

# RESEARCH HIGHLIGHTS

Selections from the scientific literature

## GENOME EDITING

### Editing enzyme made more precise

By tweaking the structure of an enzyme that cuts DNA, researchers have lowered the error rate of CRISPR–Cas9 gene editing.

Feng Zhang at the Broad Institute of MIT and Harvard in Cambridge, Massachusetts, and his colleagues engineered the Cas9 enzyme so that it is less likely to act at DNA sites that are not targeted by the RNA molecules that guide the enzyme. The team generated several versions of Cas9 that reduced off-target errors by at least tenfold compared with unaltered Cas9 enzymes. Three of those versions were just as active at their target sites as ordinary Cas9.

Even so, the error rate may need to be reduced further for CRISPR gene editing to be used for human therapies.

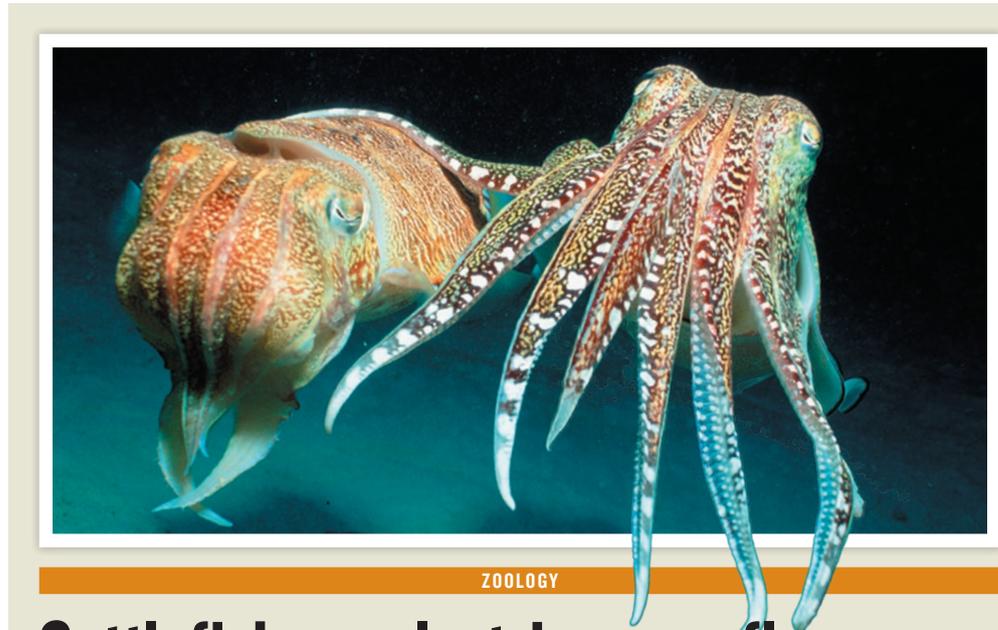
*Science* <http://doi.org/9q2> (2015)

## MICROBIOMES

### Gut bacteria change with cold

Gut microbes alter the metabolism of mice to help the animals to adapt to the cold.

Mirko Trajkovski of the University of Geneva, Switzerland, and his team studied mice that were kept at low temperatures, and found that their microbiomes diverged from those of mice housed at room temperature. When microbes from cold-exposed mice were transplanted to those without any bacteria, the recipients made more beige fat cells, which burn more energy to produce heat than white fat cells do. The transplants also improved the recipients' metabolism by boosting their insulin sensitivity. Both cold



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## ZOOLOGY

### Cuttlefish use electric camouflage

When cuttlefish freeze as enemies approach, they are reducing their bioelectric fields, which predators can detect.

Christine Bedore at Duke University in Durham, North Carolina, and her colleagues showed videos of approaching predators, including sharks, to *Sepia officinalis* cuttlefish (pictured) in lab tanks, and analysed their behaviour and the electric fields they emitted. Most cuttlefish froze when they saw the predator, flattening themselves against the tank, reducing

their breathing rate and closing their orifices. These behaviours reduced their bioelectric fields, which are generated by ion exchange between respiratory structures and seawater.

Captive sharks that were presented with electric currents mimicking both frozen and resting cuttlefish were more likely to bite at the stronger fields that represented resting creatures. This suggests that the freeze response lowers the electric 'visibility' of cuttlefish.

*Proc. R. Soc. B* 282, 20151886 (2015)

exposure and transplants increased the absorptive surface of the gut, enhancing caloric uptake.

The microbiome's control over energy expenditure could make it a therapeutic target for combating obesity, the researchers suggest.

*Cell* 163, 1360–1374 (2015)

## GEOLOGY

### Mediterranean quake risk rises

Earthquakes threaten the eastern Mediterranean more than scientists had thought.

A team led by Vasiliki Mouslopoulou at the GFZ

German Research Centre for Geosciences in Potsdam analysed and carbon-dated ancient shorelines in Crete to estimate when and how quickly earthquakes over the past 50,000 years pushed the island upwards. They conclude that at least 40 quakes of magnitude 8 or greater would have raised the land to its current level.

The quakes came in clusters separated by quieter periods. The entire eastern Mediterranean could be at higher risk of future mega-quakes — and the resulting tsunamis — than previously suspected.

*Geophys. Res. Lett.* <http://doi.org/9q3> (2015)

## SYNTHETIC BIOLOGY

### Kill switches limit modified microbes

Genetic switches that make bacteria self-destruct in response to specific signals could help to keep engineered microbes in check.

Microbes that have been genetically modified for industrial and other uses rely on the addition of certain nutrients to grow, but this makes it difficult to design organisms that can be contained in different environments. To overcome this, James Collins of the Massachusetts Institute of

Technology in Cambridge and his colleagues designed gene circuits that act as 'kill switches' when they are introduced into the genome of the bacterium *Escherichia coli*. The switches block essential genes or induce lethal toxins when triggered by environmental chemicals.

Such kill switches can be customized to respond to different cues, the authors say. *Nature Chem. Biol.* <http://dx.doi.org/10.1038/nchembio.1979> (2015)

## PLANT BIOTECHNOLOGY

## CRISPR clips crop genes

The CRISPR–Cas9 genome-editing system has been used to alter the genomes of two crop plants: barley (*Hordeum vulgare*; pictured) and *Brassica oleracea*, a species that includes broccoli and cabbage.

CRISPR–Cas9 allows researchers to easily engineer mutations in genomes and has been tested in some crops, including rice and wheat. Cristobal Uauy and Wendy Harwood at the John Innes Centre in Colney, UK, used the system in barley and the brassica species to knock out the function of genes encoding certain plant hormones that are involved in growth and seed development — both important agronomic traits.

The team generated heritable mutations and the modified plants contained no foreign genes. However, the editing system occasionally introduced unwanted, off-target genetic changes.

*Genome Biol.* 16, 258 (2015)



HAGEN ZAPF/IMAGEBROKER/CORBIS

## PHYSICS

## Long delay for electron decay

An underground experiment has yielded the strongest evidence so far that electrons are stable, by showing that they last for at least 66 billion billion years before decaying into photons and neutrinos.

The Borexino detector, located underground at the Gran Sasso National Laboratory in central Italy, is looking mainly for neutrinos. The electron-stability result it produced is about 100 times longer than previous limits, and was obtained thanks to the extremely low natural radioactivity of the 300 tonnes of highly purified mineral oil at its core, according to Mauro Pallavicini of the University of Genoa, Italy, and his team.

Because the decay of negatively charged electrons into neutral particles seems even less likely than before, the results also confirm the fundamental law saying that net electric charge is conserved. In principle, however, electrons could still decay into some other unknown particles, the authors say.

*Phys. Rev. Lett.* 115, 231802 (2015)

## LASER PHYSICS

## Lasers trigger X-rays efficiently

Bombarding clouds of a noble gas with an intense UV laser emits X-ray pulses that could be useful for imaging applications.

Single atoms zapped by a UV laser emit bright X-rays, but to get such X-rays from a cloud of atoms, a longer-wavelength laser is needed. To maximize the intensity of the emitted X-rays, Tenio Popmintchev at the University of Colorado Boulder and his colleagues found UV wavelengths that elicit strong emissions over a wide range of frequencies from single atoms or ions and clouds

## SOCIAL SELECTION

Popular topics on social media

### Should DNA donors see genomic data?

Geneticist Charles Danko turned to Twitter this week to ask for help in convincing his institutional review board (IRB) at Cornell University in Ithaca, New York, that he should be allowed to let his study participants download their own genetic information. He tweeted: "Writing IRB amendment to give subjects their genomic data. IRB does not like. Suggested reading to make the case?" Several scientists responded to Danko's request, including computational geneticist Yaniv Erlich at Columbia University in New York City, who pointed out that direct-to-consumer (DTC) genetics companies such as 23andMe already give people their data. "Another argument is that ~2 million people have access to their raw genetic data through DTC," he wrote. "No adverse events have been reported so far due to access to raw data. Other research projects do the same."

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of these particles. By carefully choosing a laser's colour and shaping a guide for the light, the team created intense X-ray pulses just 100 attoseconds long (1 attosecond is  $1 \times 10^{-18}$  seconds).

The technique produces light that could be powerful enough to probe the details of electron motion, the authors report. *Science* 350, 1225–1231 (2015)

## PHOTONICS

## Seeing movement around corners

A camera can track the movement of an object hidden around a corner.

Researchers can already reveal images of hidden items by firing a laser onto the floor and studying the light that is scattered back from all surfaces, including concealed ones. But such systems

work too slowly to track any movement. Genevieve Garipey and Daniele Faccio at Heriot-Watt University in Edinburgh, UK, and their colleagues used a laser and an ultrafast camera to measure the position and arrival time of photons from the laser bouncing back off a figurine placed around a corner (pictured). This allowed them to track the object, even while it was moving at a speed of a few centimetres per second.

The method could be useful for remote observation in hazardous areas, or to prevent vehicles colliding at blind corners, the authors say. *Nature Photon.* <http://dx.doi.org/10.1038/nphoton.2015.234> (2015)

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