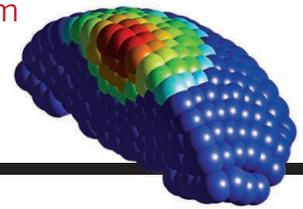


RESEARCH

Plant-shoot stem cell location

Zhou et al., p. 502



IN SCIENCE JOURNALS

Edited by Stella Hurtley



A subsea cable coiled on board a ship, ready for deployment

OPTICAL SEISMOLOGY

Submarine fiber optic earthquake detection

Seismic networks detect earthquakes and are common on continents, where they are easy to install. However, most of Earth's surface is under the oceans, where placing seismometers is difficult. Marra *et al.* now find that ordinary submarine telecommunication cables can be used to detect earthquakes. Small strain changes associated with the passage of seismic waves were detected with laser light sent through in-use fiber optic cables by ultrastable lasers. This strategy could turn intercontinental fiber optic cables into ocean-bottom strain sensors, dramatically improving our ability to record earthquakes. —BG

Science, this issue p. 486

PALEOCLIMATOLOGY

Falling from a fall in rainfall

How much did rainfall have to decrease to trigger the collapse of Lowland Classic Maya civilization during the Terminal Classic Period? This collapse is a well-cited example of how past climate change—in this case, drought—can disrupt a population. Evans *et al.* measured the isotopic composition of water in

Lake Chichancanab, Mexico, to quantify how much precipitation decreased during that period. Annual rainfall must have fallen by around 50% on average and by up to 70% during peak drought conditions. —HJS

Science, this issue p. 498

SUPERCONDUCTIVITY

Cranking up the field

Cuprate superconductors have many unusual properties even

in the “normal” (nonsuperconducting) regions of their phase diagram. In the so-called “strange metal” phase, these materials have resistivity that scales linearly with temperature, in contrast to the usual quadratic dependence of ordinary metals. Giraldo-Gallo *et al.* now find that at very high magnetic fields—up to 80 tesla—the resistivity of the thin films of a lanthanum-based cuprate scales linearly with magnetic field as

well, again in contrast to the expected quadratic law. This dual linear dependence presents a challenge for theories of the normal state of the cuprates. —JS

Science, this issue p. 479

HUMAN GENOMICS

The genetics of human short stature

Flores Island in Indonesia has a long history of hominin occupation, including by the extinct *Homo floresiensis* and a more recent settlement by modern humans. Furthermore, Flores has an extant population of pygmy humans, and *H. floresiensis* exhibited a diminutive adult size relative to other hominins. Tucci *et al.* examined genetic variation among 32 individuals, including 10 sequenced genomes, from a population of pygmies living close to the cave where *H. floresiensis* remains were discovered. These individuals exhibit signatures of polygenic selection explaining the short stature and have genomic content from both Neanderthals and Denisovans, but no additional archaic lineages. Thus, restricted height is under selection at this location and has evolved independently at least twice in hominins. —LMZ

Science, this issue p. 511

SYNTHETIC BIOLOGY

Hands-on biology education kits

Synthetic biology is a defining technology of the 21st century. Implementing hands-on synthetic biology in teaching environments is challenging

because specialized equipment and expertise are needed to grow living cells. Huang *et al.* developed two shelf-stable “just add water” synthetic biology education kits using freeze-dried cell-free (FD-CF) reactions. The inexpensive kits are designed to engage the sense of sight, smell, and touch. The kits establish an educational platform for implementing FD-CF reactions in classrooms and other low-resource environments. —NAP

Sci. Adv. 10.1126/sciadv.aat5105 (2018).

PLANT EVOLUTION Fluctuating selection in nature

Natural environmental variation can lead to individuals within a species experiencing different selective parameters. Seep monkeyflower (*Mimulus guttatus*) populations are constrained by local moisture availability and the onset of summer drought. This results in a selective trade-off between the amount of seed set, which is determined by plant size, and the timing of reproduction. Troth *et al.* sequenced and phenotyped 187 *M. guttatus* plants and identified genetic variants associated with plant and flower size and rapid flowering. In wild populations surveyed over 3 years, the magnitude of selection changed depending on the rainfall patterns. Thus, fluctuating selection may maintain genetic variation in this species. —LMZ

Science, this issue p. 475



Monkeyflower, *Mimulus guttatus*

MARTIAN GEOLOGY Liquid water under Mars' southern ice cap

Mars is known to host large quantities of water in solid or gaseous form, and surface rocks show clear evidence that there was liquid water on the planet in the distant past. Whether any liquid water remains on Mars today has long been debated. Orosei *et al.* used radar measurements from the Mars Express spacecraft to search for liquid water in Mars' southern ice cap (see the Perspective by Diez). They detected a 20-km-wide lake of liquid water underneath solid ice in the Planum Australe region. The water is probably kept from freezing by dissolved salts and the pressure of the ice above. The presence of liquid water on Mars has implications for astrobiology and future human exploration. —KTS

Science, this issue p. 490;
see also p. 448

TISSUE ENGINEERING New life for lungs

Lungs are complex organs to engineer: They contain multiple specialized cell types in an extracellular matrix with a distinctive architecture that must maintain integrity during respiration. Nichols *et al.* tackled the challenges of vascular perfusion, recellularization, and engraftment of tissue-engineered lungs in a clinically relevant pig model. Nanoparticle and hydrogel delivery of growth factors promoted cell adhesion to whole decellularized pig lung scaffolds. Autologous cell-seeded bioengineered lungs showed vascular perfusion via collateral circulation within 2 weeks after transplantation. The transplanted bioengineered lungs became aerated and developed native lung-like microbiomes. One pig survived for 2 months after transplant. This work brings tissue-engineered lungs closer to the realm of clinical possibility. —CC

Sci. Transl. Med. 10.eaao3926 (2018).

IN OTHER JOURNALS

Edited by **Caroline Ash**
and **Jesse Smith**



Young girls and boys perform equally well
in tests of intrinsic mathematical ability.

CANCER Predicting esophageal cancer

Barrett's esophagus (BE) is an abnormal change in the lining of the lower esophagus caused by stomach acid reflux injury. This is the biggest risk factor for esophageal cancer, although fewer than 1% of BE patients will develop cancer. Stachler *et al.* analyzed genomic changes in biopsy samples from almost 100 patients with BE and monitored them for esophageal cancer for 5 years. Patients who progressed to cancer showed more mutations than nonprogressors, particularly in the tumor suppressor gene *TP53*. Mutations were detected frequently before the onset of dysplasia in 46% of the progressors, but only in 5% of the nonprogressors. *TP53* mutations in BE lesions increased the risk of developing esophageal cancer by almost 14-fold. —MY

Gastroenterology 10.1053/j.gastro.2018.03.047 (2018).

DENGUE Transit time inside a mosquito

Dengue virus genetic variation and ambient temperature influence the rate of transmission by mosquitoes and thus the risk and magnitude of an outbreak. Virus in a blood meal within the vector mosquito's gut takes several days—roughly a quarter of the short life of an *Aedes* mosquito—to transition from the gut to the salivary gland, ready for inoculation into the next host. So, 1 day's difference can mean success or failure for ongoing transmission. Fontaine *et al.* found that eight strains of recently circulating dengue virus have different gut-salivary gland transit times. In an agent-based model, this parameter translated into a roughly 20% difference in the probability of a subsequent human infection, with a Haitian strain being the slowest, resulting in smaller outbreaks. —CA

PLOS Pathog. 10.1371/journal.ppat.1007187 (2018).

CELL BIOLOGY

It's all about your contacts

Membrane contact sites have recently come to the fore of our understanding of interorganelle communication. Wu *et al.* review how these important structures help to promote a variety of key functions, including organelle division and lipid transfer. Focusing on contacts between the endoplasmic reticulum and a variety of organelles or the plasma membrane reveals the generality and importance of these contacts in cellular homeostasis and organismal health. —SMH

Science, this issue p. 466

NEUROSCIENCE

Leadership and responsibility

Leadership of groups is of paramount importance and pervades almost every aspect of society. Leadership research has rarely used computational modeling or neuroimaging techniques to examine mechanistic or neurobiological underpinnings of leadership choices. Edelson *et al.* found empirically and theoretically that the choice to lead rests on a metacognitive process (see the Perspective by Fleming and Bang). Individuals who showed less “responsibility aversion” had higher leadership scores. A computational model combining signal detection theory with prospect theory provided a mechanistic understanding of this preference. Neuroimaging experiments showed how the key theoretical concepts are encoded in the activity and connectivity of a brain network that comprises the medial prefrontal cortex, the superior temporal gyrus, the temporal parietal junction, and the anterior insula. —PRS

Science, this issue p. 467;
see also p. 449

CELL BIOLOGY

Making multiplexed subcellular protein maps

Being able to visualize protein localizations within cells and tissues by means of immunofluorescence microscopy has been key to developments in cell biology and beyond. Gut *et al.* present a high-throughput method that achieves the detection of more than 40 different proteins in biological samples across multiple spatial scales. This allows the simultaneous quantification of their expression levels in thousands of single cells; captures their detailed subcellular distribution to various compartments, organelles, and cellular structures within each of these single cells; and places all this information within a multicellular context. Such a scale-crossing dataset empowers artificial intelligence-based computer vision algorithms to achieve a comprehensive profiling of intracellular protein maps to measure their responses to different multicellular, cellular, and pharmacological contexts, and to reveal new cellular states. —SMH

Science, this issue p. 468

MICROBIOLOGY

Interchanging species of similar function

Under natural conditions, bacteria form mixed, interacting communities. Understanding how such communities assemble and stabilize is important in a range of contexts, from biotechnological applications to what happens in our guts. Goldford *et al.* sampled the microbial communities from soil and plants containing hundreds to thousands of sequence variants. The organisms were passaged after culture in low concentrations of single carbon sources and were cross-fed with each other's metabolites; then, the resulting communities were sequenced

using 16S ribosomal RNA, and the outcomes were modeled mathematically. The mix of species that survived under steady conditions converged reproducibly to reflect the experimentally imposed conditions rather than the mix of species initially inoculated—although at coarse phylogenetic levels, taxonomic patterns persisted. —CA

Science, this issue p. 469

BLACK HOLE PHYSICS

An expanding radio jet from a destroyed star

If a star gets too close to a supermassive black hole, it gets ripped apart in a tidal disruption event (TDE). Mattila *et al.* discovered a transient source in the merging galaxy pair Arp 299, which they interpret as a TDE. The optical light is hidden by dust, but the TDE generated copious infrared emission. Radio observations reveal that a relativistic jet was produced as material fell onto the black hole, with the jet expanding over several years. The results elucidate how jets form around supermassive black holes and suggest that many TDEs may be missed by optical surveys. —KTS

Science, this issue p. 482

THIN FILMS

An epitaxial route to strain

Strain can have a dramatic effect on the properties of materials. Zhang *et al.* introduced a large strain in the material PbTiO₃ by growing it epitaxially in a composite with PbO. On the boundaries between the two materials, their normally different lattice constants were matched, giving rise to the strain. As a consequence, the films exhibited a very large electric polarization even in the absence of an electric field. The method may be applicable to generating other functional materials. —JS

Science, this issue p. 494

PLANT SCIENCE

Enough but not too many stem cells

In the shoot apical meristem of plants, just the right number of stem cells generates a steady supply of cells with which to build differentiated tissues. Too few stem cells, and the plant cannot grow. Too many, and growth runs amok. Zhou *et al.* analyzed the controls on stem cell proliferation. They found that the HAIRY MERISTEM proteins define a domain within which WUSCHEL (WUS) cannot work, but beyond which WUS is left free to promote stem cell proliferation. —PJH

Science, this issue p. 502

STRUCTURAL BIOLOGY

A channel for calcium

Maintaining the correct balance of calcium concentrations between the cytosol and the mitochondria is essential for cellular physiology. A calcium-selective channel called the mitochondrial calcium uniporter (MCU) mediates calcium entry into mitochondria. Yoo *et al.* report the high-resolution structure of MCU from *Neurospora crassa*. The channel is formed by four MCU protomers with differing symmetry between the soluble and membrane domains. The structure, together with mutagenesis, suggests that two acidic rings inside the channel provide the selectivity for calcium. —VV

Science, this issue p. 506

GENETICS

Altering wheat for pathogen resistance

Wheat provides ~20% of calories and protein per person globally, yet the elite crop cultivars that we grow today are beset by poor pathogen resistance. This has led to concerns about food security as emerging pests decimate wheat crops. In a Perspective, Wulff and Dhugga discuss

the challenge and potential of introducing pathogen-resistance genes from wild wheats into elite cultivars through cross-breeding or genetic modification. This approach should allow us to improve and maintain the yield of this important food source. —GKA

Science, this issue p. 451

MARINE ECOLOGY

Why seagrass meadows should be protected

Seagrasses are found along coastlines around the world but are under threat from human activities. In a Perspective, Cullen-Unsworth and Unsworth explain that seagrasses perform many important functions. For example, seagrasses provide a habitat for diverse marine species, including numerous commercial fish species, and store large amounts of carbon. Loss of seagrass meadows may thus contribute to rising carbon emissions and may threaten biodiversity and food security. Research into the extent and properties of seagrass meadows is helping to inform conservation efforts, but time is of the essence to avoid further losses of these important ecosystems. —JFU

Science, this issue p. 446

INFLAMMATION

An eye to evading the immune system

Some tissues, such as the eye, limit immune cell infiltration. Sakurai *et al.* found that a modified form of cholesterol inhibited the guanine nucleotide exchange factor DOCK2 and thus suppressed neutrophil and T cell migration. In mice, cholesterol sulfate was produced by the gland that secretes the lipids that form the outer layer of the tear film covering the eye. Mice lacking the major sulfotransferase that produces cholesterol sulfate had increased infiltration of immune cells into the conjunctiva and cornea, which was reversed by topical application of cholesterol sulfate. —AV

Sci. Signal. **11**, eaao4874 (2018).

Science

Hands-on biology education kits

Nicholas A. Peppas

Science **361** (6401), 463-464.
DOI: 10.1126/science.361.6401.463-e

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