Chapter 5 of Yeagle Structure of Biological Membranes

- Non-lamellar phases
- Spontaneous curvature
- Actual curvature

What is the physical basis of non-lamellar phase structures? Can we understand the competing forces that stabilize a lamellar versus a non-lamellar phase?

In cells, primarily lamellar structures are found, yet lipids extracted from cells will form non-lamellar phases in vitro.

Bilayer thickness
Surface charge
Dielectric constant
Lipid composition

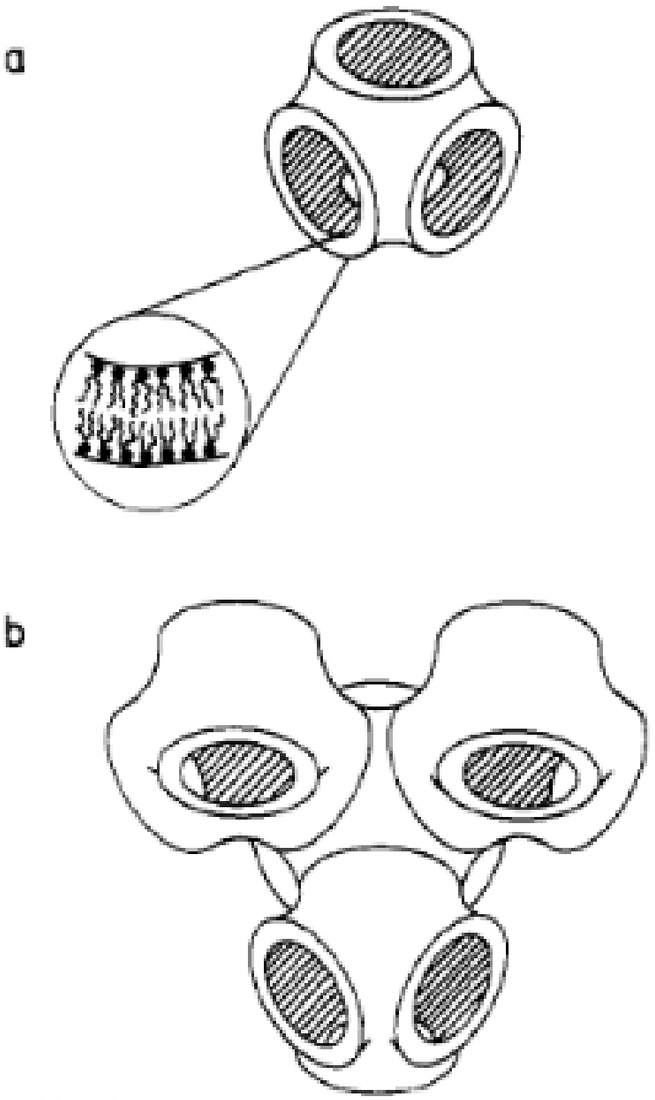


Figure 1. (a) Artist's representation of the repeating unit of a bicontinuous cubic phase with *Pn3m* symmetry. The centers of the four circular openings of the unit may be imagined as forming the vertices of an inscribed tetrahedron. The walls of the unit consist of a bilayer (inset) with water on either side of the wall. The units stack together as shown in (b). The midsurface of the bilayer wall falls on or near a minimal surface for which the mean curvature is zero everywhere. Note that in the interests of visual clarity the bilayer wall has been drawn as thin. In real lipid cubic phases the lipid concentration may exceed 50%. From ref 22.

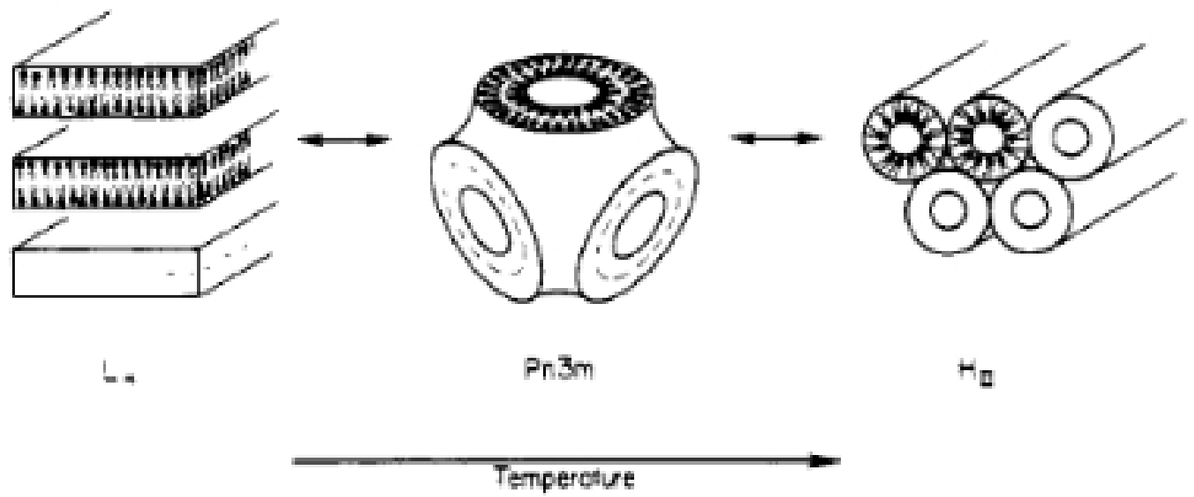
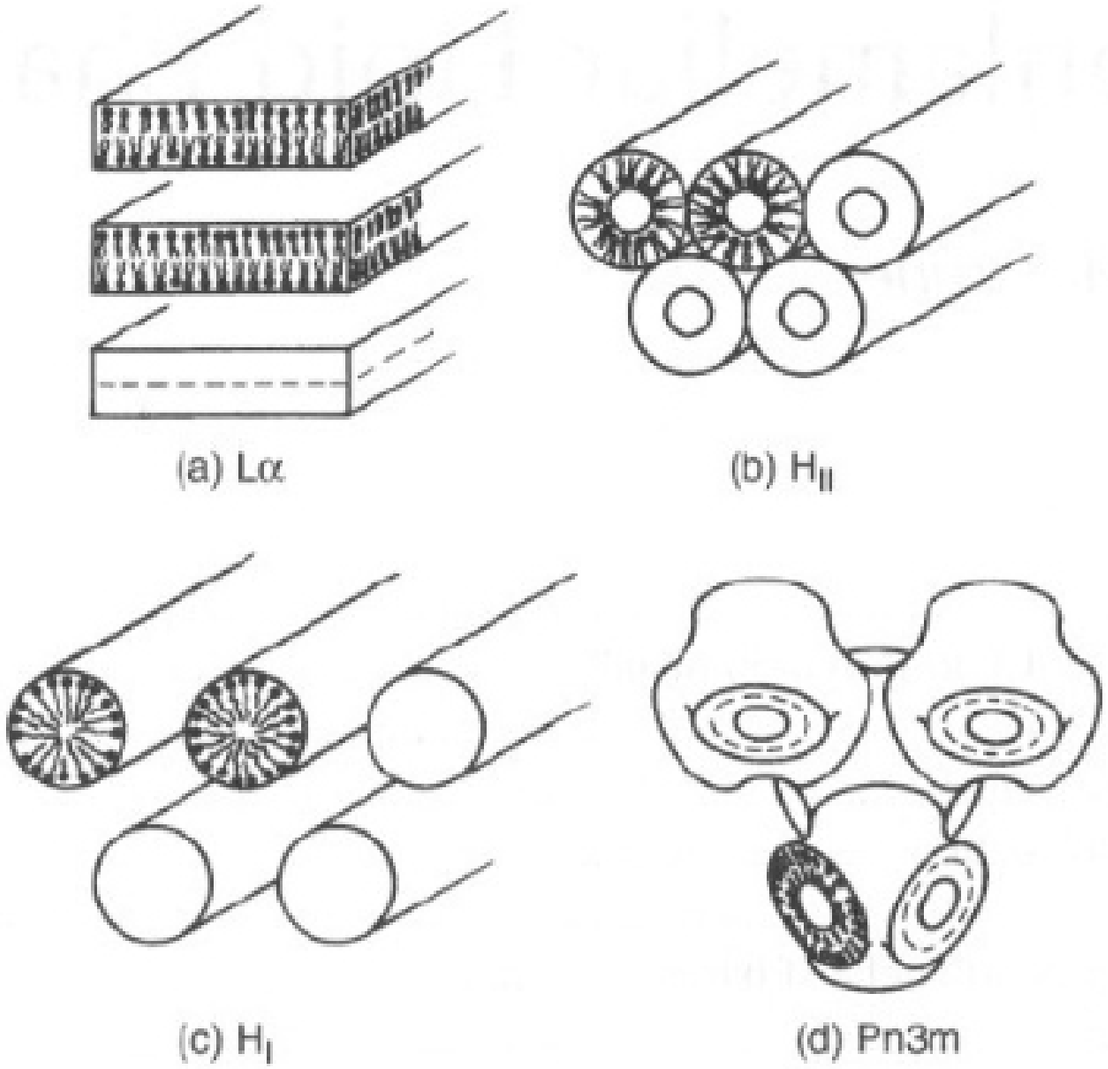


Figure 2. The mesomorphic sequence of phases which is observed as the temperature of a lipid–water system is raised is lamellar to bicontinuous cubic to inverse hexagonal. Molecules are shown schematically on some of the edges of the lipid layers. The volumes which are not filled with lipid molecules are filled with water. A similar mesomorphic sequence is observed with diblock copolymers, in which case one block substitutes for the lipid and the other block substitutes for the water. Bicontinuous cubic phases do not appear in all systems (see text), but when they do appear, it is always between lamellar and hexagonally packed cylindrical phases.

- POLYMORPHISM
- MESOMORPHISM



General Motivation:
(1) by studying structural polymorphism/mesomorphism, one gaines an understanding of the forces that are “locked-up” in biomembranes that can affect the organization and function of membrane proteins

(2) Generally extended to surfactant/detergent chemistry

This chapter is interested in phase changes that change the CURVATURE of the lipid-water interface.
These phases occur at temperatures above the gel-liquid transition, but below the transition temperature to an isotropic liquid.