Membrane Protein

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Membrane proteins are polypeptides integrated into or associated with biological membranes. They are present at roughly equal weight to phospholipids in plasma membranes of cells, in outer membranes of bacteria, mitochondria, chloroplasts and in other organelles. Membrane proteins govern the active functions of membranes, such as transport, signalling, asymmetry and polarisation. Membrane proteins follow characteristic folding patterns and have hydrophobic domains that make them compatible with the amphipathic lipid biayers.

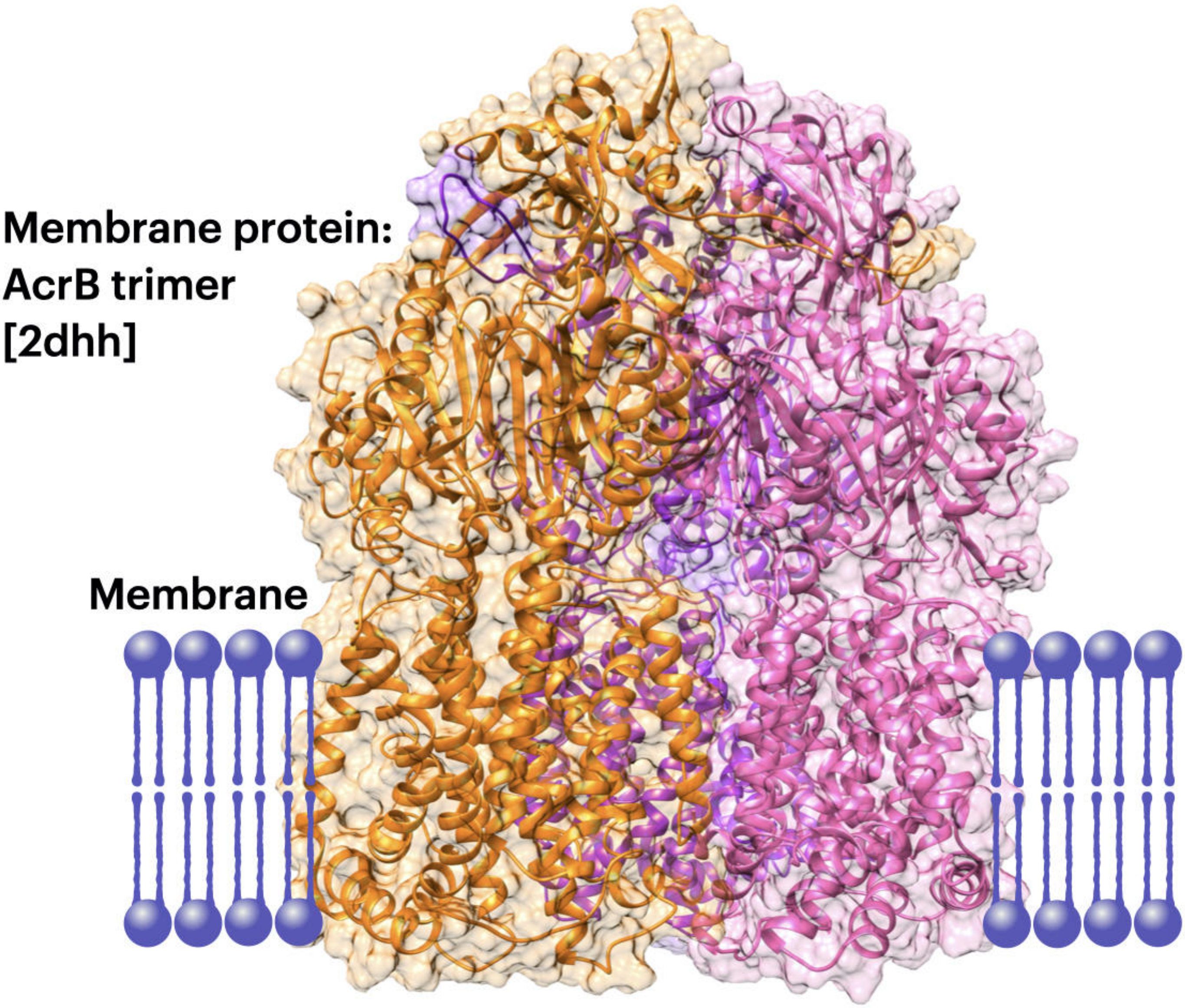
membrane protein | structure determination | structural biology | nmr | nuclear magnetic resonance | solid state nmr | membrane mimetics

1. Introduction

The plasma membrane separates and confines the cell from its environment and encapsulates this smallest and complete unit of life. The membrane consists largely of phospholipids and membrane proteins, which include peripheral proteins, attached or tethered to the membrane surfaces, as well as integral proteins that are partially or fully embedded into the membrane matrix and traverse one or both leaflets. It is estimated that around 30–40% of proteins in most genomes encode membrane proteins[1] which perform essential cellular functions as channels, transports and receptors and mediate signalling vital to cellular survival[2]. Around 60% of commercially exploited drug targets are membrane proteins[3], which shows their importance beyond their physiological role in the cell.

2. Classification

There are two main types of membrane protein: integral and peripheral membrane protein. Integral membrane proteins are permanently embedded in the membrane, either via transmembrane domain (TMD) topology or tethered by a membrane anchor. Peripheral membrane proteins may associate with the membrane temporarily via electrostatic or other interactions while coexisting with a soluble fraction in the surrounding aqueous environment[4]. Almost all integral membrane proteins fold following a transmembrane topology that belongs to one of two major classes: α-helical bundles and β-barrels. Transmembrane proteins with α helical organisation have higher flexibility to accommodate conformational changes, often functioning as receptors and channels. G-protein couple receptors (GPCR), one of the largest membrane protein families in eukaryotes, consist of seven transmembrane helices and a short surface-localised helix[5][6]. While α-helical membrane proteins are common in plasma membranes, membrane proteins with β-barrel TMDs are only reported in outer membranes of Gram-negative bacteria, mitochondria and chloroplasts[7]. Transmembrane β-barrels function as selective or non-selective pores, transporters and secretory complexes, or can be involved in outer membrane biosynthesis and assembly[8].



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