

RESEARCH HIGHLIGHTS

Selections from the scientific literature

PLANT NANOTECHNOLOGY

Bionic plant can sense explosives

By incorporating fluorescent carbon nanotubes into spinach plants, researchers have turned the plants into environmental sensors.

Michael Strano and his colleagues at the Massachusetts Institute of Technology in Cambridge coated carbon nanotubes with a peptide that binds to nitroaromatic compounds, which include explosives. They embedded the nanoparticles into the leaves of spinach plants. When chemical contaminants are absorbed by the roots or leaves, they attach to the nanotubes, causing the nanotubes' fluorescence to decrease by an amount that depends on the level of the compound. A small detector picks up the signal and relays it wirelessly to a smartphone.

Living-plant sensors could be deployed to large, remote areas for chemical monitoring, the authors say.

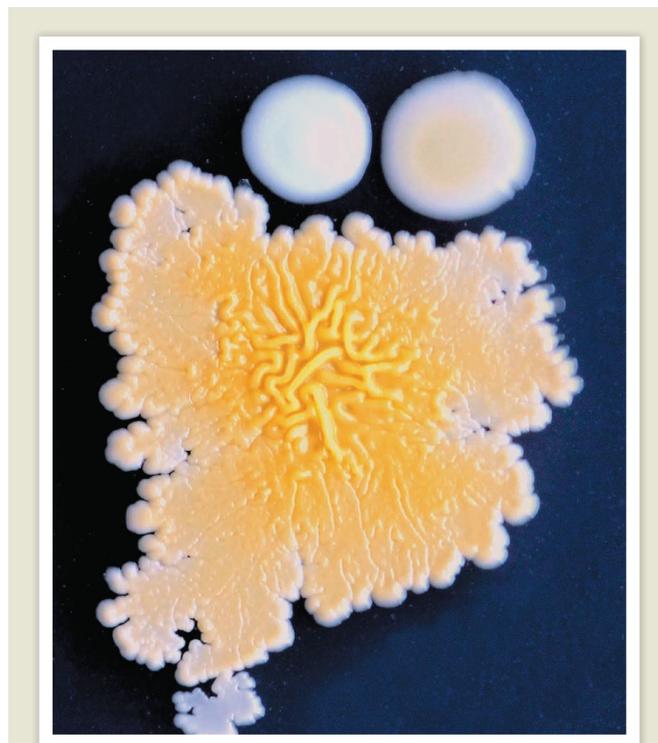
Nature Mater. <http://dx.doi.org/10.1038/nmat4771> (2016)

METABOLISM

Low oxygen resets the body clock

Cutting ambient oxygen levels helps mice to recover from a situation similar to jet lag.

In mammals, circadian clocks synchronize metabolism according to the day–night cycle. Gad Asher at the Weizmann Institute of Science in Rehovot, Israel, and his colleagues found that the amount of oxygen in the blood and kidneys of rodents varies with the time of day. Tests in cultured mouse cells showed that rhythmic fluctuations in oxygen levels synchronized



MICROBIOLOGY

Fungi boost bacterium

A study of 25 cheeses finds that a slow-growing bacterium can outcompete its relatives with the help of fungi.

Benjamin Wolfe at Tufts University in Medford, Massachusetts, and his colleagues examined the relative abundance of *Staphylococcus* bacteria (three species pictured), which are common in cheese. They found that *Staphylococcus equorum* dominated, despite being the slowest grower in lab tests. In the presence of fungi of the genus *Scopulariopsis*, *S. equorum* lowered its expression of genes involved in iron uptake and metabolism. The fungi could be providing the bacterium with freely available iron needed for growth, saving *S. equorum* the effort of acquiring and processing the nutrient, and allowing it to outcompete other bacteria.

Fungi could be influencing the diversity of other bacterial communities, including those in humans, the authors say. *mBio* 7, e01157-16 (2016)

the circadian clock; this seemed to happen through HIF1 α , a protein known to be an oxygen sensor. Mice exposed to a cycle of light and dark that was shifted by six hours to mimic jet lag adapted faster to the new conditions

when ambient oxygen levels were decreased either before or after the shift.

Modulation of oxygen levels could be a future therapy for jet lag, say the authors. *Cell Metab.* <http://doi.org/bsc9> (2016)

ASTRONOMY

Small stars host water worlds

Earth-sized planets covered in water may be abundant around red dwarfs, the most common type of star in the Universe.

Yann Alibert and Willy Benz at the University of Bern used computer simulations to predict the properties of planets that could form around red dwarfs and host liquid water. They found that the radius of the planets would be 0.5–1.5 times that of Earth, with most being around the same size as Earth. More than 90% of the simulated planets were at least 10% water by mass, suggesting that they were completely surrounded by deep oceans.

The authors say that the prospects for life on such planets are unclear, because too much water could destabilize the climate.

Astron. Astrophys. in the press; Preprint at <https://arxiv.org/abs/1610.03460> (2016)

IMMUNOLOGY

Weary T cells may not recover

Exhausted immune cells bear distinct genetic signatures, and may be difficult to revive — a finding with implications for therapies that harness the cells.

Immune cells called T cells can become 'exhausted' and dysfunctional after exposure to cancer or chronic infection. Two teams — one led by John Wherry at the University of Pennsylvania in Philadelphia, the other by Nir Yosef at the University of California, Berkeley, and Nicholas Haining at the Dana-Farber Cancer Institute in Boston, Massachusetts — looked at

E. K. KASTMAN ET AL./MBIO (CC BY 4.0)

changes in gene expression and epigenetic markers (chemical changes to DNA that do not affect its sequence) in mice infected with a virus. They found that exhausted T cells had a characteristic profile that distinguished them from functional T cells.

One of the teams also showed that exhausted T cells were reactivated by an antibody that blocks PD-L1, a protein that suppresses T-cell responses. However, this effect was transient when viral levels remained high, suggesting that certain kinds of immunotherapy may need to be combined with other treatments to yield lasting benefit.

Science <http://doi.org/bsdh>; <http://doi.org/bsdj> (2016)

ANIMAL BEHAVIOUR

Noise disrupts other senses

Noise pollution can affect how wild animals respond to other sensory inputs, such as smell.

Andrew Radford and his colleagues at the University of Bristol, UK, studied the behaviour of wild dwarf mongooses (*Helogale parvula*; pictured) that had been habituated to the presence of human observers. The team placed faeces from either a predator or a herbivore outside the mongoose burrow. When ambient natural sounds were played, mongooses were quick to inspect both types of faeces. In response to predator faeces, the animals showed increased vigilance and stayed close to the burrow. By contrast, when road noise was played, mongooses were slower to approach and showed similar

responses to both predator and herbivore faeces.

Noise pollution may distract the mongooses and increase stress, impairing the creatures' natural anti-predator behaviour, the authors say.

Curr. Biol. 26, R911–R912 (2016)

MATERIALS

3D-printed device shapes ultrasound

A specially designed lens can create ultrasound beams with the potential to precisely move, manipulate and destroy cell-sized objects.

Ultrasound beams can be made by firing pulses of laser light at a lens to create high-frequency vibrations. But glass lenses can create only relatively simple wave patterns. Claus-Dieter Ohl and his colleagues at Nanyang Technological University in Singapore used a 3D printer to build polymer lenses in 3D curved shapes. These lenses generated beams just as powerful as those made from glass, but their complex shapes allowed greater control over the beam's focus in space and time.

This could enable complex manipulations of minuscule objects, say the authors. *Appl. Phys. Lett.* 109, 174102 (2016)

FLUID DYNAMICS

Soft surfaces suppress splash

Splashing occurs when droplets strike a stiff, flat surface, but a soft material, such as silicone gel, can reduce or even eliminate splatter.

A team led by Robert Style



at the Swiss Federal Institute of Technology in Zürich and Alfonso Castrejón-Pita at the University of Oxford, UK, observed ethanol drops falling onto silicone gels of varying stiffness. Deformations of the soft substrates within a few microseconds of impact absorbed the drops' kinetic energy, decreasing splashing.

The authors say soft gels and elastic polymers could be used as inexpensive coatings to prevent splashing, which could improve many technologies, including inkjet printers.

Phys. Rev. Lett. 117, 184502 (2016)

ECOLOGY

River fish feed millions

Total freshwater-fish consumption provides for the dietary animal-protein needs of the equivalent of 158 million people, with poorer nations especially dependent on this natural and inexpensive source of food.

Peter McIntyre at the University of Wisconsin, Madison, and his colleagues used data from the Food and Agriculture Organization of the United Nations to build a global map of river fisheries, which have historically received less attention than their marine counterparts. They found that pressure from fishing was most intense in areas where biodiversity was also highest, raising concerns about conservation. The

Mekong (pictured), Amazon and Niger were some of the most heavily fished rivers, whereas rivers in the United States and Europe saw lower than expected catches.

Declines in river fish could be catastrophic for the food security of hundreds of millions of people, the authors say.

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

ANIMAL BEHAVIOUR

Magpies behave cooperatively

A species of magpie is the first bird found to show cooperative behaviour without prompting.

A team led by Lisa Horn at the University of Vienna devised apparatus that allowed East Asian azure-winged magpies (*Cyanopica cyana*) to distribute food (mealworms and crickets) to others and found that they gave out food relatively evenly to group members. The authors argue that their findings support the 'cooperative breeding hypothesis'. This states that prosocial behaviour — helping others at no or low cost — evolved in species such as humans, whose offspring are cared for by not only parents, but also other group members.

Biol. Lett. 12, 20160649 (2016)

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