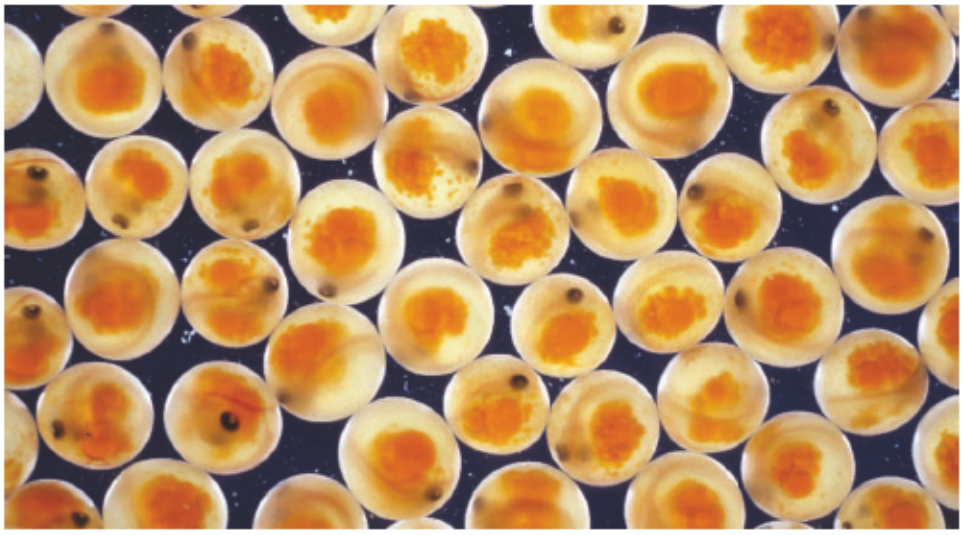
RESEARCH HIGHLIGHTS

Male cells make eggs

Proc. Natl Acad. Sci. USA
doi:10.1073/pnas.0509218103 (2006)
Cells that normally manufacture sperm can churn out working eggs instead, say researchers — at least in rainbow trout (*Oncorhynchus mykiss*).

One population of stem cells in the embryo ultimately gives rise to either eggs or sperm. Goro Yoshizaki of the Tokyo University of Marine Science and Technology, Japan, and his colleagues tested whether cells in the adults' testes retain this ability. They transplanted testicular cells into fish embryos (pictured) and found that some of these cells could indeed generate fertile eggs in females, as well as sperm in males.



R. PICKETT/ECOSCENE

GENETICS

Pregnancy problems

Nature Genet. doi:10.1038/ng1740 (2006)
Researchers in Canada have identified a gene that could shed light on why some pregnancies result in miscarriage or stillbirth.

An international team headed by Rima Slim at McGill University Health Centre in Montreal studied families in which women had repeatedly suffered from a rare problem known as a hydatidiform mole. This causes the embryo to develop abnormally. In pregnancies in which the hydatidiform mole was absent, the women also had other problems such as miscarriages.

The team says a mutation in the gene *NALP7*, which may affect a mother's immune response to her embryo, could be responsible. They also suggest that defects in the processes that this gene regulates could contribute to pregnancy problems in other women.

PHYSICS

On the scales

Phys. Rev. Lett. **96**, 042504 (2006)
Weighing an atomic nucleus can reveal how tightly the constituent protons and neutrons are stuck together. According to Einstein's energy-mass equivalence, the binding energy is equal to the difference between the nuclear mass and that of its isolated particles.

Ari Jokinen of the University of Jyväskylä in Finland and his colleagues took advantage of this principle to record the most accurate ever measurements of unusual isotopes of the elements strontium, zirconium and molybdenum. Their ion-trap experiments show that the most neutron-rich nuclei have less binding energy than theory predicts. These nuclei are thought to be highly non-spherical, and such deformations may throw the predictions off.

CHEMISTRY

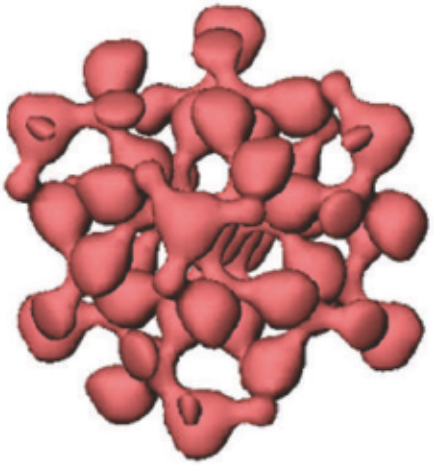
Shape-shifting surprise

Angew. Chem. Int. Edn Engl.
doi:10.1002/anie.200502787 (2006)
Chemists hoping to make novel semiconductors with catalytic properties have been surprised by a molecular reorganization.

Crystal lattices with large channels running through their structure are useful as molecular sponges and catalysts. Mercouri Kanatzidis and Nan Ding of Michigan State University, East Lansing, wanted to introduce such channels into selenium-based semiconductors, opening up the potential for electrochemistry inside the structures.

But treating cubic crystals of the selenium compound $K_6Cd_4Sn_3Se_{13}$ with hydroiodic acid, which the researchers hoped might make the substance more porous, prompted the compound to form tetrahedral crystals instead (internal structure pictured below).

The crystals allow ions to be readily displaced by other metals, so the new compound might be useful for absorbing traces of heavy metals, the pair suggests.



N. DING & M. G. KANATZIDIS

DRUG DEVELOPMENT

Antibiotic fights back

J. Am. Chem. Soc. doi:10.1021/ja0572912 (2006)
Chemists have synthesized a version of the antibiotic vancomycin that can kill bacteria that are resistant to the drug.

Vancomycin is one of the last lines of antibiotic defence, but some bacteria shrug it off. A single atom of one cell-wall molecule is altered in these strains, limiting the antibiotic's ability to bind to the bacteria.

It took Brendan Crowley and Dale Boger of the Scripps Research Institute in La Jolla, California, 24 chemical steps to manufacture a form of vancomycin with a compensating one-atom change. The molecule can kill both vancomycin-susceptible and vancomycin-resistant bacteria, and could replace the current antibiotic if cheaper manufacturing methods are found.

IMMUNOLOGY

Signal failure

J. Clin. Invest. doi:10.1172/JCI26091 (2006)
A protein called α4-integrin, which is found on the outer surface of cells, contributes to the immune-system malfunction that underlies conditions such as multiple sclerosis. But targeting the protein directly

causes severe side effects, as it is also involved in the development of immune cells.

One alternative approach might be to disrupt the signalling pathway that triggers the autoimmune reaction. Mark Ginsberg's group at the University of California, San Diego, has developed mice that carry mutated α4-integrin, and suggests that this technique could work.

The mutated protein functions well enough to allow normal immune-system development, but not harmful α4-integrin signalling. When the mice were treated with a compound that causes inflammation and thus mimics many autoimmune disorders, fewer inflammatory cells were recruited to the affected site than in control mice.

CELL BIOLOGY

A few to a kill

Science doi:10.1126/science.1124514 (2006)

"Surprising and slightly horrific," is how Richard Morimoto of Northwestern University in Evanston, Illinois, describes his finding that just a few extra misfolded proteins can kill an organism.

Morimoto and his team looked at *Caenorhabditis elegans* worms engineered to express strings of polyglutamine protein, which are prone to misfolding. They found that the presence of the strings was enough to prompt seven other proteins, which are normally stable at room temperature, to misfold. This disrupted essential cellular processes and killed the worms.

The finding suggests that a critical mass of abnormal proteins may be a common trigger for the emergence of conditions such as Alzheimer's and prion diseases, which are linked to misfolded proteins.

MATHEMATICS

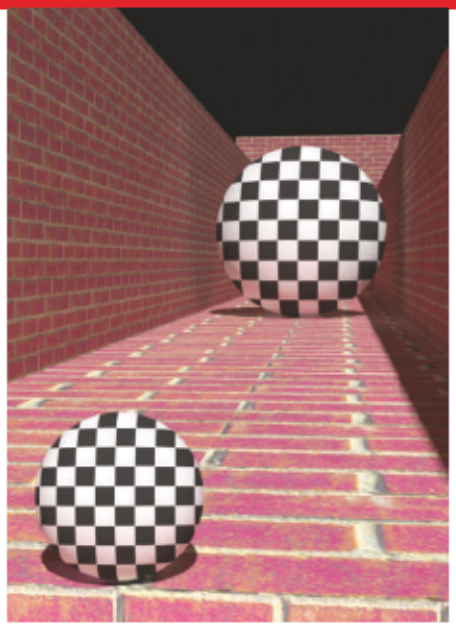
Physical manifestations

Phys. Rev. Lett. **96,** 040405 (2006)

Forget pens, paper and calculators. Mathematicians should swap their usual tools for a gas of rubidium atoms if they want to find solutions to an equation known as the Weyl polynomial, suggest Yvan Castin of the Ecole Normale Supérieure in Paris and his colleagues.

Whirlpool-like vortices form in samples of rubidium vapour that have been rotated and cooled to form a quantum-mechanical state known as a Bose gas.

The researchers show that the positions of these vortices can be mapped to the Weyl polynomial, allowing solutions to be obtained by observing the gas.



H. BOYACI/U. MINNESOTA

NEUROSCIENCE

Seeing is believing

Nature Neurosci. doi:10.1038/nn1641 (2006)

The processing of signals in the early stages of the human visual system may be more complex than currently thought.

The first area of the cerebral cortex to process visual signals after they leave the eye's retina is a region known as V1; activity here is believed to depend predominately on physical input, rather than on conscious perception. Scott Murray of the University of Washington in Seattle and his colleagues tested this by taking brain scans of subjects while they viewed three-dimensional computer-generated scenes (pictured above).

Surprisingly, the team finds that activity in V1 depends on the subjects' perception of the size and distance of the object being viewed, not just its image size on the retina. This suggests that theories on the role of V1 may have to be revised.

MICROFLUIDICS

Mini lab makes frugal tests

J. Am. Chem. Soc. doi:10.1021/ja057720w (2006)

Chemists in the United States have developed lab-on-a-chip technology that can screen reaction conditions using less than a microgram of reagents.

Researchers often tweak variables, such as the type of solvent used, to optimize reaction conditions. But this can be labour intensive and wasteful of materials, so Rustem Ismagilov of the University of Chicago, Illinois, and his colleagues developed a microfluidic system to do the job. Tiny drops of reagents are propelled through a tube using a fluorinated fluid. The drops react with a second substance that enters at a T-junction.

The authors suggest the system could also be used to improve the synthesis of drugs and other chemical compounds.

JOURNAL CLUB

Linda Hsieh-Wilson
California Institute of Technology, Pasadena

A chemist questions conventional views on adding sugar.

The realization that we have nearly the same number of genes as a worm came as a big surprise. We are taught that DNA encodes RNA, which in turn encodes proteins. So why is it that we are wonderfully complex, and the worm is not?

Hints as to what separates us from simpler organisms may come from studying the modifications made to proteins after they are translated. For instance, the addition of sugars, a process known as glycosylation, is common in higher organisms but generally absent in simple prokaryotes such as bacteria.

In the classical glycosylation model, sugars are assembled and attached in the Golgi and the endoplasmic reticulum, two cytoplasmic organelles. It is commonly believed that, once the glycoproteins reach the cell surface, the sugars will remain unchanged throughout the protein's lifetime. But a recent paper (Q. Chang *et al. Science* **310,** 490–493; 2005) challenges this conventional thinking.

The authors show that a mammalian hormone, klotho, cleaves extracellular sugars on the calcium channel TRPV5, which is a glycosylated protein. This exposes a new sugar residue, leading to activation of the ion channel.

The findings suggest that processing of sugars may be occurring in remarkably dynamic ways, which need not be restricted to the endoplasmic reticulum and Golgi. Over the years, a handful of such non-canonical forms of glycosylation have been identified.

My own research focuses on a dynamic, intracellular form known as *O*-GlcNAc glycosylation. We've found more than 40 proteins in the brain that are modified in this way, with various functions. What fascinates me about protein glycosylation is nature's ingenious mechansims for creating diversity.