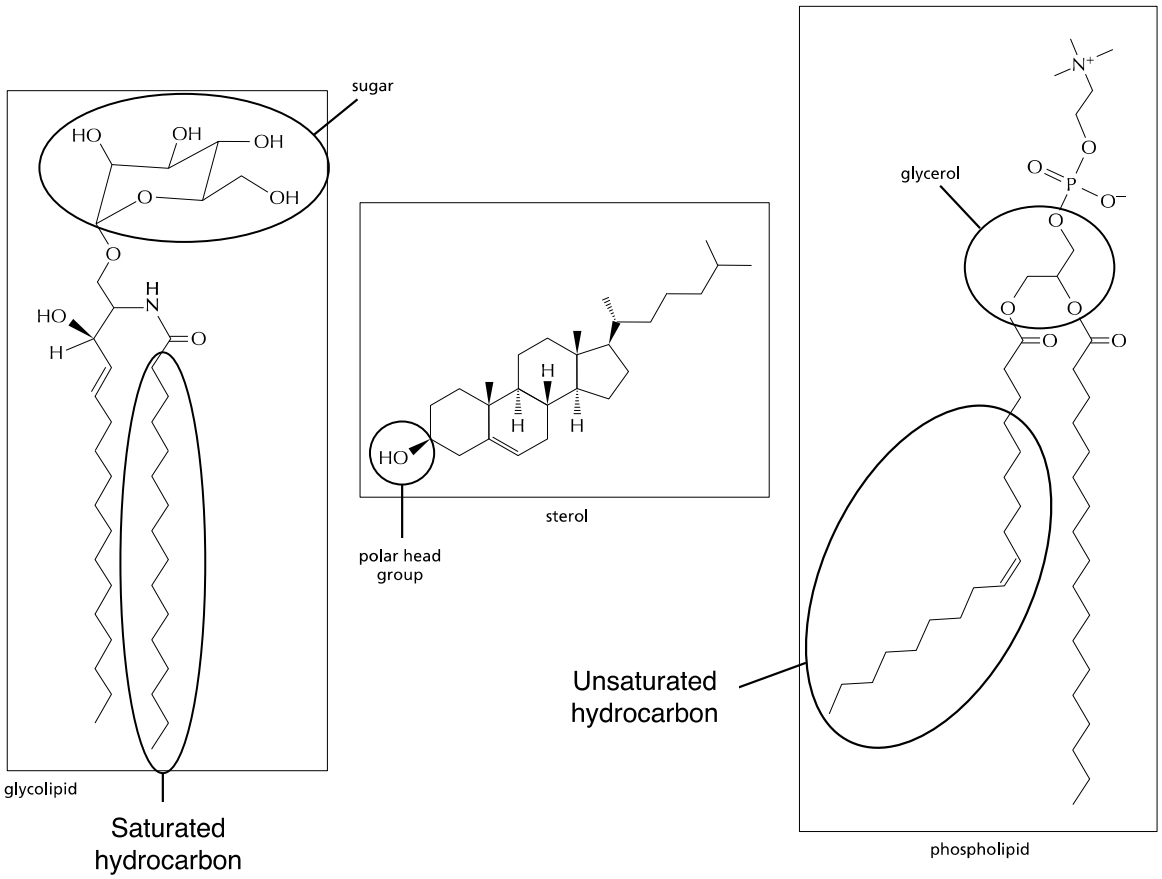
Membranes

1. A. True.
B. False. Phosphatidylcholine is the most abundant phospholipid found in cell membranes.
C. True.
D. False. The formation of a lipid bilayer is energetically favorable.

2.



3. Membrane proteins are much larger molecules than the membrane lipids. Thus, fewer are required to represent the same total mass contributed by the lipid components of the membrane. By this estimation, the molecular weight of the average membrane protein is 50 times that of the average membrane lipid.

4. Answer: D: The structure shown is that of cholesterol, an amphiphilic sterol that affects the permeability and fluidity of the membranes. Cholesterol is found in animal cells. Other eukaryotic cells have different sterols. Most prokaryotic membranes lack cholesterol or other sterols.

5. b

6. **A.** PLX could be either inside or outside the cell; these data do not allow you to distinguish between these two possibilities. PLZ is outside the cell, because PLZ is rapidly transferred to the outside of the cell and stabilized there.
   B. PLZ probably has a flippase. Whether you incorporate it on the inside of the cell or the outside of the cell, it ends up outside the cell.

7. Raft area: $3.14 \times 35^2 = 3.8.10^3$ nm^2
   Lipid area: $3.14 \times .025^2 = 0.20$ nm^2
   Thus 19000 lipids in one monolayer, 38'000 in the bilayer
   For 50 lipids per protein, we have 760 proteins
   The true ratio of protein to lipid in cell microdomains is unknow and likely to differ between types of domains

8: The same forces that dictate that certain lipids will form a bilayer, as opposed to micelles, operate in the repair of a tear in the bilayer. The tear will heal spontaneously because a bilayer is the most energetically favorable arrangement. The lipids that make up a bilayer are cylindrical in shape and therefore do not readily form a micelle (or a hemi-micelle), which would require cone-shaped lipids.

9: Bilayers formed by lipids with saturated hydrocarbon tails would be much less luid. Whereas a normal lipid bilayer has the viscosity of olive oil, a bilayer made of lipids with saturated hydrocarbon tails would have the consistency of bacon fat. In contrast, bilayers formed by lipids with unsaturated hydrocarbon tails would be much more fluid. Also, because the lipids would pack together less well, there would be more gaps and the bilayer would be more permeable to small water-soluble molecules.

10: Vegetable oil is converted to margarine by reduction of double bonds (by hydrogenation), which converts unsaturated fatty acids to saturated ones. This change allows the fatty acid chains in the lipid molecules to pack more tightly against one another, increasing the viscosity, turning oil into margarine.

11: Phosphatidylcholine is the phospholipid that is cleaved by your snake venom enzyme.

12: A. Antarctic fish, which are cold-blooded, live in freezing waters. In order to maintain an appropriate fluidity of their membranes under such extreme conditions, they require a higher proportion of unsaturated fatty acid chains in their membranes to keep them from freezing solid like a stick of margarine. Polar bears also live in extreme cold, but they are warm- blooded and maintain a high internal temperature; thus, they have no special requirement for unsaturated fatty acids in their membranes.

13: the size of a lipid raft depends on the afinity of its components for one another. If sphingolipids and cholesterol molecules, for example, bound one another suiciently tightly, they would aggregate into a single domain in the membrane. If they bound one another with the same afinity as they bind to other species of lipid molecules, they would remain dispersed. The small size of the lipid rafts indicates that sphingolipids and cholesterol molecules, for example, have only a slightly higher afinity for one another than for other lipids. Presumably, at the typical size of a raft, the aggregated lipid components, including sphingolipids and cholesterol molecules, are in equilibrium with their free forms, so that they are added to and leave a raft at equal rates.

14: It is not a paradox. the fluidity of the bilayer is strictly confined to one plane. the lipid molecules can difuse laterally, but do not readily flip from one monolayer to the other. Specific types of lipid molecule remain in the monolayer they are inserted into, unless they are actively transferred by an enzyme—a phospholipid translocator (a flippase).

15: the redistribution of phosphatidylserine from the cytoplasmic to the outer monolayer of the plasma membrane occurs by two mechanisms: (1) the phospholipid translocators that normally transport this lipid from the noncytoplasmic monolayer to the cytoplasmic monolayer are inactivated in apoptotic cells; and (2) a “scramblase” that transfers phospholipid nonspecifically in both directions between the two monolayers is activated.