

## MICROBIOLOGY

### Bacterial version of an eyeball

A freshwater bacterium can sense the direction of light by acting as a microscopic lens.

Spherical cyanobacteria called *Synechocystis*, which harvest energy from light, use protein appendages to pull themselves over wet surfaces towards light sources. A team led by Conrad Mullineaux at Queen Mary University of London found that the cells act as tiny lenses that bend and focus light. When the team illuminated one side of the cell, a bright spot appeared at the opposite end. Simulating this spot with a laser beam caused the *Synechocystis* cells to move away from the spot, towards the perceived source of light.

Light-sensing proteins embedded in the cellular membrane trigger the bacteria to move towards light, the researchers suggest.

*eLife* <http://doi.org/bcgd> (2016)

## NEUROSCIENCE

### Brain circuit for loneliness

A neural circuit at the base of mouse brains drives a loneliness-like state and motivates the animals to seek company.

Kay Tye at the Massachusetts Institute of Technology in Cambridge, Mark Ungless at the Medical Research Council's Clinical Sciences Centre in London and their colleagues found that connections between neurons in the circuit were stronger in mice that were separated from their cage mates than in those that were grouped together. Those neurons then fired more frequently when isolated mice were put in a cage with an unfamiliar mouse, compared



## PALAEONTOLOGY

### Termites had first castes

The separate castes of social insects — queens, workers and soldiers — first appeared in termites at least 100 million years ago, according to newly discovered fossils.

Although evolutionary studies have suggested that termites were first to evolve castes, there was very little fossil evidence for this. Now, Michael Engel at the University of Kansas in Lawrence, David Grimaldi at the American Museum of Natural History in New York and their colleagues report the discovery of six termite species fossilized in amber from Myanmar, which show evidence of distinct castes.

The 100-million-year-old fossils include two new species, which the authors call *Krishnatermes yoddha*, with queens, workers and soldiers (pictured), and *Gigantotermes rex*, whose 2-centimetre-long soldiers are among the largest ever reported.

*Curr. Biol.* <http://doi.org/bch6> (2016)

with animals that had not been isolated. When the scientists inhibited the neurons with light, the isolated mice showed less interest in the stranger. Activating those neurons caused the animals to actively seek other mice.

The circuit was more responsive in socially dominant animals. *Cell* 164, 617–631 (2016)

## BIOENGINEERING

### Exploding bubbles kill cancer cells

A technology using tiny exploding bubbles inside tumours could one day help to mop up cancer cells during surgery.

Surgeons lack the tools to detect microtumours during cancer surgery, increasing

the risk that cancer will come back. To address this, Dmitri Lapotko, now at the medical-technology firm Masimo in Irvine, California, and his colleagues injected gold nanoparticles into tumour-bearing mice before surgery. The particles, which have cancer-specific antibodies on their surfaces, were taken up by cancer cells. After removing the main tumour, the researchers heated up the nanoparticles using a short laser pulse, causing nanobubbles to form and explode only in the cancer cells, destroying them without harming normal tissue. The explosions generated a detectable acoustic signal.

The team spotted small numbers of these cells during surgery that would otherwise have gone unnoticed. After the surgery, no tumours regrew in any animals in which residual cancer was removed, whereas more than 80% of the mice that had standard surgery died of recurring tumours.

*Nature Nanotech.* <http://dx.doi.org/10.1038/nnano.2015.343> (2016)

## MATERIALS

### Power from water and graphene

Chemists have generated electricity from water by passing it through a material containing atom-thick sheets of carbon.

Liangti Qu at the Beijing Institute of Technology and his colleagues developed a 3D structure made from graphene oxide that had holes big enough to let moisture pass through them freely. The water molecules reacted with oxygen-containing groups in the graphene oxide, dissociating to form hydrogen ions. The oxygen groups were distributed unevenly in the material, with more at the bottom than the

top, resulting in a large-enough flow of ions to generate electric power.

The material was sandwiched between two aluminium electrodes studded with holes to let moisture pass through. The resulting power illuminated a light-emitting diode lightbulb.

*Energy Environ. Sci.* <http://doi.org/bcg2> (2016)

## TISSUE ENGINEERING

## Polymers bolster printed tissue

A 3D printer can generate tissues using cells and polymers that are larger and more robust than previously printed biological structures.

Bioprinted 3D organs could one day help people who need transplants, but existing methods tend to produce only small, simple structures. Larger ones lose their shape, or die because nutrients cannot reach their centres. To build larger, stronger tissues, Anthony Atala and his colleagues at Wake Forest Institute for Regenerative Medicine in Winston-Salem, North Carolina, devised a 3D-printing system that adds biodegradable polymers for structural support. By combining polymer-based frames with hydrogels containing cells, the researchers printed a human-sized ear (pictured), a human jawbone fragment, a segment of mouse muscle and a piece of rat skull. Microchannels printed in the structures helped nutrients to flow into the tissues.



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The team implanted some of the structures into rodents and found that the tissues survived over weeks and months.

*Nature Biotech.* <http://dx.doi.org/10.1038/nbt.3413> (2016)

## HYDROLOGY

## Stored water slows rising seas

Changes in water storage on land may have slowed sea-level rise during the past decade.

John Reager of NASA's Jet Propulsion Laboratory in Pasadena, California, and his team investigated the shifting volumes of water stored on land using global data from NASA's Gravity Recovery and Climate Experiment (GRACE) satellite, which calculates water and ice mass on the basis of changes in Earth's gravity field. They found that between 2002 and 2014, 3,200 gigatons more water than expected was stored on land as snow, soil moisture, surface water and groundwater, thanks to climate-driven changes in hydrology. This offset sea-level rise caused by melting glaciers and ice sheets by about 20% over the same period.

These results show that climate-driven land water storage is significant enough to be included in future estimates of sea-level rise, the authors say. *Science* 351, 699–703 (2016)

## CANCER BIOLOGY

## Metabolism varies within tumours

Human lung-tumour cells break down sugars in different ways in different patients and even in the same tumour.

Cells in the same tumour are known to vary genetically. To study tumour metabolism, Ralph DeBerardinis at the University of Texas Southwestern Medical Center in Dallas and his colleagues infused a harmless carbon isotope into nine people who had lung cancer, and combined clinical-imaging techniques

## SOCIAL SELECTION

Popular topics on social media

## Do female programmers face bias?

Female software developers see their contributions of code accepted more frequently by the open-source software repository GitHub than do men, according to a preprint that attracted much attention last week on social media. But this happened only when the contributor's gender was not obvious from their GitHub profile page. When gender was made clear, the acceptance rate for women fell to slightly less than that for men, say researchers who analysed data on the activity of more than 1.4 million users of GitHub. Morgan Ernest, an ecologist at the University of Florida in Gainesville, tweeted a link to the paper: "Well that's horrifying. Is that suggested programming change by a woman? Reject. Don't know it's a woman? Accept." But

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other researchers questioned whether the study, posted at PeerJ PrePrints on 9 February, definitively demonstrates gender bias. Preprint at <http://doi.org/bchz> (2016)



with mass spectrometry to track how the carbon was biochemically processed by the tumours. Cancer cells are thought to feed on glucose and release a by-product called lactate, but the team found that some tumour cells consumed both lactate and glucose. Blood-flow patterns showed that different parts of a single tumour had varying metabolic patterns.

Understanding these patterns could help to improve metabolic therapy for cancer, the authors suggest.

*Cell* 164, 681–694 (2016)

## BIOMECHANICS

## Cockroaches inspire robot

Researchers have discovered how cockroaches can speed through gaps just millimetres high — and have used their findings to build a compressible robot.

Kaushik Jayaram and Robert Full at the University of

California, Berkeley, observed American cockroaches (*Periplaneta americana*) as they squeezed through a series of crevices that decreased in height. The insects could maintain speeds of up to 60 centimetres per second after entering these tight areas, and only slowed when the ceiling height reached 4 millimetres — about one-third of the insects' free-standing height. They achieved their speed by using their legs and feet to push against friction between their bodies, the ceiling and the ground.

The cockroaches' mode of locomotion inspired the development of a soft-bodied robot (pictured left) that can compress its height by half (pictured right), allowing it to move through a tight space.

*Proc. Natl. Acad. Sci. USA* <http://doi.org/bch5> (2016)

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