Regulation of Cyclic Electron Flow in *Synechocystis* via NdhO and Bidirectional Hydrogenase *Synechocystis* 6803.

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Cyanobacteria are gram-negative oxygenic photosynthetic microorganisms that have evolved a unique CO_2 Concentrating Mechanism (CCM) to overcome the shortcomings of RuBisCO. The CCM consists of specialized NADPH Dehydrogenase Type I complexes (NDH-1 complexes). The NDH-1 is a multi-subunit protein complex that functions in respiratory electron flow and is also the main return path for photosynthetic cyclic electron flow in cyanobacteria. In both cases, reduced ferredoxin (Fd) from Photosystem 1 donates its electron to the trans-membrane plastoquinone pool (PQ) via the NDH-1 complex. One subunit of this complex is NdhO, which is an Oxygenic Photosynthetic Subunit (OPS), is located at the periphery of the NDH-1 complex and has been hypothesized to be regulating the cyclic electron flow through the complex. Additionally, an enzyme known as the bidirectional NiFe hydrogenase is present in *Synechocystis 6803*. It is a hetero pentameric enzyme and has Hox EFU (diaphorase) and Hox YH subunits. The Hox EFU consists of Fe-S clusters and oxidizes NADPH which the cyanobacterial NDH-1 complex lacks and thus unable to oxidize NADP.

We hypothesize that under conditions of stress (such as high light) Hox oxidizes NADPH. As a result of the oxidation electrons are transferred to ferredoxin which reduces it. The reduced ferredoxin transfer electrons to NDH-1MS (which likely lacks NdhO) through the PSI and are returned to Fd. Conversely, we also hypothesize that in the presence of NdhO, cyclic electron transfer through the NDH-1 complex will be lower as compared to the deletion of NdhO, because of NdhO blocking (acting as a brake or as an inhibitor) the electron transfer from ferredoxin to NDH-1MS.

The hypothesis is currently being tested in vivo with strains: the Wild-type *Synechocystis 6803*, M55 (insertionally inactivated NDH-1 complex) and ΔNdhO (mutant lacking the *ndhO* gene), OxndhO, ΔHox ΔNdhO, ΔHox OxndhO, and ΔHox (mutant lacking the bidirectional hydrogenase).

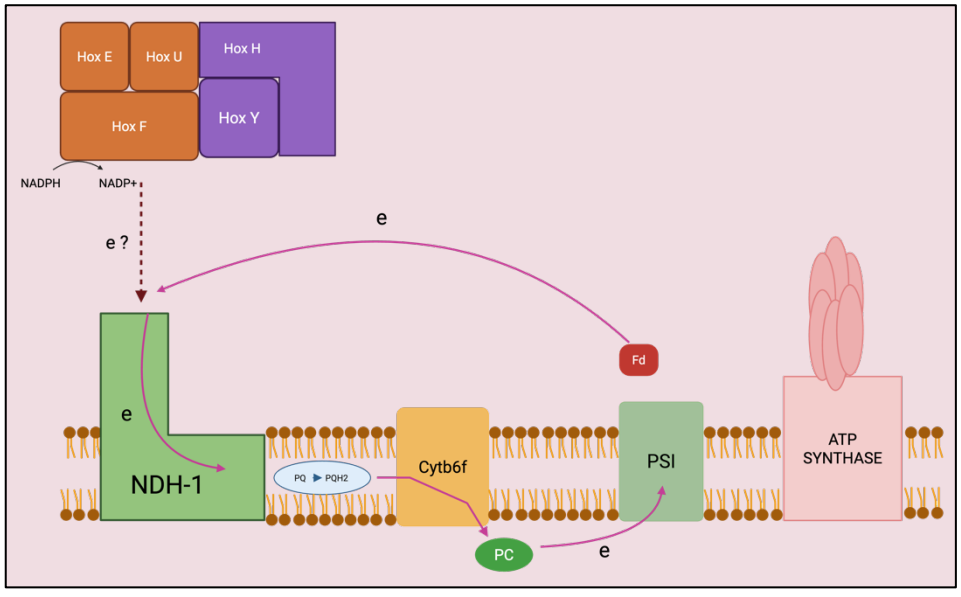

Figure 1. A schematic of the suggested movement of the electron movement from the NADPH oxidation to the NDH-1 complex directly.