November 22, 2005 | vol. 102 | no. 47 | 16907–17252

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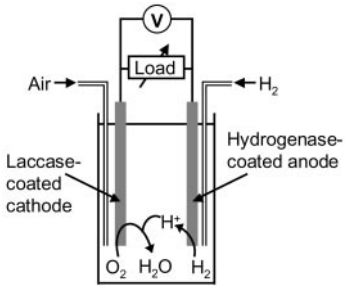
PNAS
Proceedings of the National Academy of Sciences of the United States of America
www.pnas.org

APPLIED BIOLOGICAL SCIENCES

Hydrogen fuel cell operation through bacterial enzyme

Kylie Vincent *et al*. describe the electrocatalytic oxidation of hydrogen by a bacterial hydrogenase that is unaffected by carbon monoxide and only partially inhibited by oxygen, in a simple fuel cell device. The membrane-bound hydrogenase from the β-proteobacterium *Ralstonia eutropha* H16 is known to be tolerant to oxygen. This characteristic led the authors to test the enzyme's electrocatalytic activity under demanding conditions, such as the presence of carbon monoxide, which typically inhibits hydrogen-cycling catalysts.



Hydrogen/oxygen membraneless fuel cell setup.

Vincent *et al.* created a fuel cell using a graphite anode coated with the bacterial hydrogenase and a graphite cathode coated with laccase, a fungal enzyme. The electrode catalyzed hydrogen electrooxidation in the presence of ambient levels of oxygen and was unaffected by carbon monoxide at levels up to 0.9 bar. A hydrogen/oxygen fuel cell with a single compartment, in which no membrane separated the anode and cathode, was able to produce electricity. The results from these experiments suggest that even Synthesis Gas, an industrial hydrogen/carbon monoxide mixture, could provide a viable hydrogen fuel source, the researchers say. These findings may also demonstrate the feasibility of future hydrogen fuel technologies based on biologic electrocatalysts. — R.N.

"Electrocatalytic hydrogen oxidation by an enzyme at high carbon monoxide or oxygen levels" by Kylie A. Vincent, James A. Cracknell, Oliver Lenz, Ingo Zebger, Bärbel Friedrich, and Fraser A. Armstrong (see pages 16951–16954)

ECOLOGY

Invasive species require opportunity and appropriate habitat

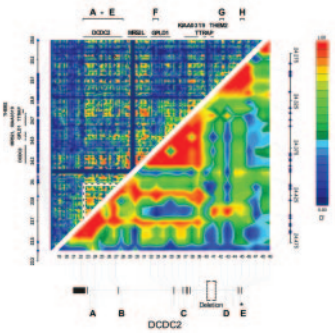
According to Andrew Suarez *et al.*, the number of times a new species is brought into a new environment directly corresponds to its ability to become invasive. Accidental transport (i.e., in imported plants and produce) accounts for a significant fraction of invasive species. However, previous studies of invasive species in the United States have relied primarily on data regarding species introduced intentionally for agricultural or pest-control purposes. The factors that underlie establishment of accidentally introduced species have remained unclear. To identify these factors, Suarez *et al.* developed a database from U.S. Department of Agriculture records of 232 different ant species transported into the United States with plant material. Comparing these records to regional surveys showed that 12% of introduced ant species became established, and ≈1% became widespread and invasive. The number of times a species was transported into the country increased the probability of establishment. In addition, ground-nesting species were more successful than those that nest in trees, suggesting that species-specific behaviors also contribute to successful establishment. These results identify factors that promote successful invasion of nonnative species and demonstrate the need to consider failed as well as successful introductions when studying the invasion process. — M.M.

"The role of opportunity in the unintentional introduction of nonnative ants" by Andrew V. Suarez, David A. Holway, and Philip S. Ward (see pages 17032–17035)

GENETICS

Potential reading disability gene identified

Haiying Meng *et al.* report that the *DCDC2* gene is associated with developmental dyslexia, or reading disability (RD). Several chromosomal regions have been identified as susceptibility loci for this neurobehavioral disorder, and of these, DYX2 on chromosome 6p22 is the most replicated RD locus. DYX2 contains ≈19 genes, most of which are expressed in the brain, and Meng *et al.* genotyped 153 families affected by RD in an effort to localize the susceptibility gene(s). Through single nucleotide polymorphism analysis, a large polymorphic deletion was identified in intron 2 of *DCDC2*, a gene of unknown function but similar to *DCX*, a gene that directs neuronal migration by regulating the organization and stability of microtubules. Consistent with this finding, RNA interference experiments showed that down-regulation of *DCDC2* shortened neuronal migration in developing rats. *DCDC2* is activated in the same brain regions in both fluent and dyslexic readers, suggesting that dysfunction, and not disruption, of this gene is associated with RD. These results indicate that *DCDC2* is a strong candidate for an RD gene, though Meng *et al.* note that the complex phenotype of RD suggests that several genes are involved. — N.Z.



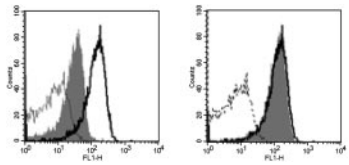
Linkage disequilibrium between SNP pairs for *DCDC2* gene.

*"*DCDC2 *is associated with reading disability and modulates neuronal development in the brain" by Haiying Meng, Shelley D. Smith, Karl Hager, Matthew Held, Jonathan Liu, Richard K. Olson, Bruce F. Pennington, John C. DeFries, Joel Gelernter, Thomas O'Reilly-Pol, Stefan Somlo, Pawel Skudlarski, Sally E. Shaywitz, Bennett A. Shaywitz, Karen Marchione, Yu Wang, Murugan Paramasivam, Joseph J. LoTurco, Grier P. Page, and Jeffrey R. Gruen* (see pages 17053–17058)

MICROBIOLOGY

Neisseria gonorrhoeae selectively interacts with human C4b-binding protein

Jutamas Ngampasutadol *et al.* present an explanation why *Neisseria gonorrhoeae* infection is restricted to humans, demonstrating that *N. gonorrhoeae* can resist complement-dependent killing by binding to the human C4b-binding protein (C4bp). C4bp is an important regulatory component of complement, and *N. gonorrhoeae* appears to bind to this protein via its porin molecules. C4bp from other animal species, such as rat, rabbit, and baboon, were found to fail to compete with human C4bp for *N. gonorrhoeae* binding. Consequently, sera from these animal species effectively killed *N. gonorrhoeae* strains, which are resistant to human serum. The addition of human C4bp to animal sera rescued the bacteria from death. One exception to human specificity occurs in *N. gonorrhoeae* with the 1B serotype for porin, which are resistant to chimpanzee sera, explaining why some bacterial strains can experimentally infect chimpanzees. Ngampasutadol *et al.* believe that these findings may be helpful in developing animal models for gonorrhea and may also have implications when considering neisserial vaccines. — N.Z.



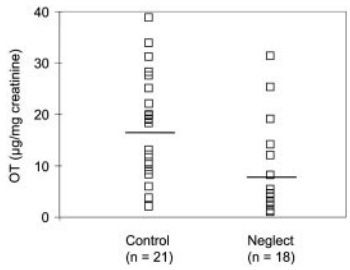
Binding of human C4bp to *N. gonorrhoeae* in the presence of no serum (black line) or animal serum (gray shading).

"Human C4b-binding protein selectively interacts with Neisseria gonorrhoeae *and results in species-specific infection" by Jutamas Ngampasutadol, Sanjay Ram, Anna M. Blom, Hanna Jarva, Ann E. Jerse, Egil Lien, Jon Goguen, Sunita Gulati, and Peter A. Rice* (see pages 17142–17147)

PSYCHOLOGY

Early childhood neglect and neurobiology of social behavior

Alison Wismer Fries *et al.* report that a lack of typical caregiving in infancy is associated with altered oxytocin (OT) and arginine vasopressin (AVP) neuropeptide systems during childhood. The researchers studied 18 children raised in foreign orphanages for an average of 16.6 months immediately after birth and then adopted by American families. The comparison control group consisted of 21 children raised by their biological parents in a typical American home environment. The children engaged in an interactive computer game for 30 min while sitting on the lap of their mother and also an unfamiliar female. Baseline and posttesting urine samples were taken to measure levels of OT and AVP. Children who had experienced early neglect had lower overall levels of AVP than did family-reared children. Also, OT levels for family-reared children increased after physical contact with their mothers, but children who experienced early neglect did not show a similar response. The data indicate that the AVP and OT pathways are affected by early social experience. These results are consistent with the view that early experience plays a critical role in the development of brain systems underlying basic aspects of human social behavior. — R.N.



Oxytocin levels are higher in control (left) than in early neglected (right) children, after interaction with mother.

"Early experience in humans is associated with changes in neuropeptides critical for regulating social behavior" by Alison B. Wismer Fries, Toni E. Ziegler, Joseph R. Kurian, Steve Jacoris, and Seth D. Pollak (see pages 17237–17240)