



The Gene and Linda Voiland School of  
**Chemical Engineering and  
Bioengineering**  
**2015 Seminar Series**  
**Monday, August 31, 2015**  
**12:10 p.m. Todd 311**



**Aaron T. Wright, Senior Scientist**  
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Aaron Wright is a Senior Scientist at the Pacific Northwest National Laboratory (PNNL) in Richland, WA and also an Adjunct Professor in the Department of Molecular Biosciences at WSU. He earned his Ph.D. in Organic Chemistry from the University of Texas and was a Postdoctoral Research Fellow at the Scripps Research Institute in La Jolla, CA. His areas of expertise include: Chemical biology; Activity-based protein profiling; Proteomics and metabolomics; Systems biology analyses of cellulolytic microbes, microbial communities, and human cells and tissues.

**Advancing our understanding of microbial regulatory processes and community associations by activity-based protein profiling**

We have a keen interest in using chemical biology to understand protein functions, interactions, and regulatory processes in living microbial systems. To interrogate key questions within these realms we use organic chemistry to synthesize chemical probes that are then deployed in living systems. Characterization of probe targets is then performed by proteomics, high-resolution fluorescence microscopy, flow cytometry and other techniques. A primary focus of ours is on the dynamic reversible reduction and oxidation of protein cysteine thiols, which we believe to be a particularly important means of regulating protein function. We have applied redox probes directly to living cells of *Synechococcus* sp. PCC 7002, a rapid growing cyanobacterium with potential as a biofuel-generating organism. We are able to characterize dynamic redox responses in response to nutrient perturbations in as little as 30 seconds, and show that proteins throughout metabolic processes and even transcriptional regulation are impacted by protein redox. In a second study, we have translated protein redox dynamics to photobiological hydrogen production by *Cyanothece* sp. 51142.

A second major effort is on the identification of transporters and proteins associated with nutrient acquisition and metabolism in microbes and phototrophic microbial mats. To complement ongoing genetic and *in silico* approaches aimed at characterizing metabolite uptake and fate, we have used chemical probes synthesized from B-vitamins. These vitamins are required, in relatively limited amounts, as intermediates/precursors in the biogenesis of key cofactors in central metabolism. As the specificity of B-vitamin transporters and binding proteins cannot be readily predicted from genome sequence information alone, chemical probes derived from B vitamins provide a unique and powerful approach for identifying these proteins. We have used the probes in auxotrophic axenic cultures procured from microbial mats, and in the mats themselves. Probes have been used with proteomics and structured illumination microscopy to characterize spatiotemporal uptake and distribution of B vitamins in microbial communities. Through our studies we have identified "design principles" from which we believe communities can be engineered to optimize metabolic outputs, e.g., for biofuel production.