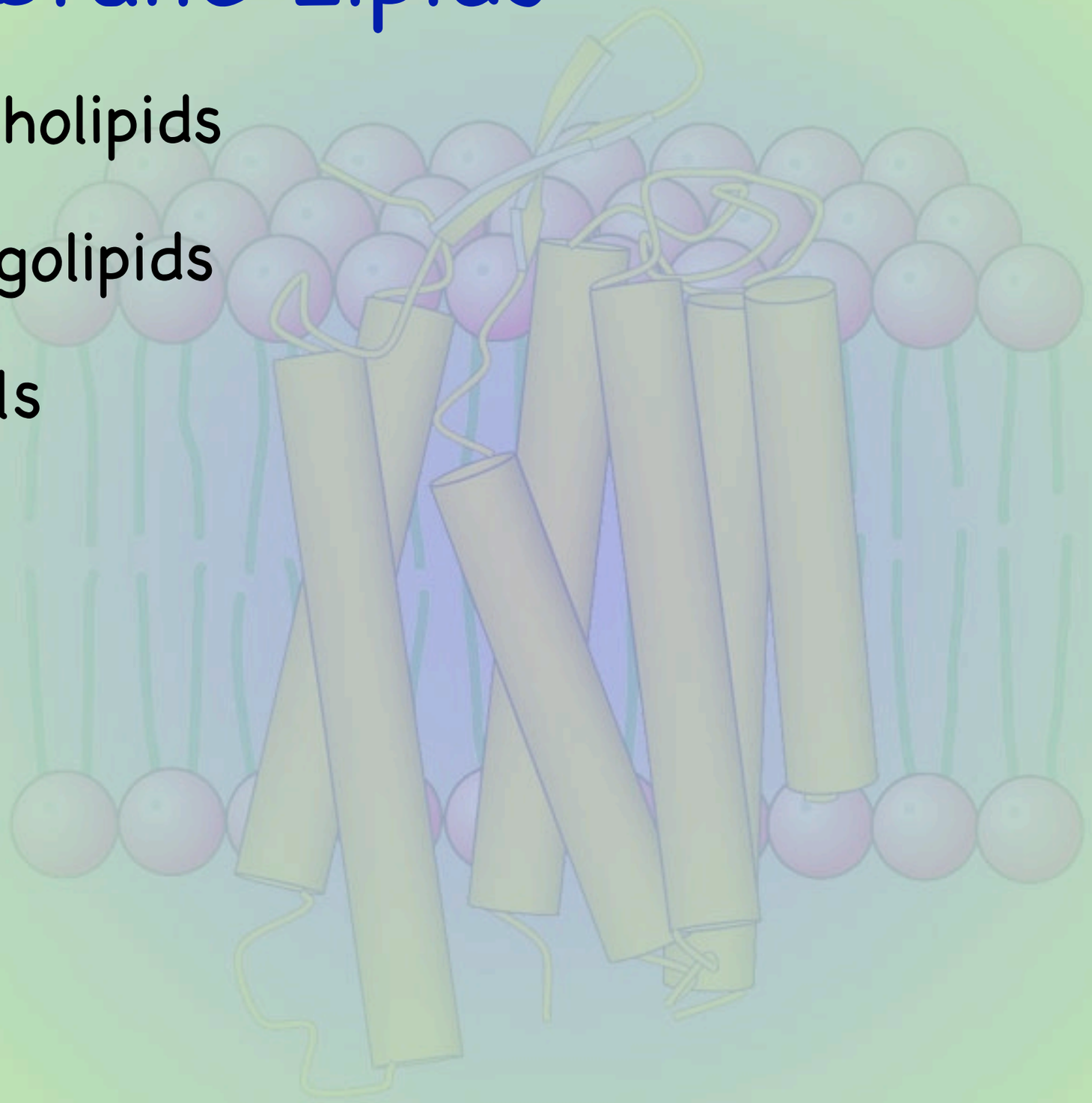
Chem 452 - Lecture 8
Lipids and Cell Membranes
111114

Like carbohydrates, lipids are one of the four major classes of biomolecules, which also include the proteins, carbohydrates and nucleic acids. Lipids are grouped not according to a chemical structure, as is the case for the other four classes, but rather they are grouped according to a physical property. Lipids comprise the molecules in a cell that can be extracted into non-polar solvents, which means they are non-polar, hydrophobic molecules. We will see that this does not mean that they do not contain hydrophilic functional groups, but all lipids molecules do contain large, hydrophobic regions. With cells being made up of largely water, this produces some very interesting and important cellular structure, not the least of which are the cell membranes.

Membrane Lipids

- Phospholipids
- Sphingolipids
- Sterols



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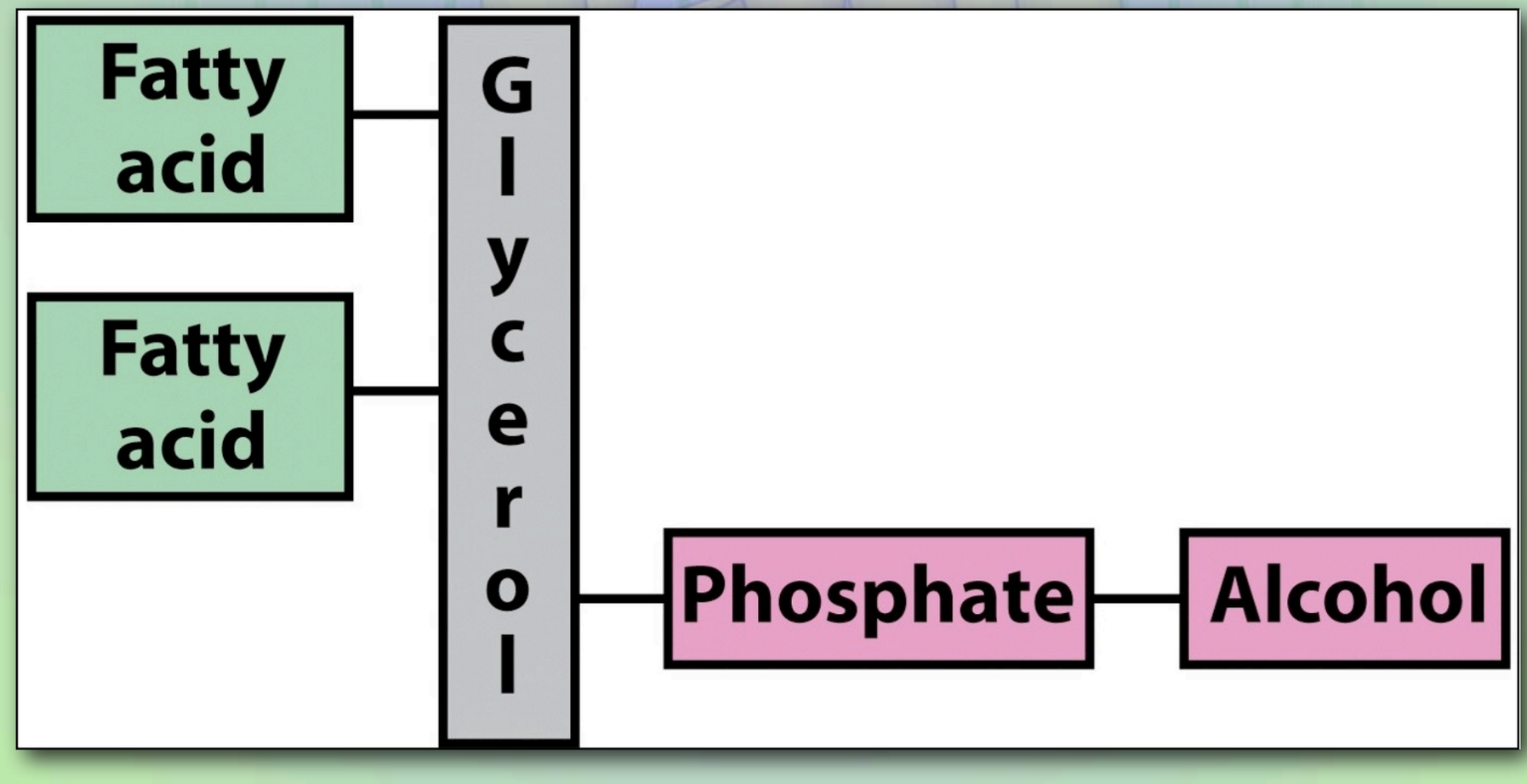
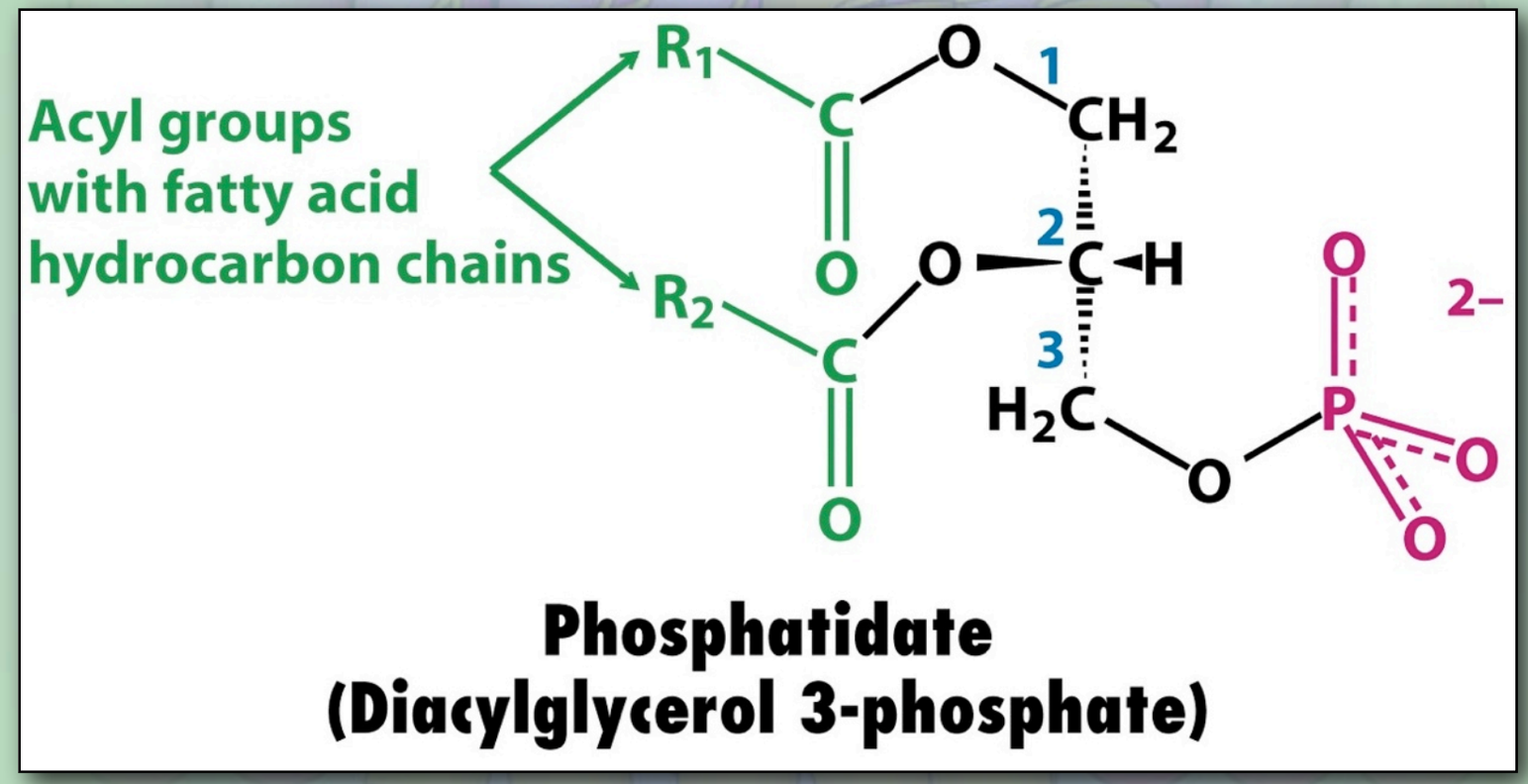


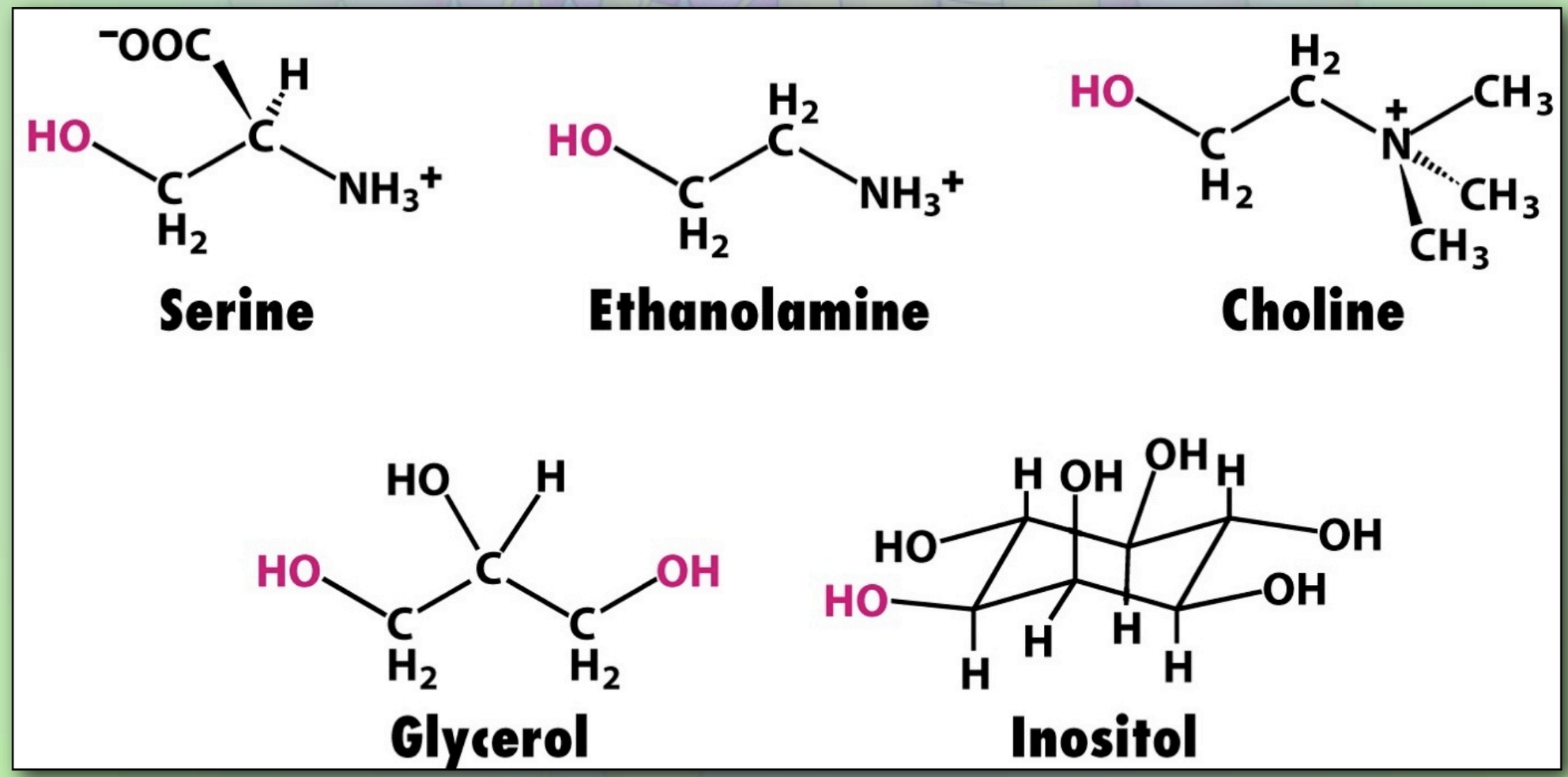
Phospholipids

- Core structure of a phospholipid



Phospholipids

- The phosphate usually forms a phosphate ester with an alcohol.



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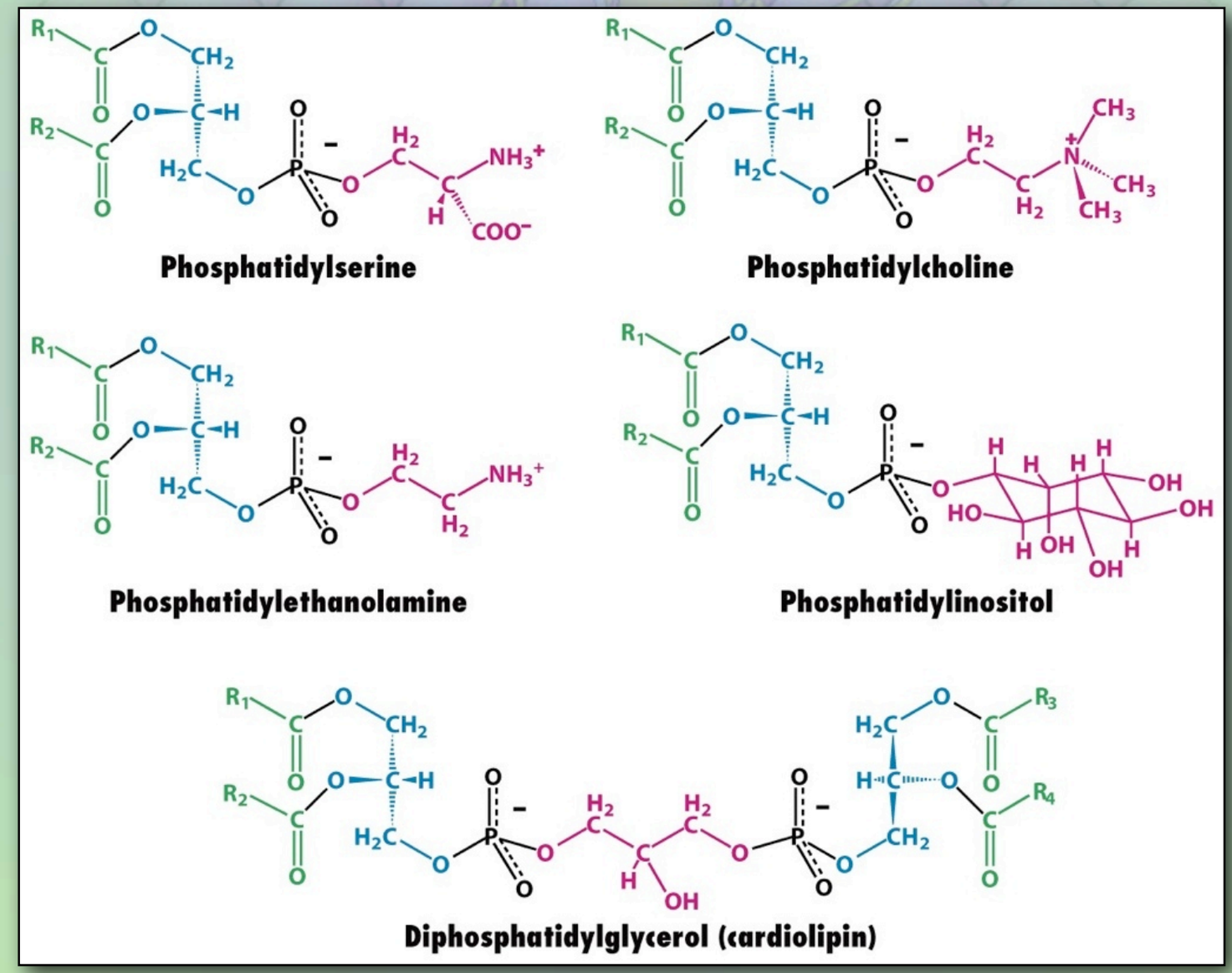

Phospholipids

Question:

Draw the structure for the phospholipid phosphotidylethanolamine with a palmitoyl (16:0) acyl group at position 1 and an oleoyl (18:1 cis-Δ9) acyl group at position 2.

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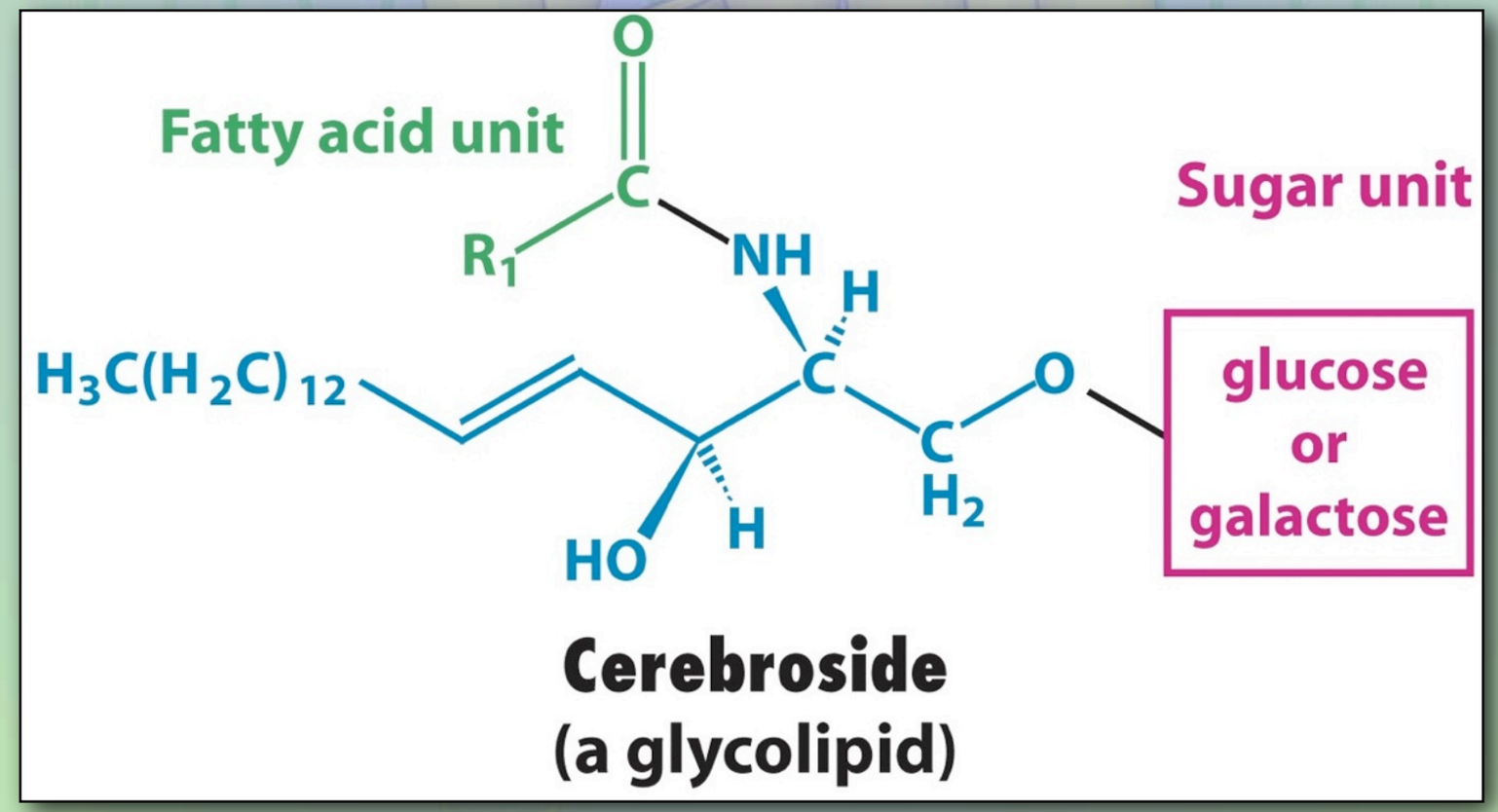
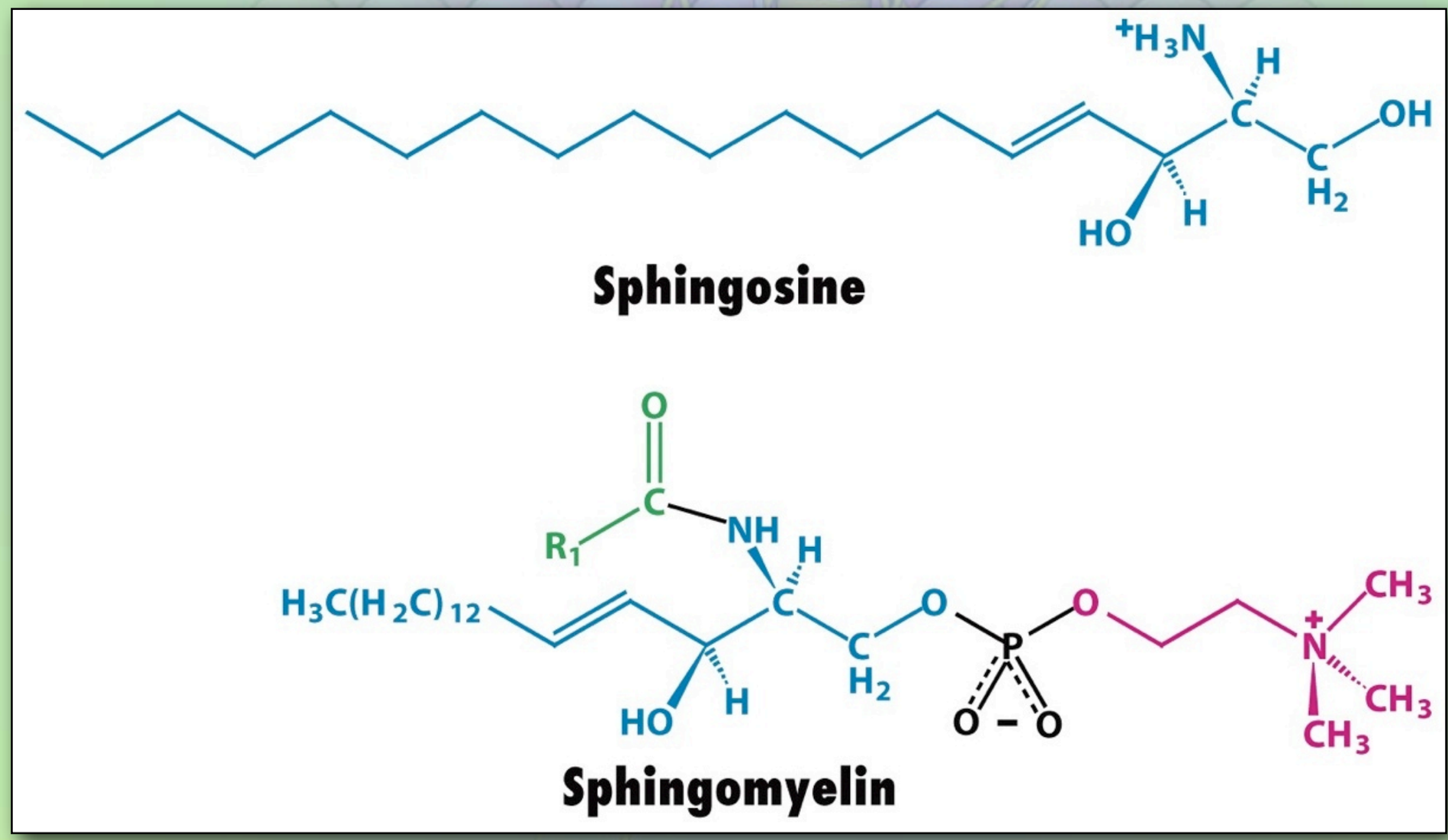


Cerebroside
(a glycolipid)

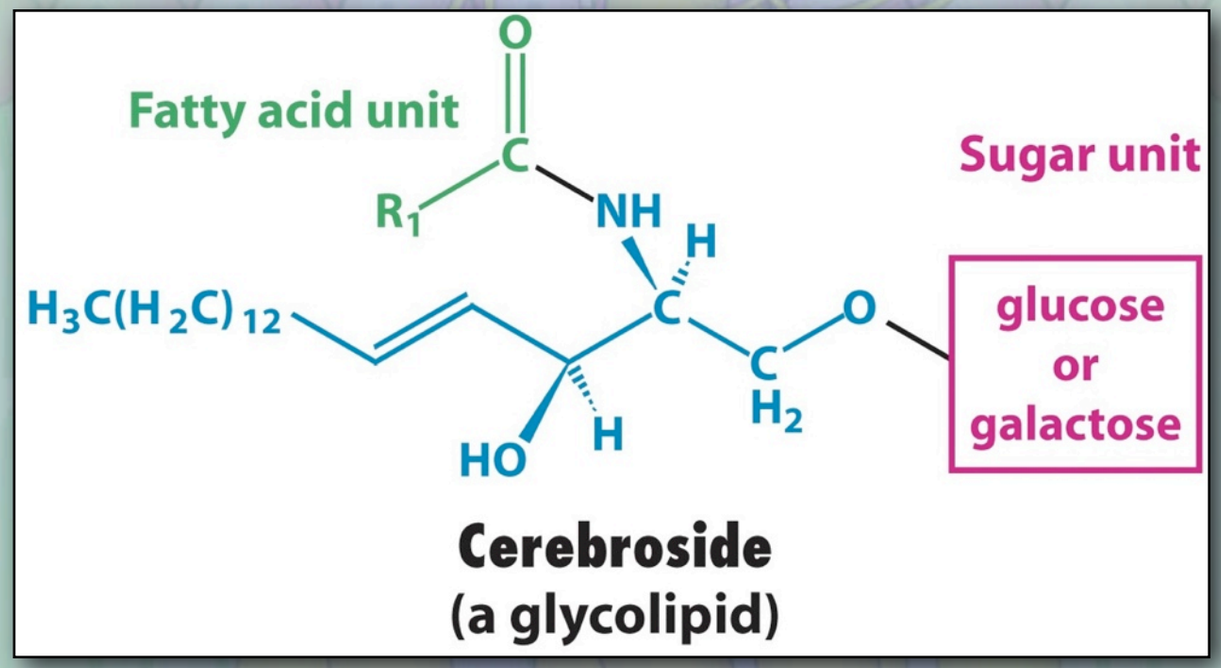
Sphingolipids

- Core is built on sphingosine instead glycerol.



Sphingolipids

- Sphingolipids often are attached to carbohydrates (glycolipids).



- Glycolipids are prevalent in nerve tissues and are associated with many neurodegenerative diseases.

Membrane Lipids

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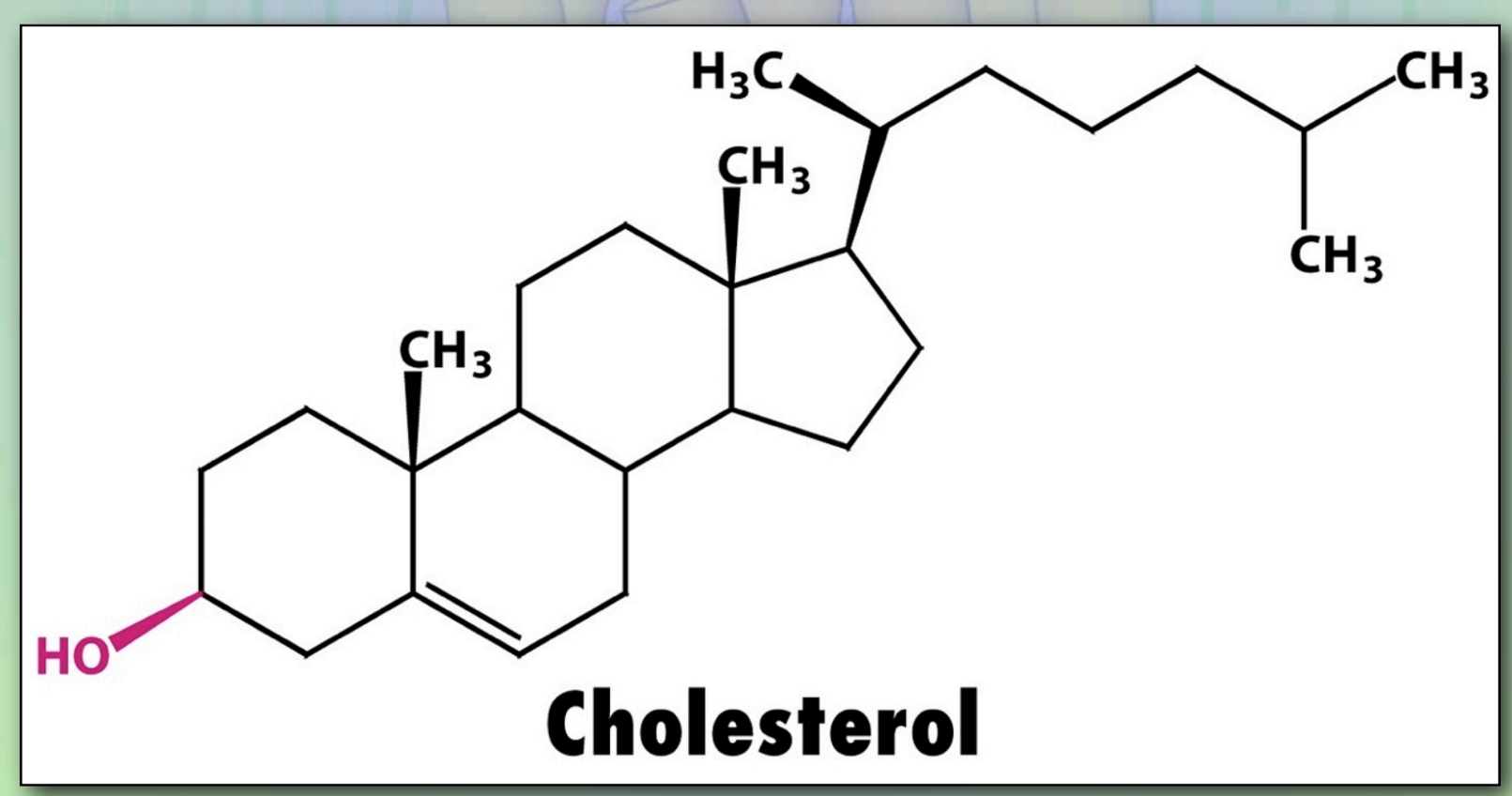
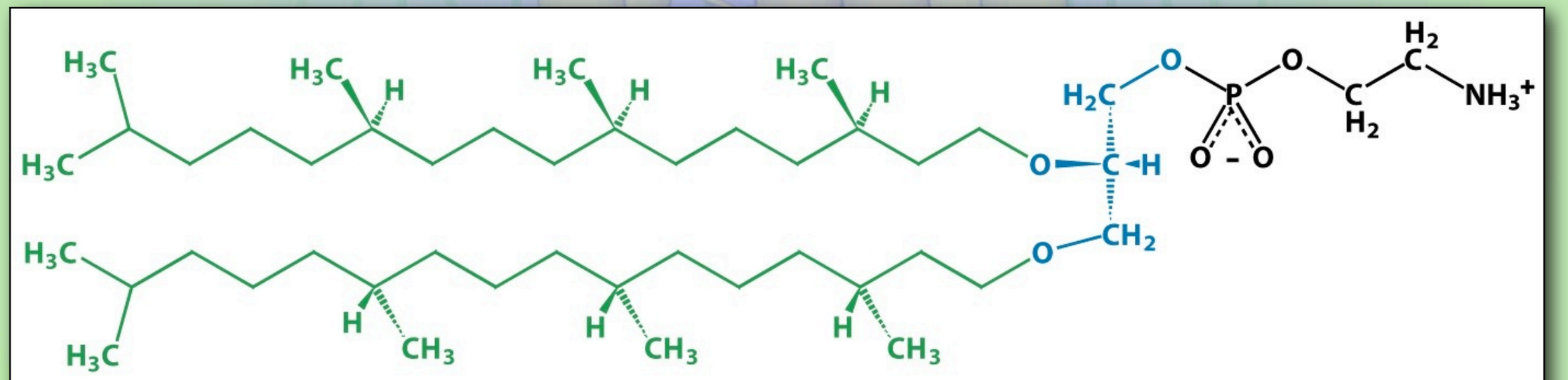


Cholesterol

Membrane Lipids

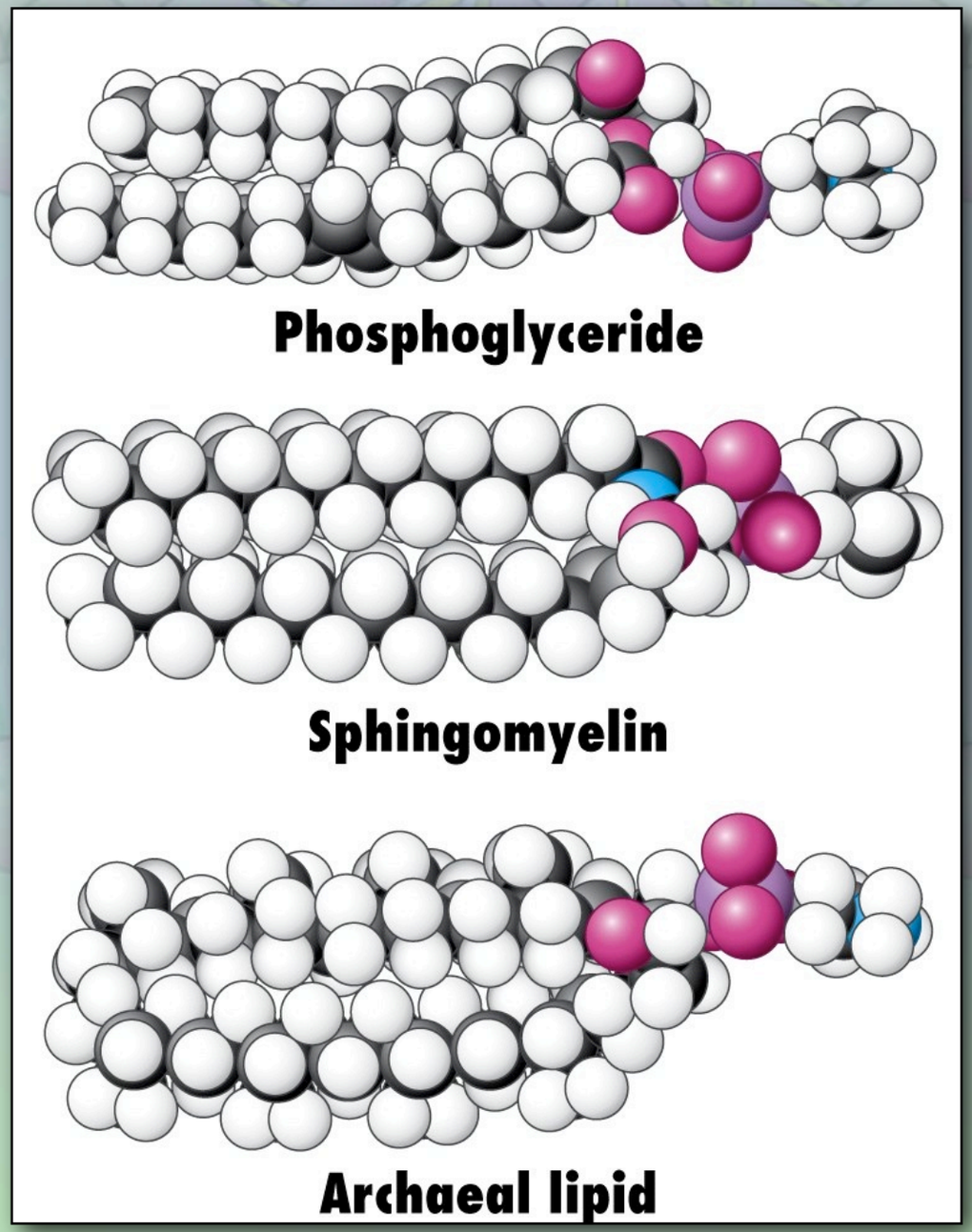
- The structure of membrane lipids is a feature that distinguishes Archean organisms from Eukaryotes and Bacteria.



Membrane lipid from the archaeon *Methanococcus jannaschii*

Membrane Lipids

- Membrane lipids are **amphipathic.**



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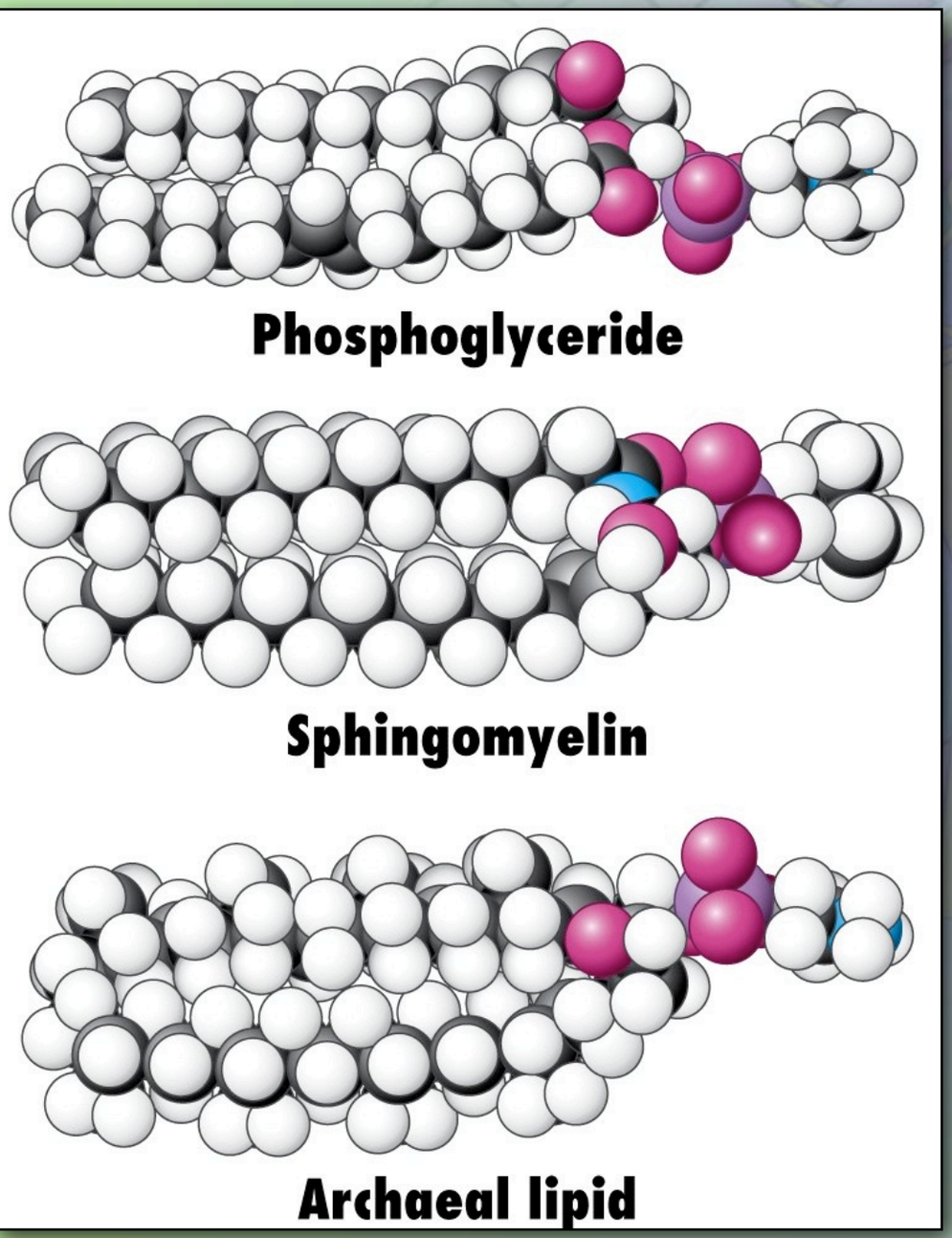
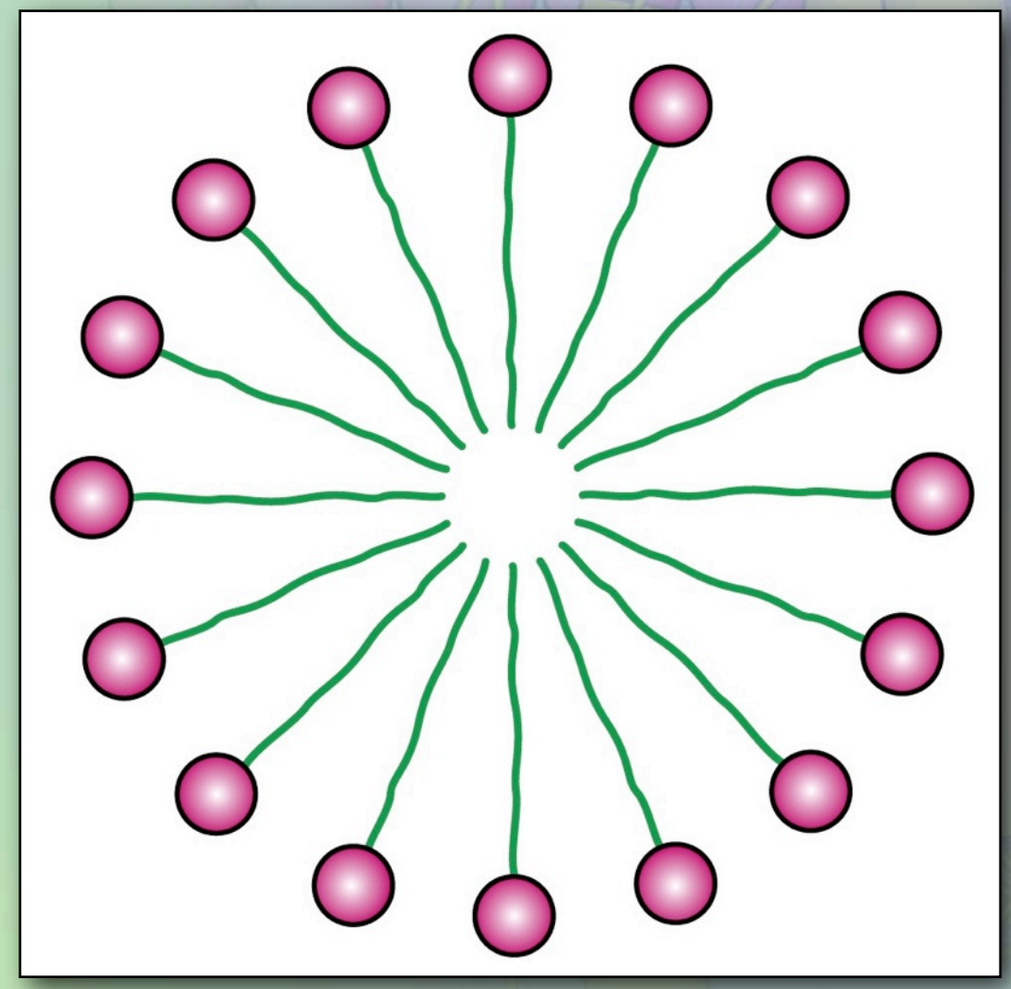


Membrane Lipids and Water

- Membrane lipids self assemble into lipid bilayers when exposed to aqueous environments.



Soaps
(Salts of Fatty Acids)
form
Micelles

Membrane Lipids and Water

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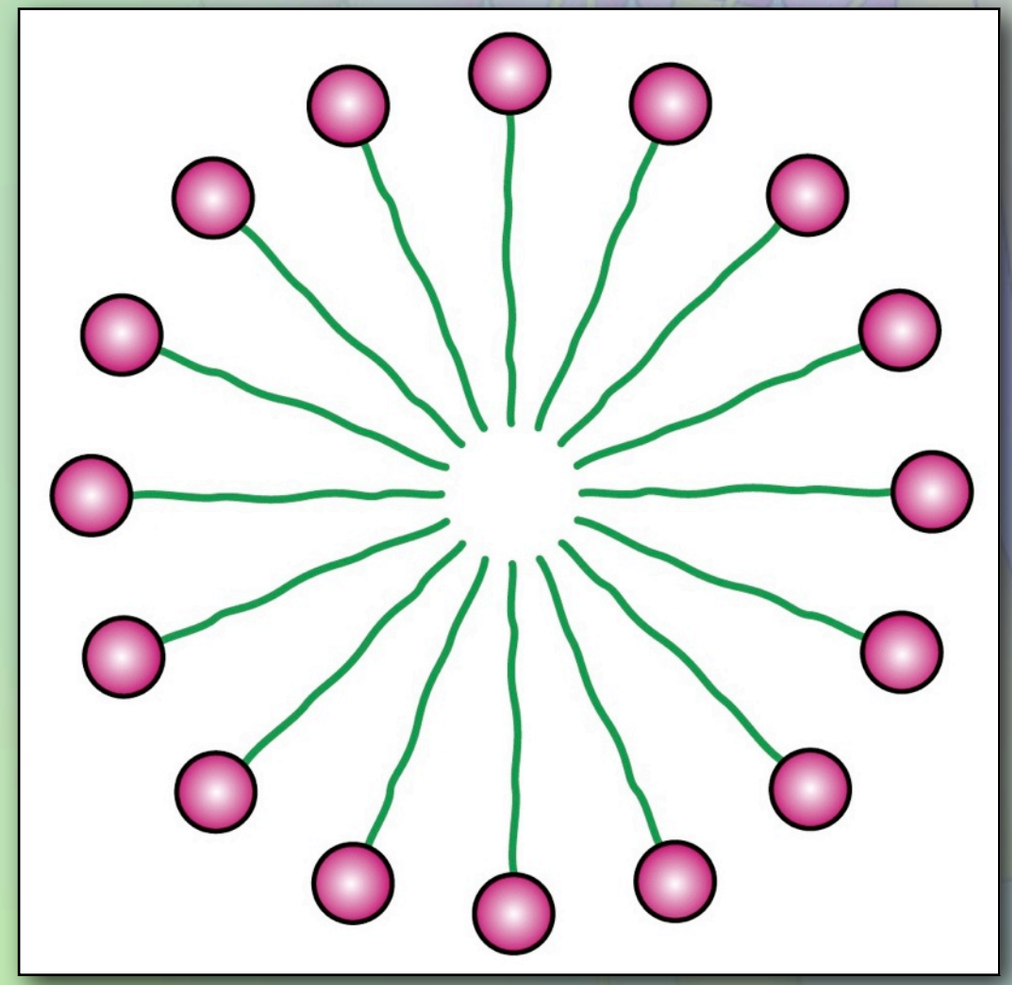

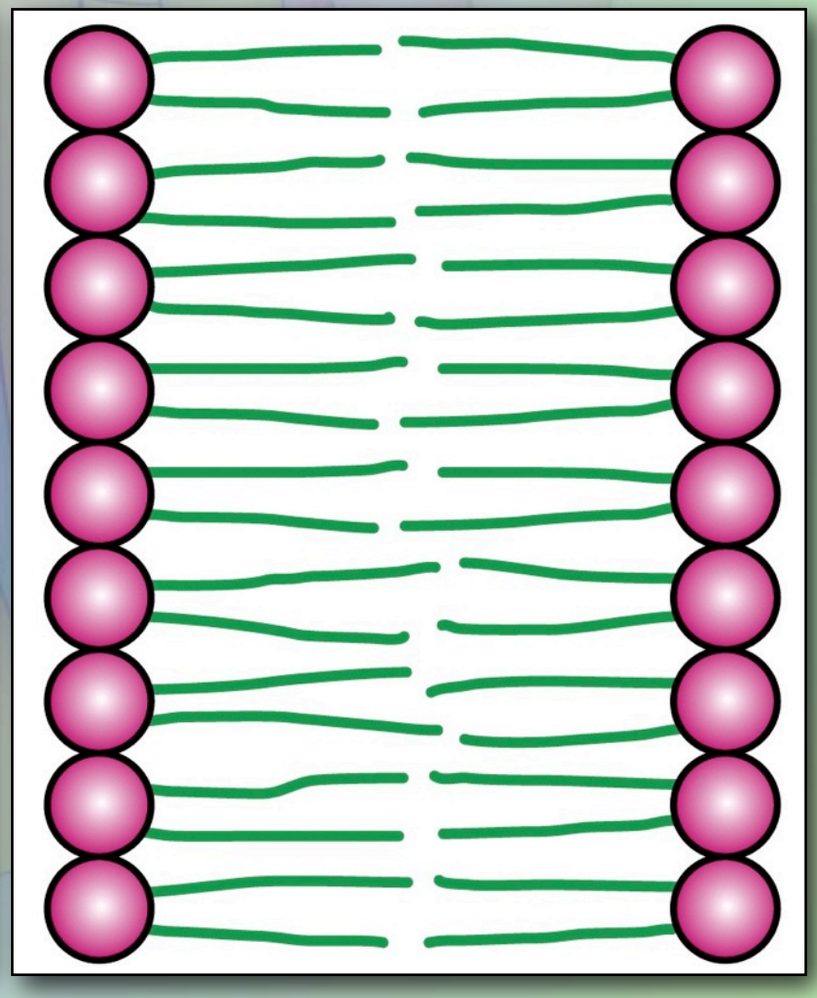

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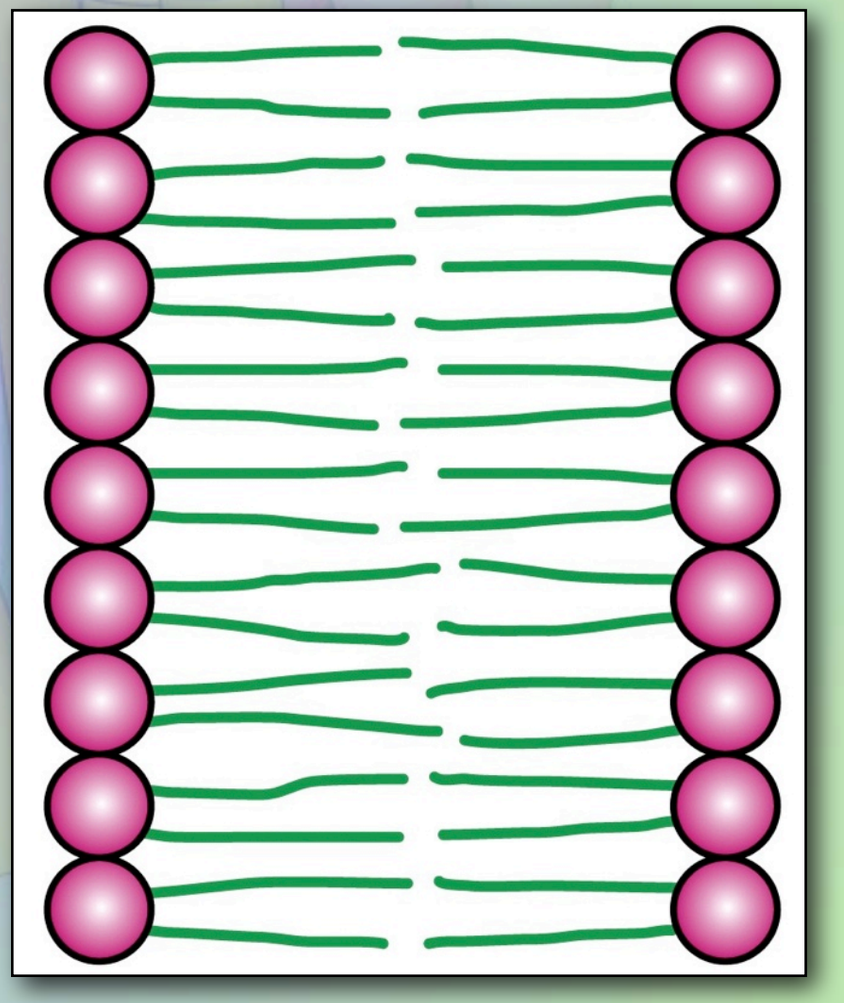
Membrane Lipids form Bilayers



Membrane Lipids and Water

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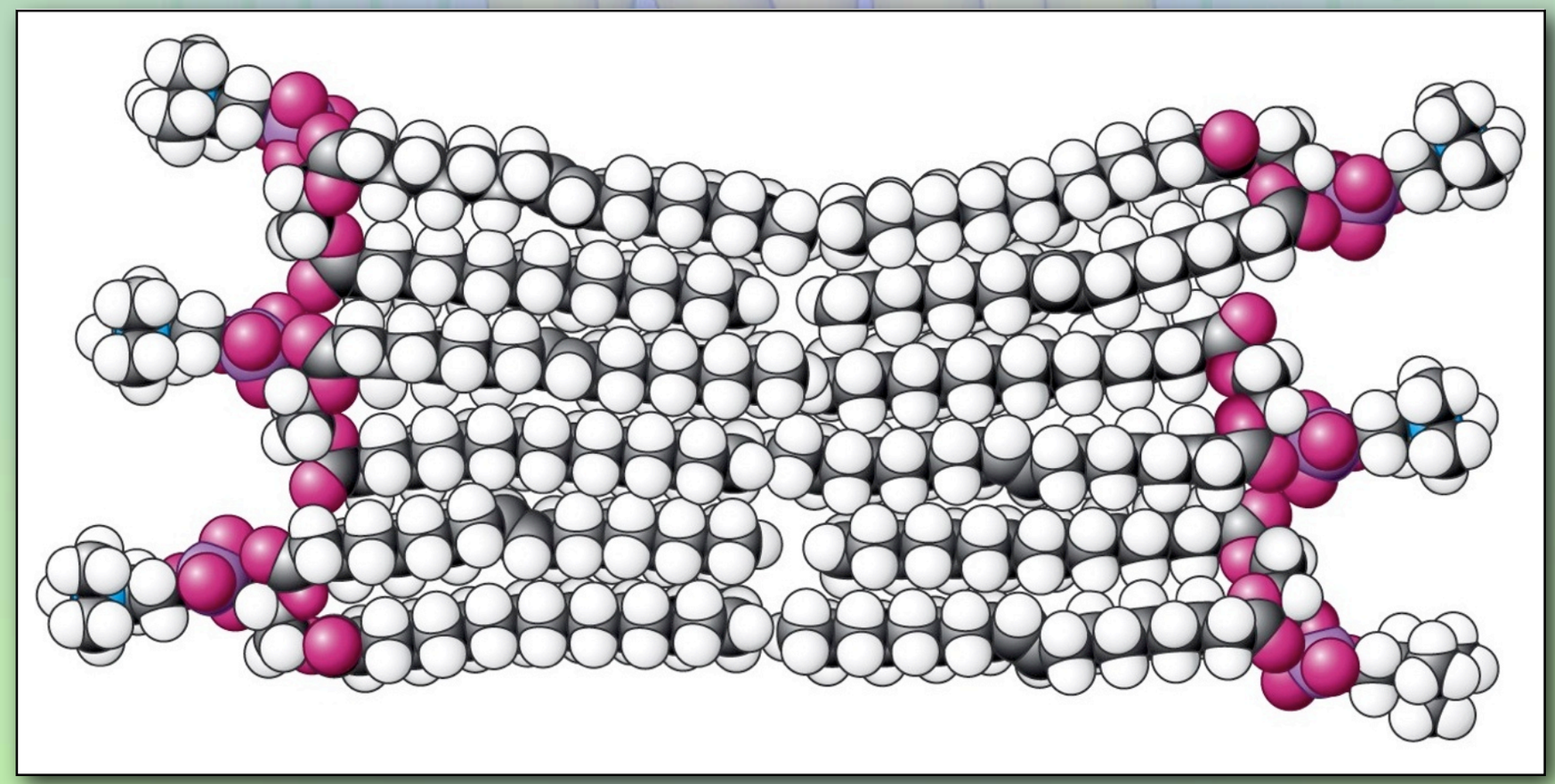
  - The process is driven by hydrophobic interactions and stabilized by vander Waals interactions.



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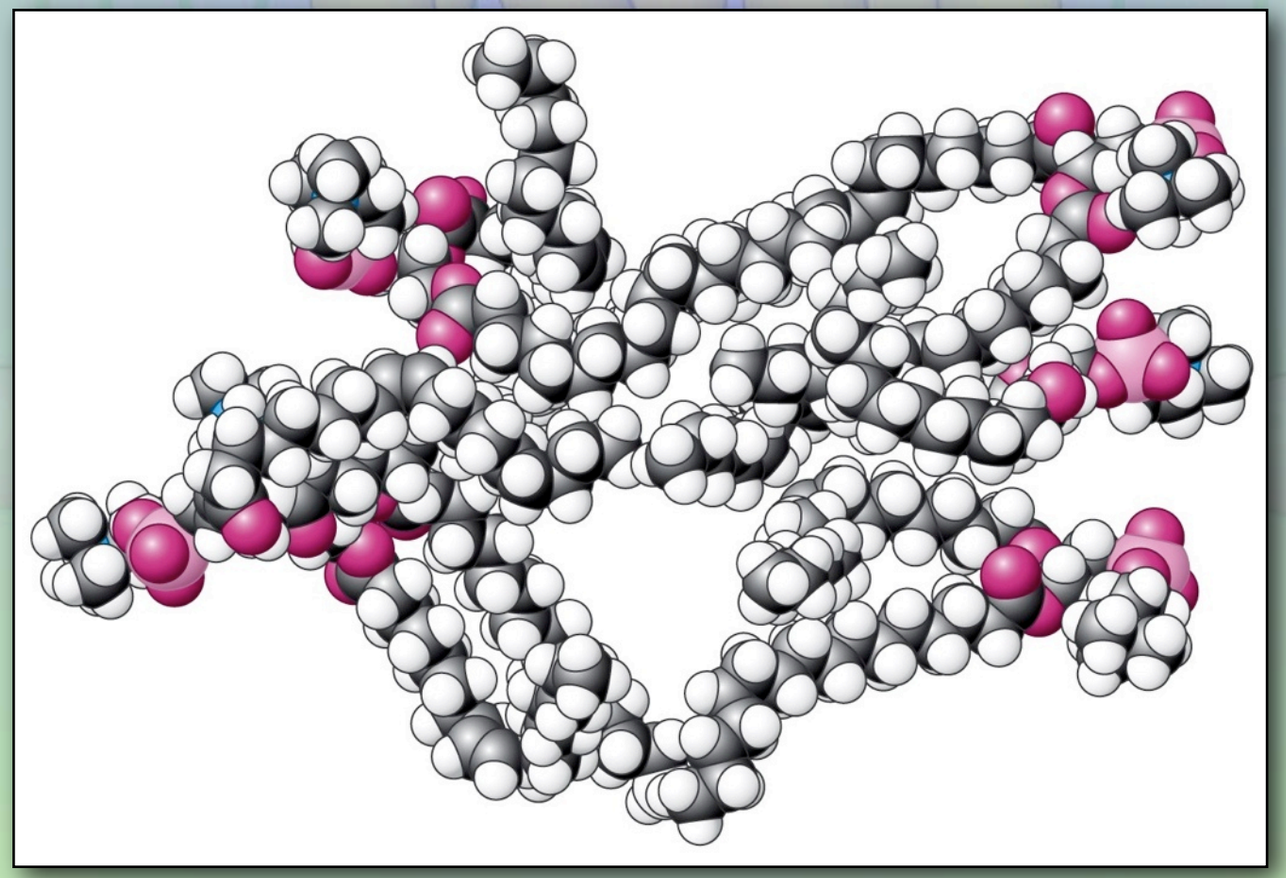
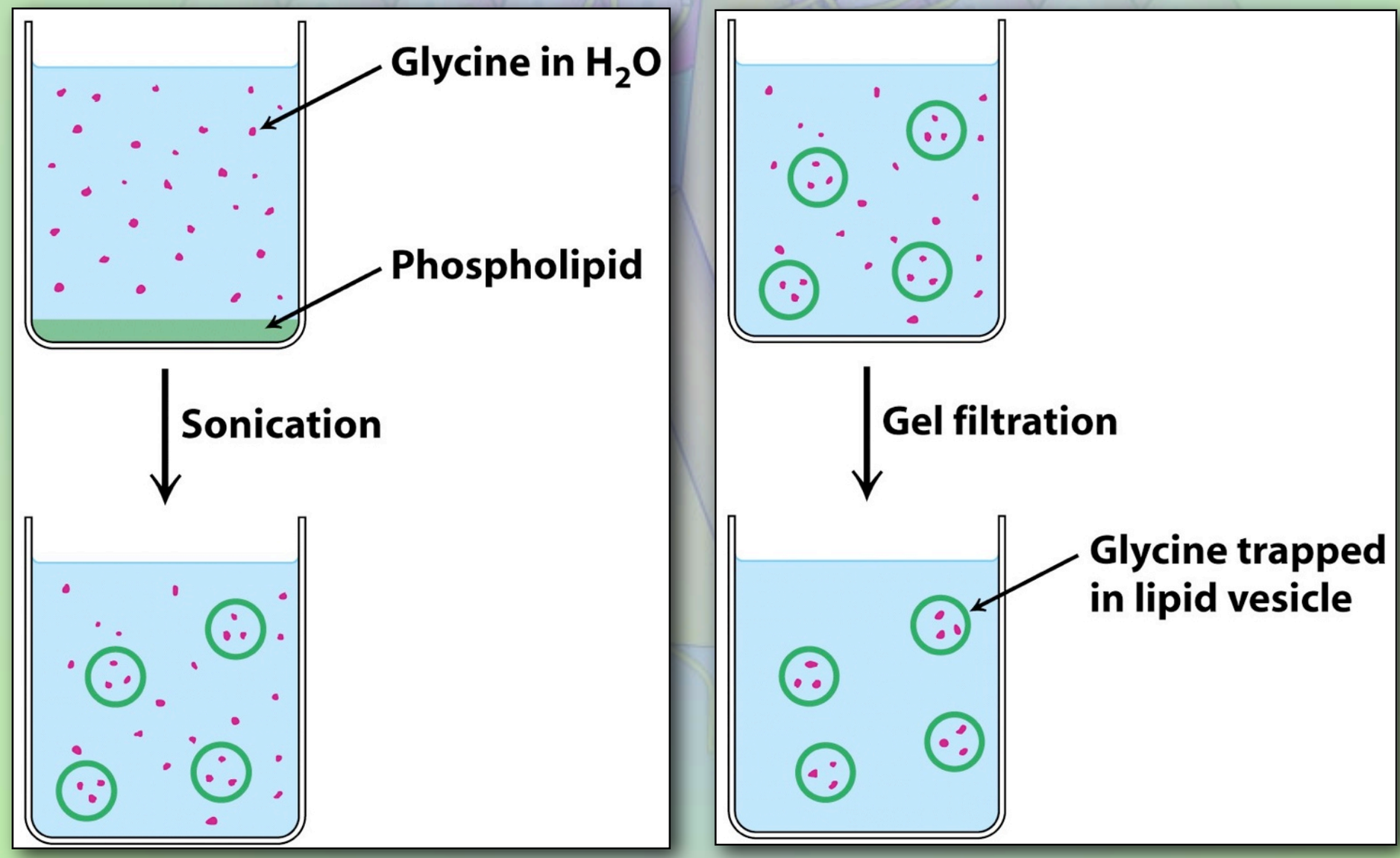


Membrane Lipids and Water

- In the lab, membrane lipids can be used to make vesicles (lipsomes).



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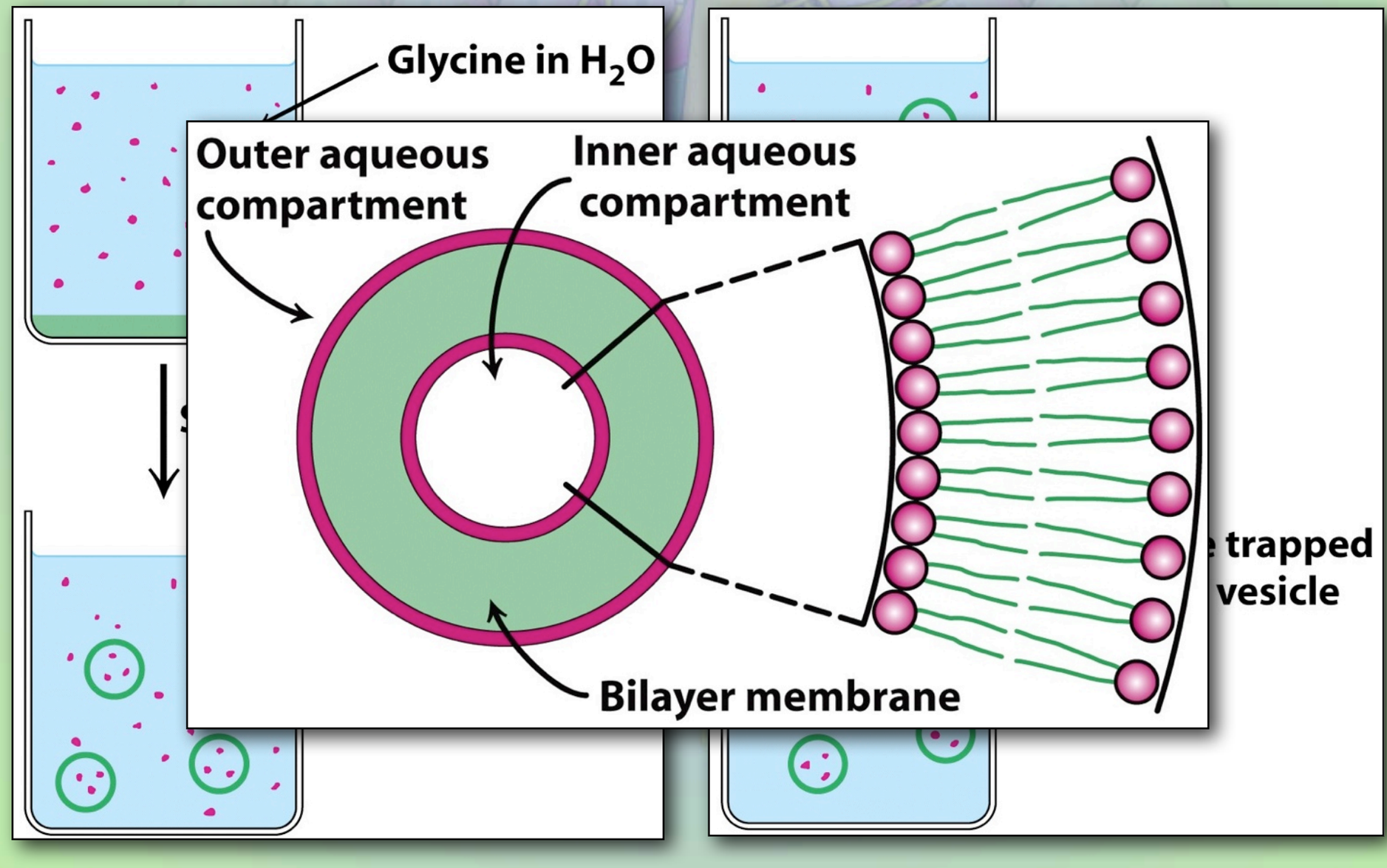

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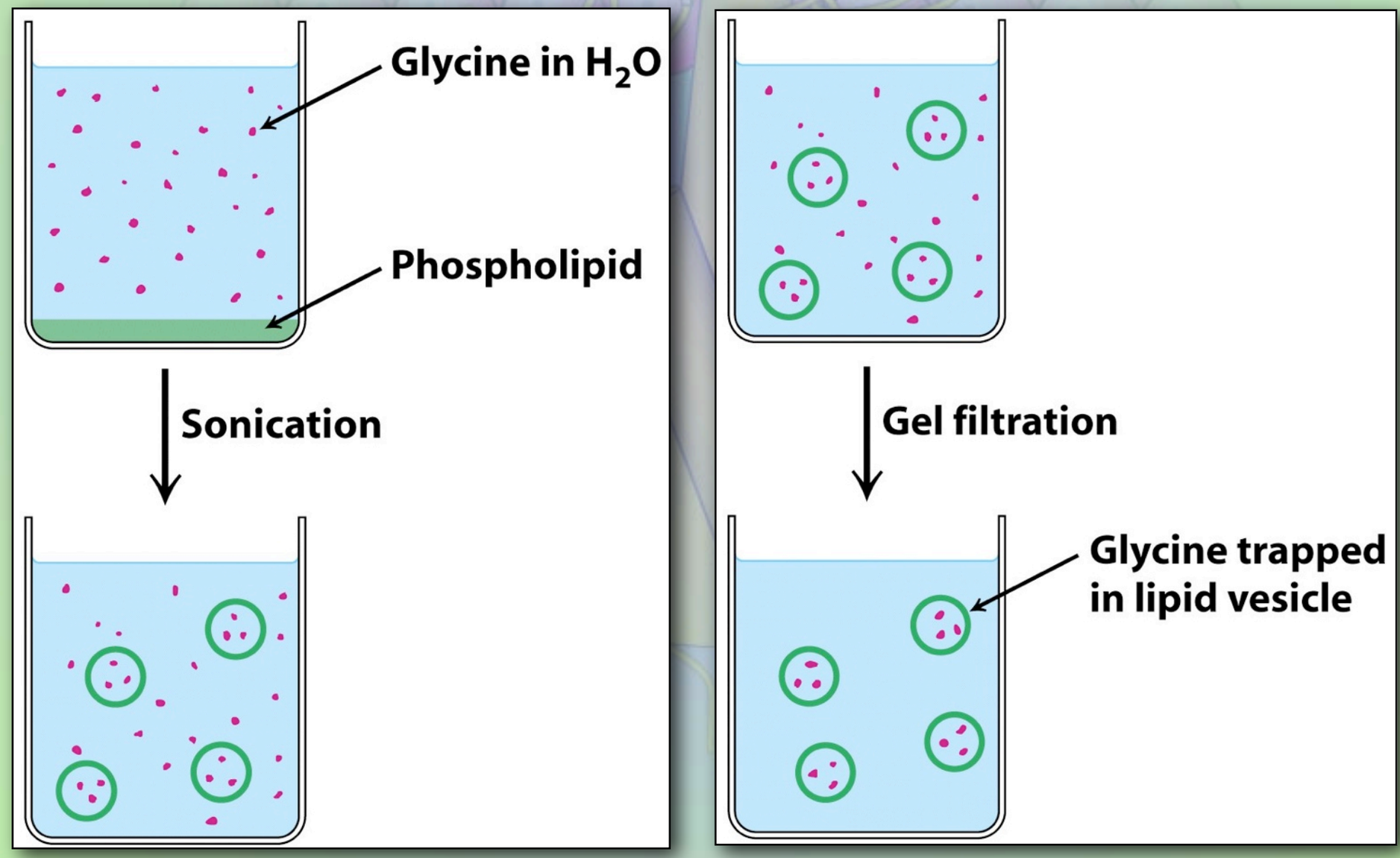
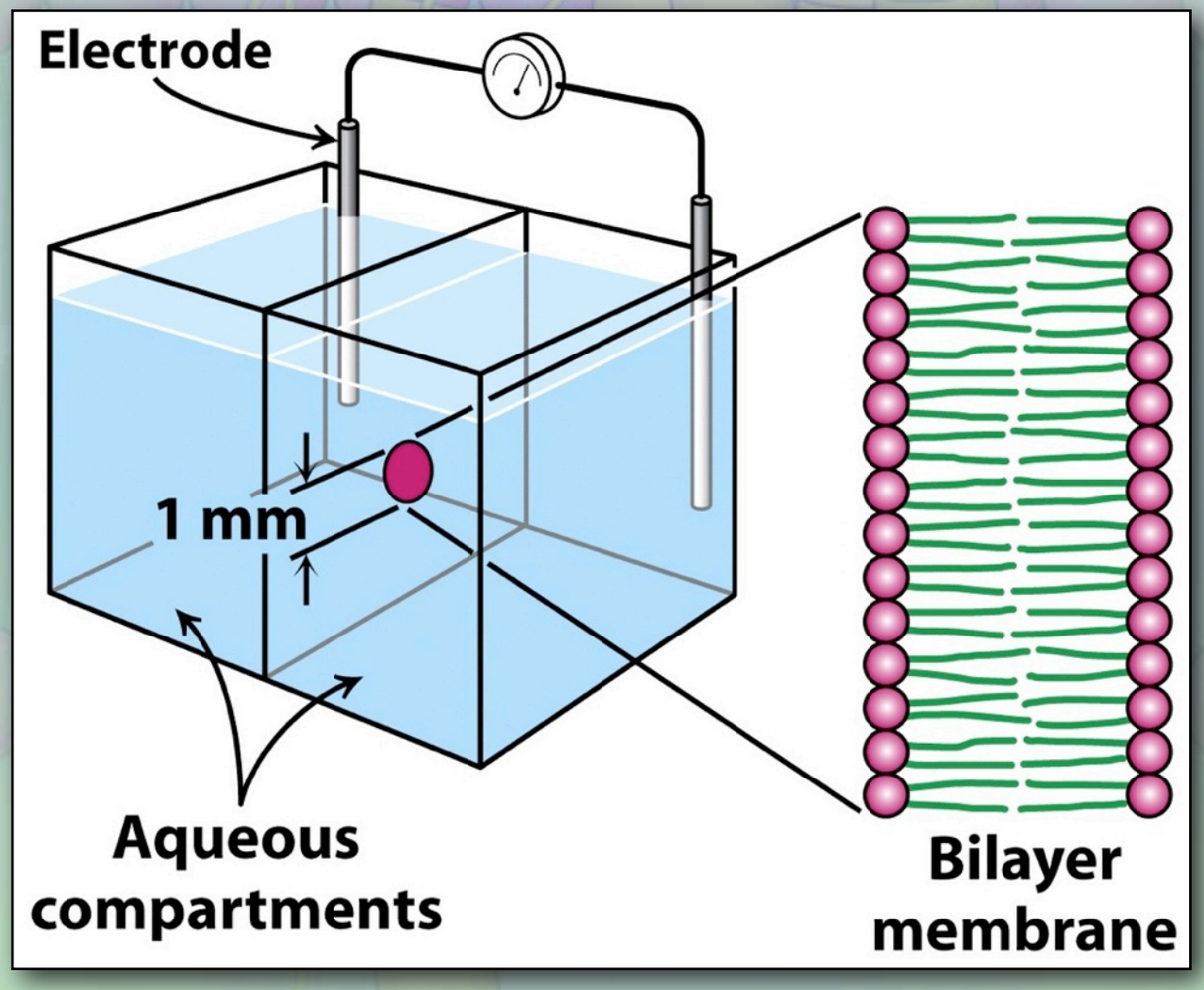


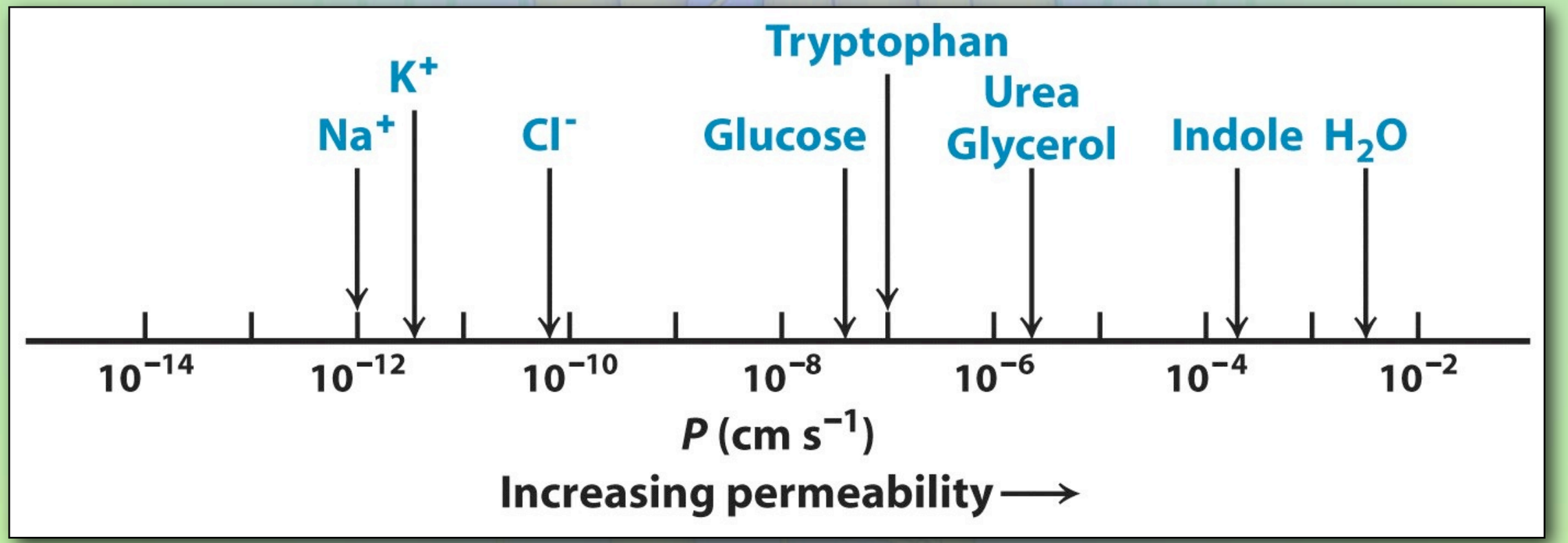
Membrane Lipids and Water

- Another way to study membranes in the lab is to suspend it across a hole.



Membrane Lipids and Water

- Lipid membranes display a wide range of permeability's to small molecules.



Next up

- Unit IV, Lecture 8 - Lipids and Cell Membranes, con'd. (Chapter 12)
  - The roles that proteins play in cell membranes.