cholesterol
Sketch	