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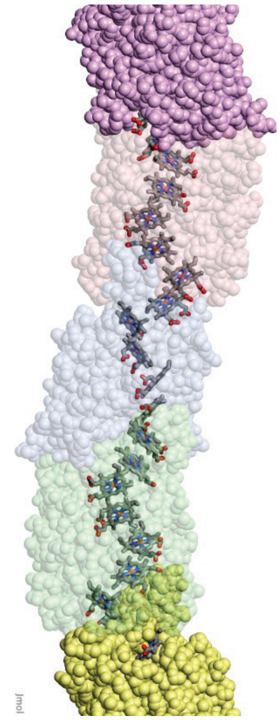

Lab meetings: Wednesday 3PM (Computation); Friday 10 AM (Experiments). We can adapt our lab meeting schedule to accommodate your class schedule. Rotations available any time.

Mechanistic understanding how common bacteria manipulate their environment via nanowires to control pathophysiology and ecology

Deep in the ocean or underground, where there is no oxygen, *Geobacter* “breathe” by projecting tiny protein filaments called "nanowires" into the soil, to dispose of excess electrons resulting from the conversion of nutrients to energy. These nanowires enable the bacteria to perform environmentally important functions such as cleaning up radioactive sites and generating electricity. Using cryo-electron microscopy, our lab has discovered that heme molecules line up to create a continuous path along which electrons travel with surrounding proteins acting as an insulation for these wires (see image) (*Cell* 2019). This discovery of nanowires was selected as Proteopedia’s highest impact structures of the century and the New York Times commented as “a strong reminder of how ready we are to ignore things we cannot imagine.” Our work explains how bacteria use nanowires for interspecies electron transfer (*Science* 2010), and electricity production via biofilm communities (*Nature Nano* 2011). Our work thus provides new insights into bacterial survival mechanisms to control their pathophysiology and ecology and demonstrates a bottom-up approach to develop self-repairing and robust electronic materials.

The students will work on one or more of the following three major research themes of our lab:

1) Assembly machinery: We are identifying the nanowire assembly machinery using genetic tools combined with x-ray crystallography and cryo-electron microscopy and tomography.

2) Conductivity Mechanism: Existing models of biological electron transfer cannot fully explain such high conductivity in proteins. We are building a new fundamental framework by performing conductivity measurements as a function of several physical and chemical probes.

3) Synthetic Protein Nanowires: We are crystallizing conductive proteins and incorporating non-standard amino acids to develop self-assembling electronically and optical biomaterials.

Rotation projects could involve structural studies, genetically engineering nanowire conductivity using synthetic biology tools, nanoscale electron transfer measurements in nanowires and living biofilms, optical spectroscopy and electrochemistry to probe the redox reactions as well as building and experimentally testing computational models (with Victor Batista, Chemistry).

We have several interdisciplinary projects embedded in these larger goals that would be great rotation projects as they provide training in a variety of biophysical, molecular biology and biochemical techniques and are likely to yield positive results/publications within the rotation.

Please come chat with me or with one of my laboratory members to match your interests with our training opportunities. Rotation projects are experimentally or computationally oriented with possibilities of combining both and no prior background in a specific discipline is necessary.