Chem 452 - Lecture 8
Lipids and Cell Membranes
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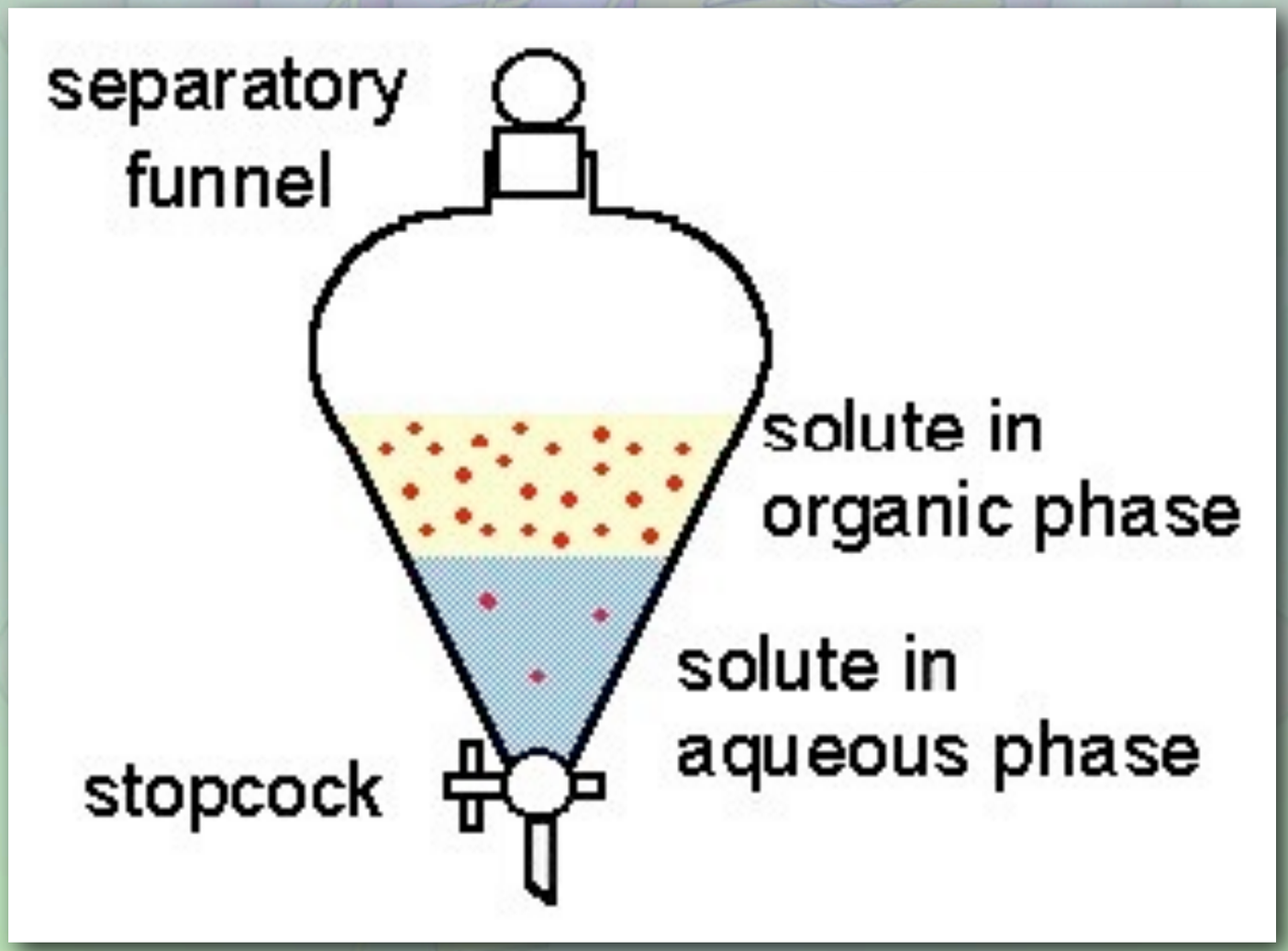
Like carbohydrates, lipids are one of the four major classes of biomolecules, which also include the proteins, carbohydrates and nucleic acids. Lipids are grouped not according to a chemical structure, as is the case for the other four classes, but rather they are grouped according to a physical property. 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.

Introduction

- **Lipids** are the components of a cell that can be extracted with organic solvents.



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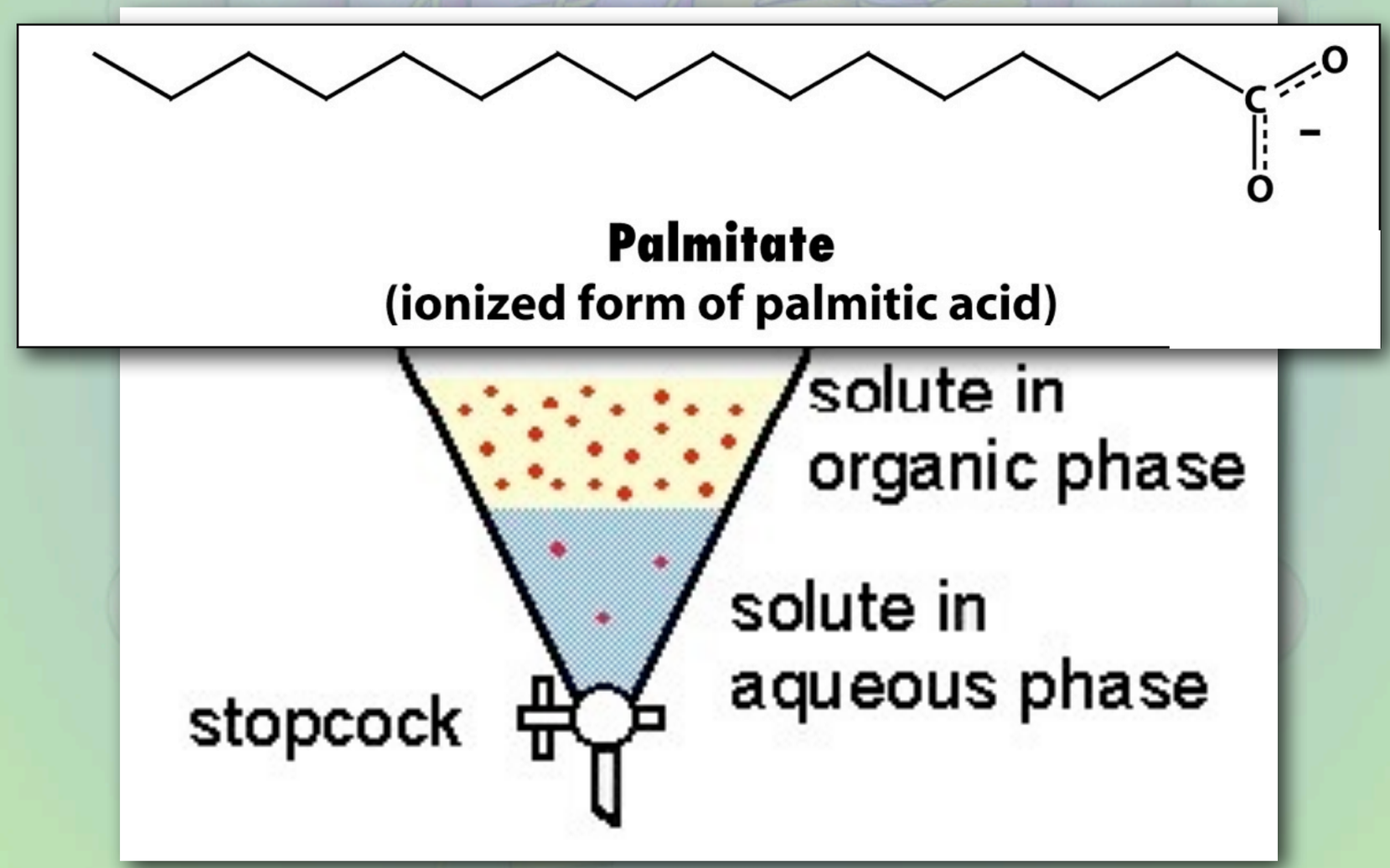

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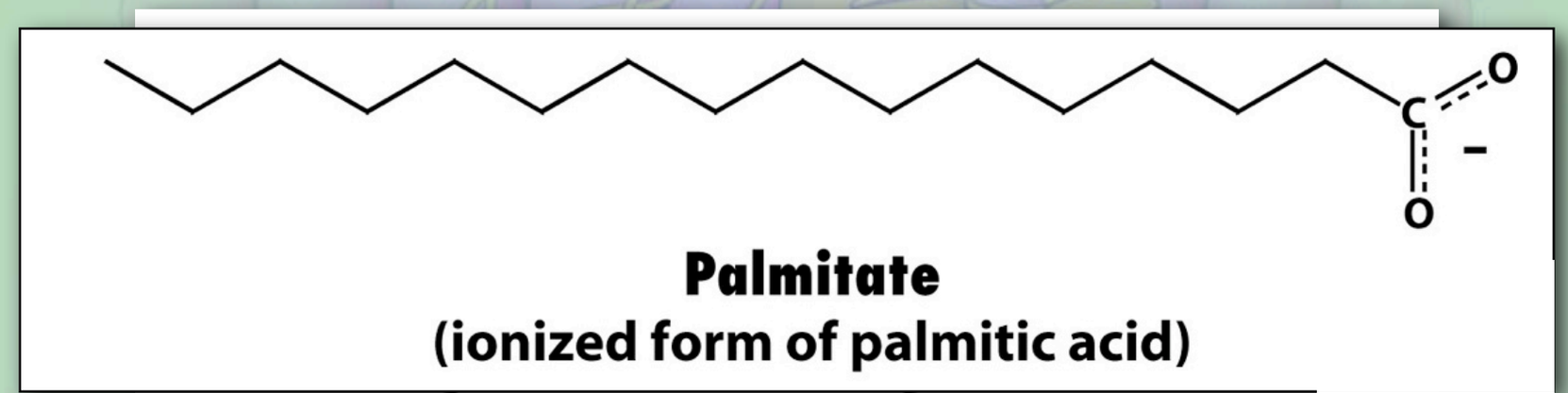

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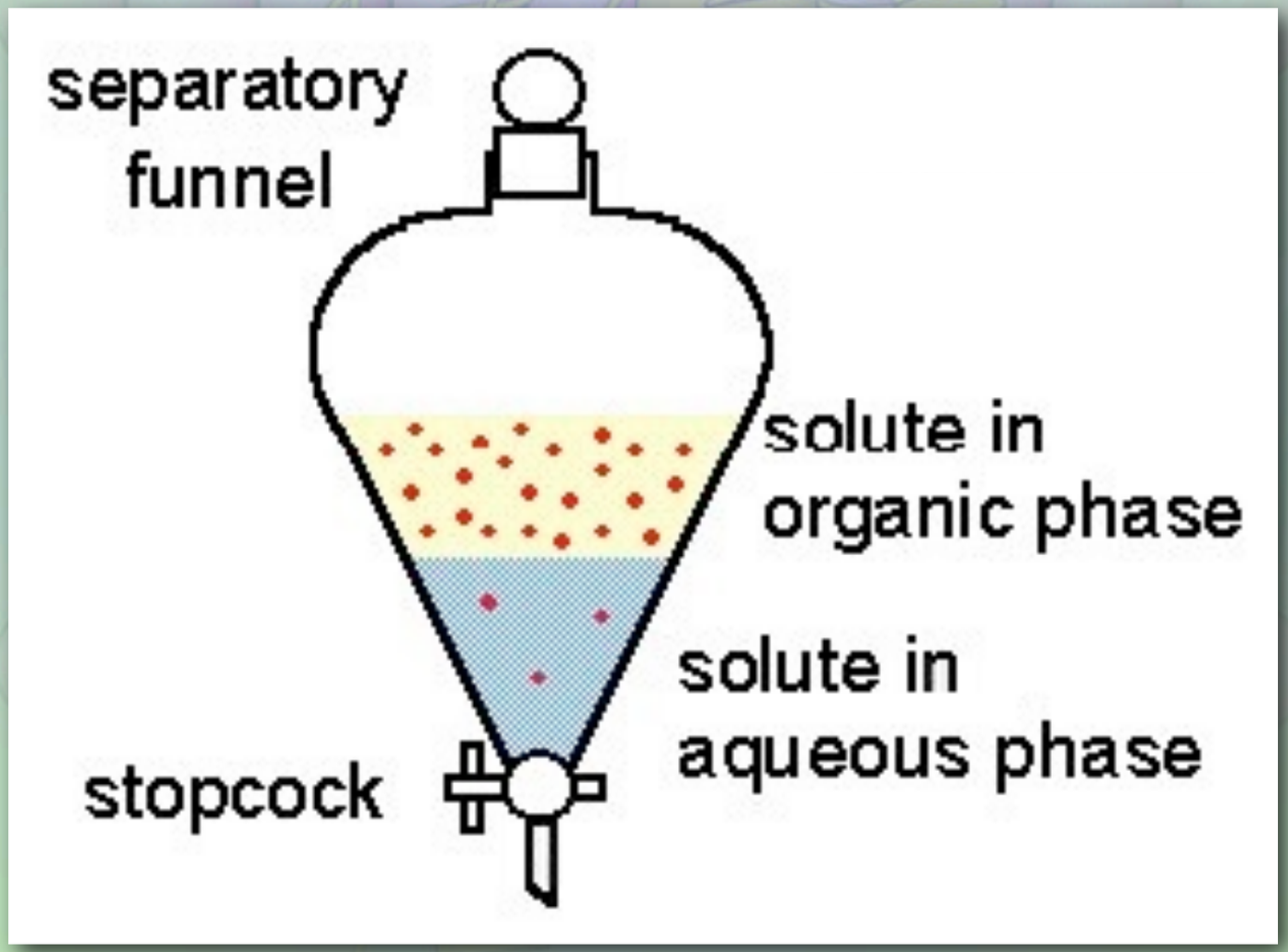
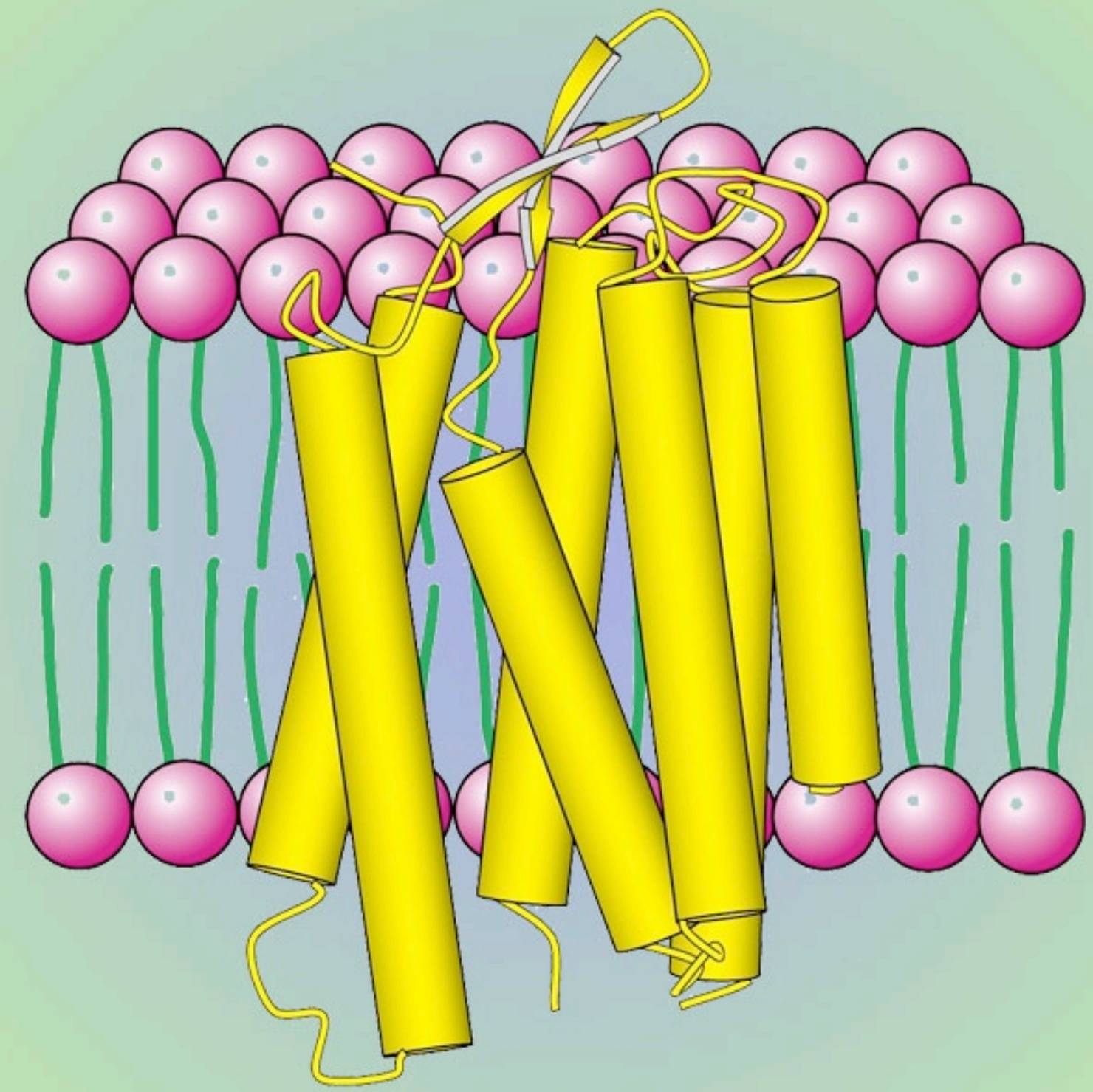


Lipids

- Are the water-insoluble molecules found in a living cell.
- Roles for these molecules include
  - Fuel
    - fatty acids and ketone bodies
  - Long term storage
    - Triacylglycerides (fat)
  - Messengers in signal transduction
    - Steroids
    - Diacylglycerol
  - Components of membranes

Introduction

- Biological **membranes** define the boundary of a cell.
  - Cellular communications with the surroundings are mediated by cell membrane
- "Membranes are dynamics structures in which proteins float in a sea of lipids."



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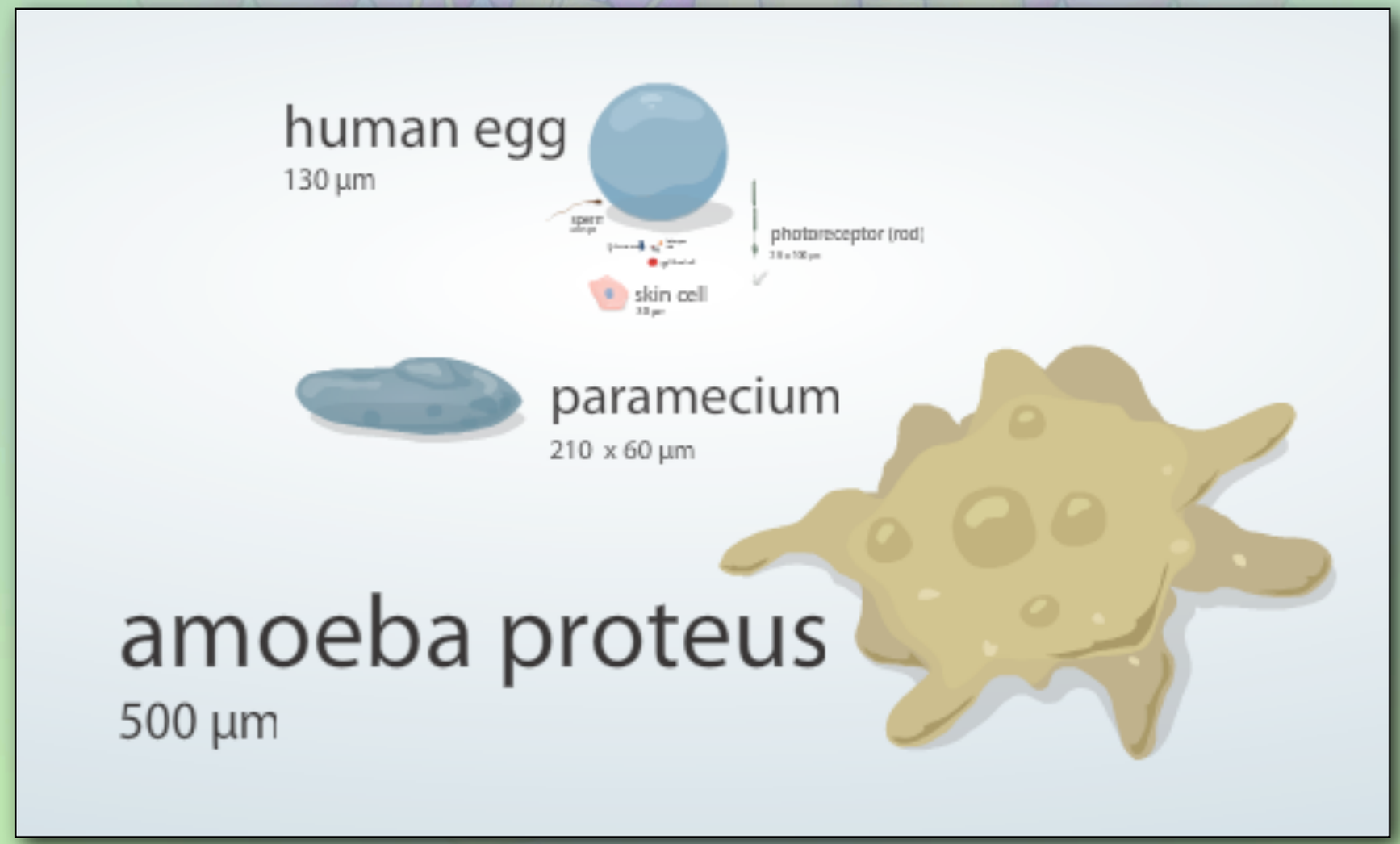
Introduction

- Membranes distinguish eukaryotic cells from prokaryotic cells.



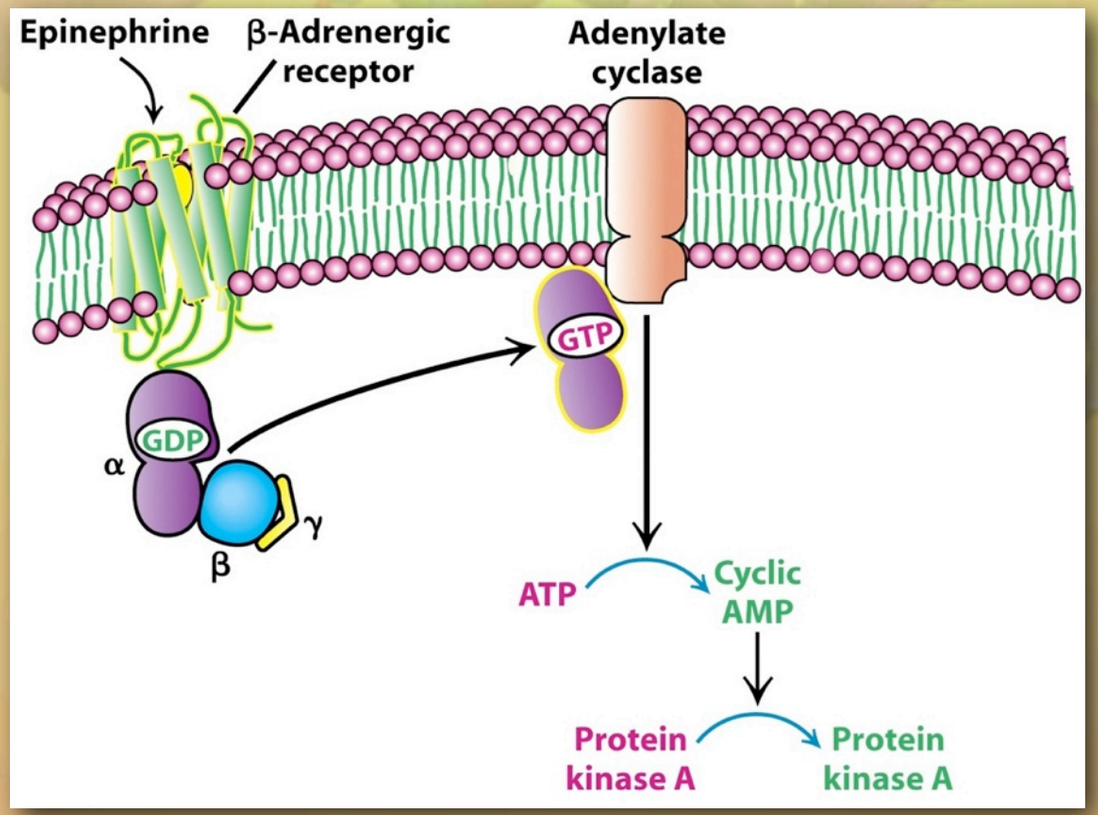
Introduction

- Membranes play important roles.
  - Energy Storage
  - Information Transduction
  - Compartmentalization

- Membranes are hydrophobic environments that separate two hydrophilic environments.

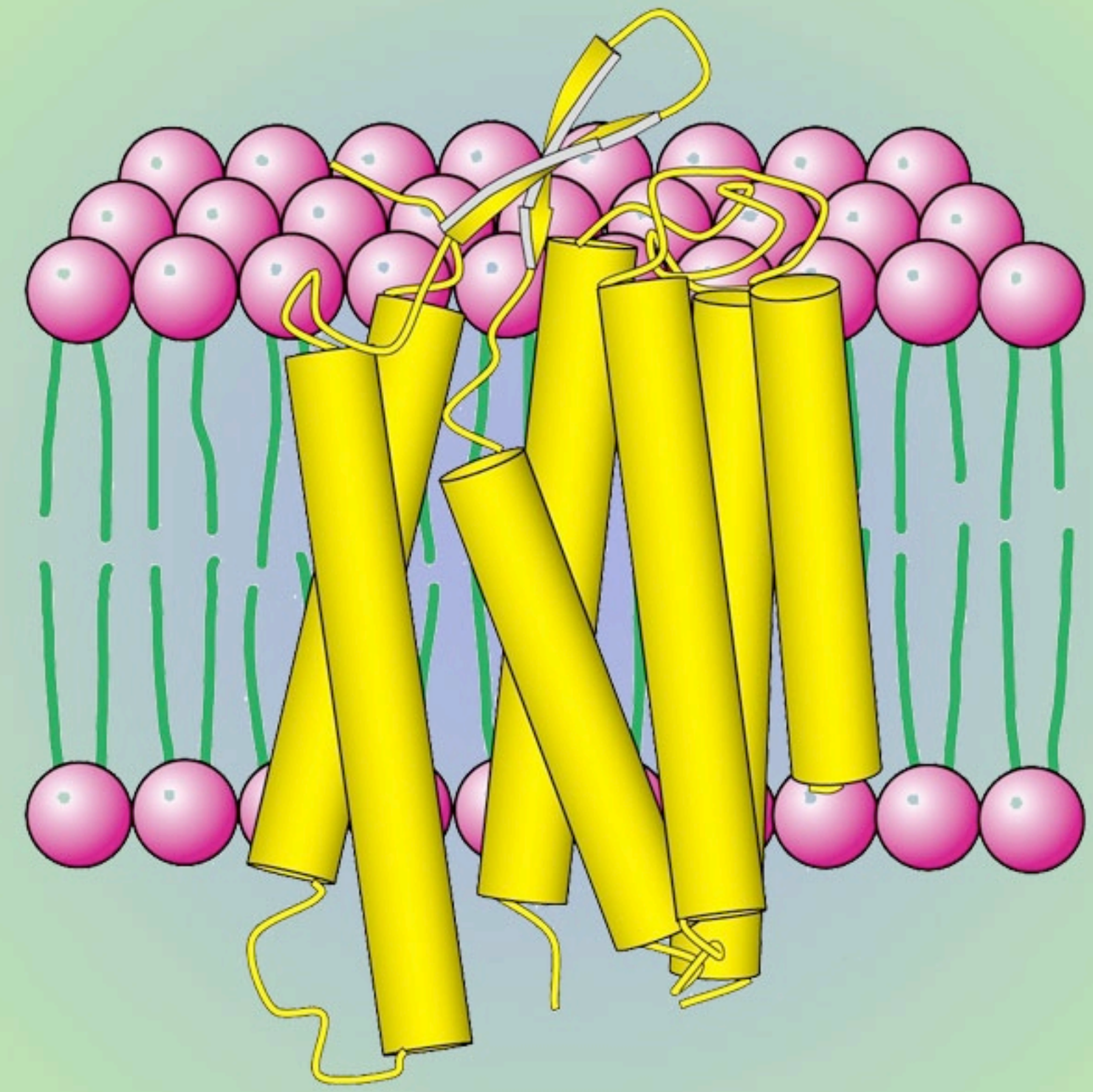
Regulation by Covalent Modification

- **Protein Kinase A** (PKA) is involved in the "flight or fight" response.
  - This response is triggered by the release of the hormone epinephrine (adrenalin) by the adrenal glands.



Introduction

- Features of membranes:
  - They are sheet-like structures that form compartments.
  - They are composed of lipids and proteins.
    - Membrane lipids are **amphipathic** (both hydrophilic and hydrophobic) and form the sheet-like structure
    - The proteins serve as the pumps, channels, receptors, energy transducers and enzymes.
  - Membranes are non-covalent, fluid, asymmetric, assemblies
  - Membranes are electrically polarized.



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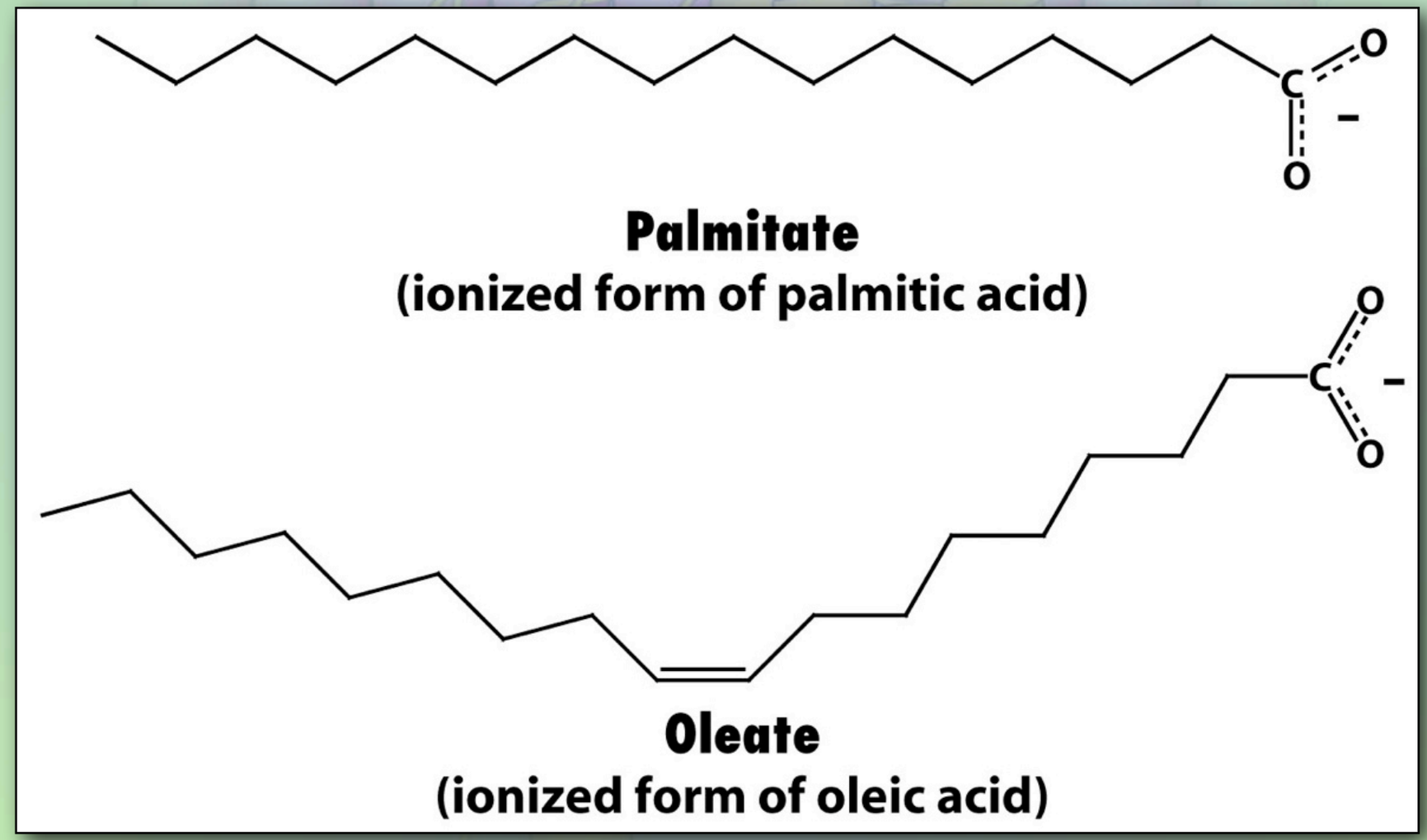
Fatty Acids

- Fatty acids are one of the major groups of lipids.



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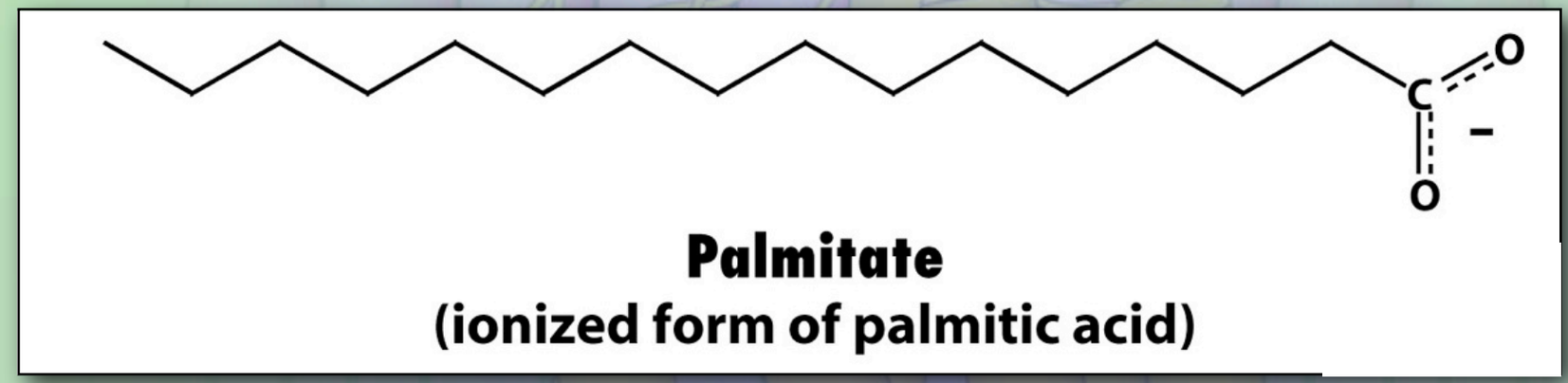
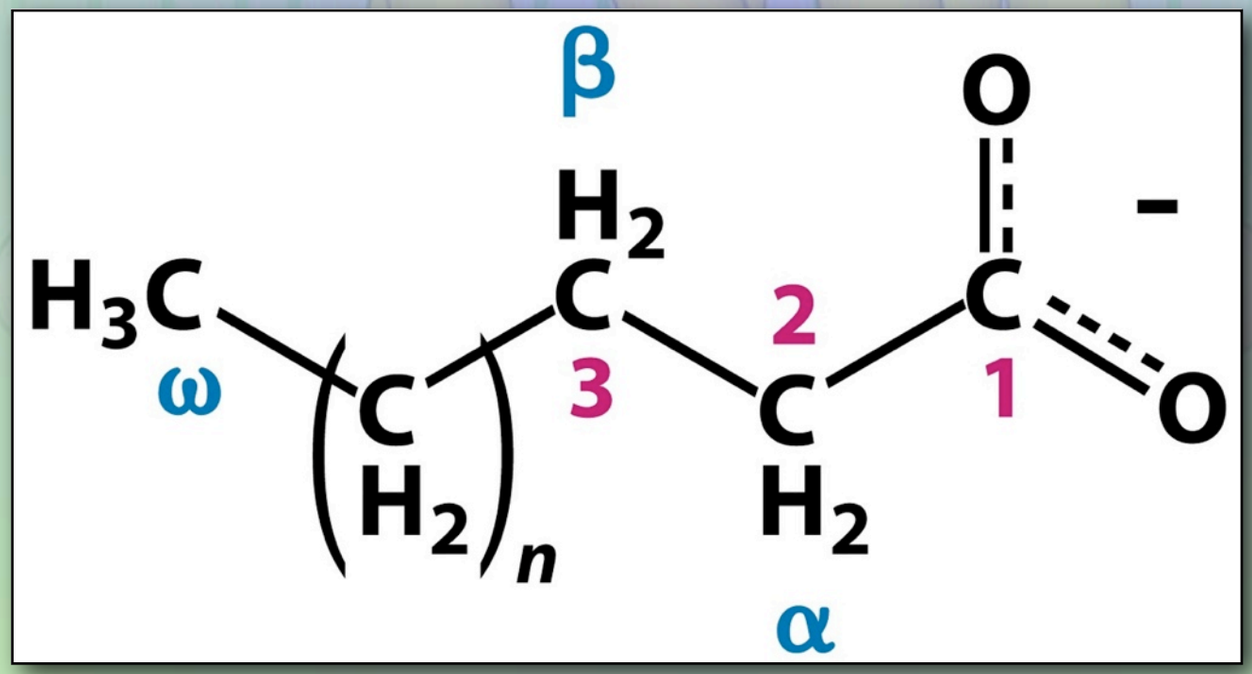


Palmitate
(ionized form of palmitic acid)



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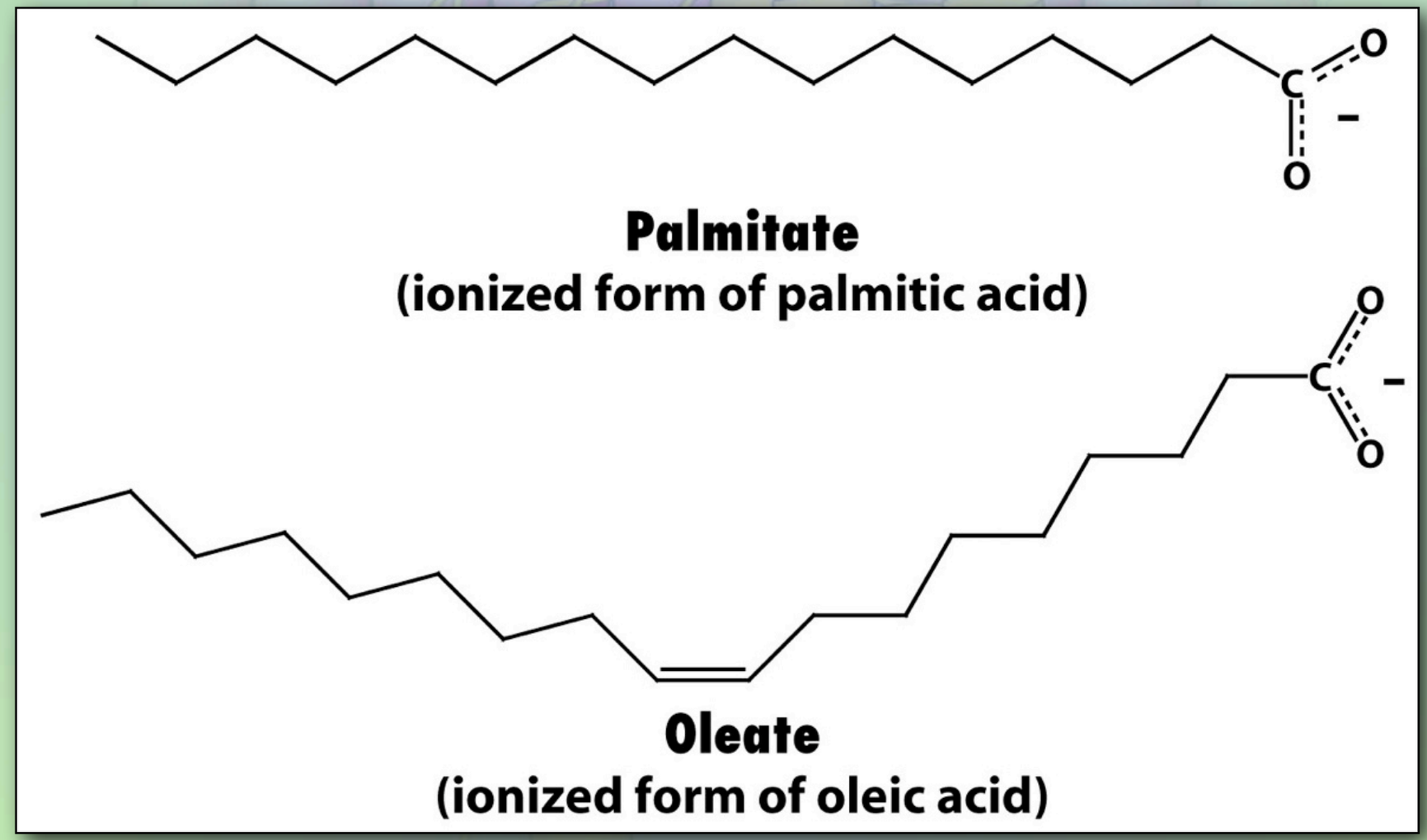

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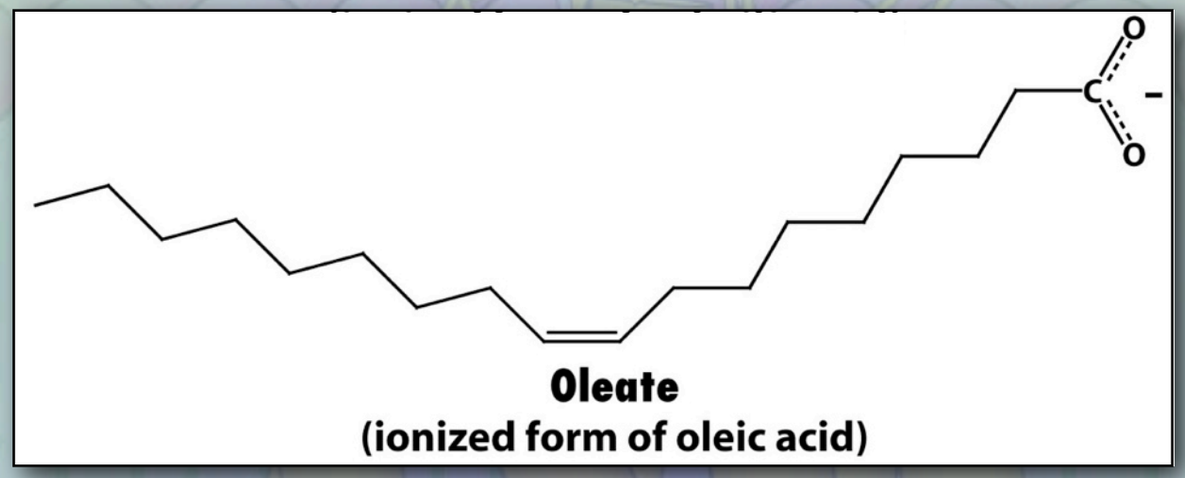
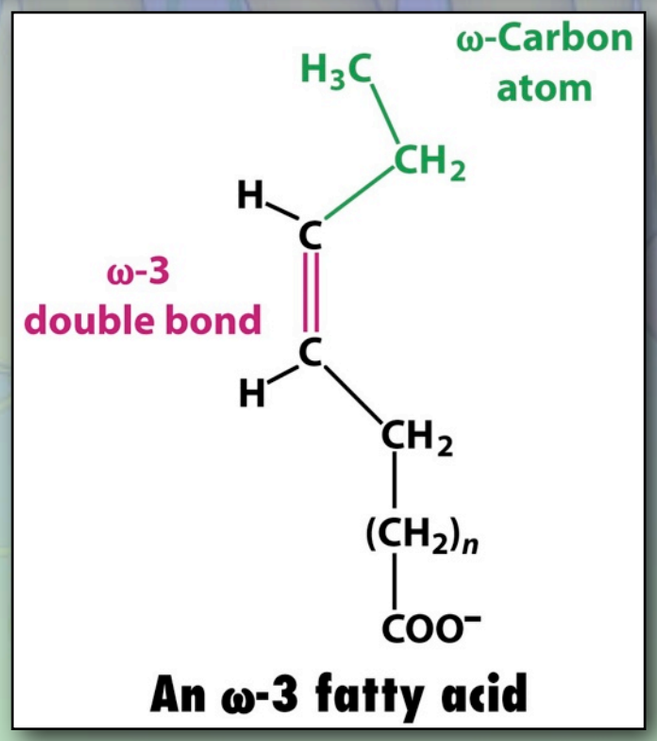




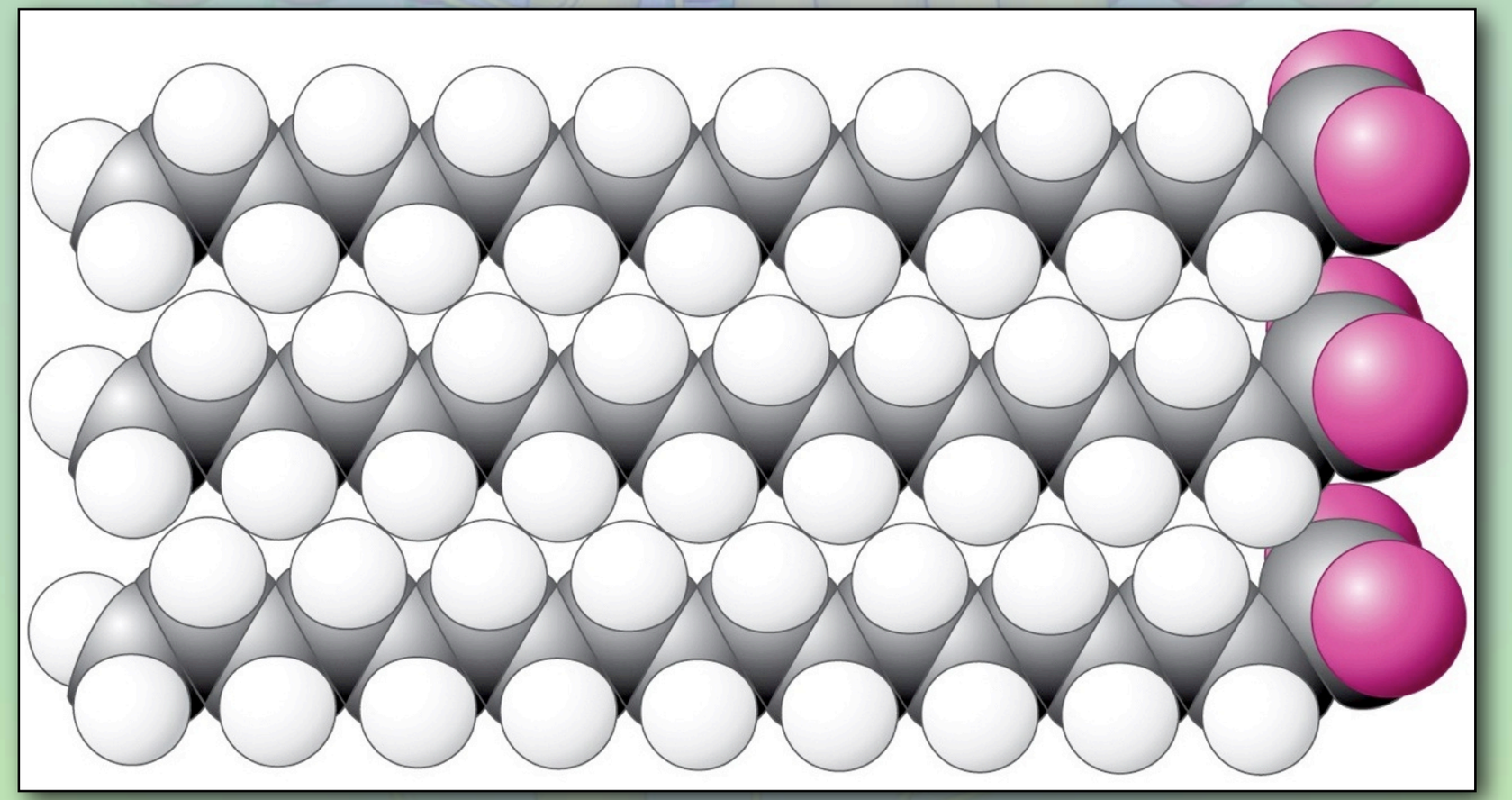
Fatty Acids

TABLE 12.1 Some naturally occurring fatty acids in animals

Number of carbons	Number of double bonds	Common name	Systematic name	Formula
12	0	Laurate	*n*-Dodecanoate	$CH_3(CH_2)_{10}COO^-$
14	0	Myristate	*n*-Tetradecanoate	$CH_3(CH_2)_{12}COO^-$
16	0	Palmitate	*n*-Hexadecanoate	$CH_3(CH_2)_{14}COO^-$
18	0	Stearate	*n*-Octadecanoate	$CH_3(CH_2)_{16}COO^-$
20	0	Arachidate	*n*-Eicosanoate	$CH_3(CH_2)_{18}COO^-$
22	0	Behenate	*n*-Docosanoate	$CH_3(CH_2)_{20}COO^-$
24	0	Lignocerate	*n*-Tetracosanoate	$CH_3(CH_2)_{22}COO^-$
16	1	Palmitoleate	*cis*-Δ^9-Hexadecenoate	$CH_3(CH_2)_5CH{=}CH(CH_2)_7COO^-$
18	1	Oleate	*cis*-Δ^9-Octadecenoate	$CH_3(CH_2)_7CH{=}CH(CH_2)_7COO^-$
18	2	Linoleate	*cis,cis*-Δ^9, Δ^{12}-Octadecadienoate	$CH_3(CH_2)_4(CH{=}CHCH_2)_2(CH)_6COO^-$
18	3	Linolenate	all-*cis*-$\Delta^9,\Delta^{12},\Delta^{15}$-Octadecatrienoate	$CH_3CH_2(CH{=}CHCH_2)_3(CH_2)_6COO^-$
20	4	Arachidonate	all-*cis* $\Delta^5,\Delta^8,\Delta^{11},-\Delta^{14}$ Eicosatetraenoate	$CH_3(CH_2)_4(CH{=}CHCH_2)_4(CH_2)_2COO^-$

Fatty Acids

- Melting points are affected by chain length and the presense of cis double bonds.



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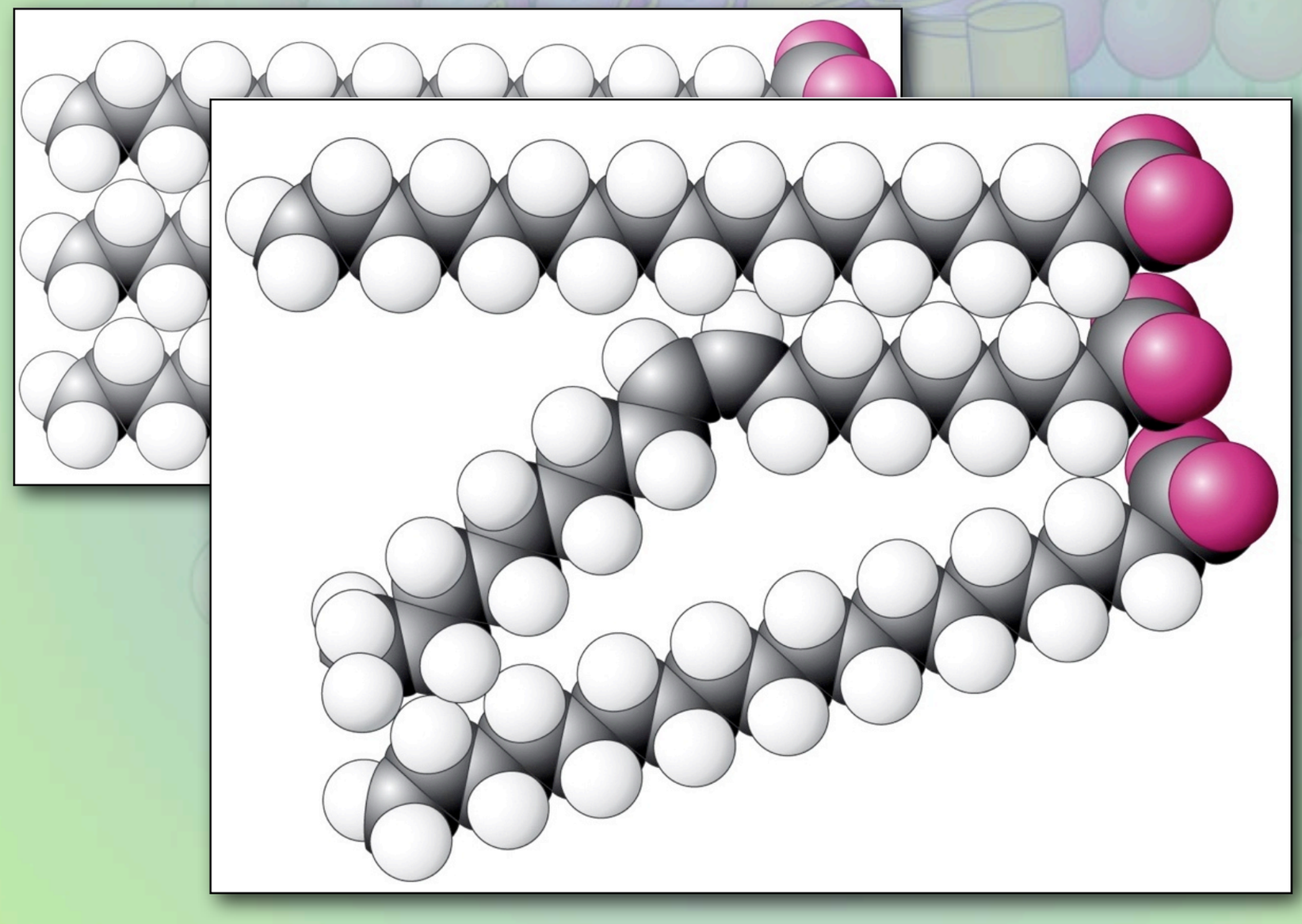

Next up

- Unit IV, Lecture 8 - Lipids and Cell Membranes, con'd. (Chapter 12)