

TUBERCULOSIS

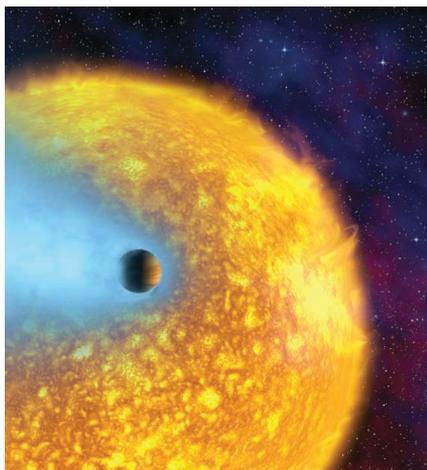
Using a diabetes drug to treat tuberculosis

The increasing prevalence of drug-resistant strains of *Mycobacteria tuberculosis*—the bacterium that causes tuberculosis (TB)—has led to a paradigm shift in the search for new drugs. Rather than targeting the bacterium itself, researchers are trying to augment host defenses. Now, Singh *et al.* report that the FDA-approved drug metformin, currently used to treat type 2 diabetes, can improve the immune response to *M. tuberculosis* infection. Metformin inhibited the growth of *M. tuberculosis* by enhancing specific immune responses in vitro and in infected mice. Furthermore, in human diabetic patients with TB, metformin treatment decreased TB severity. — ACC
Sci. Transl. Med. **6**, 263ra159 (2014).

EXOPLANET MAGNETISM

Transit marked by magnetosphere effects

Life on Earth exists under the protective sheath of our magnetosphere that deflects charged particles blown out by the Sun. Kislyakova *et al.* calculated the strength of the magnetic field of a well-studied hot-Jupiter-type exoplanet that produces similar effects. During the planet's transit in



Transit observations of an exoplanet reveal its atmospheric and magnetic properties

front of its host star, HD 209458, hydrogen atoms leave a peculiar asymmetric signature in the transmitted spectrum. — MMM
Science, this issue p. 981

METABOLISM

Making the brain promote fat loss in mice

Obesity is a growing global problem associated with diabetes and metabolic syndrome. Signals from the brain regulate whole body metabolism and can trigger adipose tissue to burn fat. Perino *et al.* found that mice that expressed catalytically inactive forms of two phosphoinositide 3-kinases (PI3K β and PI3K γ) were leaner, burned more fat, and expended more energy than normal mice. Fat loss also occurred in mice that received inhibitors of PI3K β and PI3K γ delivered specifically into the brain. Thus, drugs that block these enzymes in the brain could potentially help to fight obesity. — WW
Sci. Signal. **7**, ra110 (2014).

INFLUENZA IMMUNOLOGY

Hills and valleys of influenza infection

Each one of us may encounter several different strains of the ever-changing influenza virus during a lifetime. Scientists can now summarize such histories of infection over a lifetime of exposure. Fonville *et al.* visualize the interplay between protective responses and the evasive influenza virus by a technique called antibody landscape modeling (see the Perspective by Lessler). Landscapes reveal how exposure to new strains of the virus boost immune responses and indicate possibilities for optimizing future vaccination programs. — CA
Science, this issue p. 996; see also p. 919

IN OTHER JOURNALS

Edited by Kristen Mueller and Jesse Smith

Scanning electron micrograph of *Trichomonas vaginalis*



MICROBIOLOGY

Mycoplasma doubles the cost of an STD

It's cruel enough to acquire one sexually transmitted infection, but gaining two for one is harsh. Trichomoniasis is a very common protozoal infection of the vagina that causes symptoms ranging from urogenital inflammation to pregnancy complications. Fettweis *et al.* analyzed the microbiomes from vaginal samples collected from more than 1300 women and now report that a previously unknown mycoplasma (a type of bacteria) tightly associates with trichomonas organisms. The genome of the new mycoplasma (called candidatus *Mycoplasma girardi*) encodes proteins similar to known virulence factors, which suggests that the mycoplasma might be contributing to trichomoniasis disease. — CA
PLOS One **9**, e110943 (2014).

BIOTECHNOLOGY

Disorder enhances binding cooperativity

Some natural proteins, such as hemoglobin, bind their ligands in a cooperative manner, whereby the binding of the first ligand alters the structure of

the protein, favoring binding of subsequent ligands. Taking inspiration from this mechanism, Simon *et al.* created unstructured receptors from DNA. Upon binding their ligand, the disordered receptors become structured, forming sites for further ligands to bind. Because



MATERIALS SCIENCE

Climbing up the walls like a gecko

The Tokay gecko scurries across ceilings with the help of tiny hair on its feet, which generate weak intermolecular forces that add up to a secure foothold. Scientists have recreated dry gecko-like adhesion using silicones, plastics, carbon nanotubes, and other materials, but they've run into a scaling problem: The stickiness drops rapidly with increasing surface area. Hawkes *et al.* offer a solution: an adhesive consisting of 24 tiles that distribute loads evenly among themselves, offering the same adhesive strength for sizes from a square millimeter to the area of a human hand. The adhesive works even if one tile fails to stick. Wearing hand-sized adhesives, a 70-kilogram human can climb a vertical glass wall, the team showed. — JY

J. R. Soc. Interface, 10.1098/rsif.2014.0675.

ligands bind more favorably to these sites than to the unstructured receptor, the binding of subsequent ligands is enhanced. Relatively small changes in ligand concentration can therefore lead to an all-or-none binding response, a feature that could prove useful for artificial biotechnologies. — MDC

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1410796111 (2014).

QUANTUM COMMUNICATION

Symmetric photons make good communicators

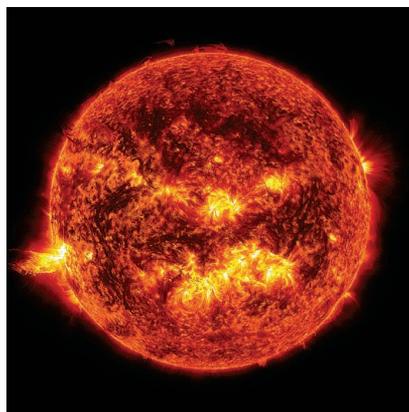
Future communication networks will be based on quantum mechanics and will rely on the ability to store quantum information in quantum nodes and transfer that information between them. Photons offer the ability to transfer information over long distances, but that requires that single photons be emitted and detected reliably at each end of the communication channel—a feat that requires the photons to be symmetric. Using a superconducting-based quantum circuit, Pechal *et al.* demonstrate how to generate the symmetric microwave photons that will be necessary to carry quantum information successfully. — ISO

Phys. Rev. X 4, 041010 (2014).

COSMOLOGY

Dark matter may yield x-ray glow nearby

Dark matter often has been observed to influence the dynamics of galaxies. Still, astrophysicists have great difficulty demonstrating the presence of dark matter with some type of direct detection. Now, observations made by the European XMM-Newton satellite of what should be blank sky instead show a variable background x-ray signal that could result from axions, a proposed component of dark matter. Fraser *et al.* explain that these candidate particles—a billionth the mass of an electron—could be produced by the Sun and then converted into x-rays by Earth's magnetic field. This



step toward understanding dark matter still may be supported or refuted by further x-ray measurements with other observatories. — MMM

Mon. Not. Roy. Astron. Soc. 10.1093/mnras/stu1865 (2014).

AAA+ ATPASES

Redox regulation of Lon protease

Bacteria and other organisms use so-called AAA+ proteases to degrade cytosolic proteins. The Lon protease is the main protease used by bacteria to degrade damaged or misfolded cytosolic proteins, which can be toxic to the cell. Both too much and too little Lon protease activity is bad for survival. Nishii *et al.* asked how cells keep Lon activity levels just right. By examining the crystal structure of Lon from *Escherichia coli* they identified conserved cysteine residues that acted as a redox switch. The exit pore changed in size depending on whether the bacteria were growing in the presence or absence of oxygen: Reducing its size decreased products

from passing through the pore and therefore the activity of the enzyme. —SMH

Nat. Chem. Biol. 10.1038/nchembio.1688 (2014).

EDUCATION

Follow scientists, not the lab notebook

Scientific experiments rarely go as planned. Despite following the scientific method, experiments often double back, repeat a step, or move in a new direction. Why then, do classroom laboratory exercises present students with a linear set of tasks resulting in a known outcome? To create a more authentic experience, Alaimo *et al.* redesigned four undergraduate organic chemistry labs to allow students to generate reliable data through repeating experiments, participate in authentic data analysis, and receive instruction in data-driven decision-making. These changes shifted the lab from an exercise in following directions to an exercise of learning the iterative process of a scientific study. — MM

J. Chem. Educ. 10.1021/ed400510b (2014).

HUMAN IMMUNOLOGY

A (w)holistic approach to track T cells

Immunologists know a lot about mouse T cells: how they develop, respond to infection, form memory cells, and where they reside. But whether this knowledge holds true for human T cells is still a black box because of the difficulty in obtaining samples from anywhere other than the blood. To gain more insight into human T cell biology, Thome *et al.* performed multidimensional, quantitative analyses on T cells obtained from the blood, lymph nodes, spleen, and mucosal tissues of 56 individual organ donors aged 3 to 73 years. They find that the distribution and maintenance of different T cell subsets depends on the differentiation state of the T cell and its location within the body. — KLM

Cell 159, 814 (2014).