RESEARCH HIGHLIGHTS

EVOLUTION

Fickle enzymes

Science **310**, 499–501 (2005)

It is surprisingly easy for enzymes to switch their preference for the molecule they work with, according to US researchers. Their study shows that a small number of mutations can dramatically alter a protein's function. This allows the protein to evolve new abilities quickly, without taking intermediate forms that harm the organism's fitness.

Antony Dean and his team at the University of Minnesota, St Paul, studied an enzyme called isopropylmalate dehydrogenase, or IMDH. IMDH needs the help of another molecule, called NAD, to function. Working in bacteria, Dean's team altered amino acids in IMDH and found that just five swaps were needed to make IMDH switch to a different helper molecule known as NADP.

MOLECULAR BIOLOGY

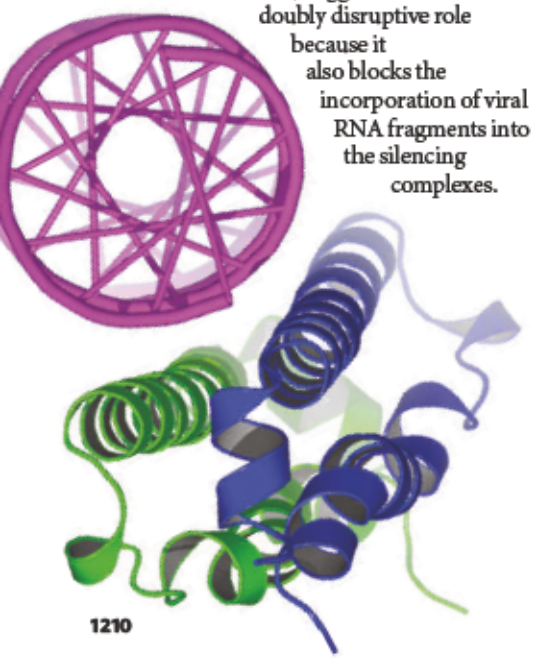
Double defence

Nature Struct. Mol. Biol. doi:10.1038/nsmb1005 (2005)

The structure of a protein (pictured below) produced by the insect- and plant-infecting Flock House virus sheds light on how some viruses might counter their hosts' defences.

Two B2 proteins (blue and green) form a four-helix bundle that binds to the virus's double-stranded RNA (pink). This protects the viral RNA against cleavage — the host cell needs to cleave viral RNA to build RNA silencing complexes in response to infection.

The researchers, led by James Williamson of the Scripps Research Institute in La Jolla, California, suggest that B2 has a doubly disruptive role because it also blocks the incorporation of viral RNA fragments into the silencing complexes.

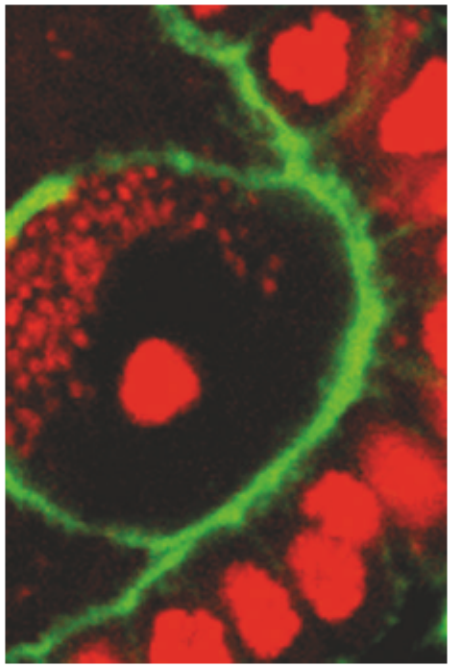


From mother with love

PLoS Pathogens **1**, e14 (2005)

Wolbachia — a parasitic bacterium that lives inside the cells of many insect species — is transmitted by females to their offspring. William Sullivan from the University of California, Santa Cruz, and his colleagues have looked in unprecedented detail at this process.

The parasite resides in the cytoplasm, a component of eggs but not of sperm. The researchers showed that, in the fruitfly *Drosophila*, *Wolbachia* infects immature egg cells and multiplies rapidly during the egg's development. They also found that the bacteria cluster at the top of the egg (pictured; *Wolbachia* and host DNA shown in red). Both the localization and rapid multiplication depend on *Wolbachia* commandeering its host's transport system, consisting of the cell's network of microtubules and associated motor proteins.



P. M. FRYDMAN & W. SULLIVAN

NANOTECHNOLOGY

Live wire

Angew. Chem. Int. Edn **44**, 2–7 (2005)

In an exciting union of microbe and machine, living bacteria have been incorporated into an electronic circuit to produce a humidity sensor.

Vikas Berry and Ravi Saraf from the University of Nebraska, Lincoln, placed *Bacillus cereus* bacteria on a silicon chip inlaid with gold electrodes, then applied a wash containing gold particles measuring just 30 nanometres across. This covered the microbes with a bristle-like gilt that conducts electricity.

The size of the electrical current depends on the separation of the particles, so a rise in moisture levels that causes the bacteria to swell is detected as a drop in current. Tests indicate that the device is much more sensitive than a conventional humidity gauge.

CANCER

Two roles in tumours

Nature Cell Biol. doi: 10.1038/ncb1314 (2005)

It's easy to tire of learning about players in the p53 pathway, but this research reveals an interesting case. It explains how the transcription factor KLF4 can suppress tumour growth in some situations, yet act as a tumour promoter in others.

Daniel Peeper and his colleagues report that KLF4 regulates, in opposing directions, two genes central to growth control. It suppresses *p53*, whose gene product suppresses tumours, and it induces *p21 CIP1*, a gene controlling normal cell proliferation.

The researchers, from the Netherlands Cancer Institute in Amsterdam, demonstrate that KLF4 becomes a growth promoter when p21CIP1 is dysfunctional — as occurs in most cancers. In these genetic circumstances, KLF4's suppression of *p53* goes unchecked.

ASTRONOMY

X-ray vision

Astrophys. J. **632**, L99–L102 (2005)

The discovery of X-rays coming from a 35-year-old supernova, 1970G, has helped astronomers to extract data on the object from older, lower resolution observations.

Compiling these data gives a unique record that traces the object's X-ray emissions from when the star exploded through its transition to a supernova remnant. The X-rays probably emanate from material heated up by a shock wave closing in on the remnant's centre. The X-rays were discovered using a powerful space telescope — the Chandra X-Ray Observatory — and were analysed by Stefan Immler and Kip Kuntz of the NASA Goddard Space Flight Center in Greenbelt, Maryland.

NATURE STRUCT. MOL. BIOL.

NEUROSCIENCE

Thumbs up

J. Neurosci. **25**, 9339–9346 (2005)

Just observing an action can lead to the formation of a corresponding motor memory, according to a study led by Joseph

S. HORRELL/SPL

Classen at the University of Würzburg in Germany, and Leonardo Cohen of the National Institute of Neurological Disorders and Stroke, based in Bethesda, Maryland.

The researchers applied a magnetic field to the primary motor cortex region of the brain in human subjects, provoking a thumb twitch that was biased in one direction. The subjects then watched thumbs being twitched in a different direction. When the magnetic field was applied again, in the same way as before, their thumb movements were more likely to match the second, observed action.

The researchers say the formation of the memory may be linked to mirror neurons in the primary motor cortex, which fire both when an action is performed and when it is observed.

MATERIALS

Evidence of distortion

Science **310**, 468–470 (2005)

A debate over the complex behaviour of solids made from carbon buckyballs may be settled by recent experimental evidence.

Using a scanning tunnelling microscope, researchers headed by Michael Crommie from the University of California, Berkeley, found that deforming the football-shaped spheres of 60 carbon atoms helped to make the material switch from behaving as a metal, to behaving as an insulator.

Although the idea has been mooted before, this study presents images of a charge-induced Jahn–Teller distortion occurring in a monolayer of the material deposited on gold. The layer's properties change as it is doped with potassium atoms, which transfer electrons to the spheres. The build-up of charge leads to the carbon cages being squished across one axis, the team reports.

OPTICS

Bright sparks

Phys. Rev. Lett. **95**, 143902 (2005)

A 'molecule' of light has been sent down an optical fibre by Martin Stratmann and his colleagues at the University of Rostock in Germany.

The molecule was made from two optical solitons, which are pulses of light that maintain their shape and intensity. The researchers showed that the solitons could be bound to one another, so that a pair can, in principle, travel tens of kilometres down optical fibres (pictured right) without becoming separated — in the same way that a diatomic molecule might drift through space. They suggest the robust doublet could be used in optical data transmission to represent a third character, in addition to the binary 0 (dark) and 1 (a single bright pulse).

NEUROBIOLOGY

Calling time

Neuron **48**, 213–219; 221–227; 267–278 (2005)

Starting from entirely different points, three groups have identified the receptor for a neuropeptide that helps to regulate circadian rhythms in insects. The receptor, which is for pigment-dispersing factor (PDF) in the fruitfly *Drosophila*, is a class II G-protein-coupled receptor dubbed CG13758. It appears in neurons that make up the master clock, and in some outside this time-keeping centre. Moreover, genetic manipulation of the receptor's expression suggests that PDF may be part of the network that synchronizes the rhythms of individual clock neurons.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

CELL BIOLOGY

RNA in reserve

Cell **123**, 249–263 (2005)

Researchers believe they may have discovered a new class of messenger RNA.

David Spector of Cold Spring Harbor Laboratory, New York, and his co-workers have found that some RNA transcripts of a mouse gene called *mCAT2* remain as back-up copies in the cell nucleus, only being released into the cytoplasm when the cell is stressed.

The normal protein product of *mCAT2* helps cells to respond to pressures such as viral infection; so mobilizing this reserve RNA might allow the cell to react more quickly. The researchers have named the reserve strands CTN-RNA, for CAT2-transcribed nuclear RNA.

JOURNAL CLUB

Monica Justice
Baylor College of Medicine, Houston, Texas

A researcher from the mouse genome project argues that comparing sequences could help to explain gene regulation.

"Bioinformatics is not science," grumbled the student, frustrated with our committee's insistence that he compare his bat sequence to several other genomes.

To us, the sequence was incomplete without such analysis. To the student, it was a tedious exercise that would yield no mechanistic insight.

But it might well open other doors. I am reminded of how the discovery of the four bases of DNA led to a crucial understanding of how proteins are encoded. Similarly, learning how genomes are related and organized over evolutionary time may teach us more about how chromosomes and genomes work.

In trying to make sense of genomic data, Adam Siepel from the University of California, Santa Cruz, and his colleagues have realized that to compare the genomes of highly divergent species, sequences need to be calibrated.

Millions of years after species split, non-coding regions of DNA are expected to contain more base substitutions than coding regions. Siepel's team came up with a model to predict this variation, then adapted a computer program that compares genomes to correct for it. Searches among five vertebrate, four insect, two worm and seven yeast species revealed some surprisingly long, highly conserved elements (Siepel, A. *et al. Genome Res.* **15**, 1034; 2005).

New ways of looking at the big picture are bound to lead to further discoveries. There are hints that the elements that Siepel's group have found play a role in regulating genes, through RNA editing and splicing. If we help the student to do his comparison, he might just find that the difference between the bat wing and the human hand is down to regulation too.