CHEMISTRY

Plasmonic Water Splitting

One issue in harvesting the energy in sunlight to split water for hydrogen generation is utilizing the lower-energy visible-light component. Mubeen *et al.* report on an integrated platform in which plasmons excited in gold nanorods (~50 nm in diameter) create electron-hole pairs for driving the reaction. The nanorods are capped with a thin layer of titanium dioxide decorated with platinum nanoparticles, which act as the hydrogen generation catalysts. The sides of the nanorods are decorated with an inorganic cobalt-based oxygen evolution catalyst, so the nanorod also acts as the wire that completes the circuit. The plasmonic nature of the excitation generation was verified by showing that when operated as a photocathode (no cobalt catalyst but with a counterelectrode), the current generated tracked the changes in visible light intensity with wavelength. Indeed, the device operates less efficiently when illuminated only in the ultraviolet. Although the photon-to-hydrogen conversion efficiency is still low (~0.1%), improvements such as increasing the surface area devoted to the platinum catalyst could be made. The device could also be used in tandem with devices that are more efficient in the ultraviolet than in the visible range. — PDS

Nat. Nanotechnol. 10.1038/nnano.2013.18 (2013).

ECOLOGY

A Good Hiding Place

Dormancy in seeds is a common feature of plants, allowing seeds to be dispersed and to survive through unfavorable seasons before germinating. Dormancy can be physiological, terminated by some environmental cue; or it can be physical, whereby germination is prevented by the presence of a hard outer seed coat and is only achieved when the coat is ruptured. Paulsen *et al.* proposed an additional or alternative explanation for the function of hard seed coats, whereby escape from seed predators (rather than facilitation of dormancy) has been the selective force behind their evolution. An experimental system was used to compare the success of hamsters in detecting buried hard and soft dimorphic seeds of legume species. Soft seeds were located more easily owing to their production of a cocktail of volatile compounds that give their presence away. The authors suggest that hard seeds, even if detected, may be able to survive a second dispersal event when re-cached or pilfered by hoarding rodents, whereas soft seeds constitute a "payment" for dispersal services. The fact that hard/soft seed dimorphism has evolved at least six times provides further support for this interpretation. — AMS

CREDITS (TOP TO BOTTOM): GETTY IMAGES/HEMERA; TORBJØRN R. PAULSEN

New Phytol. 10.1111/nph.12191 (2013).

ATMOSPHERIC SCIENCE

Not Our Fault

The stratosphere contains a large inventory of aerosol particles. These aerosols are composed largely of sulfuric acid droplets, the precursors of which originate in the troposphere. Thus, the question has been asked whether anthropogenic emissions of sulfur-containing compounds such as sulfur dioxide have contributed substantially to the aerosol content of the stratosphere. Neely *et al.* report that changes in the concentration of stratospheric aerosols during the period from 2000 to 2010 were caused mostly by moderate volcanic eruptions and that the large increase in SO_2 emissions from China and India had no significant impact on it. They also conclude that the middle and upper stratosphere (which contains the bulk of the ozone layer) was not measurably affected by increased anthropogenic emissions of SO_2 from Asia during that interval. — HJS

Geophys. Res. Lett. 10.1002/grl.50263 (2013).

PHYSICS

Correcting for Quantum Collapse

The predicament faced by Schrödinger's cat is, perhaps, a broadly known if not wholly understood example of quantum mechanics that illustrates well the weirdness of the quantum world and the kinds of barriers faced by those now trying to control and manipulate it. The rules of quantum mechanics dictate that the mere measurement of a quantum system, describable mathematically in terms of a wavefunction, results in the irreversible collapse of that wavefunction and forces a definitive answer—the cat being either dead or alive. In quantum computing, wavefunction collapse presents a real issue because errors induced by unavoidable interactions with its environment look very much like measurements and can lead to a breakdown of the very quantum state you are trying to do a computation with. Methods have been introduced to correct those errors, which are then fed back into the system to keep the quantum state functional. Schindler *et al.* show that such error correction strategies can be used to undo a quantum measurement. Using a system of cold atoms and a series of laser

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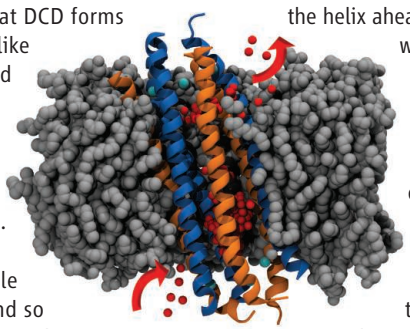
pulses, they distributed some of the knowledge they had of the quantum state of the atom of interest across the whole system. In doing so, they have shown that the state of a particular atom can be measured, but that it can be returned to the same superposition state (being both alive and dead) that it was in before the measurement. Such manipulations should lead to Schrödinger's cats with more than nine lives and, perhaps, simpler architectures for quantum processors. — ISO

Phys. Rev. Lett. **110**, 070403 (2013).

MICROBIOLOGY

AMPs In Action

Antimicrobial peptides (AMPs) provide an important first-line defense against bacteria and fungi in multicellular organisms. They do so by targeting the microbial cell membrane, but their precise mechanisms of action are not well understood. Song *et al.* used a combination of x-ray crystallography, electrophysiology, and molecular dynamics simulations to better understand the mechanism of one such AMP: dermcidin (DCD). DCD is secreted into human sweat and found on the skin. It is active against a range of bacteria, including methicillin-resistant *Staphylococcus aureus* and *Mycobacterium tuberculosis*. The authors' analysis revealed that DCD forms a hexameric barrel-like channel of elongated α helices in bacterial membranes. Stabilization of the channel required the presence of zinc. The channel formed was highly permeable to water and ions and so was a major membrane disruptor. This ability to disrupt the transmembrane potential of bacterial cell membranes can lead to rapid cell death and thus provide protective antimicrobial activity to the host. — KLM



CREDIT: CHEN SONG

Proc. Natl. Acad. Sci. U.S.A. **110**, 10.1073/pnas.1214739110 (2013).

EDUCATION

Owning Up

One argument in favor of inquiry-based instruction is that it provides students with a sense of ownership over their learning. How do we characterize student ownership? Hanauer *et al.* examined the idea of project ownership among undergraduates involved in different types of laboratory experiences. A quantitative method for assessing project ownership was developed using both content and computational linguistic analysis of transcribed student interviews. A set of 14 elements, both positive and negative, that influenced the degree of project ownership experienced by a student was constructed. Five elements were found to foster student project ownership: facilitating personal agency, personal significance of the research project, scientific value of the scientific inquiry, social interaction and mentorship, and research that demands problem solving. Because the interviews for this study were conducted in 2008, the degree of student ownership could be correlated with the persistence of a scientific career. Students that expressed a higher level of project ownership also persisted further in science. — MM

CBE—Life Sci. Educ. **11**, 378 (2012).

MOLECULAR BIOLOGY

Mapping Supercoils

During transcription, the two strands of double-helical DNA must be locally separated, so that the RNA polymerase can transcribe the DNA, and then the helix must be resealed again. Opening the two strands and then moving this opening along the DNA as the template DNA strand is fed through the polymerase causes the helix ahead of the opening to be over-wound (positively supercoiled) and the helix behind the opening to be under-wound (negatively supercoiled). Either state has the potential to generate a topological impediment to transcription.

Kouzine *et al.* developed a method using the DNA cross-linking agent psoralen to map transcription-dependent supercoiling across the genome of human tissue culture cells. They find that, on average, negative supercoiling is prominent up to 1.5 kb upstream of the transcription start sites (TSSs) of moderately or strongly activated genes. Dynamic supercoiling was not associated with enhancers, regardless of the distance from their associated promoters. Topoisomerase I and II, enzymes that can dissipate supercoils, were found to act redundantly at moderately active genes, whereas topoisomerase II acted preferentially at the TSS of highly active genes. The results suggest that dynamic supercoiling is caused by frictional restriction of DNA twist diffusion and that it does not seem to be confined by fixed boundaries in chromatin. — GR

Nat. Struct. Mol. Biol. **20**, 10.1038/nsmb.2517 (2013).

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