SYSTEMS AND SYNTHETIC BIOLOGY ADVANCEMENTS TO IMPROVE *SYNECHOCYSTIS* SP. PCC 6803 STRAIN ENGINEERING IN THE INDUSTRIALLY-RELEVANT CONDITION OF DIURNAL LIGHT-DARK CYCLES

Christie Peebles, Chemical and Biological Engineering at Colorado State University, USA
cpeebles@colostate.edu

Key Words: cyanobacteria, metabolomics, synthetic biology, metabolic engineering

Cyanobacteria are an interesting chassis for industrial chemical production due to their ability to utilize sunlight and carbon dioxide as substrates. However, much of the strain engineering has been done under low- and continuous- light laboratory conditions as opposed to the realistic day/night cycle of outdoor sunlight availability. Our lab previously demonstrated that engineered free fatty acid production is decreased in daily light-dark cycles as opposed to continuous light relative to wild-type. This observation motivated system and synthetic biology developments to improve strain engineering efforts specifically in realistic day/night cycles. Toward this goal, we have improved systems biology understanding and developed synthetic biology tools for use in day/night cycles. Specifically, we discovered and characterized four native *Synechocystis* sp. PCC 6803 promoters which enable light-activated gene expression in daily light-dark cycles. We engineered a photobioreactor system which enables diurnal sinusoidal light cycles with peak-light intensities reaching over 1,500 µmol photons m^{-2} s^{-1} and report interesting *Synechocystis* sp. PCC 6803 growth in these conditions. We also developed and implemented a multi-platform 'omics study investigating the dynamic behavior of *Synechocystis* sp. PCC 6803 in sinusoidal day/night cycles. We have engineered and optimized bisabolene production in *Synechocystis* sp. PCC 6803. Together, these advances contribute to the advancement of *Synechocystis* sp. PCC 6803 as an industrially-relevant chassis for chemical production.