Preparing Inquiring Minds for a Hydrogen-Powered Future

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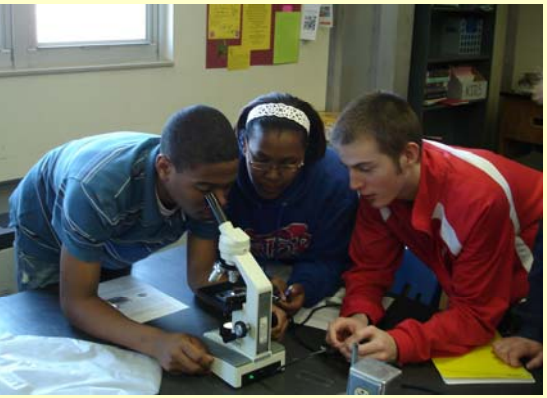
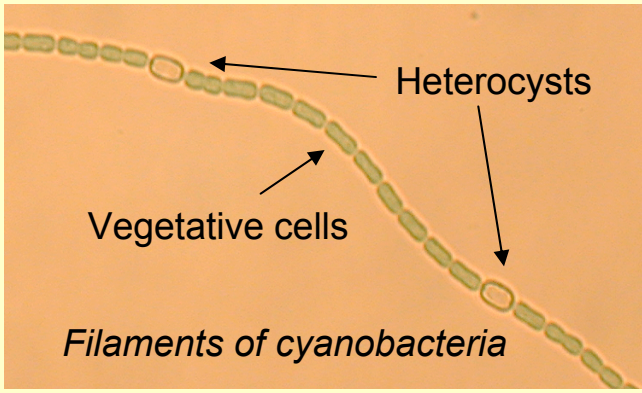
CHE 610177

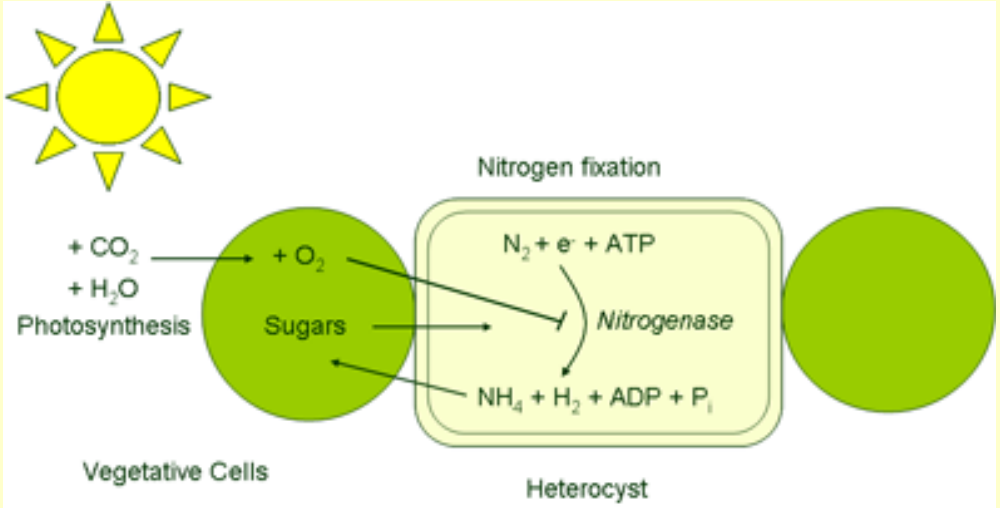


Students from area high schools learn about hydrogen production from nitrogenase and set up experiments to optimize H_2 from this photosynthetic cyanobacterium.



This hands-on introduction to photobiological hydrogen production teaches:

- Experimental design
- Enzyme function
- Scientific inquiry
- Gas laws
- Quantitative analysis
- Critical thinking



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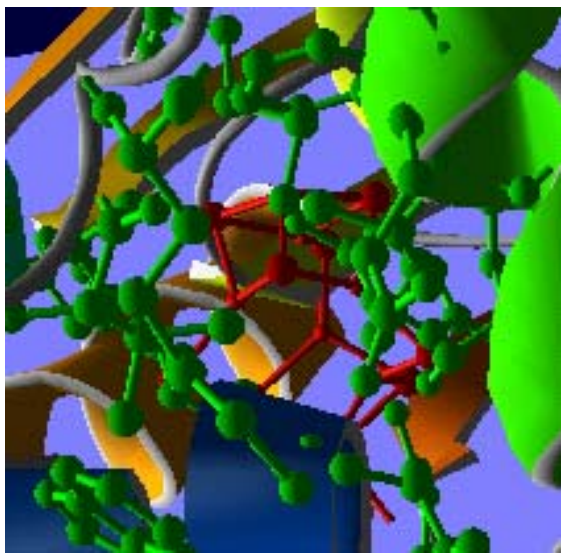
Nitrogenase produces hydrogen gas as well as ammonia:

$$N_2 + 8\,e^- + 8\,H^+ + 16\,MgATP \rightarrow 2\,NH_3 + H_2 + 16\,MgADP + 16\,P_i$$

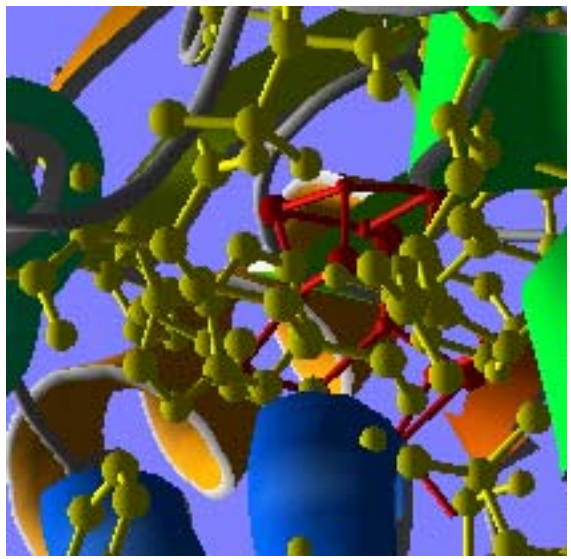
Different nitrogenases produce different ratios of H_2 to NH_4:

- 1:2 for Nitrogenase 1
- 3:2 for Nitrogenase 3

Residue #	**Nitrogenase 1**	**Nitrogenase 3**
70	Val	Val
71	Val	Ile
72	Trp	Gly
75	Ile	Leu
78	Met	Thr
96	Arg	Lys



Nitrogenase 1



Nitrogenase 3

Comparison of amino acids surrounding active sites (red polyhedron) in nitrogenases with open (left) and more blocked (right) substrate channels leads to the hypothesis that bulky amino acids along the channel lead to more H_2.

Site-directed mutations will selectively alter the amino acids to cause a change in the H_2 to NH_4 ratio of products and test this hypothesis.