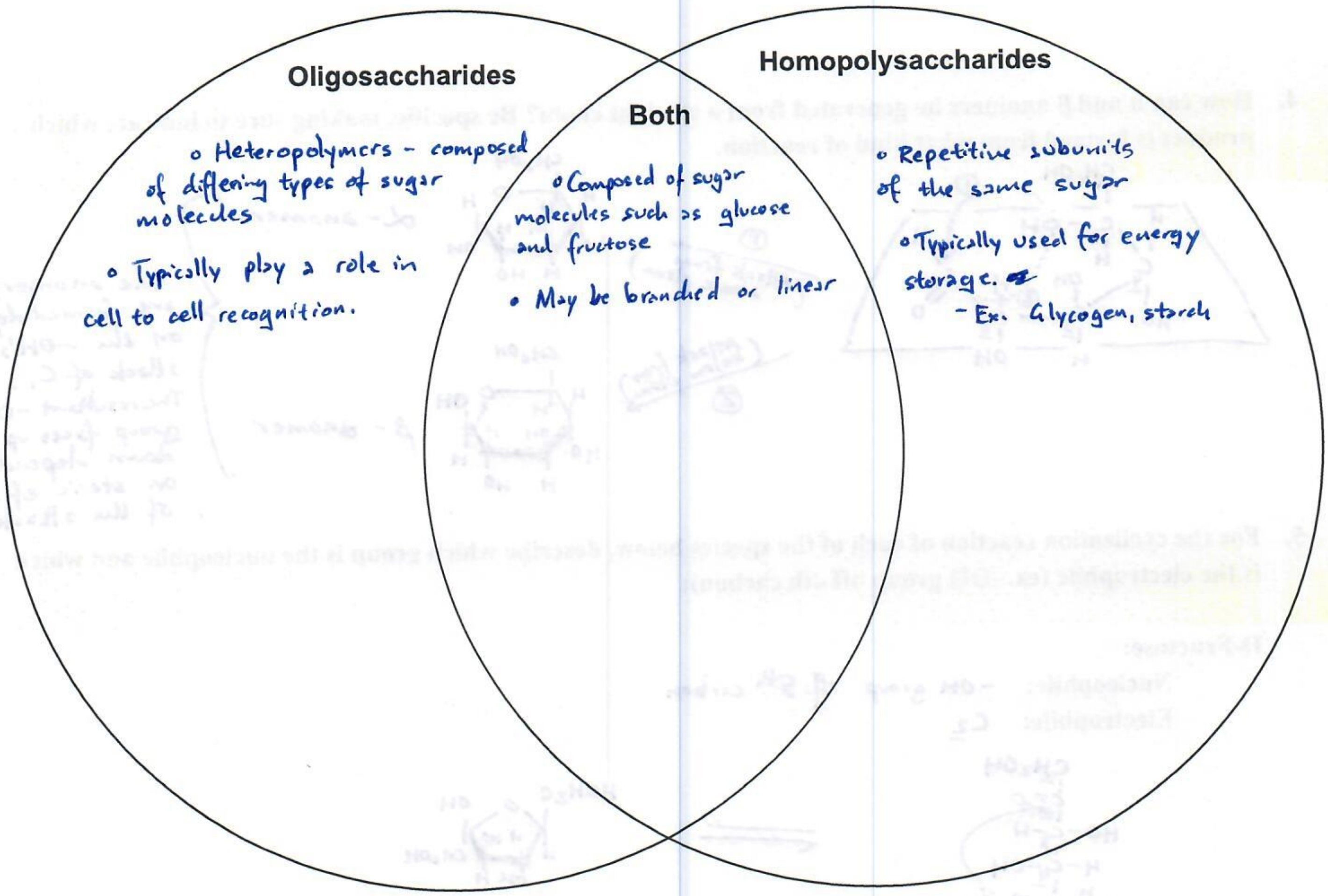
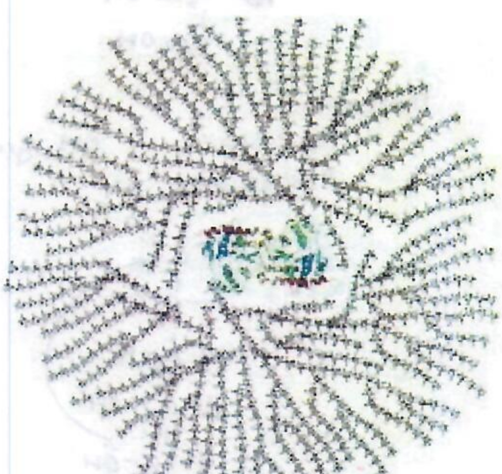
BCHM 463 GSS Collaborative Worksheet
Wednesday 10/05/2022 - Carbohydrates and Lipids

Part I - Carbohydrates

1. **In the Venn diagram below, distinguish between oligosaccharides and homopolysaccharides by detailing their similarities and differences. (Double click to edit diagram)**



2. **Functionally, why is it important for glycogen to be branched in a way similar to the diagram on the right?**

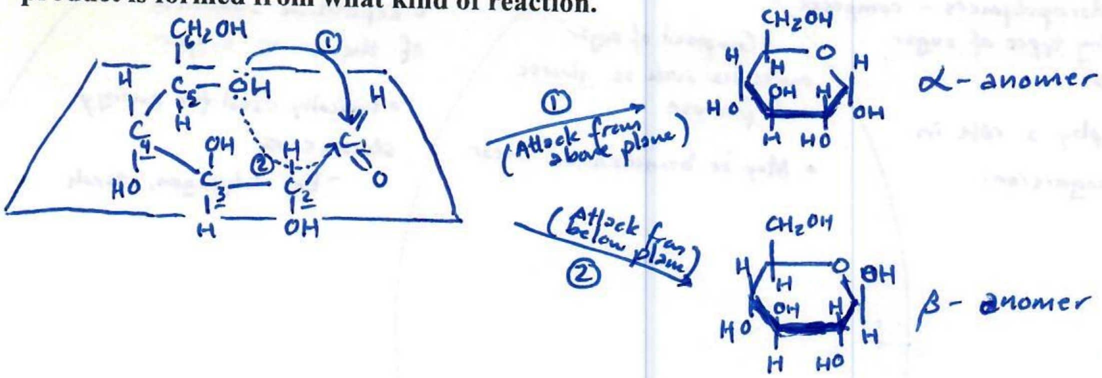


More free ends of glucose means that more glucose can be broken off the glycogen chain at once, allowing for a faster physiological response to glucose deficiency than if sugars were stored linearly (~~one~~ only one free end → one enzyme acts only → slow glycogen breakdown)

3. **Vertebrates are usually incapable of breaking down** $\beta(1\rightarrow4)$ **sugar linkages. One notable exception to this is the disaccharide** lactose**. However, some individuals lacking the enzyme responsible for cleaving this bond are not able to break down this bond.**

In other organisms, polysaccharides connected by this linkage are typically used for structure**. Cows and other ruminants are able to break this bond because they have gut bacteria which produce enzymes to cleave this linkage.**

4. **How can α and β anomers be generated from a straight chain? Be specific, making sure to indicate which product is formed from what kind of reaction.**



The anomers are formed depending on the -OH's attack of C_1. The resultant -OH group faces up or down depending on steric effects of the attack.

5. **For the cyclization reaction of each of the species below, describe which group is the nucleophile and which is the electrophile (ex. -OH group off 4th carbon):**

D-Fructose:

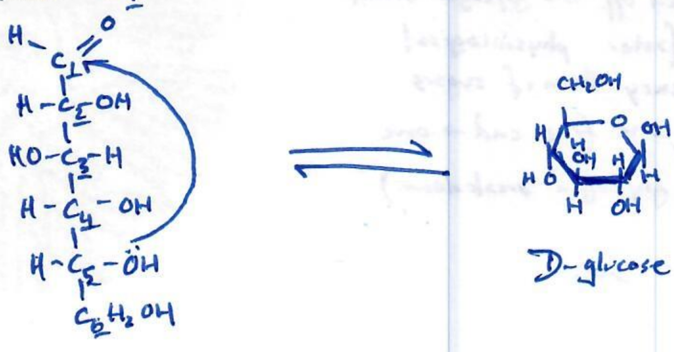
Nucleophile: -OH group off 5th carbon

Electrophile: C_2

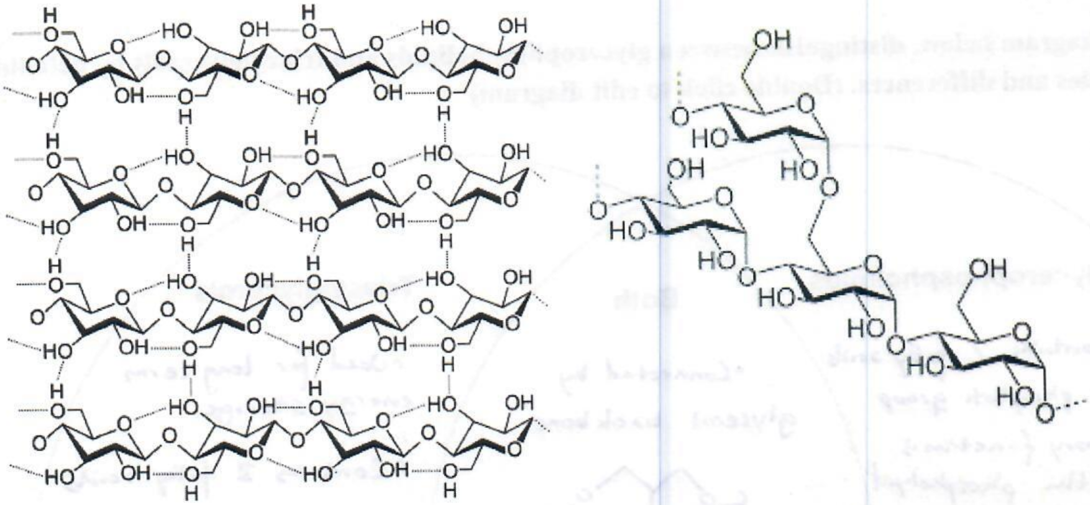
D-Glucose:

Nucleophile: - OH group off 5th carbon

Electrophile: C_1



6. **Consider the binding patterns of cellulose (left) and starch (right).**



Describe two differences you see between the structures. How might these differences contribute to differences in biological functions?

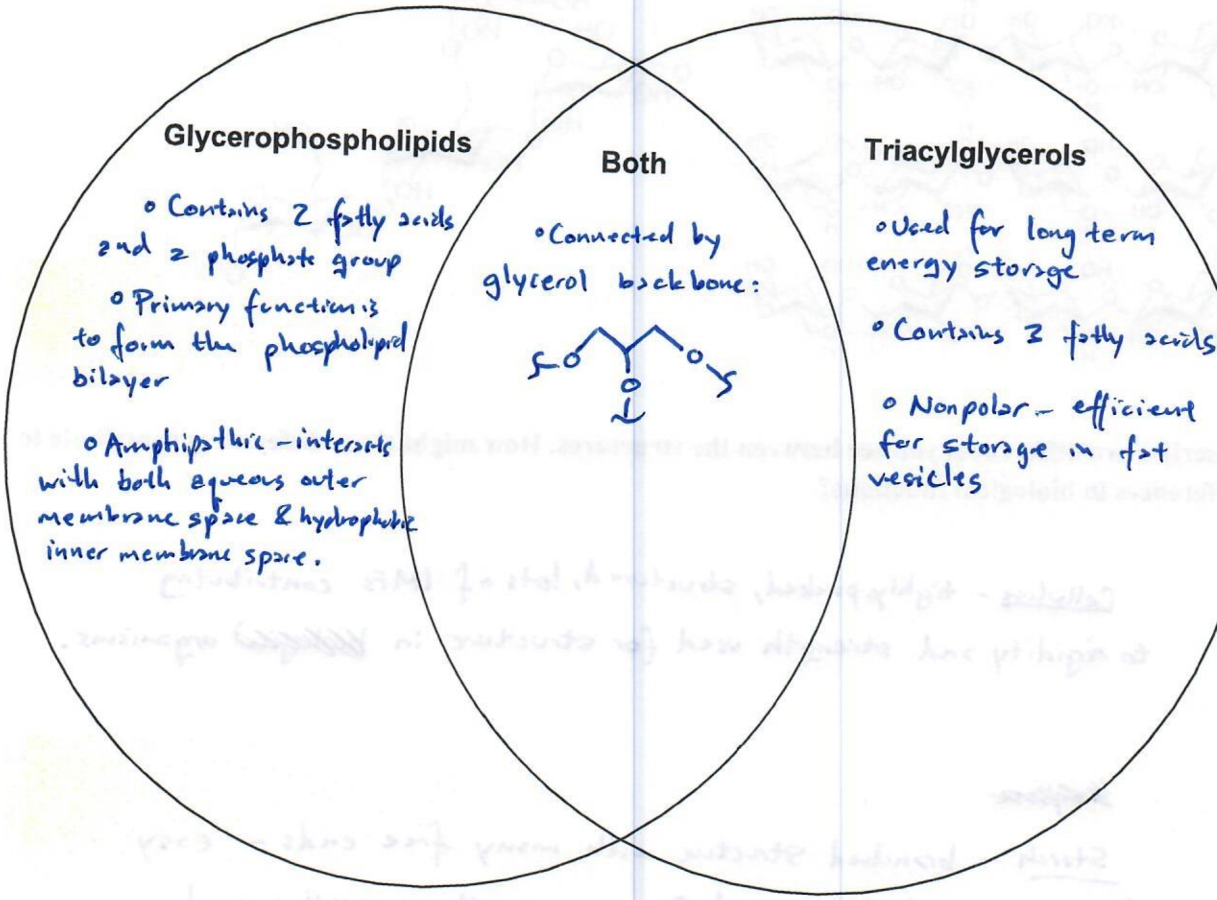
Cellulose - tighly packed, structured, lots of IMFs contributing to rigidity and strength used for structure in ~~biological~~ organisms.

~~Amylose~~

Starch - branched structure with many free ends - easy access to glucose used for energy, thus mostly used for energy storage.

Part II - Lipids

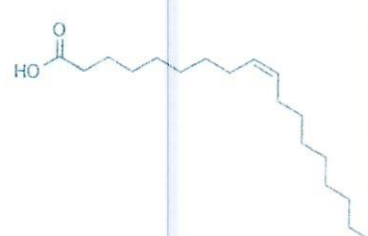
1. **In the Venn diagram below, distinguish between glycerophospholipids and triacylglycerols by detailing their similarities and differences. (Double click to edit diagram)**



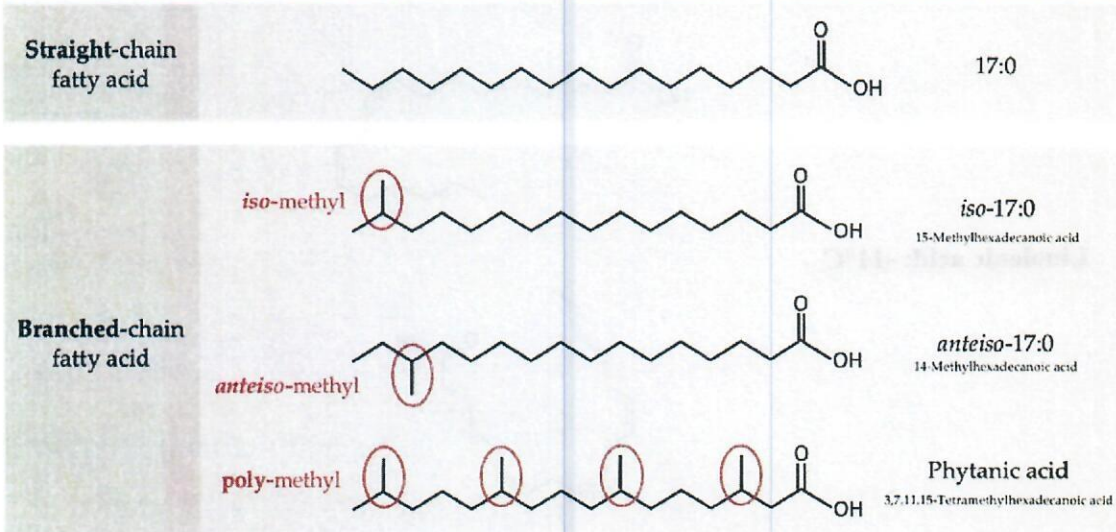
2. **The melting points of a series of 18-carbon fatty acids decrease significantly with an increase in saturation (amount of double bonds in aliphatic chain):**

Stearic acid: 69.6°C

Oleic acid: 13.4°C



3. **Bacterial cells are uniquely able to produce branched-chain fatty acids such as the ones shown below:**

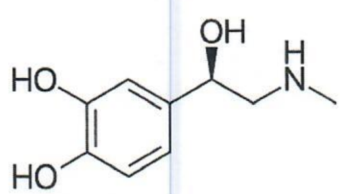


How would the incorporation of these branched chain fatty acids into a membrane impact the fluidity of the membrane?

The membrane would be more fluid since the methyl groups of these fats can disrupt intermolecular interactions between straight-chain fatty acids through steric hindrance.

4. **Hormones are the body's way of signaling to adapt to changing conditions. These hormones may act extracellularly or intracellularly to induce a cellular response depending on their polarity. For the following small molecule hormones below, predict whether the hormone would bind to proteins in the aqueous extracellular domain or diffuse through the lipophilic intermembrane space:**

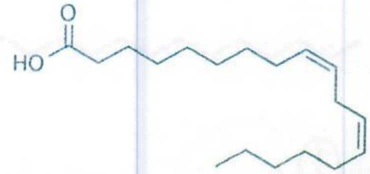
   a. **Adrenaline**



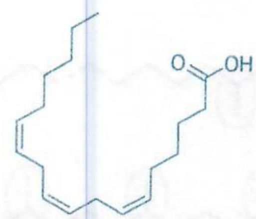
Largely Polar molecule

Intracellular **Extracellular**

Linoleic acid: -5°C



Linolenic acid: -11°C



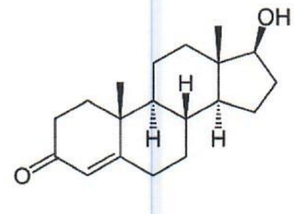
a.) Why might the melting points of these compounds follow this trend? Think of the structural consequences on a large scale.

More saturation (double bonding) → more distorted, less linear structure → less surface area for IMFs (since cylindrical ~~linear~~ → spherical dec. surface area) → less interactions b/w molecules overall → ~~lower~~ less binding due to less efficient packing (think of stacking sheets of paper vs. stacking baseballs) → lower melting temperature.

b.) Predict whether oleic acid (shown above) or elaidic acid, a trans-fat (shown below) would have a higher melting point. How did you arrive at your conclusion?

Elaidic acid would have a higher melting point than oleic acid. ~~Desp~~ Despite the presence of a double bond in this trans fat, the trans-bonding characteristic of this molecule allows for the molecule to retain its efficient packing characteristics, leading to a higher melting point.

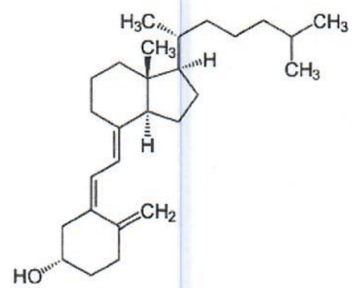
b. Testosterone



Despite $\overset{O}{\parallel}$ and —OH group, still largely <u>nonpolar</u>. Thus, diffuses through intramembrane space.

Intracellular Extracellular

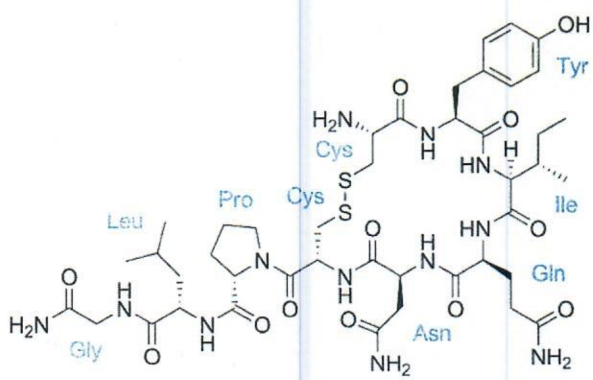
c. Cholecalciferol (Vitamin D_3)



Largely nonpolar.

Intracellular Extracellular

d. Oxytocin



~~[illegible]~~

Nonapeptide. Contains many polar AA residues (Tyr, Gln, Asn, etc.) suggests interaction with some membrane protein.

Intracellular Extracellular