Proteins extend through the membrane or sit on one surface.

Phospholipid molecules form a double layer, with their hydrophilic heads on the inner and outer surfaces, and their hydrophobic tails sandwiched in between.

Oligosaccharide chains are attached to some phospholipids and some proteins on the outside surface of the membrane.
Relationships between Membrane Lipid Composition and Biological Properties of Rat Myocytes

**EFFECTS OF AGING AND MANIPULATION OF LIPID COMPOSITION**

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Cultures of newborn rat heart myocytes undergo major age-related alterations as demonstrated by comparing 5-6-day-old cells ("young cells") and 14-15-day-old cells ("old cells"). This includes: 1) changes from spherical to elongated shape; 2) sphingomyelin and cholesterol level/cell increase by 100% and 50%, respectively, while the phosphatidylcholine is reduced by 15-20% with almost no change in content of total phospholipids. 3) There is a 50% increase in total protein content/cell while DNA content remain constant.

The specific heat capacity of the cell membrane is also reduced by 25%.

All the above can be reversed by modification of the fatty acid composition of the phospholipids. Small amounts of phosphatidylcholine, which normally constitutes only 20% of the cell membrane, can significantly increase the heat capacity of the membrane.

Biological membranes differ widely in their lipid composition (1-3). It is evident that although the basic physiological properties of biological membranes must derive primarily from protein components, there is much evidence to suggest that these functions may be markedly influenced by lipid composition (for reviews see Refs. 2, 3, and 4). In most biological membranes, sphingomyelin content is high and phosphatidylcholine content is low. The reverse is seen in myocytes. The sphingomyelin content of the heart myocytes is decreased by 15-20% with almost no change in content of total phospholipids. This decrease in sphingomyelin content is accompanied by an increase in phosphatidylcholine content.

These results suggest that membrane lipid composition has major influence on cellular properties which are described in the accompanying paper (Yechiel, E., Barenholz, Y., and Henis, Y. I. (1985) J. Biol. Chem.)

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**Effects Of Aging And Manipulation Of Lipid Composition**

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Several diseases, including atherosclerosis, certain types of cancer, cataract, and in Niemann-Pick disease (7, 11). A 6-fold change in sphingomyelin to phosphatidylcholine mole ratio takes place in the aorta and arterial wall during aging of normal humans. The change of this ratio in atherosclerosis is even more striking. In this disease the sphingomyelin content can be as high as 70-80% of the total phospholipids in advanced aortic lesion (see Refs. 7 and 11, and references therein). It is worth noting that in diseases such as leukemia the sphingomyelin content of the leukemia cell membranes is reduced (7, 11). In general, there is a strong positive correlation between the content of sphingomyelin and cholesterol in membranes. In addition, changes in the content of one are followed by comparable changes in the other (Refs. 2, 7, and 11, and references therein). It is still not clear how cells

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1The abbreviations used are: PC, phosphatidylcholine; SM, sphingomyelin; SUV, small unilamellar vesicles; DPPC, di-phytanoylphosphatidylcholine; HPES, 4-(2-hydroxyethyl)-1-piperazinethane-sulfonic acid.
Beating myocytes
PC and Myocytes: Yechiel and Barenholtz

- Rat myocytes plates on standard culture media contract at 160 bpm

- 3 groups:
  - Group A plated on PC starting day 6 to the end of the study.
  - Group B plated on standard media and not given PC until day 16 to the end of study.
  - Group C Given PC days 6-11 then withheld until day 16.

The inside of a cell membrane

- PUFAs (loops)
- Mono USFAs ('free' form)
- Saturated FA (straight – mostly pointing back into this image)