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. 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.