pseudoknot resists unfolding as it lodges at the entry of the ribosomal messenger RNA channel. This causes backsliding of the viral RNA, resulting in a minus-1 shift of the reading frame of translation. A partially folded nascent viral polyprotein forms specific interactions inside the ribosomal tunnel that can influence the efficiency of frameshifting. —DJ

Science, abf3546, this issue p. 1306

GENE THERAPY
Gene correction for SCD stem cells
Sickle cell disease (SCD) is an autosomal-recessive disease resulting from a point mutation in the β-globin gene that leads to sickle-shaped red blood cells, pain crises, and decreased life span. Lattanzi et al. studied ex vivo β-globin gene correction in autologous patient-derived hematopoietic stem and progenitor cells (HSPCs) as a potential cure for SCD. The authors demonstrated 20% gene correction after transplantation of corrected HSPCs into immunodeficient mice, with no evidence of genotoxicity or tumorigenicity. The gene-corrected HSPCs could also be reliably produced at scale. These studies lay the groundwork for a clinical trial of this gene correction strategy in patients with SCD. —MN


QUANTUM SIMULATION
A spinning quantum gas
Ultracold atomic gases are very good at simulating electrons in solids but lack one essential party trick: charge. Their neutrality makes it challenging to simulate phenomena such as the quantum Hall effect, which, in the case of charged electrons, is easily induced by an external magnetic field. One way to produce a similar effect in a neutral system is to rotate it, but achieving the equivalent of strong magnetic fields remains difficult. Fletcher et al. rotated a gas of trapped sodium atoms, reaching a state in which the gas could be described by a single lowest Landau-level wavefunction. The system is expected to be a testbed for studying the behavior of strongly interacting many-body states. —JS

Science, aba7202, this issue p.1318

MAGNETISM
Capturing exotic magnetism
Ferromagnetism is associated with the breaking of time-reversal symmetry, most frequently by the spin degree of freedom. Although the orbital motion of electrons can also contribute to ferromagnetism, in most materials, it is small relative to the spin contribution. Tschirhart et al. showed that the reverse is true in an unusual magnetic state hosted by twisted bilayer graphene. Their scanning magnetochemistry measurements were consistent with ferromagnetism of predominantly orbital origin. —JS

Science, abd3190, this issue p.1323

VACCINES
Cytokine vaccine for asthma
The cytokines interleukin-4 (IL-4) and IL-13 play important, nonredundant roles in the pathogenesis of asthma. Monoclonal antibodies against IL-4 receptor α (IL-4Rα), which inhibit both IL-4 and IL-13 signaling, can effectively ameliorate severe asthmatic exacerbations. However, monoclonal antibody therapy is expensive and requires regular injections. Conde et al. developed conjugate vaccines (“kineoids”) against IL-4 and IL-13 by coupling these cytokines with a nontoxic mutant of diphtheria toxin. These kineoids were effective as both prophylactics and therapeutics in mouse models of allergic airway inflammation, durably reducing hallmarks of disease including serum immunoglobulin E, airway hyperresponsiveness, and mucus hypersecretion. Similar results were obtained with transgenic mice expressing human IL-4, IL-13, and IL-4Rα. Thus, dual IL-4/IL-13 vaccination may be a long-lasting and economical approach to the treatment of asthma and other allergic diseases. —STS


IN OTHER JOURNALS
Edited by Caroline Ash and Jesse Smith

ECOLOGY
Persistent seeds predict invasiveness
U

nderstanding the biological traits that predict the potential of an organism to colonize and occupy new territory is key to ameliorating and combating the problem of alien species invasion, a problem that has been exacerbated by global networks of travel and trade. In an analysis of seed trait data from 2350 angiosperm species, Gioria et al. found that the ability of seeds to form a persistent seed bank in the soil (where persistence was defined as >1 year) was strongly associated with potential to become naturalized or invasive. Adding seed persistence to the suite of plant traits that predict invasiveness may be beneficial to efforts to prevent or eradicate new introductions before they are beyond control. —AMS


A germinating sunflower seed

CORONAVIRUS
Shifting frames to make more proteins
Severe acute respiratory syndrome coronavirus 2 critically depends on the ribosomal frameshifting that occurs between two large open reading frames in its genomic RNA for expression of viral replicase. Programmed frameshifting occurs during translation, when the ribosome encounters a stimulatory pseudoknot RNA fold. Using a combination of cryo–electron microscopy and biochemistry, Bhatt et al. revealed that the

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accurate forecasts of activity up to 8 weeks in the future. These findings illustrate the potential of modern artificial intelligence (AI) to better track and predict local epidemic dynamics up to several weeks ahead of current health care–based surveillance systems, which would support better public health policy and individual decisions. —A JC


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**FOREST ECOSYSTEM**

**Losing trees despite the forest**

When we think of human impacts on forests, we usually think of whole-scale destruction from logging or other habitat destruction. However, loss of individual trees within a persistent forest can have unforeseen effects. Such losses occur through drivers such as disease and drought and can occur within a specific tree species or across species. Fleming et al. conducted a large meta-analysis of mostly North American and Australian studies and found both positive and negative impacts on forest animal abundance. Species that rely on specific living tree resources such as nectar and pollen declined, whereas those that rely on resources such as tree cavities, open canopies, and ground resources increased. Impacts also shifted over time, with individual tree deaths leading to increases that eventually shifted to overall decline. Although sometimes occurring in opposite directions, species responses were substantial enough that increased tree loss could lead to altered forest communities. —SNV  *Biol. Rev. Camb. Philos. Soc.* 10.1111/brv.12725 (2021).

A fallen dead and rotted tree in the Białowieża Forest

**SOLAR CELLS**

**Efficient organic solar cells**

There is currently considerable interest in the development of organic solar cells (OSCs) because of the emergence of so-called non-fullerene acceptors, which has pushed the power conversion efficiencies of OSCs close to those of inorganic and hybrid semiconductor solar cells. Chen et al. combined experimental and theoretical study of more than 30 non-fullerene OSC devices to demonstrate the key electronic structure parameters of the donor-acceptor blends, establish the relationships between these parameters and the nonradiative voltage losses, and show that these losses can be reduced without sacrificing the charge-generation efficiencies. This work opens the way for the future rational design of high-efficiency OSC materials. —YS  *Nat. Energy* 10.1038/s41560-021-00843-4 (2021).

**METABOLISM**

**Innervating the gut**

Sensory neurons that detect signals in the gut and relay them to the brain are an important feature of regulating food intake and metabolic responses to food. When such gut-brain signaling is impaired, overeating, weight gain, and metabolic dysfunction can occur. Borgmann et al. investigated feeding and glucose regulation by different sensory neurons that innervate the gut of mice. Their findings enabled reconstruction of peripheral and central sensory neuron projections and revealed differential innervation of the mucosal and muscular layers of the intestine and different regions of the gastrointestinal tract, likely reflecting distinct responses to specific signals in the gut. These subsets of neurons may provide targets for controlling metabolic diseases in the future. —GKA  *Cell Metab.* 10.1016/j.cmet.2021.05.002 (2021).

**BIOMATERIALS**

**Magnetic guidance for nerve repair**

After an injury, peripheral nerve regeneration is possible but often fails to fully restore function, in part because of the need for slow-moving axons to traverse long distances. Although adult stem cell therapies have shown some promise, there is a challenge in getting enough cells to the injury. Soto et al. enhanced adipose-derived mesenchymal stem cell delivery by loading the cells with citric acid-coated superparamagnetic iron oxide nanoparticles. Tests were done in rats using a Wallerian degeneration model of the sciatic nerve. By magnetically guiding the cells to the injury site, they were able to improve recovery, with partial conservation of the nerve structure and indications of remyelination. —MSL  *Acta Biomater.* 10.1016/j.actbio.2021.05.050 (2021).

**COSMOLOGY**

**Sounding out the Universe**

Propagation of sound waves in the early Universe imprinted characteristic density fluctuations known as baryon acoustic oscillation (BAO). Galaxies preferentially form in higher-density regions, so BAO can be measured using galaxy redshift surveys. Alam et al. report the final cosmological parameters from the extended Baryon Oscillation Spectroscopic Survey (eBOSS) both independently of other datasets and in combination with alternative cosmological techniques. The authors found strong support for standard cosmology with cold dark matter, a flat Universe, and dark energy described by a cosmological constant. The only notable inconsistency was the well-known tension in measurements of the Hubble constant, which persists in the new data. —KTS  *Phys. Rev. D* **103**, 083533 (2021).