

Structure and composition of Plasma Membrane

**Prince Kumar
Assistant Professor
Department of Botany
T. S. College, Hisua, Nawada
Magadh University, Bodhgaya**

Introduction

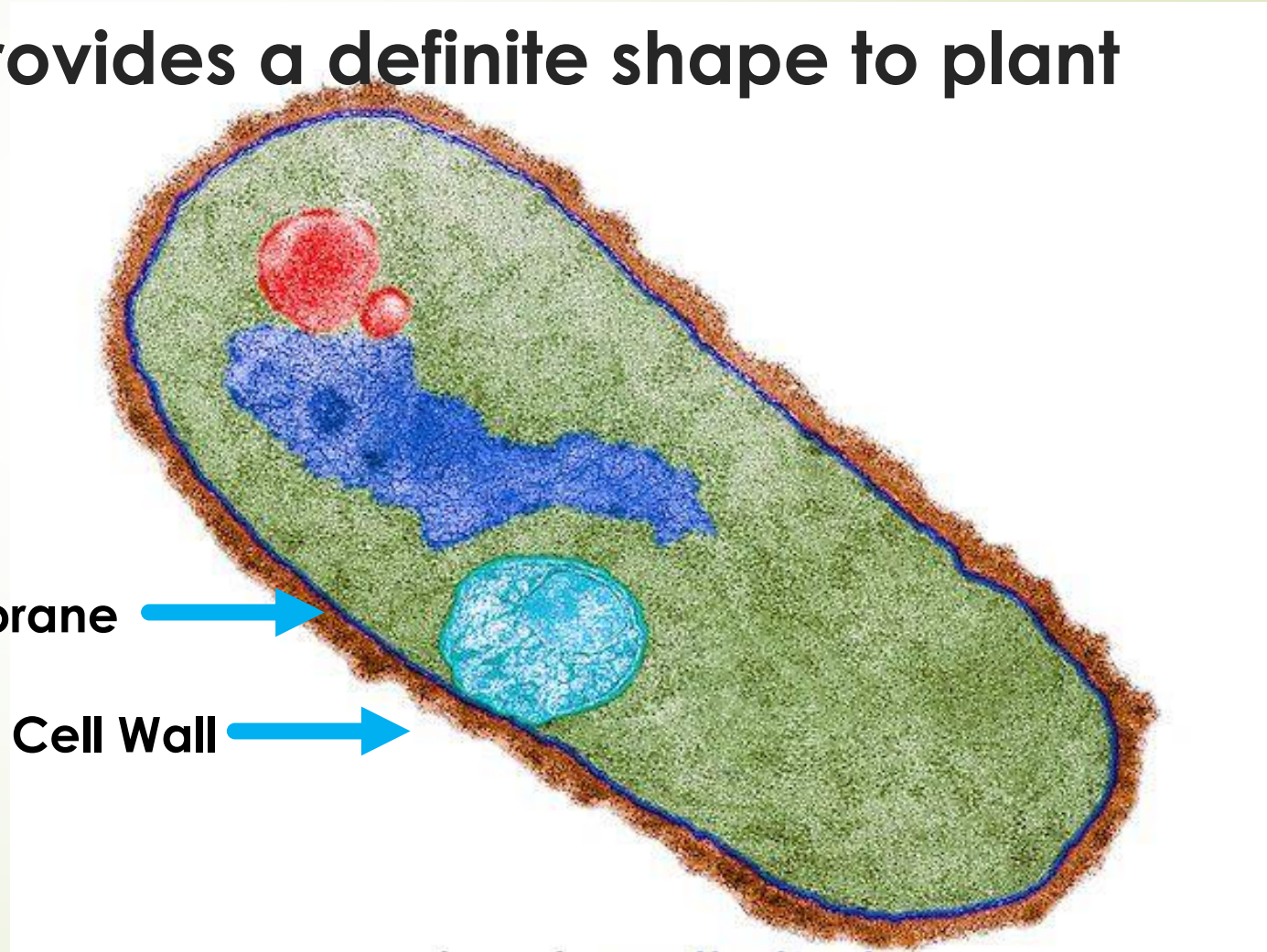
- ❖ Plasma membrane is the boundary that separates the living cells from its surroundings.
- ❖ This film like structure is only about 8 nm thick.
- ❖ The plasma membrane regulates the transport of materials entering and exiting the cell.

In bacteria, fungi, and plant cells, plasma membrane is further covered by cell wall, which is comparatively rigid in texture and provides a definite shape to plant cell.

Plasma Membrane



Cell Wall



Introduction

- ❖ Plasma membranes appears trilaminar, when viewed under electron microscope.
- ❖ It is an important cell organelle composed of lipids and proteins.
- ❖ The plasma membrane exhibits selective permeability; that is, it allows some substances to cross it more easily than others.

History of Cell membrane

- ❖ After the discovery of microscopes by Leeuwenhoek, in 1665, Robert Hooke examined a piece of fungus under a light microscope and he called each space as “cellula”.
- ❖ The lines that actually bounded the “cellula” were not the cell membrane, but the cell wall.
- ❖ For about 200 years, no one thought the cell membrane existed as they could only see the cell wall.

History of Cell membrane

- ❖ **The cell membrane was discovered by Swiss botanist Carl Naegeli and C. Cramer in 1855.**
- ❖ **They had shown that the cell membrane is semipermeable and is responsible for the osmosis exhibited by living cells.**
- ❖ **The term plasma membrane was used in 1855 by Nageli, before that he used the term zellen membrane in his early papers.**

Membrane Models: Scientific Inquiry

- ❖ Scientists began building molecular models of the membrane decades before membranes were first seen with the electron microscope in the 1950s.
- ❖ In 1895, **Ernest Overton** proposed that cell membranes were made of lipids.
- ❖ In 1915, membranes isolated from red blood cells were chemically analyzed and found to be composed of lipids and proteins.

Membrane Models: Scientific Inquiry

- ❖ In 1925, two Dutch scientists, **E. Gorter** and **F. Grendel** proposed phospholipid bilayers hypothesis.
- ❖ Building on the idea that a phospholipid bilayer was the main fabric of a membrane, the next question was where the proteins were located.

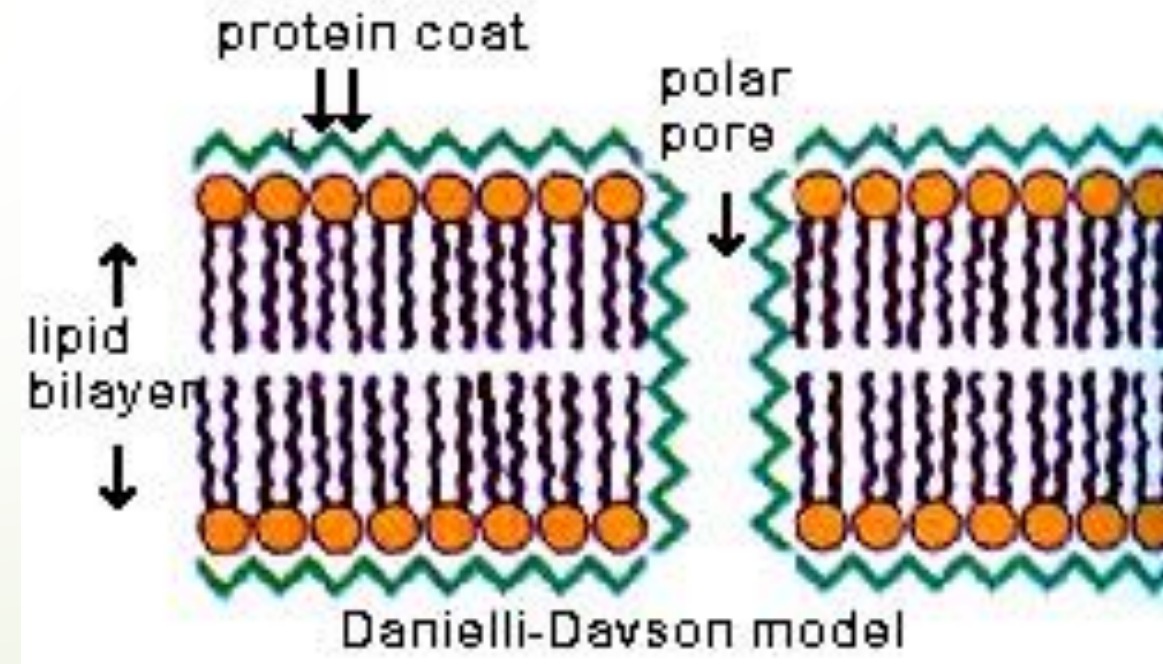
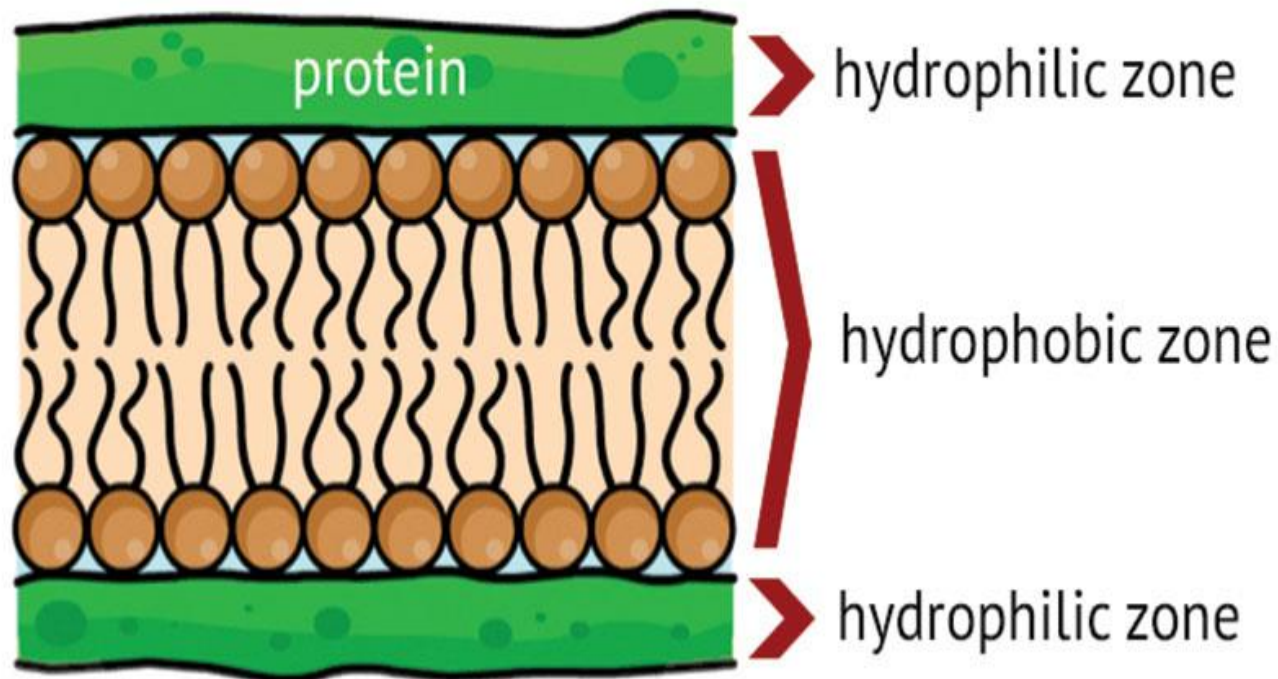
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Sandwich Model of cell membrane

- ❖ In 1935, Danielli and Davson proposed **Sandwich Model** to explain the structure of the cell membrane.

Sandwich (Davson-Danielli) model of cell membrane



Sandwich Model of cell membrane

- ❖ According to this Model Lipid bilayer is sandwiched between two dense protein layers.
- ❖ Outer ends of lipid molecules are hydrophilic and polar.
- ❖ Inner ends of lipid molecules are hydrophobic and non polar, membranes are held together by electrostatic attraction between lipid layers.
- ❖ Proteins are attached at the outer ends of lipid layer by ionic exchanges and hydrostatic forces.

Problems with Sandwich Model

- ❖ The first problem was the generalization that all membranes of the cell are identical, whereas amount and type of membrane protein vary greatly different cells.
- ❖ A second, more serious problem with the sandwich model was the protein placement, whereas membrane proteins are largely hydrophobic and therefore should not be found where the model positioned them.
- ❖ This model fails to explain all the functions of the membrane.

Robertson (1950)-Unit membrane Model

- ❖ Robertson observed the two distinct **electron light zone** and the **electron dense zone** in electron micrograph.
- ❖ Plasma membrane has a three layers structure-two dense layers of 20A (protein) and a clear middle layer of about 35A (lipid bilayer).

Total thickness 75A.

**It does not explain
how some molecules
pass through it.**



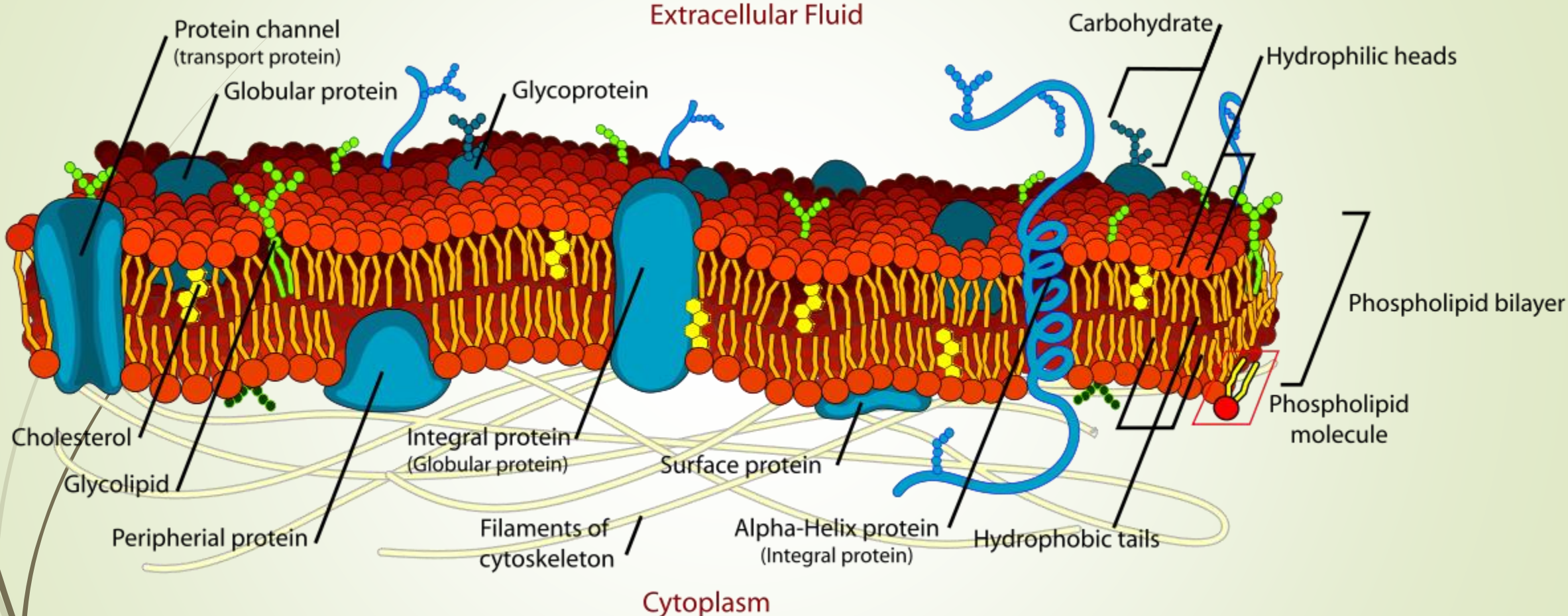
Fluid Mosaic Model (Singer and Nicholson)

- ❖ This is the most acceptable model of the plasma membrane.
- ❖ It explains various observations regarding the structure of functional cell membranes.
- ❖ The lipids are thought to be arranged primarily in a bilayer in which protein molecules are embedded.
- ❖ The term 'fluid' is given because the lipid layer is present in the fluid state.

Fluid Mosaic Model (Singer and Nicholson)

- ❖ **Singer classifies membrane proteins as peripheral or integral.**
- ❖ **The proteins varied in size and dissolved to varying degrees in the lipid matrix are able to diffuse laterally in the plane of membrane, and the entire structure is hence dynamic.**

Fluid Mosaic Model (Singer and Nicholson)





Thank You