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Lipid Membrane and Nanoparticle Interactions
A Model System for Cell-Protein Interactions

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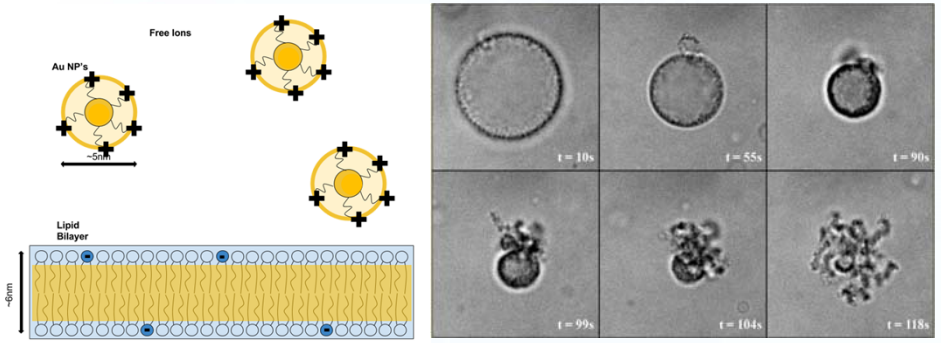
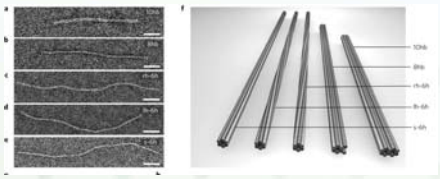
In a cell membrane, lipids and proteins work in tandem to provide shape, structure, and protection for the cell. These biological examples inspire applications in which membranes could form artificial adaptive materials that encapsulate and deliver materials. Achieving this goal requires that we first understand the basic principles for remodeling membranes.

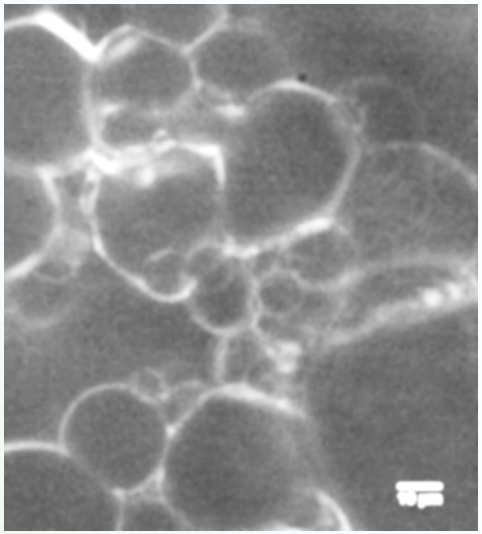
In this MRSEC study, we made simplified cell membranes (called vesicles). We exposed them to nanoparticles that adhered to the membranes with a controllable binding energy. When the binding energy was strong enough to overcome the membrane-bending energy, the membranes suffered a surprising and dramatic inversion of the shape, leaving an octopus-like structure. Computer simulations helped to identify criteria for this process to occur. Using DNA origami, we also made particles with different shapes (here, twisted rods) that bound to membranes and yielded different structures. This approach will help us predict how protein/particle shape drive membrane remodeling.



Top left: Schematic of gold nanoparticles and a lipid membrane. Top right: images of a lipid vesicle being destroyed by spherical nanoparticles that bind to it.



Siavashpouri, et al, Nature Materials, **16** 849-856 (2017)]
Left images: DNA origami rods have tunable length and twist. Right: The DNA origami rods bind to the membrane and cause vesicles to adhere to one another. The result is a soft gel that is mostly water and can encapsulate materials.



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