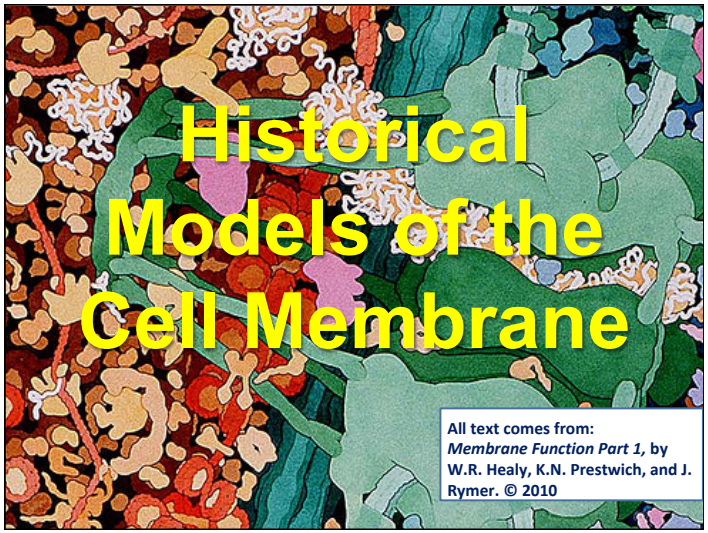


What is a model?

- Models are conceptual representations used to explain and predict phenomena.
- Models can be quite useful when the subject under study (the membrane in this case) cannot be observed directly.
- Models have limitations. No model can possibly explain every detail of a phenomena.

SCIENTIFIC MODELS are HYPOTHESES THAT…

A. ***Explain*** observations

B. ***Predict*** future observations

C. Are ***realistic***

Early Observations of the Cell Membrane

- Although it could not be observed under the light microscope, early cell biologists quickly grasped that something must exist that effectively separates the inside of the cell from its external environment.
- They also realized that this structure would be more than a simple barrier since it obviously let some substances pass while it blocked others.
- Moreover, the rate at which it let materials pass often varied over time.

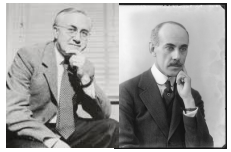
Gorter & Grendel's Model

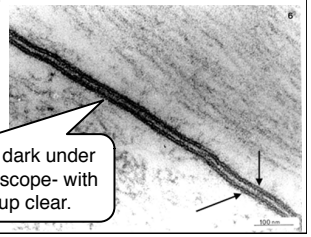
- In 1925 Gorter and Grendel (Dutch scientists) extracted phospholipids from the cell membrane of red blood cells
- Calculated that the surface area of the phospholipids when arranged in a monolayer was twice as large as the surface area of the intact red blood cell.
- *What could Gorter and Grendel deduce about the cell membrane's structure from this evidence?*

Onbekende fotograaf

Davson and Danielli's Model

- In the 1930's, it was discovered that the cell membrane is made of both phospholipids AND proteins.
- Using the newly invented electron microscope that allowed for greater magnification of the membrane.
- *What could Davson and Danielli deduce about where proteins and lipids are found in the cell membrane based on this evidence?*



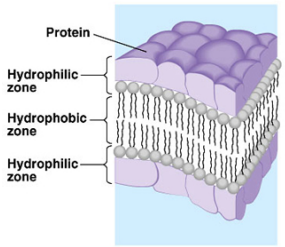


Proteins show up dark under the electron microscope- with lipids showing up clear.

IB Bioninja; Academic Family Tree

Evidence Against the Davson & Danielli Model

- The Davson-Danielli model of membrane structure was accepted by most cell biologists for about 30 years.
- Results of many experiments fitted the model including X-ray diffraction studies and electron microscopy.
- In the 1950's and 60's some experimental evidence accumulated that did not fit with the Davson-Danielli model.



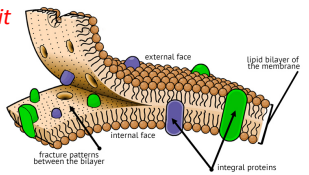
(a) The Davson-Danielli model

Pearson Education

Evidence Against the Davson & Danielli Model

Freeze-etched electron micrographs:

- This technique involves rapid freezing of cells and then fracturing them. The fracture occurs along lines of weakness, including the center of membranes.
- Globular structures scattered through freeze-etched images of the center of membranes were interpreted as transmembrane proteins.
- *How does this not fit with Davson & Danielli's Model?*



Philpot Education

Evidence Against the Davson & Danielli Model

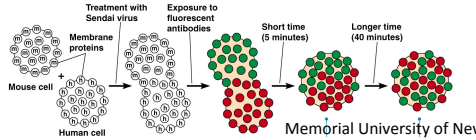
Structure of membrane proteins:

- Improvements in biochemical techniques allowed proteins to be extracted from membranes.
- The proteins were found to be very varied in size and globular in shape so were unlike the type of structural protein that would form continuous layers on the periphery of the membrane.
- Also the proteins were hydrophobic on at least part of their surface so they would be attracted to the hydrocarbon tails of the phospholipids in the center of the membrane.
- *How does this not fit with Davson & Danielli's Model?*

Evidence Against the Davson & Danielli Model

Fluorescent antibody tagging:

- Red or green fluorescent markers were attached to antibodies that bind to membrane proteins.
- The membrane proteins of some cells were tagged with red markers and other cells with green markers.
- The cells were fused together and within 40 minutes the red and green markers were mixed throughout the membrane of the fused cell.



Singer & Nicolson's Model

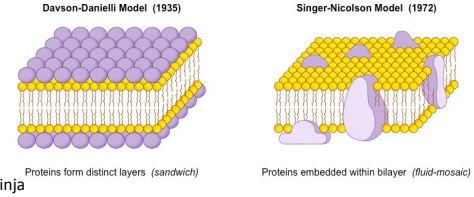
SJ Singer and GL Nicolson had further questions and doubts about Davson & Danielli's model in 1972:

- How could membranes vary in function if they all had the same structure?
- How could lipid soluble material pass through membranes regardless of size if a protein cap protected the lipid?

Phillipec

Singer & Nicolson's Model

- As evidence mounted which undermined the accepted model of membrane structure, Singer & Nicholson proposed a new model that was more consistent with experimental data.
- This model, called the **fluid mosaic model**, emphasized the dynamic nature of membranes in sharp contrast to the static Davson-Danielli model.



IB Bioninja

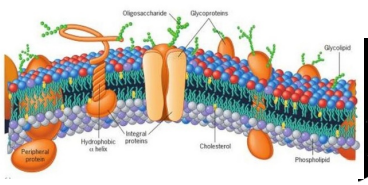
Singer & Nicolson's Model

According to Singer and Nicolson:

- The molecular structure of the membrane is not rigid and fixed, but rather flows - especially the bimolecular layer of lipids.
- The lipids are not capped with a solid protein coating. Instead, proteins are dispersed throughout the membrane, leaving many portions of the lipid bare and exposed to the extra- and intracellular environments. It is through these bare areas that lipid-soluble molecules pass.
- In addition to being attached to both lipid surfaces (peripheral proteins), proteins are also embedded in the lipid matrix itself (integral proteins).

Singer & Nicolson's Model

- The Singer & Nicolson fluid mosaic model has been the leading model now for over 50 years.
- It would be unwise to assume though that it will never be superseded, there are already some suggested modifications of the model…



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