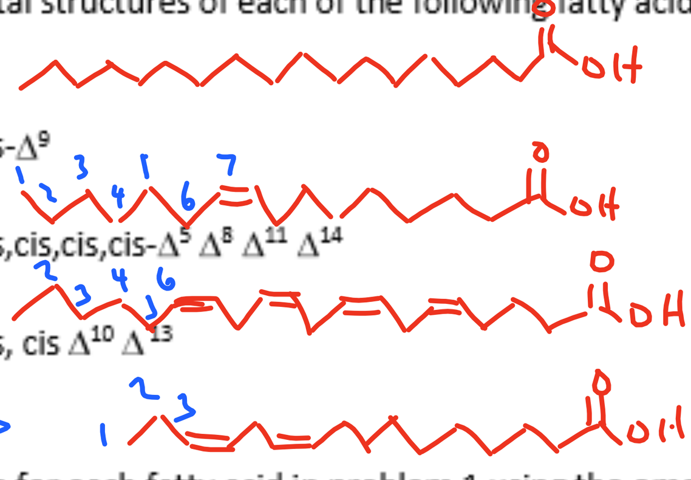
atty Acids

Monday, January 23, 2017 4:21 PM

Fatty Acid and Phospholipid Class Activity

1. Draw the skeletal structures of each of the following fatty acids:
   a. 18:0 — 18:0 saturated non-essential
   b. 16:1 cis-Δ^9 — omega 7 — 16:1 n-7 non essential unsaturated
   c. 20:4 cis,cis,cis,cis-Δ^5 Δ^8 Δ^{11} Δ^{14} — omega 6 — 20:4 n-6 essential unsaturated
   d. 16:2 cis, cis Δ^{10} Δ^{13} — omega 3 — 16:2 n-3 essential unsaturated



2. Write the name for each fatty acid in problem 1 using the omega nomenclature.

   blue above

3. Classify each of the fatty acids in problem 1 as:
   a. Saturated or unsaturated — blue above
   b. cis fat or trans fat (or N/A) — all cis unsaturated
   c. omega 3, 6, or 9.
   d. Most likely to be essential or unessential

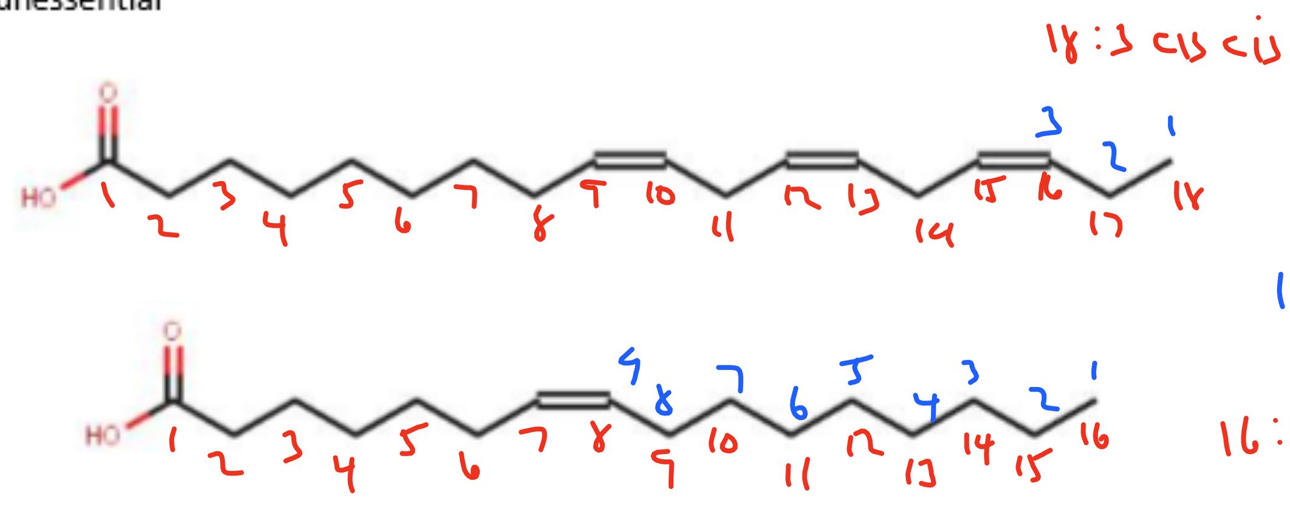
4. Provide the name (using both conventions) for the following fatty acids and state whether they are likely to be essential or unessential

18:3 cis cis cis $\Delta^9 \Delta^{12} \Delta^{15}$

18:3 n-3

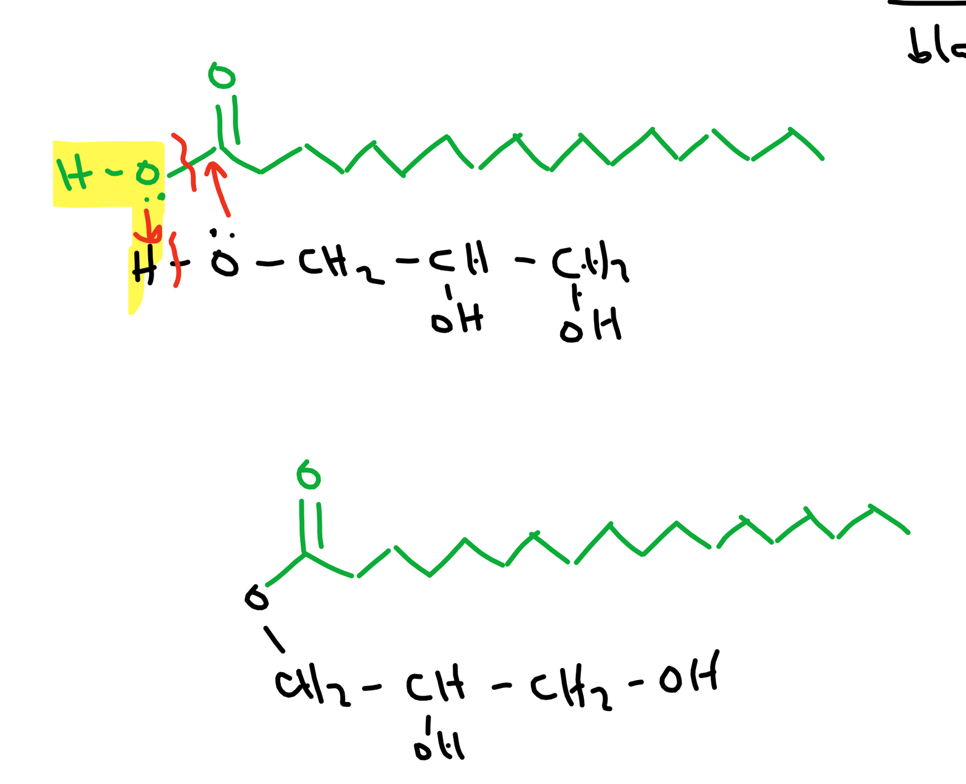
16:1 cis Δ^7

16:1 n-9



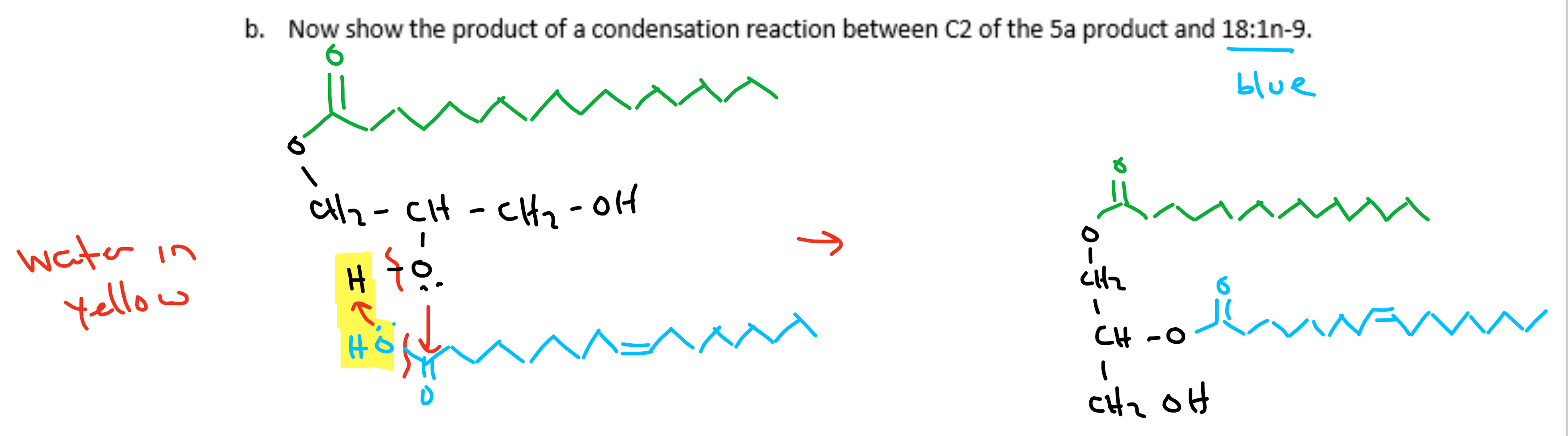
5. Building a phospholipid:
   a. Show the product of a condensation reaction between carbon 1 of glycerol and 18:0. (black, green)

water in yellow



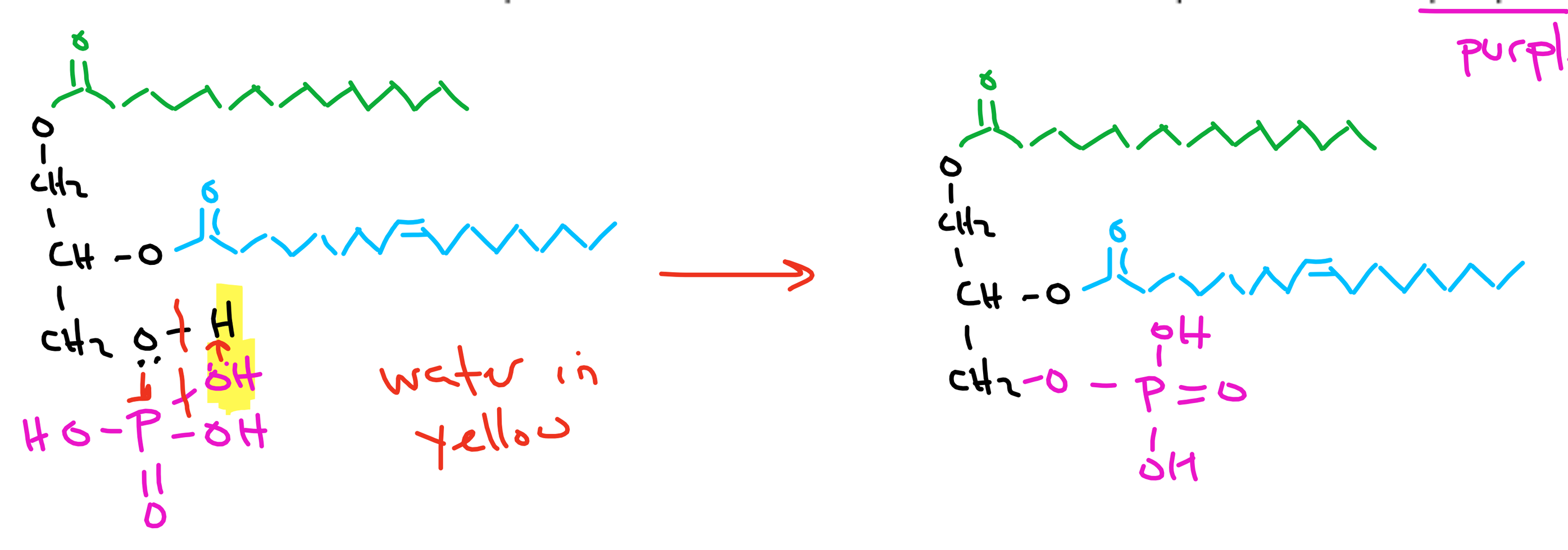
b. Now show the product of a condensation reaction between C2 of the 5a product and 18:1n-9. (blue)

water in yellow



c. Now show the product of a condensation reaction between the product of 5b and phosphate. (purple)

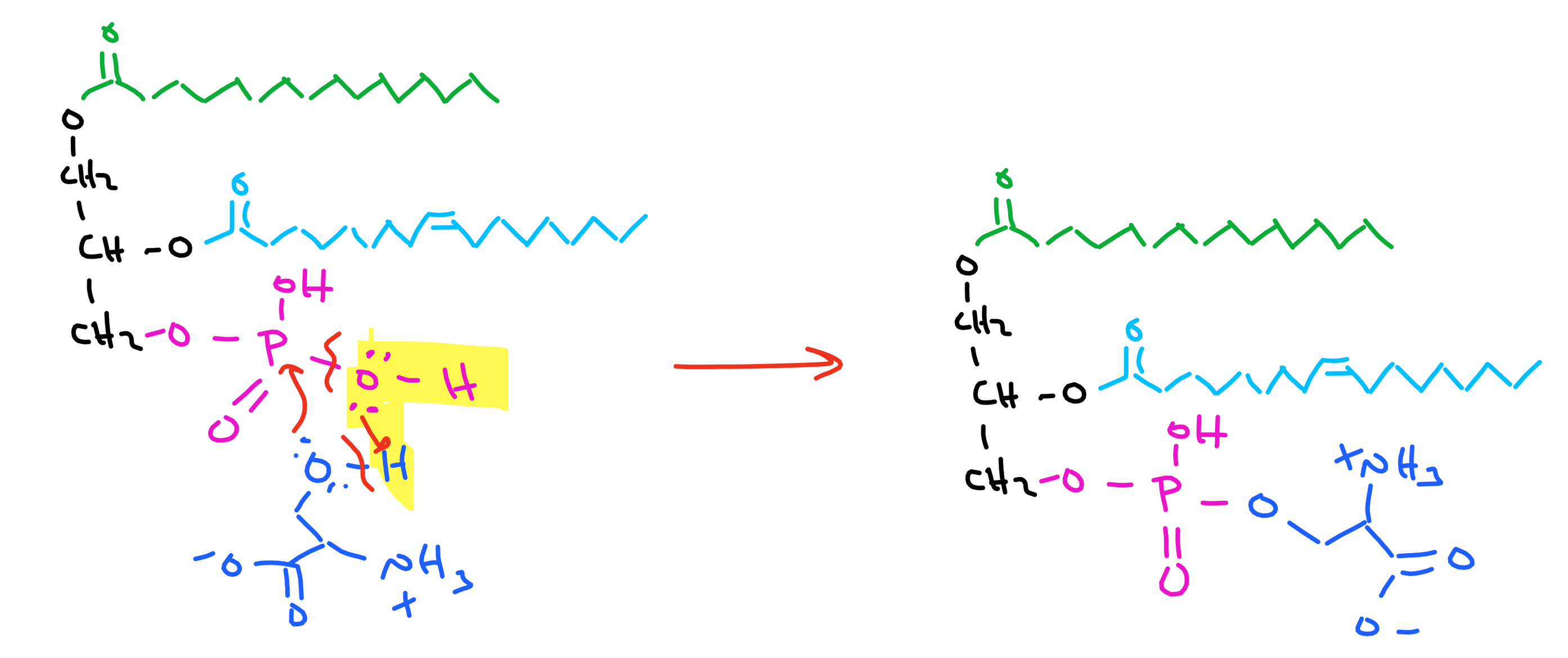
water in yellow



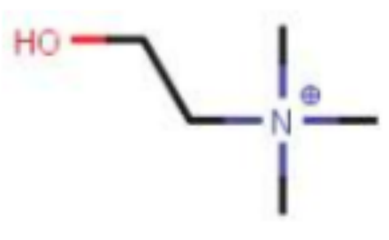
d. Finally, let's finish the polar head group. Determine the product of a condensation between 5c product and the alcohol functional group of serine. This is phosphatidylserine. Serine is the polar head group and the "phosphatidyl" tells you that it's linked up to a phospholipid.

Serine

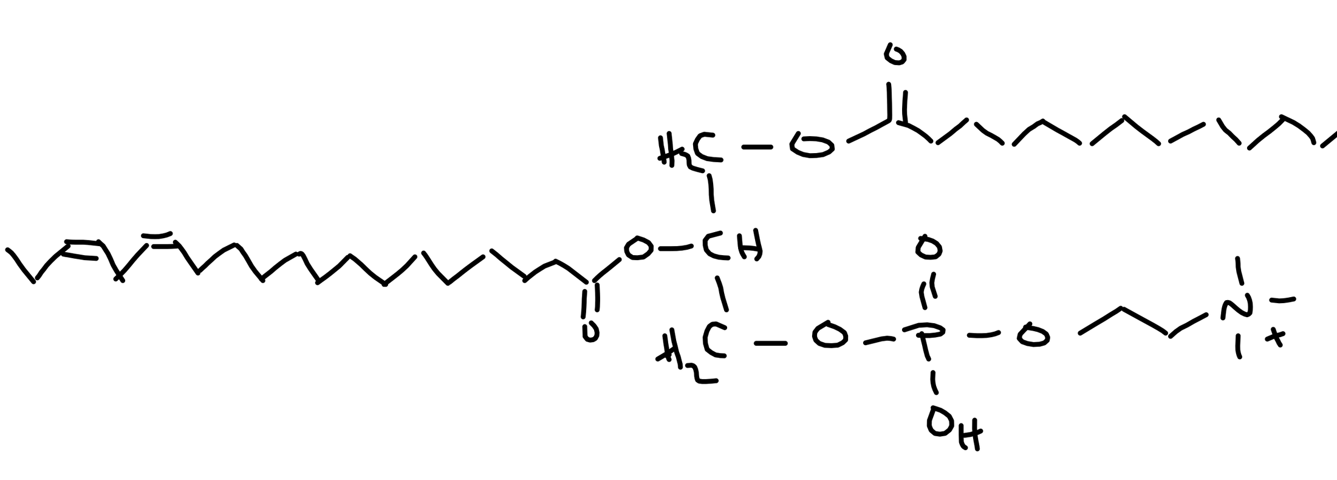
in blue



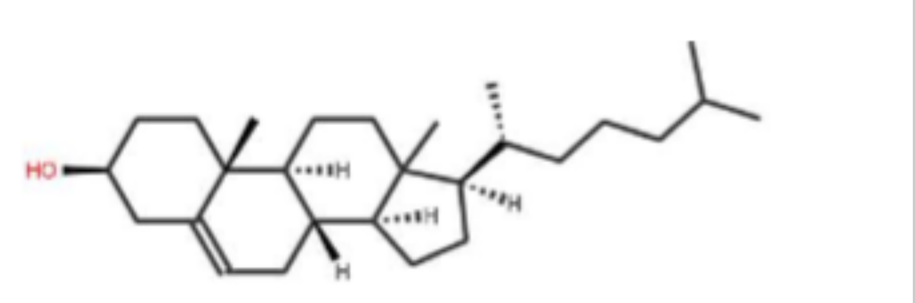
6. Draw phosphatidylcholine that is made with 16:0 and 20:3n-3.



Choline



7. Consider cholesterol:



   a. Is cholesterol a planar molecule? How do you know?

   No - most of the carbons are sp^3

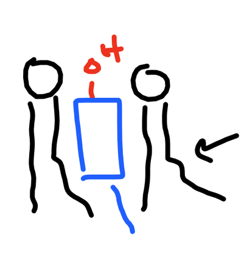
   b. Can cholesterol be part of a lipid bilayer? Why do you make this prediction?

   it has a polar group (OH) and a nonpolar tail

   c. How many H-bonds can cholesterol make? 3 → 1 donor, 2 acceptor
   d. Why are some of the hydrogen atoms shown in the skeletal structure?

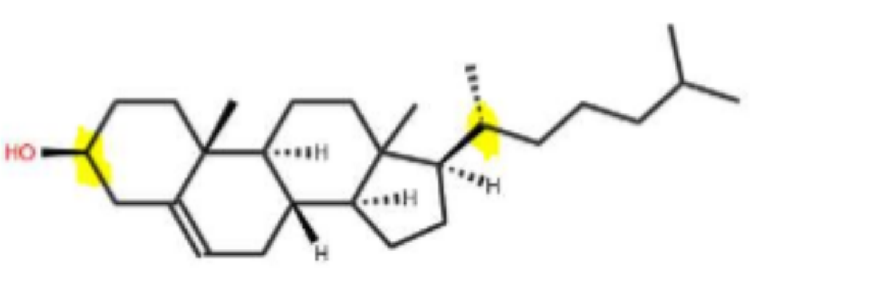
   They are shown in or out of the plane of the paper. 3D structure must be important

   e. Sketch a lipid bilayer that shows how cholesterol is a participant in the structure. Remember to take into account that each phospholipid contains one unsaturated fatty acid.



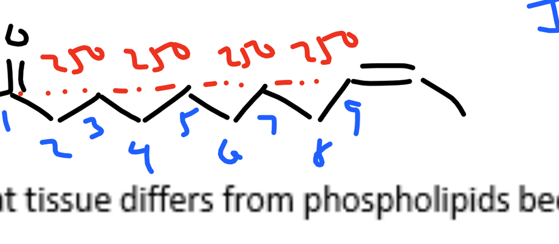
← kink from unsaturated fatty acid

   f. The distance between the two highlighted carbons on cholesterol is almost exactly 10 Å (angstroms where 1 Å = 10^{-10} m)). Noting that the distance between C_1 and C_3 in propane is 251 pm, predict how the position of the 1st double relative to the carboxylic acid. For example Δ^3 would be the 3rd carbon.



$10\text{ Å} \times \frac{10^{-10}\text{ m}}{1\text{ Å}} \times \frac{1\text{ pm}}{10^{-12}\text{ m}}$

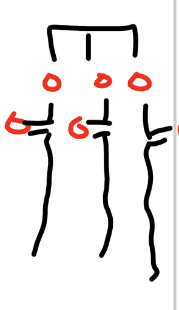
$10\text{ Å} = 1000\text{ pm}$



If double bond is on 9th carbon, cholesterol's ring system would fit into the gap nicely

8. Fatty acids in fat tissue differs from phospholipids because they replace the polar head group with another fatty acid.
   a. How does this change the physical properties of the fatty acids? Why are these properties important for fat tissue?

   No polar head group, so everything is non-polar. consequently, no way to interact with H_2O



   b. To use stored fat as an energy sourceThe enzymes that are responsible for breaking apart fat (either dietary or stored in your adipocytes) are called lipases. These enzymes catalyze hydrolysis reactions. Predict the product(s) of lipase degradation of the compound shown below: