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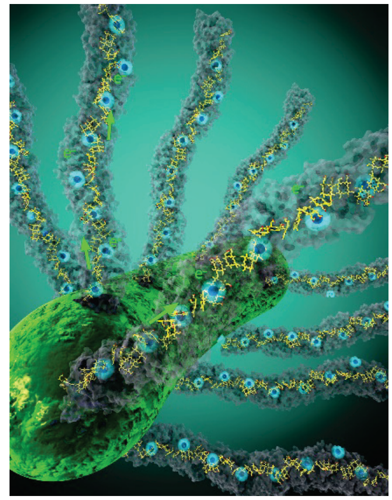
ABC 216 / Bass 230
Lab meetings: Monday 9 AM. Journal Club: Friday 12 PM. We can even adapt our lab meeting schedule to accommodate your class schedule. Rotations available any time.



Our overarching goal is to define the mechanisms by which microbes interact with and manipulate their environment, with the ultimate goal of engineering these interactions to control microbial pathophysiology and ecology. Our research is focused on how electricity-producing microbes use electron transfer via hair-like protein appendages as "nanowires" (*Cell* 2019) for communication (*Science* 2010), and biofilm formation (*Nature Nano* 2011), allowing bacteria to survive in environments that lack membrane-permeable electron acceptors such as oxygen. Our discovery of protein nanowires offers fundamentally new method to synthesize materials that can transport charge and energy at rates and distances unprecedented in biomolecular systems; helps to explains a wide range of globally important phenomena; and provides new insights into bacterial survival mechanisms.

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

1) Protein Structure: We recently solved the structure of nanowires that revealed a surprise that nanowire have a core of hemes that line up to create a continuous path for electrons (*Cell* 2019). Previously nobody suspected such a structure. We are now identifying the nanowire assembly machinery using 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 incorporating non-standard amino acids in proteins to develop electronically and optically functional biomaterials (with Farren Isaacs, MCDB).

4) Bacterial infections: Most bacteria cannot cause diseases without pili. In collaboration with Yale Cystic Fibrosis Center, we are evaluating how bacterial electron transfer helps adhesion to the host as well as iron & sulfur metabolism using *Pseudomonas aeruginosa* as a model system.

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 build and experimentally test computational models of nanowires (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. All rotation projects are experimentally oriented and no theoretical/computational or any prior background in a specific discipline is necessary.