

SYNTHETIC BIOLOGY

Sounding out mammalian cells

Live cell imaging allows us to observe cellular processes in real time. Most methods rely on light, and the poor penetration of light into tissues limits their application. Ultrasound penetrates tissues, and cellular reporters that respond to ultrasound have been developed recently. These reporters are air-filled protein structures that provide buoyancy in the bacteria they are derived from, but when surrounded by a fluid medium, they reflect sound waves. Farhadi *et al.* achieved expression from multiple genes to create these complex structures in mammalian cells. In addition to optimizing reporter production and detection, they visualize cells in a proof-of-principle experiment in mouse tumor xenografts. —VV

Science, this issue p. 1469

PLANT ECOLOGY

Habitat connectivity enhances diversity

Fragmentation of ecosystems leads to loss of biodiversity in the remaining habitat patches, but retaining connecting corridors can reduce these losses. Using long-term data from a large, replicated experiment, Damschen *et al.* show quantitatively how these losses are reduced. In their pine savanna system, corridors reduced the likelihood of plant extinction in patches by about 2% per year and increased the likelihood of patch colonization by about 5% per year. These benefits continued to accrue over the course of the 18-year experiment. By the end of monitoring, connected patches had 14% more species than unconnected patches. Restoring habitat connectivity may thus be a powerful technique for conserving biodiversity, and investment in connections can be expected to magnify conservation benefit. —AMS

Science, this issue p. 1478

IMMUNOGENOMICS

Immune landscape of the human kidney

Single-cell RNA sequencing has begun to shed light on the full cellular diversity of specific organs. However, these studies rarely examine organ-specific immune cells. Stewart *et al.* sequenced healthy adult and fetal kidney samples at a single-cell level to define the heterogeneity in epithelial, myeloid, and lymphoid cells. From this dataset, they identified zonation of cells, with relevance to disease and the varied perturbations that occur in different tumor settings. This profiling of the human kidney generates a comprehensive census of existing cell populations that will help inform the diagnosis and treatment of kidney-related diseases. —LMZ

Science, this issue p. 1461

VACCINES

Hinting at a herpes vaccine

A vaccine for genital herpes does not currently exist, despite the prevalence of this sexually transmitted disease. Previous attempts to make vaccines against herpes simplex virus 2 (HSV-2) included trials with protein subunit vaccine candidates that delayed infection onset but were not protective. Awasthi *et al.* describe a vaccine candidate that is composed of nucleoside-modified mRNA in lipid nanoparticles that encodes the HSV-2 glycoproteins C, D, and E. This trivalent vaccine protected mice and guinea pigs from developing genital lesions and reduced viral shedding. Neutralizing antibody and CD4⁺ T cell responses were detected in immunized mice. These results suggest that an mRNA-based HSV-2 vaccine may have potential for further preclinical development. —CNF

Sci. Immunol. **4**, eaaw7083 (2019).

IN OTHER JOURNALS

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A red variety of maize, derived from the wild teosinte corn plant first cultivated in Central America 7000 years ago

PLANT BREEDING

Hybrid decay mystery

Plant breeders seek new combinations of alleles to improve crop performance. While investigating the effects of teosinte genes in a predominantly maize background, Xue *et al.* obtained a lineage of plants that appeared normal in the first hybrid generation, but subsequent offspring backcrossed into maize exhibited deleterious effects. Genetic analysis of individuals in this lineage showed that this was caused by the propagation of multiple teosinte regions in the maize genetic background, which the authors called hybrid decay. Hybrid decay appeared to be associated with unstable genomic regions and increased copy numbers of repetitive DNA-like transposable elements. Further, expression differences in known genes, short RNAs, and novel transcripts, as well as differences in methylation, were all noticed in the hybrids. It remains to be seen how common hybrid decay is among eukaryotes, and if it is solely the result of effects related to the silence of transposable elements within the genome. —LMZ

Genetics **213**, 143 (2019).

CLIMATE CHANGE

Temporary richness

Direct human disturbance poses a challenge to making accurate assessments of the effects of climate change on species. In cooler and especially polar regions, greater absolute changes in conditions are being experienced. Because plants underpin ecosystem resilience and food security, Suggitt *et al.* have chosen to analyze data in a modeling framework on local plant diversity changes. For cooler latitudes, the alpha diversity of plants has declined in drier regions but increased by as much as 9% per decade in zones that have experienced more precipitation—likewise, but less certainly, for temperature changes. However, the model showed that in equatorial and arid regions, wetter and warmer conditions cannot undo the negative effects of nonclimate disruptions, including those of humans. It is important not to confuse local effects with climate change heightening global extinction risk for many species. —CA *Curr. Biol.* 29, 2905 (2019).

Tundra flowers (mountain avens and vetch),
Victoria Island, Nunavut, Canada



QUANTUM PHYSICS

Protecting the quantum

Robust, fast, and with the capability of traveling vast distances, single photons are ideal carriers of quantum information. However, for on-chip applications, the photons inevitably interact with the surrounding medium and can be lost, which is perhaps even more true for delicate entangled photons where the nonclassical correlations between the photons can fizzle out. Recent developments have shown that topology can provide protection for photons and entangled photons against dissipation and disorder. Wang *et al.* demonstrate an integrated photonic chip approach in which the quantum correlations between two-photon states is given topological protection. A specially designed and

fabricated photonic crystal provides topological boundary states within which the quantum correlations between entangled photons are maintained. —ISO

Optica 6, 955 (2019).

QUANTUM SIMULATION

Toward dynamical gauge fields

Ultracold atomic gases have been proven to be a powerful tool for the quantum simulation of many-body systems. However, creating analogs of dynamical gauge fields—which couple to matter and govern the behavior of many systems that cold gases aim to simulate—has been challenging. Görg *et al.* build on methods used to engineer static gauge fields in optical lattices by “shaking” the lattice at two frequencies resonant with on-site interactions.

The resulting tunneling matrix is density-dependent, creating a coupling between the gauge and matter fields in the system. The researchers anticipate that this advance will enable the exploration of exotic phases of matter.

—JS

Nat. Phys. 10.1038/s41567-019-0615-4 (2019).

EARTH OBSERVATION

Another point of view

Understanding Earth’s energy balance is fundamental for understanding climate. The amount of solar energy incident on the top of the atmosphere is well known, but the outgoing radiative flux is more uncertain because traditional ground-based, aircraft, and satellite instruments see only a fraction of Earth at a time, and their data must be extrapolated, interpolated, or combined to

create a whole-planet picture. Carlson *et al.* present measurements made by the instrument NISTAR, which can see all of Earth at once because it is located at the Lagrangian L-1 point 1.6 million miles in the direction of the Sun. This allows them to determine the total outgoing radiation flux and its spectrum at subseasonal resolution. —HJS

Geophys. Res. Lett. 10.1029/2019GL083736 (2019).

METABOLISM

Sensing diet

The hypothalamic region of the brain is associated with regulation of metabolism and feeding. In mice fed a high-fat diet, innate immune cells in the brain called microglia become activated and hypothalamic inflammation occurs prior to the onset of weight gain. Kim *et al.* report that high-fat diets induce expression of the uncoupling protein 2 (*Ucp2*) gene, as well as mitochondrial changes in the microglia. Ablation of the *Ucp2* gene in microglia prevented these changes and protected mice from high-fat diet–induced obesity. —GKA

Cell. Metab. 10.1016/j.cmet.2019.08.010 (2019).

AGING

Stand up for longevity

Physical activity brings health benefits, although evaluation of exactly how can be complicated by unreliable self-reporting by study subjects. Ekelund *et al.* combined data from a series of studies on middle-aged or older adults that used accelerometer measurements to record physical activity to more precisely assess dose-response effects of physical activity on overall mortality. The authors conclude that “any level of physical activity regardless of intensity was associated with a substantially lower risk of mortality.” Their takeaway message from the more than 240,000 person years of participant follow-up is simple: sit less and move more. —LBR

BMJ 366, i4570 (2019).