BIOLOGY

The Cell Membrane

Objectives :

- Study the structures and functions of the molecules that make up the cell membrane (including amphipathic nature of the phospholipid molecules , integral proteins , peripheral proteins , cholesterol , glycoproteins)

- Learn how to draw the fluid mosaic membrane.

- Analysis of evidence from electron microscopy that led to the proposal of the Davson-Danielli model.

- Analysis of the falsification of the Davson-Danielli model that led to the Singer-Nicolson model.

Resources :

Student book pages 10,11

https://www.youtube.com/watch?v=Je_E8ryCqNE Davson – Danielli 2

https://www.youtube.com/watch?v=ipa1vmQ7H_4 fluid mosaic membrane 3

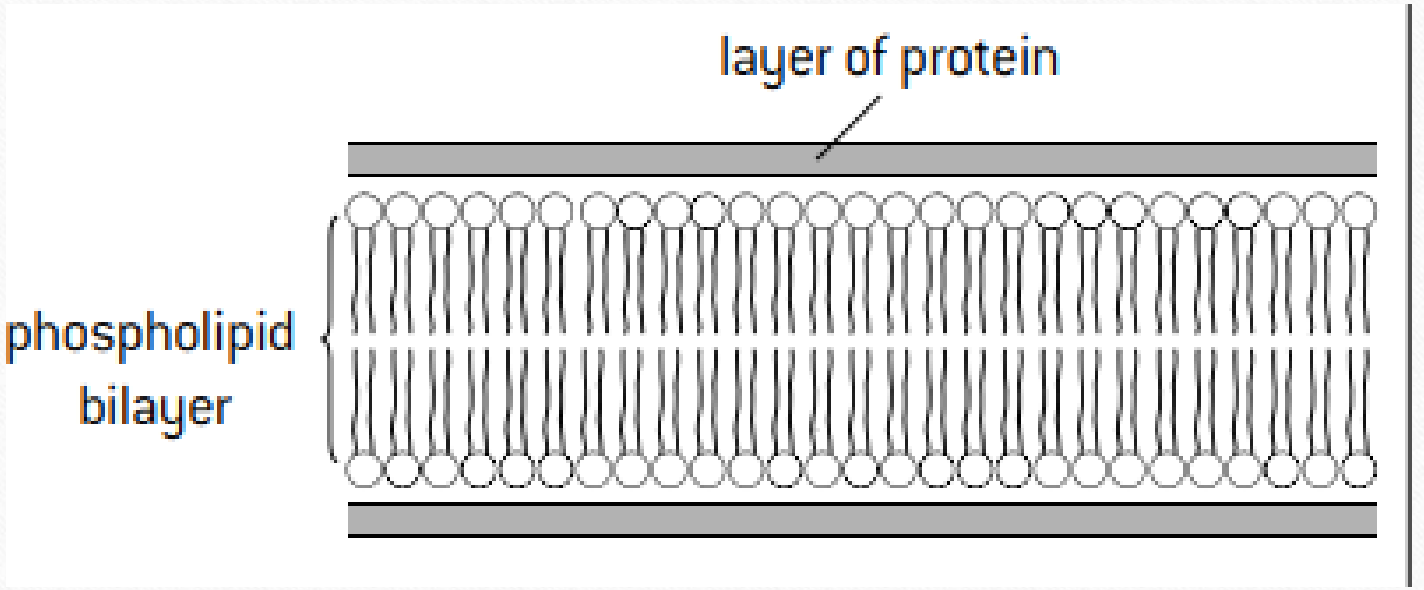
https://www.youtube.com/watch?v=TSH2xw9L1Dg drawing

Cell Membrane Structure and Function – YouTube Cell membrane 1

Inside the Cell Membrane – YouTube cell membrane 1

THE DAVSON-DANIELLI MODEL

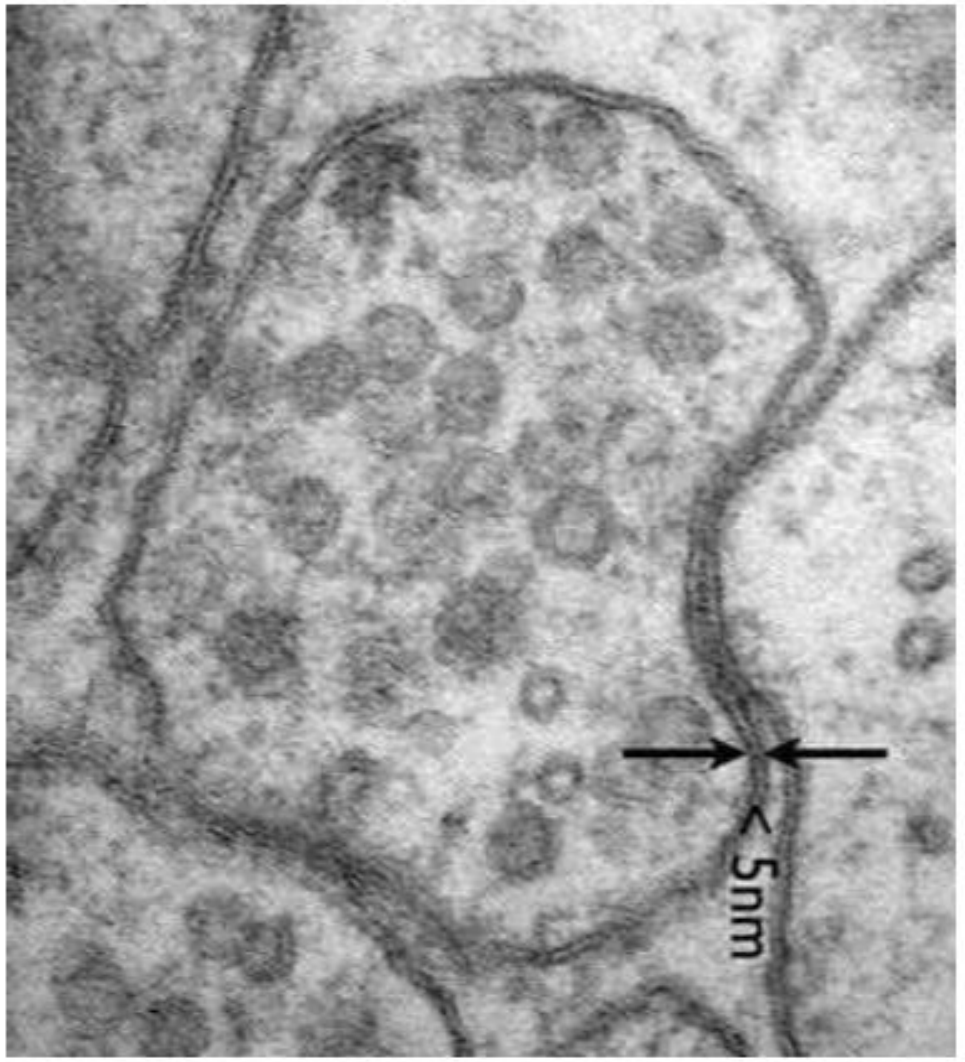
In this model of membrane structure there is a bilayer of phospholipids in the center of the membrane with layers of protein on either side. It was developed by Davson and Danielli in the 1930s.



Testing the model:

High magnifcation electron micrographs were first produced in the 1950s. In these micrographs membranes appeared as **two dark lines separated by a lighter band.** This seemed to fit the Davson Danielli model, as proteins usually appear darker than phospholipids in electron micrographs. The electron micrograph below shows membranes both at the surfaces of cells and around vesicles with the appearance that seemed to back up the Davson Danielli model.

Electron micrograph of biological membranes



THE SINGER NICOLSON MODEL or **fluid mosaic model.**

In the 1950sand 60s evidence accumulated that did not fit the Davson-Danielli model:

1. Freeze-fracture electron micrographs showed that globular proteins were present in the center of the phospholipid bilayer .
2. Analysis of membrane proteins showed that parts of their surfaces were hydrophobic, so they would be positioned in the bilayer and in some cases would extend from one side to the other.

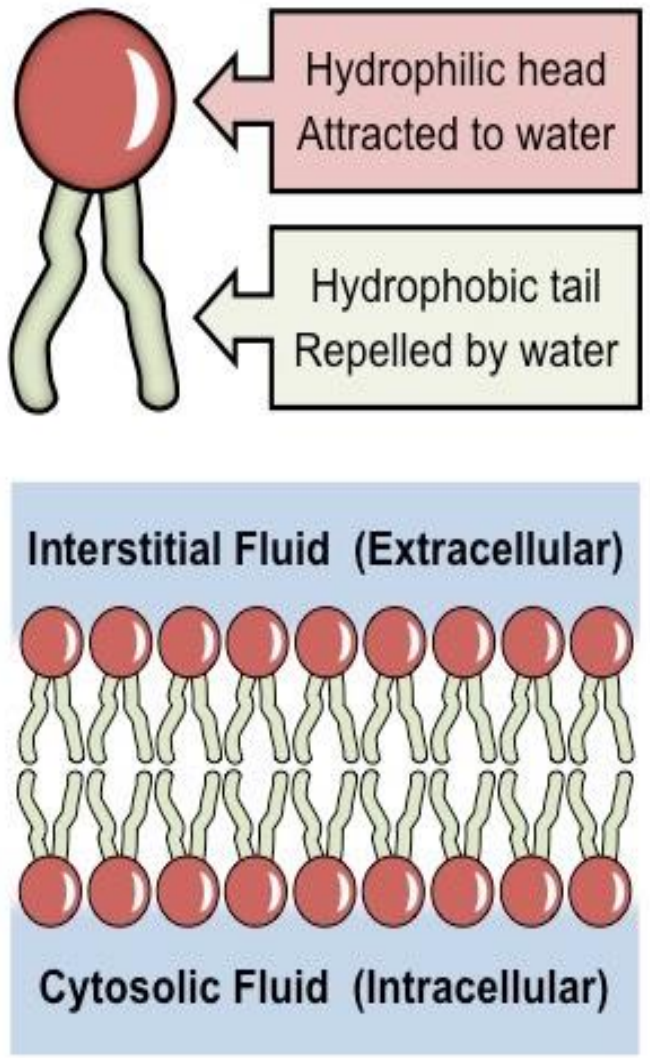
This evidence falsified the Davson Danielli model.

Hydrophilic :the ability to mix well, dissolve, or to be attracted to water.

Hydrophobic : It means lacking affinity for water, and tending to repel or not to absorb water. Hydrophobic molecules tend to be non-polar molecules and group together. Oils and fats are hydrophobic.

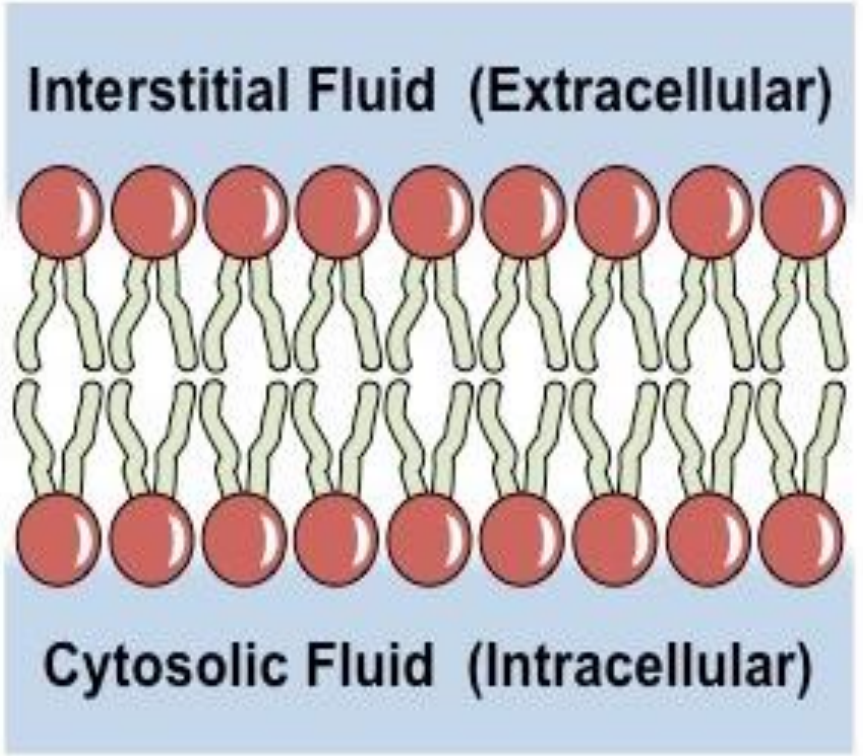
The phospholipid bilayer

The cell membrane is made up of a bilayer of phospholipid molecules . Each phospholipid molecule is made of a **head and a tail**. The head is hydrophilic (attracted to water) and faces the outside of the cell whereas the tail is hydrophobic (repelled by water) and faces the inside of the membrane. This results in the phospholipid bilayer acting as a hydrophobic barrier; this means that non-polar (hydrophobic) substances can pass easily while polar (hydrophilic) substances cannot. Therefore, the phospholipid bilayer is a partially selective membrane. The structure of the phospholipid bilayer allows the cell membrane to change shape easily.



Phospholipid molecules are amphipathic.

This means that part of the molecule is attracted to water (hydrophilic)
and part is not attracted to water(hydrophobic).

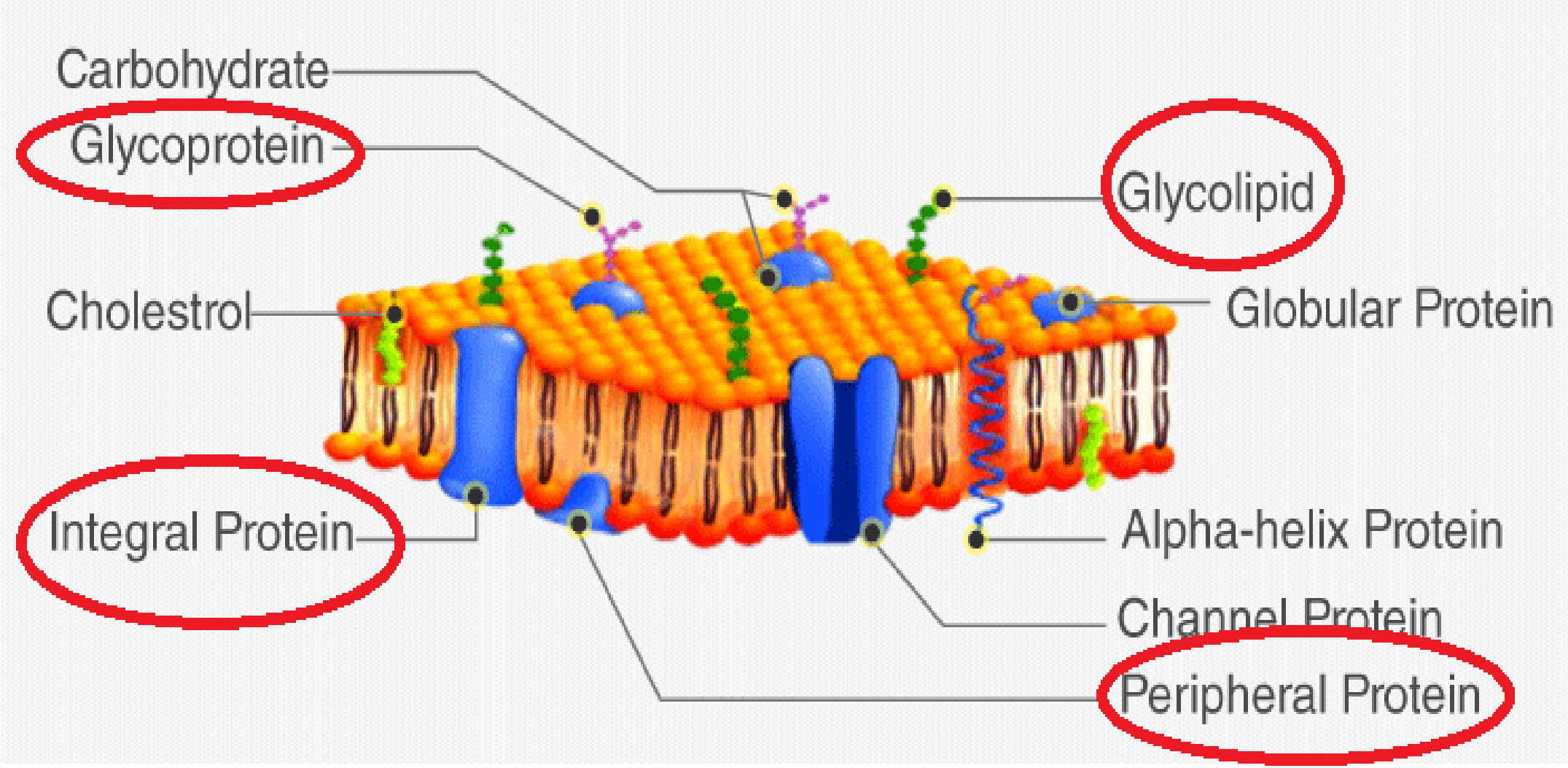


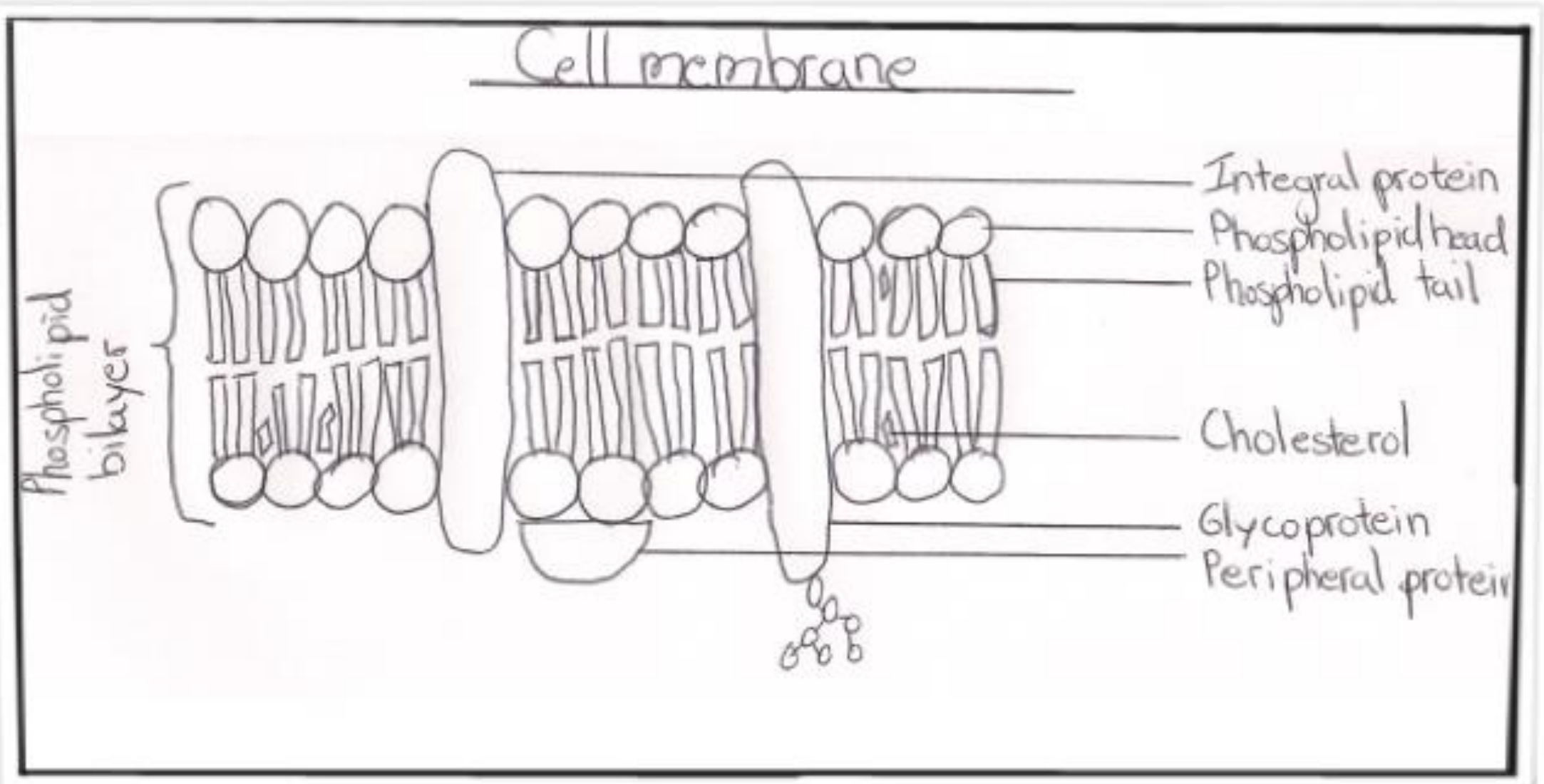
There are different types of membrane proteins that differ in structure, position and function.

- **Integral proteins** : proteins that penetrate the phospholipid bilayer . The integral proteins mostly act as pumps in active transport, or channels in facilitated diffusion, and therefore control the entry or exit of specific substances across the membrane.
- **Peripheral proteins** : these are membrane proteins that remain on the surface . These proteins usually play a role in cell recognition which is involved in immune response.
- **Glycoproteins** : **made of a charbohydrate attached to a protein molecule**. Many glycoproteins are embedded into the cell membrane and serve various vital biological functions.

Animal cell membranes contain cholesterol, which is a lipid component that is found in the hydrophobic region of the bilayer.

Cholesterol has a role in decreasing the fluidity of the cell membrane and lowering its permeability to some molecules.


Carbohydrate
Glycoprotein
Cholestrol
Integral Protein
Glycolipid
Globular Protein
Alpha-helix Protein
Channel Protein
Peripheral Protein


Cell membrane
Phospholipid bilayer
Integral protein
Phospholipid head
Phospholipid tail
Cholesterol
Glycoprotein
Peripheral protein