IEH Undergraduate Intern Mentoring Opportunity

Deadline: **March 15th, 2016**

Name/Title/Institution(s) of senior mentor(s): Dr. Joe Needoba, Dr. Tawnya Peterson

Name/Title/Institution(s) of frontline mentor(s): Stuart Dyer

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Project Title: Exploring the role of cyanotoxins as effector molecules in cyanobacterial metabolism and stress response, with an emphasis on environmental factors that contribute to cyanotoxin production in harmful algal blooms.

Context for Project:

Cyanobacteria are ubiquitously distributed across the Earth and account for a substantial portion of global biomass production, oxygen evolution, and carbon sequestration. Despite their evolutionary and modern day importance, many aspects of cyanobacterial metabolism and cellular life remain obscure.

Recent advances in analytical techniques, the increasing feasibility of, and accessibility to, omic assays, and the interest in cyanobacteria as feedstocks for (photo)synthetic product development have led to a number of important discoveries. Chief among these, and of direct importance and impact to human populations, are the diverse range of non-ribosomally synthesized, non-proteogenic peptides and amino acids commonly referred to as cyanotoxins.

While most cyanotoxins are acutely hepatotoxic and/or nephrotoxic, their biosynthesis is restricted to discrete species or small taxons. This is not the case for β-methylamino-L-alanine (BMAA), which has been detected in representative species of the entire cyanobacterial clade, leading to the postulate that BMAA is not a secondary metabolite, but rather, an a small effector molecule—akin to glutamate and 2-oxoglutarate—of conserved cyanobacterial systems.

Proposed Outcomes/Broader Impact:

An increasing body of evidence indicates that bioaccumulation of BMAA in human food is causal to the atypical rate of amyotrophic lateral sclerosis/parkinsonism-dementia complex (ALS/PDC) type symptoms seen in multiple, geographically isolated populations.

BMAA-attributable ALS/PDC-like symptoms frequently occur in areas subjected to natural, and anthropogenically induced, massive surface cyanobacteria blooms. Cyanobacteria blooms are increasingly common in the United Sates, especially in inland waterways subjected to nutrient pollution.

Through our endeavors, we hope to contribute to a more detailed understanding of the cellular role of BMAA in cyanobacteria, as well as the environmental factors that contribute to cyanotoxin production.

Proposed timeline (within a 10 week span):

Because of the approach taken, which seeks to bridge environmental and biomolecular milieu, we will conduct as many differential growth experiments as possible. These experiments will focus on modulating the nutrient composition, light regimes, and stressors BMAA-exposed cyanobacterial cultures are subjected to.

As manifestations of the cellular responses to various nutritional and environmental states occur on a minute-to-week timeline, continually setting up culture experiments will be of key importance**.** Ideally an intern would spend the first week reviewing lab protocols and instrumentation, establishing cultures from preexisting cell lines, and preparing for the flurry of activity to come. The following nine weeks would be segmented into two-week and one-week periods of experimental set-up and sample processing/analysis, respectively. As many measurements must be taken on a daily basis, the two-week periods will still be chalk full of activity and learning opportunities.

Owing to the massive harmful algal blooms that have recently been observed in various rivers in the Portland metro area, we will also be collecting field samples to determine BMAA concentrations in the environment. Thus, opportunities exist for the intern to participate in the field work.

Intern academic experience and skill set should include:

A joy of learning and the ability to apply information from diverse knowledge bases to a complicated and multifaceted environmental concern.

The ability to ask and be asked demanding questions; remember, “I don’t know,” is at times an excellent answer!

Successful completion of general chemistry and biology sequences. Advanced understanding of organic/inorganic chemistry, microbiology, and environmental ecology preferred.

Proficiency in data processing software: excel, matlab, etc.