

RESEARCH HIGHLIGHTS

Selections from the scientific literature

NEUROSCIENCE

BOLD strides in brain imaging

To visualize brain activity, neuroscientists use functional magnetic resonance imaging (fMRI) to measure blood oxygen levels, known as BOLD signals, which are considered a proxy for cellular activity. However, it has been unclear which types of brain cell contribute to these signals.

Fritjof Helmchen and his colleagues at the University of Zurich in Switzerland have developed a method that tracks the activity of neurons and glial cells — support cells that might also contribute indirectly to neurotransmission — during an fMRI scan. They found that activation of both cell types correlates with BOLD signals.

The team used an optical fibre to record the activity of dye-loaded brain cells that fluoresce when calcium enters them — an indication of cell activation. This composite method will help scientists to interpret BOLD signals, the authors say.

Nature Methods <http://dx.doi.org/10.1038/nmeth.2013> (2012)

PHYSIOLOGY

Bladder under circadian control

Most adults produce less urine at night than during the day, and store more of what is made, thanks to the circadian regulation of daily urination patterns.

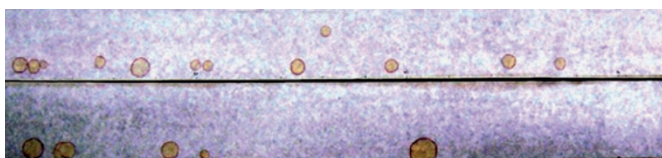
Hitoshi Okamura and Osamu Ogawa at Kyoto

University in Japan and their colleagues developed a machine that measures the urine discharges of mice, as stains on paper (**pictured**), over time. They focused on a protein, connexin43, which increases the frequency of urination by making the bladder muscles more sensitive to neural signals. They found that connexin43 levels peaked

during the night when the nocturnal creatures were active. Mice without the circadian clock gene *Cry* produced less connexin43 during the night than did normal mice, and did not show daily rhythms in urination patterns. Another clock gene, *Rev-erba*, regulates connexin43 expression.

The authors suggest that other genes related to bladder-muscle contraction and daily cycles might also have a role in staving off night-time trips to the toilet.

Nature Commun. <http://dx.doi.org/10.1038/ncomms1812> (2012)



CLIMATE SCIENCE

A check on speeding glaciers

Analysis of a decade-long record of Greenland's glaciers suggests that the ice sheets are not accelerating towards the ocean as much as previously forecast.

Earlier work on a small number of glaciers had uncovered large increases in speed. Using satellite radar data to calculate the movements of more than 200 of the island's ocean-terminating glaciers between 2000 and 2010, Twila Moon at the University of Washington, Seattle, and her colleagues found a range of accelerations and decelerations, with an overall acceleration.

Glaciers in the northwest and southeast — where approximately 80% of ice loss occurs — accelerated by about 30% over the ten-year period, whereas glaciers elsewhere exhibited a generally steady flow.

Glacial melting can lead to an increase in sea level. However, Moon and colleagues' data suggest that Greenland's current glacial acceleration is unlikely to produce the previously forecast worst-case scenario of a 0.5-metre sea-level rise by 2100.

Science 336, 576–578 (2012)

GEOCHEMISTRY

North Sea starved of oxygen

Summer oxygen levels are declining in some parts of the North Sea, probably because of ocean warming and the decay of photosynthetic blooms that form as a result of nutrient influx.

Bastien Queste at the University of East Anglia in Norwich, UK, and his team compared the results of an oceanographic field survey conducted in August 2010 with twentieth-century records of

TONY WALTHAM/ROBERT HARDING

oxygen concentrations in the North Sea. They found that the intensity of seasonal oxygen depletion in highly stratified regions — where there is little mixing between layers of water of different temperature — has increased markedly since 1990.

In 2010, dissolved oxygen in the central North Sea and in an area known as the Oyster Grounds near the Dutch coast came close to ecologically critical values that, if reached, would require management action under the European Union's Water Framework Directive, the team reports.

Biogeochemistry <http://dx.doi.org/10.1007/s10533-012-9729-9> (2012)

EVOLUTION

Gene duplication for bigger brains

DNA-duplication errors that upped the number of copies of a gene may have catalysed the evolution of complex brains in early humans.

The gene *SRGAP2* is expressed during development of the brain's neocortex — a region involved in cognition. Evan Eichler at the University of Washington in Seattle and his team report that humans have four different versions of *SRGAP2*, as did Neanderthals, whereas other primates have just one. The group estimates that successive duplications of *SRGAP2* occurred between 3.4 million and 1 million years ago, as *Homo* species evolved.

Meanwhile, Franck Polleux at the Scripps Research Institute in La Jolla, California, and his team show that one of the newer versions of the gene, *SRGAP2C*, blocks the activity of the ancestral *SRGAP2* when it is artificially expressed in the brains of mice. Mouse neurons expressing *SRGAP2C* develop features of human neurons, such as a denser array of projections called dendritic spines that forge connections with neighbouring neurons. The cells also migrated across the developing brain faster than normal mouse neurons.

The authors suggest that

these changes, driven by the emergence of *SRGAP2C*, could have occurred in early humans, who had much larger brains than their ancestors.

Cell <http://dx.doi.org/10.1016/j.cell.2012.03.033>; <http://dx.doi.org/10.1016/j.cell.2012.03.034> (2012)

For a longer story on this research, see <http://go.nature.com/osz4hk>

NANOBIOTECHNOLOGY

Radio remote control of genes

Externally applied radio waves can be used to switch on a modified gene in a mouse, thanks to radiation-absorbing nanoparticles injected into the animal. The technique could enable researchers to activate cells and genes non-invasively.

Jeffrey Friedman at the Rockefeller University in New York and his team coated iron oxide nanoparticles with antibodies so that they bound to a cell-surface protein complex, TRPV1, that admits calcium ions to the cell at a temperature of 42°C. The researchers used radio waves to heat the nanoparticles, which, in turn, heated TRPV1. Calcium entering the cell activated the gene for an insulin precursor, which had been modified to contain a calcium-sensitive regulatory region.

In live mice, 30 minutes of radio-wave exposure boosted insulin and lowered blood sugar levels.

Science 336, 604–608 (2012)

BIOPHYSICS

High-throughput cell stretcher

A chip on which cells flow through tiny channels can be used to measure the size and deformability of individual cells at a rate of 2,000 per second — several orders of magnitude faster than existing methods. The chip could be used to detect cancer cells, which are more deformable than healthy cells.

Dino Di Carlo and his team

COMMUNITY CHOICE

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DRUG DELIVERY

On-demand drug release

HIGHLY READ
on pubs.acs.org
in April

Drug-carrying nanoparticles that shrink and release their payload when irradiated with ultraviolet (UV) light could offer a way to get drugs deep into tissues

and to unleash them on demand. This could be a valuable therapeutic tool for diseases such as cancer.

Currently available drug-delivering nanoparticles are at least 100 nanometres in diameter, which makes it difficult for them to squeeze into tumours. Daniel Kohane at the Children's Hospital Boston in Massachusetts and his colleagues made their particles out of organic molecules that switch conformation when hit with UV light. The nanoparticles were able to carry a number of drugs, including several used in cancer treatment, and shrank from roughly 150 to 40 nanometres under UV light. Irradiated particles released their drug cargo at a higher rate and diffused farther through both a collagen gel and corneal tissue than those not exposed to UV light.

J. Am. Chem. Soc. <http://dx.doi.org/10.1021/ja211888a> (2012)

at the University of California, Los Angeles, developed the microfluidic device, which suspends cells single-file in a liquid, stretches them, and then uses automated image analysis to measure their size and rigidity. The team detected cancerous cells in samples from patients with a sensitivity of 91% and a specificity of 86%. The researchers were also able to classify stem cells on the basis of their deformability.

Proc. Natl Acad. Sci. USA <http://dx.doi.org/10.1073/pnas.1200107109> (2012)

EVOLUTION

Cheating cuts offspring fitness

'Monogamous' female birds often produce young with another partner. This was presumed to yield offspring fitter than those produced with the paired partner, but a study of song sparrows suggests that 'cheating' comes with no evolutionary reproductive benefit.

Jane Reid at the University of Aberdeen, UK, and her team analysed 17 years' worth of genetic parentage data



REBECCA SARDELL

from a small population of song sparrows (*Melospiza melodia*; nestlings pictured) on Canada's Mandarte Island. They compared the lifetime reproductive success of half siblings with the same mother and found that young sired outside of monogamy were less reproductively fit than their half-siblings, producing on average 40% fewer offspring and 30% fewer grand-offspring.

The researchers suggest that there may be indirect selection against, not for, cheating in song sparrows.

Am. Nat. <http://dx.doi.org/10.1086/665665> (2012)

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