

## CATALYSTS

### Silicon added to life's toolbox

Molecules containing both carbon and silicon have become a standard part of synthetic chemistry, but life uses silicon only in inorganic compounds such as the shells of diatoms.

Now, Frances Arnold and her collaborators at the California Institute of Technology in Pasadena have engineered bacteria to produce carbon–silicon bonds. The team inserted a gene encoding an enzyme from the bacterium *Rhodothermus marinus*, which lives in Iceland's underwater hot springs, into *Escherichia coli*. The resulting bacterium catalysed carbon–silicon bonding in a variety of artificial precursors by inserting carbon into silicon–hydrogen bonds.

The researchers improved the efficiency of their biocatalyst by directed evolution — sequentially inducing mutations in the enzyme's active site and screening for improved activity — and say it could lead to new classes of pharmaceuticals and industrial catalysts using organosilicon molecules.

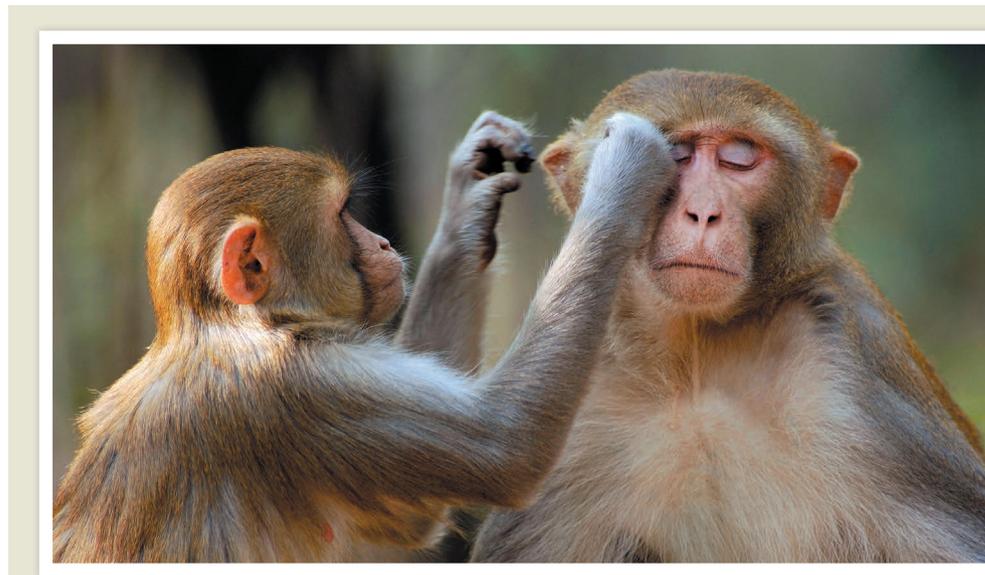
*Science* 354, 1048–1051 (2016)  
See [go.nature.com/2fgot89](http://go.nature.com/2fgot89) for a longer version of this article.

## CANCER

### 'Jet lag' increases mouse cancer risk

Mice with simulated jet lag have an increased risk of developing liver cancer.

Sleeping out of step with the day–night cycle has been linked to various health disorders in humans. David Moore, Loning Fu and their colleagues at Baylor College of Medicine in Houston, Texas, subjected mice to disrupted



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## IMMUNOLOGY

### Macaque social status alters immunity

Changing the social status of macaques also changes their immune systems.

Low social status has been linked to multiple health problems in humans and other primates, some of which may not be linked to the accessibility of food and other resources.

Jenny Tung of Duke University in Durham, North Carolina; Luis Barreiro of the University of Montreal, Canada; and their colleagues analysed the immune cells and gene expression of female macaques before and after they

artificially altered the relative social status of the animals by creating new social groups.

Low status was linked to inflammation, including alterations in the make-up of immune cells in the animals' blood and changes in gene expression that could promote an inflammatory response. This link between social subordination and altered immune response was present despite no variation in access to food or health care among the animals.

*Science* 354, 1041–1045 (2016)

day–night cycles using artificial lights to simulate chronic jet lag. Compared with mice under steady 24-hour light–dark cycles, jet-lagged animals had impaired liver metabolism and were more prone to developing fatty liver disease and liver cancer.

Much of the disrupted metabolism was linked to excessive accumulation of bile acid in the liver and altered activities of the nuclear receptors FXR and CAR, which might be targets for preventing liver cancer in future.

*Cancer Cell* <http://doi.org/btr7> (2016)

## SEISMOLOGY

### Gravity changes before quake hits

Researchers have for the first time detected temporary changes in Earth's gravitational field just before an earthquake.

Jean-Paul Montagner at the CNRS Institute of Earth Physics in Paris and his team analysed gravimetric and seismic data recorded during the massive 2011 Tohoku earthquake in Japan. They detected a signal that exceeded the background seismic noise and whose amplitude was consistent with that predicted

by theoretical models. The signal occurred several seconds before seismic waves arrived.

Developing sensors to detect such transient gravity signals could lead to new early-warning systems for tsunamis and other earthquake hazards, the authors say.

*Nature Commun.* 7, 13349 (2016)

## CLIMATE CHANGE

### Shifting niches spell trouble

Plants and animals will probably be unable to respond to changes in environmental conditions fast enough to keep

pace with climate change.

Tereza Jezkova and John Wiens of the University of Arizona, Tucson, looked at 56 plant and animal species and documented shifts in their 'climatic niche' — the temperature and precipitation conditions they survive in.

They compared these shifts in climatic niches with rates of predicted future change under global warming. On average, expected rates of change in temperature were more than 200,000-fold higher under future climate conditions than rates seen in past shifts, and precipitation changes were more than 10,000-fold higher. Even those groups that had the fastest niche shifts in the past will still experience rates of temperature change that are 300-fold higher in future.

Historical changes were slowest for tropical species, suggesting that they will be especially vulnerable to climate change, the authors warn. *Proc. R. Soc. B* <http://doi.org/btn5> (2016)

## PALAEOLOGY

## Ancient reptile had a diaphragm

The muscle that allows mammals to breathe deeply — the diaphragm — may have been present in some reptiles 300 million years ago, about 50 million years before it was thought to have appeared. Markus Lambertz at the University of Bonn in Germany and his colleagues studied the fossilized skeletons of caseids: extinct mammal-like reptiles that lived 300 million years ago (artist's impression **pictured**). These creatures weighed around 500 kilograms, with short necks that would have made foraging difficult and barrel-shaped bodies that would have restricted their ability to move air into their lungs. Their bones were lightweight and filled with air bubbles, similar to modern whales. The researchers conclude that caseids were probably aquatic, similar to present-day

manatees (sometimes known as sea cows), and must have had muscular diaphragms to inhale all the air they needed during brief trips to the surface.

*Ann. N.Y. Acad. Sci.* <http://doi.org/btkw> (2016)

## QUANTUM PHYSICS

## Record set for linked photons

Particles that have linked quantum states, known as 'entangled' particles, can affect each other's states even if they are physically separated. Now scientists have set a record by entangling ten photons — two more than achieved previously.

Entangled particles should one day enable quantum computing and communications, but they are inefficient to produce. A team led by Jian-Wei Pan of the University of Science and Technology of China in Hefei created the ten entangled photons by running five photon pairs through a series of four polarizing beam splitters. They also developed a laser light source that produced their photon batches about 100 times faster than did previous tests.

*Phys. Rev. Lett.* 117, 210502 (2016)

## MATERIALS SCIENCE

## Atom-thick coats for copper

Coating metals with a high-quality, single-atom-thick layer of 2D boron nitride can protect them from corrosion.

Layers of 2D materials have been touted for use as protective coatings on surfaces but have shown mixed results,

with some apparently even increasing corrosion rates in the long term.

Zhenguo Huang at the University of Wollongong in Australia and his colleagues used optical microscopes and spectroscopy to study how well films of the insulator boron nitride protect copper from corrosion. They found that copper coated with a high-quality atom-thick film of the material remained almost unaffected by salt water over 1 hour, whereas coating the metal with a multi-layered but cracked film increased corrosion. Such defects probably accelerate oxidation, so coatings could be improved by patching up imperfections and growing films with fewer defects, the authors suggest. *Adv. Mater.* <http://doi.org/f3s8tb> (2016)

## MATERIALS

## Sensor detects UV exposure

A sensor that sticks to the skin can give colour-coded readouts of ultraviolet light levels from the Sun, the leading cause of skin cancer.

John Rogers at the University of Illinois at Urbana-Champaign and his colleagues developed the stretchable device (**pictured**), which is less than one-fifth of a millimetre thick. It has several layers, including a compound that changes the colour of a dye when activated by UV light; filters to monitor both UV-A and UV-B radiation levels; and a small chip that wirelessly sends signals to a nearby device.

The technology could be used to manage UV exposure



on certain regions of the body, and could be adapted to sense other types of environmental exposure, such as pollution and chemical or biological agents, the authors say.

*Adv. Funct. Mater.* <http://doi.org/f3s7dr> (2016)

## EPIGENETICS

## Gut microbes shape DNA

Gut microbes and the fatty acids they produce can regulate gene expression by influencing the 3D shape of their hosts' DNA.

Intestinal bacteria are known to affect several aspects of host health, including the risk of cardiovascular and metabolic diseases. To study the mechanisms by which this occurs, Federico Rey and John Denu at the University of Wisconsin-Madison and their colleagues compared mice raised with and without gut bacteria. They found that gut microbes mediate chemical changes to histone proteins, which in turn regulate gene expression by binding to DNA and altering its 3D conformation.

Feeding mice a high-fat, high-sugar diet provides little material for microbes to digest and so blocked some of the changes to DNA shape. Giving short-chain fatty acids (which are produced by gut microbes) to mice raised without gut bacteria restored these effects.

*Mol. Cell* <http://doi.org/btr6> (2016)

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