BIOLOGY
Topic Summary

LT9 - THE DAVSON-DANIELLI MODEL

The Davson-Danielli model was the first model to describe membrane structure and was widely accepted before the fluid mosaic model. This model was proposed by Hugh Davson and James Danielli in 1935.

The Davson-Danielli Model

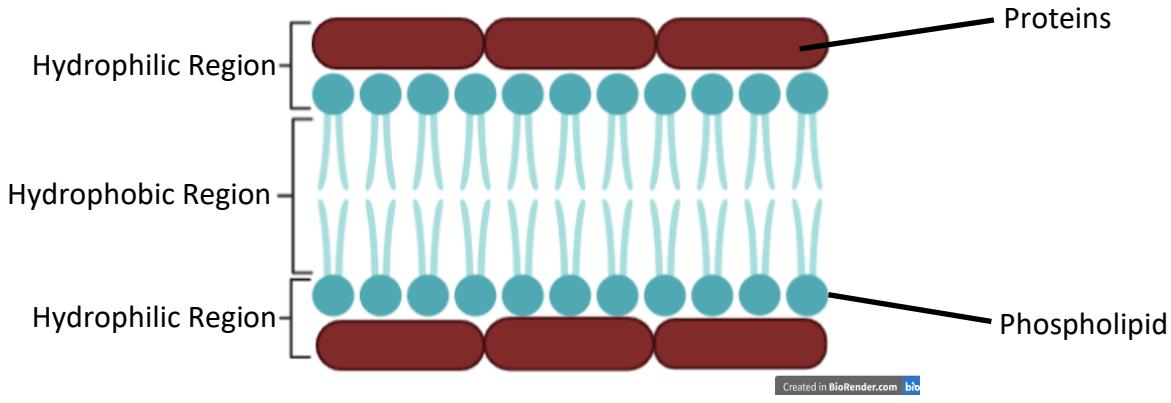
Davson and Danielli proposed that the membrane of cells was made up of two layers of phospholipids (the phospholipid bilayer) which were 'sandwiched' in by two layers of proteins on either side.

Membranes exhibit a trilaminar appearance when viewed under a transmission electron microscope (TEM). This means that membranes have 3 layers. 2 of these layers are dark outer layers and 1 inner, lighter layer.

A cell membrane viewed under a TEM. Image from - http://203.250.122.194/lecture/histology/histofigs/chapter01-1/his01-1_comp_03.htm

They believed there was a bilayer of phospholipids in the centre, surrounded by a layer of proteins on either side. This was described as a 'lipo-protein sandwich' as the phospholipids were sandwiched between two layers of proteins. They thought this as they assumed the darker layers seen were proteins and the lighter layer were lipids. Usually proteins are darker in electron micrographs while lipids are lighter.

Davson and Danielli also believed that the proteins which coated the phospholipid bilayer were hydrophilic.



The Davson-Danielli Model

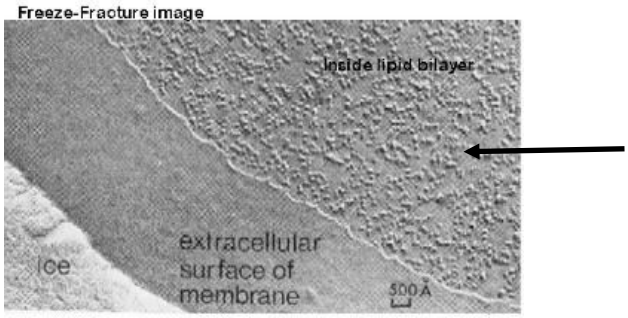
Falsification of the Davson-Danielli Model

After the proposal of the Davson-Danielli model, experimental evidence was found to show flaws in this model.

Scientists tagged proteins in the membrane with fluorescent markers. One cell would've been tagged with red marker while another with green markers. These cells were then fused together. They found that after a while the red and green markers were mixed throughout the membrane of the fused cells. This suggested that the proteins in the membrane were moving around and weren't fixed in a layer. This also gave evidence to support the fluidity of the fluid mosaic model.

It was also found that the proteins found within the membrane had different properties and sizes depending on where they were found. Some parts of the membrane proteins were hydrophobic while others were hydrophilic. This meant that the membrane proteins would in fact be embedded within the membrane not layers on the outside as their hydrophobic parts would be able to sit within the membrane alongside the phospholipid tails.

They also used a technique called freeze facture to split open the plasma membrane in the middle. They noticed an irregular rough surface within the membrane. This suggested that there were proteins embedded within the membrane and were not only found on the surface of the membrane.

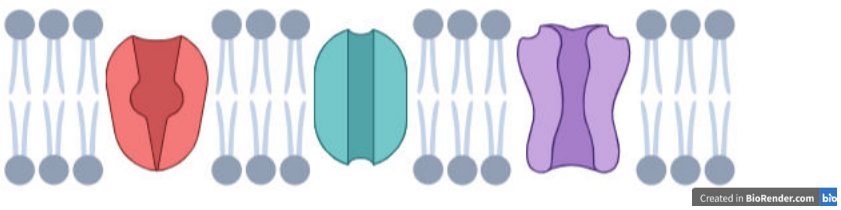


Rough surface inside the phospholipid bilayer represents transmembrane proteins.

Image from - http://cytochemistry.net/cell-biology/membrane.htm

The Singer-Nicolson Model

A new model was required to explain the presence of transmembrane proteins. After the limitations of the Davson-Danielli model were found, the Singer-Nicolson model/ the fluid mosaic model was proposed in 1972. This model is widely accepted today as much of the evidence found to falsify the Davson-Danielli model, directly supports the fluid mosaic model.



Above is a diagram of the fluid mosaic model with only the phospholipid bilayer and proteins. This model has proteins embedded within the phospholipid bilayer