BCHM 421/422 – 2018/2019

Project #3 Outline: Many bacteria use long protein adhesins to make initial contact with the surface to which they will bind and form biofilms. The ligand-binding domains of adhesins are grouped at the far end of these long proteins that are anchored to the bacterial outer membrane. This project will involve changing the binding specificities of natural and artificial adhesins by adding, deleting or swapping ligand-binding domains. Protein engineering along these lines has the potential to change the targeting of bacteria to surfaces, other organisms, and biofilms. For example, the inclusion of an ice-binding domain into the adhesin of an oil-eating bacterium might anchor the microorganism to ice for the bioremediation of oil spills in the Arctic.

Supervisor: Peter L. Davies

Project Title: Engineering bacterial adhesins to have new binding affinities

Keywords (3-5):

1. **Bioinformatics**
2. **Biofilms**
3. **Protein engineering**
4. **Microfluidics**
5. **Fluorescence microscopy**

Project Goals: Alter the binding properties of a bacterium in a predictable manner by changing its natural ligand-binding domains. Observe and record the new binding specificity using microfluidic devices.

Experimental Approaches: Bioinformatic analysis of bacterial adhesin targets. Ligand-binding domain swapping in adhesins by genetic recombination. Semi-synthesis of codon-optimized artificial adhesin genes for transformation into bacteria. Observation of bacterial binding and biofilm formation by microscopy in microfluidic chambers.

Timing: Can be started in Sept 2018 or Jan 2019. Therefore, suitable for a co-op student returning from first placement.

References: Guo, S., Stevens, C.A. Vance, T. D.R., Olijve, L.L.C., Graham, L.A., Campbell, R.L., Yazdi, S.R., Escobedo, C., Bar-Dolev, M. Yashunsky, V., Braslavsky, I., Langelaan, D.N., Smith, S.P., Allingham, J.S., Voets, I. K., **Davies P.L.** (2017) Structure of a 1.5-MDa adhesin that binds its Antarctic bacterium to diatoms and ice. Sci Adv. 2017 3(8):e1701440. doi: 10.1126/sciadv.1701440