School of Molecular Sciences
Arizona State University

SMS Spring 2024 O'Keeffe Lecture

Friday February 9 | 3:00 pm | Biodesign Auditorium

Membrane Mimetic Chemistry in Synthetic and Living Cells

Lipid membranes in cells are fluid structures that undergo constant synthesis, remodeling, fission, and fusion. The dynamic nature of lipid membranes enables their use as adaptive compartments, making them indispensable for all life on Earth. Efforts to create life-like artificial cells will likely involve mimicking the structure and function of lipid membranes to recapitulate fundamental cellular processes such as growth, transport, and signal transduction. As such, there is considerable interest in chemistry that mimics the functional properties of membranes, with the express intent of recapitulating biological phenomena. I will present recent efforts from our lab that leverage advances in chemical biology and systems chemistry to mimic the remarkable properties of living membranes. Specifically, I will discuss how we have been able to repurpose membrane translocating proteins to enable the self-encoded display of peptides on artificial cells. By programming synthetic cell-cell interactions, these studies have allowed us to achieve the de novo generation of functional synthetic tissues. Inspired by our ongoing work in developing lipid bioconjugation strategies to generate artificial cell membranes, we have also developed new tools for manipulating membranes in cells. I will discuss strategies for the selective bioconjugation of lipids in live cells. We hope that these tools will help reveal the location and functional roles for unique lipid species that are found within human cells.

Neal Devaraj, PhD

Professor, University of California, San Diego

Neal K. Devaraj is a Professor and the Murray Goodman Endowed Chair in Chemistry and Biochemistry at the University of California San Diego (UCSD). A major research thrust of his lab involves understanding how non-living matter, such as simple organic molecules, can assemble to form life. Lipid membranes are required to organize cellular reactions and regulate the exchange of matter and energy with the environment. State-of-the-art approaches to mimic cell membranes have relied on using *static lipid structures that are at thermodynamic equilibrium*, formed from hydrating dried lipid films or using microfluidic techniques. However, we currently do not understand the rules for reconstituting and maintaining *lifelike* lipid membranes that function *far from equilibrium*. Along these lines, his research group has developed approaches for the in-situ synthesis of synthetic cell membranes by using selective reactions to "stitch" together lipid fragments. This work has enabled the demonstration of self-reproducing lipid vesicles and artificial membranes that can remodel their chemical structure. Recently, his lab has developed techniques to synthesize lipid species within living cells, enabling studies that decipher how lipid structure affects cellular function. For his scientific contributions, Professor Devaraj has been recognized by multiple awards including the American Chemical Society Award in Pure Chemistry, being named a Blavatnik National Laureate in Chemistry, the Eli Lilly Award in Biological Chemistry, The Leo Hendrik Baekeland Award, a Guggenheim Fellowship in the Natural Sciences, and the Vannevar Bush Faculty Fellowship.

*ZOOM option available: https://asu.zoom.us/j/81517529537