

NREL Shows How Cyanobacteria Build Hydrogen-Producing Enzyme

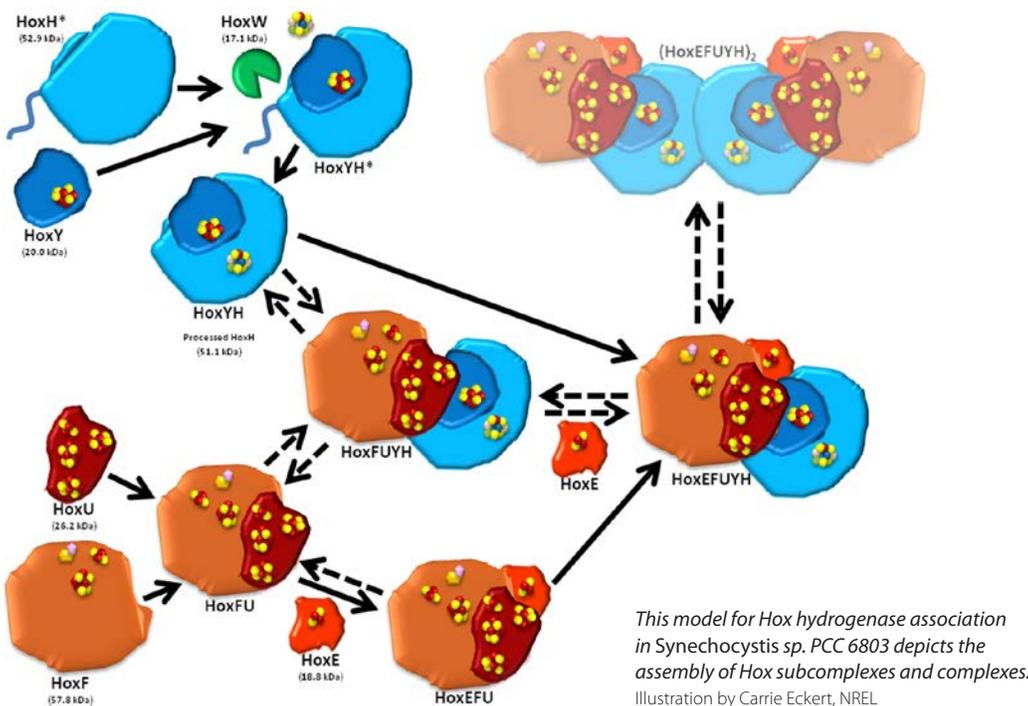
Highlights in
Science

Results will help researchers improve microbial hydrogen production.

Scientists at the National Renewable Energy Laboratory (NREL) have demonstrated how the cyanobacterium *Synechocystis* sp. PCC 6803 assembles five different protein subunits to produce a functional hydrogenase enzyme complex. The NREL scientists used genetic tools to perform an in-depth study of Hox hydrogenase, an organometallic enzyme that catalyzes the photoproduction of hydrogen in *Synechocystis*, and generated new data on the assembly, maturation, and activity of this important enzyme.

To perform this study, NREL generated a series of Hox hydrogenase subunit mutants from a common strain to provide a consistent platform for comparing hydrogenase activity and growth due to the targeted mutations. Genetic analysis of these mutant strains resulted in comprehensive data on how the Hox subunits associate, which revealed the compositions and abundance of the subcomplexes, how the absence of individual Hox subunits or subcomplexes affects enzyme activity, and how genetic mutations affect growth and photosynthesis.

NREL's work yields new evidence about how the various subunits and subcomplexes of Hox hydrogenase interact with each other to form a functional enzyme, clears up inconsistencies in the literature, and advances understanding of the fundamental processes governing Hox hydrogenase function. It also reveals for the first time the underlying mechanism controlling the assembly and maturation of a complex hydrogenase such as Hox. The previous model for hydrogenase maturation is solely based on a simpler hydrogenase (containing only two subunits) in *E. coli*, with little knowledge of its more complex counterparts. This newly gained understanding will help guide future modifications to improve Hox hydrogenase activity and increase hydrogen production yields.



Key Research Results

Achievement

NREL demonstrated how the cyanobacterium *Synechocystis* assembles five different proteins to make a functional hydrogenase enzyme.

Key Result

Genetic analysis of *Synechocystis* Hox hydrogenase revealed new insights about the presence and interactions of Hox hydrogenase subunits and subcomplexes *in vivo*, providing a basis for understanding Hox assembly, maturation, and activity.

Potential Impact

This understanding will help guide future modifications to improve Hox hydrogenase activity and increase hydrogen production yields.

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Reference: Eckert, C.; Boehm, M.; Carrieri, D.; Yu, J.; Dubini, A.; Nixon, P. J.; Maness, P.-C. (2012). "Genetic Analysis of the Hox Hydrogenase in the Cyanobacterium *Synechocystis* sp. PCC 6803 Reveals Subunit Roles in Association, Assembly, Maturation, and Function." *Journal of Biological Chemistry* (287); pp. 43502–43515.

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