Learning Objectives

• state the different kinds of dynamical motions of double chain amphiphiles in lipid bilayers, differentiating between motion of entire molecules and motion within a molecule
• describe experiments that could be used to study lateral and flip-flop diffusion in vitro and in vivo
• explain the use of exogenous labels (fluorescent, radioactive, electron spin resonance) that allow laboratory determination of lipid location and movement
• explain similarities and differences in measurement and explanations of phase transitions in water and in lipid vesicle
• explain the biological effects and necessities of membrane dynamics

• **C1: Dynamics of Membranes**
  Molecules are not static, but rather are dynamic. This also applies to molecular aggregates. In the first part of the section, we will discuss the rigid movement of whole lipid molecules in a bilayer, within a leaflet and between leaflets. In the second part and the following supplement, we will consider the movement of atoms within a molecule. The movements include motions like bond bending, bond stretching and torsion angle changes like we saw in the previous chapter section on the conformation.

• **C2: Lipid Distribution in Cells**

• **C3: Lipid Rafts**
  Certain lipids often cluster within a leaflet to form lipid “rafts” which can be considered to result from a lateral phase separation of the lipids within one leaflet of the bilayer. Rafts also appear to be enriched in cholesterol and lipids with saturated fatty acids, especially sphingolipids, which would lead to regions of enhanced packing and reduced fluidity. Cholesterol would stabilize packing in spaces created with lipids with large head groups.

• **C4: Lipid Conformational Transitions**

• **C5: Membrane Permeability**

• **C6: General Links and References**

• **Molecular Mechanics and Dynamics**
  - A. Introduction to Molecular Mechanics and Molecular Dynamics
  - B. Energy (E), Force (F) and Motion
  - C. Molecular Mechanics
  - D. Bonded Interaction Energy
  - E. Non-Bonded Interaction Energy
  - F. Summary Interactions
  - G. Molecular Dynamics
  - H. Links and Reference

• **Thermodynamics Review**
  - A. Reactions and Energy Changes
  - B. Equilibrium Constants
C. Change in Free Energy $G$
D. The System, Surroundings, and the Universe - Laws of Thermodynamics
E. Summary

Contributors and Attributions

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