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You are what you eat: the biological consequences of lipidomic complexity

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Your cell membranes are made mostly of lipids, the class of biological macromolecule that includes fat, oil, and wax. This "lipidome" is a complex mixture of some 800 different types of lipid, which changes with your diet and with the administration of lipid synthesis drugs like statins. Altering the lipid composition of a membrane changes its biophysical properties, such as thermodynamic phase, fluidity, viscosity, and curvature stress. Changes in biophysical properties may in turn affect cellular functions like signaling, which often relies on the diffusive encounter of membrane-bound receptors. I will give an overview of the state of membrane biophysics, with a particular focus on recent experimental breakthroughs which admit measurements of lipid diffusion with unprecedented spatiotemporal precision. I will then discuss our own efforts to use modeling approaches in collaboration with experimental colleagues to rationalize lipid and protein spatiotemporal organization in model membranes, and our plans to extend these approaches to interpret recent measurements on live cell membranes