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Critical composition fluctuations in artificial and cell-derived lipid membranes

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Cell plasma membranes contain a mixture of lipid types which can segregate into coexisting liquids, a thermodynamic phenomenon which may contribute to biological functions. Simplified, artificial three-component lipid vesicles can be prepared which display a critical miscibility transition near room temperature. We found that such vesicles exhibit concentration fluctuations whose size, composition, and timescales vary consistently with critical exponents for two-dimensional conserved order parameter systems. However, the critical miscibility transition is also observed in vesicles formed directly from the membranes of living cells, despite their more complex composition and the presence of membrane proteins. I will describe our critical fluctuation measurements and also review a variety of more recent work by other researchers. Proximity to a critical point alters the spatial distribution and aggregation tendencies of proteins, and makes lipid mixtures more susceptible to domain formation by protein-mediated interactions, such as adhesion zones. Recent work suggests that critical temperature depression may also be relevant to the mechanism of anaesthetic action.