

## Playing with the Molecules of Life

### Abstract:

Our research program combines the tools and principles of chemistry with the molecules and processes of living cells to synthesize new molecules and molecular assemblies with novel physical, chemical and biological functions. By studying the structure and function of the resulting molecules, new insights can be gained into the mechanisms of complex biological and chemical systems. Examples of this synergistic chemical/biological approach to synthesis will be discussed including (1) the addition of amino acids with novel biological, chemical and physical properties to the genetic codes of prokaryotic and eukaryotic organisms, (2) recapitulating the evolution of mitochondria in a synthetic eukaryotic system, (3) characterizing organisms with chimeric RNA-DNA genomes, and (4) the identification of small molecules that control stem cell fate *in vivo*.