Interdisciplinary Science & Applications at the Cell Surface

The Membranes Team is an interdisciplinary group of faculty focusing on key aspects of cellular and biomimetic model membranes through studies that encompass fundamental advances, medical applications, and emergent technologies.

Probing Key Disease-Related Issues Involving Membrane Binding
- Targeting of mammalian cells by bacterial enzymes
- Trans-membrane signal transmission by membrane proteins
- Influence of force on membrane binding
- Examining the coupling between binding and membrane curvature
  (Dinsmore, Gershenson, Heuck, Santore, Thompson, You)

Identifying and Manipulating the Key Interactions Essential to Membrane Permeation
- Assembly of pore-forming bacterial proteins in host membranes
- The influence of cholesterol on bacterial protein insertion and pore formation
- Membrane disruption by antimicrobial and bacterial peptides
- Engineering peptides and macromolecules to tune membrane interactions for macromolecular delivery
  (J. Chen, M. Chen, Heuck, Santore, Tew)

Probing Key Disease-Related Issues Involving Membrane Biogenesis
- Assembly of plasma membrane and cell wall
- Drug targeting of glycolipid biosynthesis
- Plasma membrane compartmentalization and dynamics
  (Dinsmore, Morita)

Near the Cell Membrane
Engineered nanoparticles approach but do not penetrate the membranes of S. aureus bacteria
(Santore, Rotello)
In addition to the powerful facilities in IALS, Membranes Team Scientists develop unique research tools housed in individual labs for the study of cellular and model membranes. Membranes Team faculty also lead the development of membrane models to study disease and drug interactions.

### Membrane Models
- Supported bilayers and micro-pore spanning membranes
- Phospholipid and polymeric bilayers and vesicles
- Mechanically-responsive membrane systems
  (Chen, Dinsmore, Heuck, Santore)

### Specialized Probes
- Fluorescent membrane probes single photon microscopy
- Nucleotide-based membrane probes for localization of applied force
- Membrane-based particle tracking for membrane dynamics
- Novel Synthesis of designer molecules for membrane interactions
  (Chen, Dinsmore, Heuck, Tew, You)

### Custom Instrumentation
- Micropipette aspiration to monitor uptake and insertion kinetics, molecular permeation, adhesion, impose curvature, and membrane tension
- Fluorescence correlation spectroscopy to monitor binding events in real time
- Electrical impedance spectroscopy to monitor single molecules crossing membranes and translocation through pores.
  (Chen, Dinsmore, Heuck, Santore)

### Biomimetic Membranes in Emergent Technologies
Membranes Team Faculty, recapitulating biomimetic and super-biological behaviors in biomolecular membranes, are developing new membrane-based sensors and responsive materials for emergent health, energy, and environmental applications.

- **Super-Biological Sensors**
  The selectivity and sensitivity transmembrane OmpG nanopores are engineered by adjusting ligand tether length
  (Chen lab, ACS Sensors)

- **Touching Cells at the Molecular Level**
  Lipid-based approach to immobilize DNA probes on the outer membranes of live cells, to measure transient membrane lipid encounter events and cellular mechanotransduction
  (You lab, Nature Nanotechnology)

- **Consequences of Membrane Binding**
  Bilayer reorganization
  (Dinsmore and Rotello labs)

For more information on the IALS Core Facilities, please visit: umass.edu/ials/core-facilities.