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Structural Analysis of Phospholipid Membranes and Toxin Assault

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In nature, membranes perform several functions of the living cell from selective transport and recognition, to simple sequestration. In general, the membrane consists of a single bilayer or in special cases, such as the lung surfactants, a single monolayer. Using powerful new neutron and x-ray sources, the techniques of reflectivity and grazing incidence diffraction permit us to obtain structural information on single lipid monolayers and supported bilayers in an aqueous environment. Recently, we demonstrated that 18 keV x-rays can be used to study lipid bilayers at the solid-liquid interface by x-ray reflectivity. We establish that this is a powerful technique for investigating biological systems in a previously inaccessible manner. Our measurements enabled the density distribution of single phospholipid bilayer membranes in bulk water to be measured with unprecedented precision enabling subtle variations in leaflet segregation to be resolved. Recent results on membrane perturbation by toxin binding will also be highlighted. In this case, scattering techniques enable us to distinguish binding and subsequent penetration of lipid layers upon toxin activation.