RESEARCH HIGHLIGHTS

Selections from the scientific literature

VIROLOGY

Viruses switch hosts to evolve

Viruses more often evolve by jumping from one host species to another than by remaining within a particular species.

Edward Holmes and his colleagues at the University of Sydney in Australia compared the evolutionary histories of 19 virus families with those of their animal or plant hosts. They found that, in almost all cases, the trees of life for the viruses had very different branching patterns compared with the trees for the viruses' current hosts. This suggests that viruses jump between host species more often than expected. The authors report that RNA viruses — particularly the Rhabdoviridae (which includes the rabies virus) and Picornaviridae — switch host species more frequently than other viruses, whereas double-stranded DNA viruses do so the least.

These findings highlight the remarkable ability of viruses to adapt to new hosts.

PLoS Pathog. 13, **e1006215 (2017)**

GETTY

MATERIALS

Graphene layers give colourful warning

A material made of overlapping layers of graphene (atom-thick sheets of carbon) changes colour according to the level of stress applied. This could be used in structures to provide early warning of damage.

A team led by Shanglin Gao of the Leibniz Institute of Polymer Research in Dresden, Germany, designed the coating so that it changes colour more dramatically with increasing amounts of deformation. The material was placed on a glass-fibre surface and mimics fish scales (pictured) and butterfly wings, which reflect different colours depending on the viewing angle, because of interference between light waves bouncing off the surface.

The authors say that the coating could be placed on buildings or vehicles to provide a visual indication of potential structural failure, which usually starts as tiny, invisible cracks and deformations.

Mater. Horiz. **http://dx.doi.org/10.1039/C6MH00559D (2017)**

DEVELOPMENTAL BIOLOGY

Fatty bones weaken with age

The build-up of fat cells in the bone marrow could explain why bones grow weaker and heal more slowly with age.

Tim Schulz at the German Institute of Human Nutrition in Potsdam-Rehbrücke and his colleagues identified a population of stem-cell-like cells in the bones of mice that gives rise to both bone and fat cells. These progenitors produced more fat cells than bone cells in older animals and in those that ate a high-fat diet, compared with younger mice and those eating a normal diet, respectively. In mice with a fractured tibia, fat-cell precursors injected near the injury site slowed the healing process.

The researchers found that cells in the fat-cell lineage produced a protein called dipeptidyl peptidase-4 that impaired bone regeneration. These cells also inhibited the generation of stem cells in the bone marrow that give rise to blood and immune cells.

Cell Stem Cell **http://doi.org/b4dv (2017)**

ASTRONOMY

Star orbits close to black hole

A white dwarf star that circles a black hole every 28 minutes may have the closest orbit of its kind ever seen in our Galaxy.

The system, called 47 Tuc X9, is some 4.5 kiloparsecs away. It was already thought to contain two objects orbiting each other, one of them probably a black hole, but the identity of the second object was uncertain. Arash Bahramian at the University of Alberta in Edmonton and his colleagues analysed X-ray and radio observations of the system from Earth- and space-based telescopes. They discovered that the system has high oxygen levels and noted a change in X-ray brightness roughly every half an hour. The researchers inferred that a white dwarf — a dense remnant of a Sun-like star — is orbiting the black hole at a distance of about 2.5 times that between Earth and the Moon.

The black hole has probably been sucking material from the star for tens of millions of

years, but the star is unlikely to be engulfed by the black hole, say the authors.
Mon. Not. R. Astron. Soc. 467, **2199–2216 (2017)**

ENERGY

Sodium battery packs a punch

A cheap, rechargeable sodium-based battery could one day deliver high power at room temperature thanks to its hybrid solid electrolyte.

Electrolytes allow electrical charge to flow between a battery's electrodes. Liquid electrolytes can leak and tend to react with sodium metal, an abundant, low-cost material used for electrodes in some batteries, whereas purely solid electrolytes are poor conductors at room temperature. Shufeng Song at Chongqing University in China and his colleagues developed a hybrid solid electrolyte for sodium batteries by combining solid polyethylene oxide, sodium perchlorate and silica with an ionic liquid. They tested this in a sodium-metal battery and observed high conductivity at room temperature — a step towards increased power — and high stability over 56 cycles.

The electrolyte is a promising material for safer and more efficient sodium batteries, the authors suggest.
J. Mater. Chem. A **http://doi.org/b2vm (2017)**

CLIMATE-CHANGE BIOLOGY

Heat could lead to tiny mammals

Mammals might respond to global warming by shrinking in size.

During a large warming event called the Palaeocene–Eocene Thermal Maximum (PETM), some 56 million years ago, mammals became smaller. To see how common this climate-driven dwarfing might have been, Abigail D'Ambrosia of the University of New Hampshire in Durham and her colleagues measured the size of fossil teeth from four common mammal species from the Bighorn Basin in Wyoming, as a proxy for body size. The fossils, including those of an ancestral horse and a rabbit-sized, hoofed animal, spanned a time period that included a climate-warming event called the Eocene Thermal Maximum 2, which occurred 53 million years ago and was less hot than the PETM.

The team found that the rabbit-sized animal shrank by about 15% during the later warming event. The ancient horse species decreased in size by about 14%, whereas previous research suggested that a closely related horse shrank by roughly 30% during the PETM.

The authors hypothesize that reduced size could have helped the animals to disperse heat by increasing their surface-to-volume ratio, or could be due to dietary changes or climate-change-related drought.
Sci. Adv. 3, **e1601430 (2017)**

ANIMAL BEHAVIOUR

Kingsnakes go for the big squeeze

Kingsnakes have superior crushing power, allowing them to squeeze bigger snakes to death, even when these snakes are also constrictors.

David Penning at Missouri Southern State University in Joplin and Brad Moon at the University of Louisiana at Lafayette studied 182 snakes from six species, measuring the cross-sectional area of the animals' muscles, and quantifying the pulling force that the snakes use to escape predators and the pressure used to constrict prey. Muscle area and pulling force increased with size for all snakes, but the three kingsnake (*Lampropeltis)* species had significantly higher constriction power per unit of body weight than three ratsnake (*Pantherophis*) species, which are larger constrictors preyed on by kingsnakes (**pictured**, *Lampropeltis getula* eating a Texas ratsnake, *Pantherophis obsoletus*).

This strong crushing ability may result from the snakes' distinctive posture during constriction — regularly aligned coils wrapped around the prey — that allows them to apply more pressure, the authors say.
J. Exp. Biol. 220, **1154–1161 (2017)**

DAVID PENNING

EVOLUTION

Oldest algal fossils found

Fossils of organisms resembling red algae suggest that multicellular life may have emerged on Earth some 400 million years earlier than previously thought.

Fossils of the earliest algae — which are closely related to the ancestors of modern plants — are rare and, until now, the most ancient specimen was around 1.2 billion years old. Stefan Bengtson at the Swedish Museum of Natural History in Stockholm and his colleagues studied fossils from Chitrakoot in India, and found two types of multicellular colony dating to 1.6 billion years ago. One is a thread-like form (*Rafatazmia chitrakootensis*, **pictured**), whereas the other is lobe-shaped (*Ramathallus lobatus*). Using 3D X-ray microscopy, the team found that the colonies contained structures characteristic of red algae, including some that may have been used in photosynthesis.

This discovery may mean that dates of divergence for key parts of the tree of life need to be recalibrated, the authors say.
PLoS Biol. 15, **e2000735 (2017)**

DRUG DISCOVERY

CRISPR finds drug synergy

Certain combinations of drugs might kill drug-resistant tumours, and a method based on the CRISPR–Cas9 gene-editing system offers a way to find them.

Tumours often become resistant to individual drugs, leading clinicians to use combinations of medicines in the hope of thwarting resistance. Michael Bassik and his colleagues at Stanford University in California developed a method that systematically disables two genes at a time in cells. They used the system to knock out 21,321 pairs of potential drug targets in leukaemia cells, looking for combinations that work synergistically to kill cancer cells.

The team found that disabling two genes called *BCL2L1* and *MCL1* killed drug-resistant cells. Drugs that inhibited the proteins encoded by these genes killed more leukaemia cells than each of the two medicines did individually.
Nature Biotechnol. **http://dx.doi.org/10.1038/nbt.3834 (2017)**

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