Saturated/Unsaturated/Trans/Cis Fats

What is fat? - George Zaidan

This video goes over saturated and unsaturated fats, as well as trans and cis configurations. It does a great job breaking them down while keeping it interesting.

If you are struggling with telling the difference between saturated and unsaturated fats, here is how I think about it…

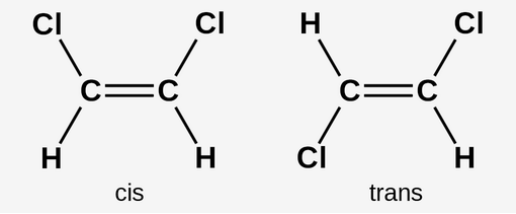
When I think of saturated fats, I imagine they just had a big meal of hydrogens and they are saturated or "satiated" with hydrogens.

When I think of unsaturated fats, I imagine them being very hungry and "unsatiated" (unsaturated) meaning they are could have more hydrogens!

We can also use this to remember which would be SOLID at room temp, and which would be LIQUID at room temp.

- In my mind, saturated fats are solid at room temperature because they are super full!
- Conversely, unsaturated fats are liquid at room temperature because they do not have anything "filling them up" and they are super hungry!

Additionally, if you struggle between trans and cis fats… remember that "cis" means "same" so the carbon chains will be coming off the same side of the double bond. Conversely, "trans" means "opposite" so the carbon chains will be coming off of opposite sides of the bonds.



If you are still struggling to understand, here is another video that goes through different triglycerides to explain all of these.

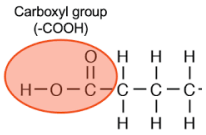
Essential Fatty Acids (+ Clinical Relevance)

What are essential fatty acids? Essential fatty acids are termed "essential" because we cannot synthesize them on our own and need to get them from an outside source.

Fun fact: we cannot make double bonds past the 9th carbon from the carboxyl end! (The video uses Omegas, so do not get confused!)

Clinical relevance: Linoleate (Omega 6) and a-Linoleic Acid (Omega 3)
These essential fatty acids are talked about in this video as well as what an essential acid is!
~I would make sure to watch this whole video- she talks about their importance in membrane fluidity which is good to know!

Naming
MCAT Bio/Biochem Review: Fatty Acid Nomenclature
This video goes over the naming of fatty acids. Unfortunately, she goes over 4 methods, but for this class you only need to know two! She describes the omega system (#3 in the video), but the systemic naming system is considered to be a slight mix of both the IUPAC and Delta naming system as she describes them. (These are #1 and #4 in the video). See below for how they come together.
Remember…



Systemic naming begins at the CAYBOXYLIC end (so any time you see this guy) →
This naming system also uses Δ (delta) in front of the first *double bond* and uses this number as a superscript.
Here is an example:

16	1	Palmitoleate	*cis*-Δ^9-Hexadecenoate
18	1	Oleate	*cis*-Δ^9-Octadecenoate
18	2	Linoleate	*cis, cis*-Δ^9, Δ^{12}- Octadecadienoate
18	3	Linolenate	all-*cis*-Δ^9, Δ^{12}, Δ^{15}- Octadecatrienoate
20	4	Arachidonate	all-*cis* Δ^5, Δ^8, Δ^{11}, Δ^{14}- Eicosatetraenoate

(# of carbons, # of double bonds, common name, systemic name)
If you notice, both of the bonds contain the delta and superscript, while including the IUPAC "cis" and "trans" nomenclature.

Triacylglycerols
Molecular structure of triglycerides (fats) | Biology | Khan Academy
This video does a great job explaining triacylglycerols. He goes over how they get their name, how they are formed, and what their structure looks like.

To remember why they are great energy sources, I like to think about triacylglycerols in their components.

1.) Highly reduced→ more electrons for oxidation (saturated with hydrogens)
    a.) When you need energy (lets think of all of the hydrogens as "potential energy" for now) wouldn't you prefer to have the ability to squeeze LOTS of energy out of the molecule, rather than just a little bit? That is what our hydrogens are doing. The more saturated with hydrogens, the more capacity for energy you have!
        i.) Now, do not get confused, triacylglycerols can be considered both "saturated" and "unsaturated". This just refers to the bonds we were talking about earlier→ cis and trans double bonds. However, these triacylglycerols are still generally considered saturated with hydrogens since they contain a bunch of them, especially relative to the other types of lipids we will be talking about.
2.) Anhydrous
    a.) This just means it has no water weight.
        i.) Unlike glucose, which is stored in the body with about 3-4 grams of water per gram of glucose, triacylglycerols do not interact with water or store any weight with it in the body! → This is what allows humming birds to fly as long as they do (500m+) as they have a great energy source but very low weight.

Membrane Lipids

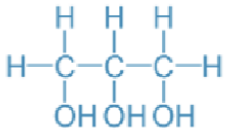
Phospholipids

Phospholipid structure | Cells | MCAT | Khan Academy (Until 2:40)

This video goes over the structure of phospholipids if you would like a review. It also shows the individual components of a phospholipid separately.

Remember, the two types of phospholipids:

1. Glycerol (the most common)
    a. These guys are what is described in the video, 3 carbon backbone (that then attaches the 2 fatty acid chains and a phosphate group)
        i. Ester bonds!!
2. Sphingosine (sphingolipids)
    a. These are long, 18 carbon backbones.
        i. Found in nerve cells



Glycerol

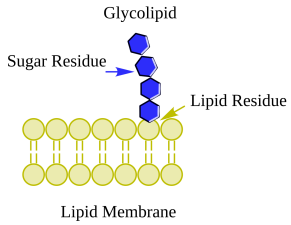
Sphingosine

I remember the differences between these two because glycerol is the "short" word→ short backbone, and vice versa!

Glycolipids

What are Glycolipids? Difference between Cerebroside and Ganglioside (Stop 1:44)

This video goes over glycolipids and explains their components. It also explains what cerebroside is.



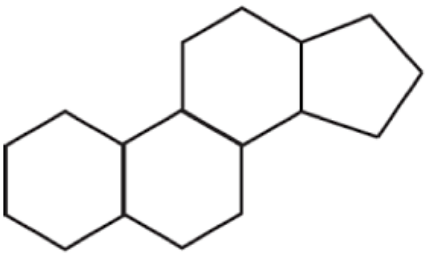
I like to think of glycolipids as a flag hanging outside the membrane. They hang out in the membrane, and are there to help other cells recognize them and communicate, help with immune system identification, and aid in tissue specific interactions!

Steroids

Lipids Part 2: Steroids

This video by Prof. Dave does a great job summarizing steroids!

To remember steroids, I like to think of the 4 carbon rings as being "really buff". Here, let me demonstrate.



If you look at the structure of the 4 carbon rings, it almost makes the shape of someone flexing their muscles…
Since steroids are typically known for their use with body builders, it helps me remember that if I see a four carbon ring, it's a steroid!

Protein-Lipid Interaction

Lipid anchors: Lipids that allow proteins to localize to the cell membrane.
Case study:
During folding, Lamin A is bound to the nuclear membrane by farnesyl A (lipid anchor). When this association does not degrade and allow Lamin A to the nuclear lamina, it causes Hutchinson-Gilford progeria syndrome.
Understanding Hutchinson-Gilford progeria syndrome