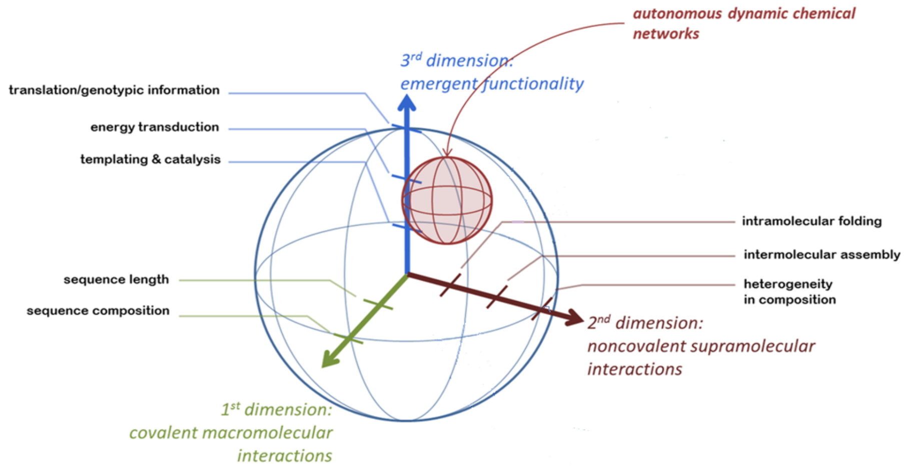
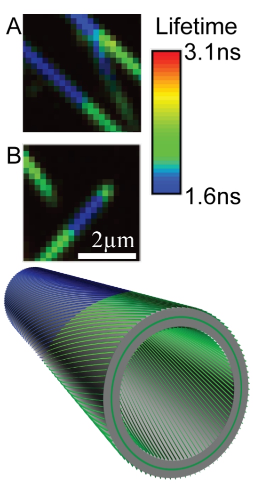
Mutualistic Co-evolution of Biopolymers *Allisandra Mowles, Chenrui Chen, **Jay T. Goodwin,** Junjun Tan, Tolulope O. Omosun, Anil K. Mehta, Sha Li, Dibyendu Das, W. Seth Childers, Rong Ni, Neil R. Anthony, Keith M. Berland, & David G. Lynn, Departments of Biology, Chemistry and Physics, Emory University, Atlanta, GA 30322*



Life may best be understood as molecular information streaming at the nanometer scale. The diversity of DNA sequences, both known and yet to be characterized throughout Earthly realms, along with the vast repertoire of catalytic and structural forms of proteins, constitute the dynamic evolving molecular network that underpins our tree of life. Most remarkably, the information flow is achieved with two foundational biopolymers locked in mutualistic synergy through three hierarchical dimensions, ultimately yielding life as we currently know it.[1,2] We will show how covalent macromolecular synthesis can be intimately tied to non-covalent folding and supramolecular associations; we will also define several of the chemical and physical functions emerging from these diverse structural networks. Dynamic feedback processes, both chemical and physical, and cooperatively expressed across all dimensions of the network, underpin the DCN's evolutionary potential.[3-5] These results suggest a range and degree of order accessible with nucleic acids and peptides that can yield a remarkably wide diversity of phases, from compartments to metabolism and informational polymers. While less effective than extant biology, we will demonstrate that specific phases can be propagated, selected, and exploited for their unique structural and chemical functions. Even in this limited sampling, the mutualism of scaffolds available for the creation of cooperative functions and supramolecular order appears limitless and poised to expand our understanding of the astrobiological possibilities.



References

1. Goodwin JT; Lynn DG. (**2014**). *Alternative Chemistries of Life – Empirical Approaches.* Emory University, ISBN: 978-0-692-24992-5. http://alternativechemistries.emory.edu/
2. Goodwin JT, Mehta AK, Lynn DG. **2012** *Digital and Analog Chemical Evolution*. Acc Chem Res. *45*, 2189-99 *DOI: 10.1021/ar300214w*
3. Liang, C; Smith-Carpenter, J; Ni, R.; Childers, W.S.; Mehta, A.K.; Lynn, D.G. **2014** Kinetic Intermediates in Amyloid Assembly, *J. Am. Chem. Soc. 136:* 15146-9. DOI**:** 10.1021/ja508621b.
4. Anthony NR, Mehta AK, Lynn DG, Berland KM **2014** Mapping amyloid-β (16-22) nucleation pathways using fluorescence lifetime imaging microscopy. *Soft matter*, 10: 4162-4172. DOI: 10.1039/C4SM00361F
5. Guo, Q, Mehta, AK, Grover, MA, W. Chen, W., Lynn, DG, Chen, Z. **2014**. Shape Selection and Multi-stability in Helical Ribbons, App *Phys Letts*, 104: 211901, http://dx.doi.org/10.1063/1.4878941