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Commentary

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Membrane Biochemistry frontiers with molecular compositions

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ABOUT THE STUDY

The purpose of this study is to outline the various aspects of this area of research that deal with the function of specific membrane components and fundamental physical, biochemical, and cell biology principles underlying the functioning of cellular membranes. Membranes are stable structures with varying degrees of lateral mobility in their constituent parts. They offer a physical barrier that enables constant communication between the inside and exterior worlds. The structure of membranes is significantly more complex than what scientists first hypothesised, in which proteins floated in a sea of fluid lipids. The non-homogeneous lateral distribution of the components of biological membranes results in the creation of domains with highly varied molecular compositions and super-molecular architecture that are sustained by interactions between the constituents.

The biological membranes of polarised cells exhibit micron-sized macro-domains morphologically. However, biological membranes also contain sub-micron and nanometre size domains. This is supported by the finding that even in membrane areas with no discernible morphological architecture, sphingolipids and proteins form distinct clusters that are transiently limited to micro-domains rather than undergoing free and continuous lateral diffusion. These characteristics were initially explored in relation to the Golgi and plasma membranes, but recent findings contend that they apply to all cell membranes. Lipid rafts, membrane regions rich in sphingolipids and cholesterol that are enriched in explored in relation to the Golgi and plasma membranes GPI-anchored proteins and membrane-anchored signal transducer molecules like the Src family kinases Lyn and c-Src, are perhaps the most researched membrane domains. Depending on the fixation and measurement techniques, the width of these membrane domains exhibits a wide variation, ranging from 5 nm to 300 nm.

However, multiple studies imply that not all of these molecules must belong to the same domain and that domains enriched in glycosphingolipids are distinct from those enriched in GPI-anchored proteins or caveolar domains.
The topic of "membrane rafting" is extensively covered in the section Lipid Micro-domains, along with the synthesis, classification, and function of their constituent parts, as well as the chemical and physical underpinnings of the stability of lipid raft micro-domains and their role in membrane polarity. The reader can discover a summary of current findings about the topology and organisation of certain membrane components, as well as their interactions and assembly within various membranes, including those of the nervous system, under the section Membrane Organization.

Last but not least, the class of sphingolipids receives a lot of attention in Membrane Function and Disease, including their significance in a number of disorders and their function in membrane remodelling. Together, these "Frontiers in Membrane Biochemistry" give the reader the chance to learn about the most recent developments in membrane molecular cell biology and to cross the frontier into innovation.