

MICROBIOLOGY

Gut microbes' survival tactics

Gut bacteria protect themselves from host inflammation by modifying their outer membranes.

Immune responses designed to wipe out infection could, in theory, also perturb helpful flora that reside in the gut. To find out how these microbes resist the effects of inflammation, Andrew Goodman of Yale University in New Haven, Connecticut, and his colleagues studied 17 bacterial species that normally live in the human gut. They found that the microbes were all resistant to antimicrobial peptides released by hosts to kill pathogens.

In the bacterium *Bacteroides thetaiotaomicron*, this resilience was linked to expression of a protein called LpxF, which neutralized the negative charge of the cell membrane, preventing the positively charged peptides from binding to the gut microbe's surface. Mutants that did not express LpxF were outcompeted in mouse guts by other microbes during inflammation. *Science* 347, 170–175 (2015)

MATERIALS

Arsenic forms a semiconductor

Single-atom-thick layers of arsenic and antimony could be efficient semiconductors that have more applications than other two-dimensional materials.

Atom-thick materials can have unique electronic and optical properties, but some operate only at certain wavelengths of light, owing to small 'band gaps'. On the basis of quantum mechanical calculations, Zhongfang



ANIMAL BEHAVIOUR

Monkey in the mirror

Macaques can be trained to recognize themselves in a mirror, the first such observation in any monkey species.

Most animals encountering their reflections act as if they are seeing another creature. To find out whether monkeys can be trained to recognize their own reflections, Neng Gong and his team at the Shanghai Institutes for Biological Sciences placed rhesus macaques in front of a mirror and shone a low-powered laser beam on their faces to produce a mild heat irritation. They rewarded animals when they touched the irritating spot on their face (pictured).

After 12 to 38 days of this regimen, 5 out of 7 macaques using the mirror touched an odourless mark applied to their faces. With a mirror in their cages, some of these monkeys seemed to use it to explore parts of their bodies that they could not otherwise see. It is not clear, however, whether these behaviours mean that the monkeys have higher cognitive abilities such as self-awareness, the authors say.

Curr. Biol. <http://doi.org/x54> (2015)

Chen at the University of Puerto Rico in San Juan, Haibo Zeng at the Nanjing University of Science and Technology in China and their colleagues predict that arsenic and antimony can switch

from being semi-metallic in bulk to semiconducting as a single-atom layer. These materials, called arsenene and antimonene, have wider band gaps than other two-dimensional semiconductors,

meaning that they could be used in short-wavelength optoelectronic devices such as blue or ultraviolet light-emitting diodes.

The authors say that such materials could soon be synthesized in the lab.

Angew. Chem. Int. Edn <http://doi.org/f2x29z> (2015)

EVOLUTION

Lungs began with many chambers

The lungs of ancestral, land-based vertebrates may have had multiple chambers rather than just one, as was believed.

Markus Lambertz at the University of Bonn in Germany and his colleagues studied lung samples from 73 species of amniotes, which include mammals, birds and reptiles. They also looked at lung development in embryos of a gecko, *Paroedura picta*, which has single-chambered lungs. They found that all multi-chambered lungs shared key anatomical features, such as branching of the arteries. These features were present even in the single-chambered lungs of lizards and snakes, and in the embryonic gecko lung.

Ancestral amniotes evolved multi-chambered lungs as they shifted to life on land, the authors say. Some, however, may have later developed single-chambered lungs as they evolved into smaller creatures to maximize air space in the lungs, the team adds.

Biol. Lett. 11, 20140848 (2015)

SUSTAINABILITY

Resource use peaks worldwide

The rates at which humans consume multiple resources such as food and wood peaked at roughly the same time, around 2006. This means

that resources could be simultaneously depleted, so achieving sustainability might be more challenging than was thought.

Ralf Seppelt of the Helmholtz Centre for Environmental Research in Leipzig, Germany, and his colleagues estimated the peak rate of extraction for 27 resources. For 20 of them, mostly renewables such as meat and rice, the peak-rate years occurred between 1960 and 2010, with many clustering around 2006. Only coal, gas, oil, phosphate, farmed fish and renewable energy have yet to peak.

Humans use multiple resources to generate new ones and to meet basic needs, which could explain the synchronicity of peak usage, the authors suggest.

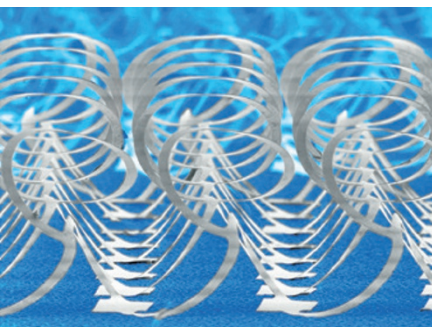
Ecol. Soc. 19, 50 (2014)

MATERIALS

Silicon buckles to form 3D shapes

Researchers have created a variety of small, three-dimensional structures by buckling strips of silicon and other materials.

Turning advanced two-dimensional materials into three-dimensional shapes has proved difficult. John Rogers at the University of Illinois at Urbana-Champaign and his colleagues added hydroxyl groups at specific locations along the length of silicon ribbons as narrow as 800 nanometres and as thin as 100 nm. They also added these groups in specific patterns to an elastic, stretched substrate, and allowed the silicon strips to bond to the substrate.



When the substrate returned to its original shape, the silicon buckled to form a range of structures less than a millimetre wide (pictured), including helices, boxes and flowers. These could then be assembled into larger configurations.

The method uses a variety of materials, such as metals and polymers, and has the potential to make structures for a wide range of electronic devices, the authors say.

Science 347, 154–159 (2015)

EVOLUTION

Mosquitoes gain resistance

A malaria-carrying mosquito inherited insecticide-resistance genes from a related species, around the time that bed nets treated with insecticide were increasingly used in West Africa.

Gregory Lanzaro at the University of California, Davis, and his colleagues analysed DNA from more than 1,000 specimens of *Anopheles coluzzii* and *Anopheles gambiae* in Mali from 2002 to 2012. They found that a group of genes, including one for insecticide resistance, from *A. gambiae* moved into *A. coluzzii* around 2006 when the two species mated.

Campaigns to encourage the use of insecticide-treated bed nets began in 2005 in this region, and the authors suggest that the nets favoured the selection of hybrid, insecticide-resistant mosquitoes.

Proc. Natl Acad. Sci. USA
<http://doi.org/x56> (2015)

PHOTONICS

Few photons make 'ghost image'

Physicists have captured an image of a wasp's wing using less than one photon per pixel.

Peter Morris and his colleagues at the University of Glasgow, UK, used a technique called ghost imaging, which uses pairs of photons whose positions

SOCIAL SELECTION

Popular articles on social media

Unveiling secret funding decisions

Many scientists struggle to understand why some grant applications succeed and others fail, perhaps explaining the online popularity of an article calling for increased transparency in the grant peer-review process. Writing in *PLoS Biology*, Daniel Mietchen, an evolutionary biologist at Berlin's Museum of Natural History, argues that, among other things, all successful proposals and their reviews should be released to the public. "Open science is now old hat; here's a call for open research funding processes," tweeted Dorothy Bishop, a neuropsychologist at the University of Oxford, UK. But some see a downside to transparency. James Johnson, a diabetes researcher at the University of British Columbia in Vancouver, Canada, tweeted: "I try to be open, but I've also had desperate people steal my ideas."

PLoS Biol. 12, e1002027 (2014)



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are inextricably correlated, or entangled. One of each photon pair was either transmitted or absorbed by the wing, while its twin was used to reconstruct the image.

Each photon was collected at a separate detector. To avoid recording stray photons that cause noise, a camera captured the 'image-creating' photon only when its partner from the wing was detected. Applying image-compression techniques, the authors further reduced the number needed to just 0.45 photons per pixel.

Such techniques could be useful in biological imaging when high levels of light could damage the sample, they say.

Nature Commun. 6, 5913 (2015)

PLANT GENETICS

Maize's journey out of Mexico

DNA from the cobs of ancient maize (corn) shows how the crop was taken to the US southwest from Mexico.

Maize was domesticated from the wild grass teosinte, an inedible weed, more than

6,000 years ago in southern Mexico, and later spread throughout the Americas. A team led by Rute da Fonseca and Thomas Gilbert at the University of Copenhagen analysed nuclear DNA from 32 maize samples from several archaeological sites spanning Mexico and the US southwest (pictured is a 5,000-year-old specimen).

They conclude that maize arrived in the US southwest around 4,000 years ago along a highland route in central Mexico — not by a Pacific coastal route as other studies had suggested. Along the way, maize evolved into a sweeter and more drought-tolerant crop.

Nature Plants <http://doi.org/x6p> (2015)

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