

# RESEARCH

Toward an insect  
evolution resolution  
*Misof et al., p. 763*



IN SCIENCE JOURNALS

Edited by Stella Hurtley



## ANIMAL BEHAVIOR

### Competing bats jam one another's signal

**A**nimals that live in large social colonies may benefit from many aspects of group living, but also have to contend with many of the downsides of living and foraging, with countless neighbors. Corcoran and Conner show that Mexican free-tailed bats, which live in colonies that can number in the hundreds of thousands, deal with this high level of competition for food by actively jamming competitors' echolocation. The interfering bats produce an ultrasonic signal just as the foraging bat produces its feeding call, effectively jamming the echolocation signal and causing the forager to miss its target. — SNV

*Science*, this issue p. 745

Free-tailed  
bats in flight

## BIOCHEMISTRY

### Protein folds as phosphorylation sites

Proteins fold into complex three-dimensional structures, yet most modification sites in proteins have been identified in short linear consensus motifs in the primary amino acid sequence. Duarte *et al.* found that kinases can recognize a consensus site that is formed by noncontiguous parts of the folded substrate

protein. They characterized such a "structurally formed" consensus site in a substrate for the kinase PKC and identified structurally formed consensus sites in other substrates of PKC and of another kinase, PKA. Thus, researchers need to look at both the linear sequence and the three-dimensional structure to identify all the potential phosphorylation sites in a protein. — NRG

*Sci. Signal.* **7**, ra105 (2014).

## THE RIBOSOME

### Making mitochondrial hydrophobic proteins

Mitochondria produce chemical energy for the cell. Human mitochondria have their own specific ribosomes—mitoribosomes, which are distinct from cytoplasmic ribosomes. Mitoribosomes synthesize the mitochondrial membrane proteins that generate the chemical energy.

Brown *et al.* used cryo-electron microscopy to determine the high-resolution structure of the large subunit of the human mitoribosome. The mitoribosome has a number of unique features, including an exit tunnel lined with hydrophobic amino acid residues. — GR

*Science*, this issue p. 718

## PHOTOCHEMISTRY

### Doubling up on optically driven catalysis

During photosynthesis, plants absorb light from the Sun four consecutive times before they accumulate enough energy to make oxygen from water. In contrast, when chemists harness light energy to promote reactivity, they tend to rely on single discrete absorption events. Ghosh *et al.* now show that a particular dye molecule can channel the combined energy from two absorbed photons to the reduction and subsequent coupling reactions of aryl halide molecules. The method expands the reach of photocatalysis to a broader range of compounds, such as chlorides, which are too stable to breach with a single photon. — JSY

*Science*, this issue p. 725

## QUALITY CONTROL

### Trashing misfolded membrane proteins

Proteins move to and from the inner nuclear membrane (INM) from the rest of the endoplasmic reticulum through the nuclear pores. This movement is tightly controlled. Consequently, the INM accumulates a specific

set of proteins required for a variety of functions, including chromosome organization and transcriptional control. But when INM proteins misfold, how are they eliminated? Foresti *et al.* addressed this question in yeast and found that a previously elusive branch of the endoplasmic reticulum-associated degradation system was key (see the Perspective by Shao and Hegde). — SMH

*Science*, this issue p. 751; see also p. 701

## EARLY UNIVERSE

### A diffuse cosmic glow is not primordial

A cumulative map of all photons ever emitted by any star or galaxy is a highly desirable historical record of the universe's evolution. For this reason, cosmologists have sought to measure this diffuse distribution of light: the extragalactic background light. Zemcov *et al.* sent up a rocket to measure the fluctuations in this faint background and found large-scale fluctuations greater than known galaxies alone should produce (see the Perspective by Moseley). Stars tidally stripped from their host galaxies are the most likely culprit, rather than unknown primordial galaxies. — MMM

*Science*, this issue p. 732; see also p. 696



Rocket launch June 2013

CREDITS: (LEFT TO RIGHT) TOSHIKAZI ARAI; MEDICALRF/SCIENCE SOURCE

## NOROVIRUS

### Bacteria help norovirus infect B cells

Stomach ache, nausea, diarrhea—many people know the sort of gastrointestinal havoc norovirus can wreak. Despite this, norovirus biology remains unclear, because human norovirus cannot be grown in culture. Jones *et al.* now report that with the help of bacteria, human norovirus can infect cultured B cells (see the Perspective by Robinson and Pfeiffer). To infect B cells, human norovirus required the presence of gut bacteria that expressed proteins involved in determining blood type. Mouse norovirus also infected B cells, and the treatment of mice with antibiotics protected them from norovirus infection. — KLM

*Science*, this issue p. 755; see also p. 700

## EARLY EARTH

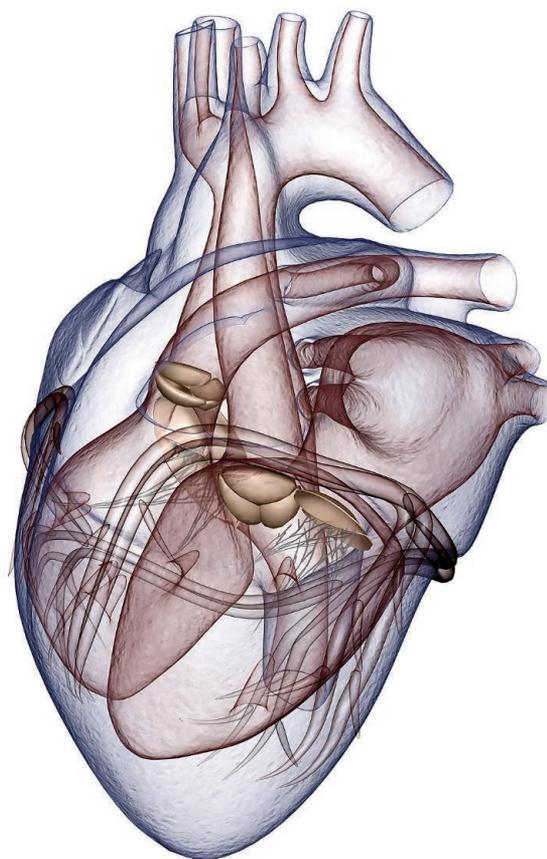
### Dissecting ancient microbial sulfur cycling

Before the rise of oxygen, life on Earth depended on the marine sulfur cycle. The fractionation of different sulfur isotopes provides clues to which biogeochemical cycles were active long ago (see the Perspective by Ueno). Zhelezinskaia *et al.* found negative isotope anomalies in Archean rocks from Brazil and posit that metabolic fluxes from sulfate-reducing microorganisms influenced the global sulfur cycle, including sulfur in the atmosphere. In contrast, Paris *et al.* found positive isotope anomalies in Archean sediments from South Africa, implying that the marine sulfate pool was more disconnected from atmospheric sulfur. As an analog for the Archean ocean, Crowe *et al.* measured sulfur isotope signatures in modern Lake Matano, Indonesia, and suggest that low seawater sulfate concentrations restricted early microbial activity. — NW

*Science*, this issue p. 703, p. 742, p. 739; see also p. 735

## IN OTHER JOURNALS

Edited by Kristen Mueller and Jesse Smith



## BIOMEDICINE

### Disease biomarkers: What's the risk?

With approximately 60% of cardiac events occurring in patients of low or moderate risk, doctors need new biomarkers to accurately predict which of their patients will develop disease. Antibodies targeting the protein apolipoprotein A-1 (apoA-1), which plays a role in lipid metabolism, are one such candidate. Some of these antibodies may confer more risk than others, depending where on apoA-1 they bind. Using serum samples from cardiac patients, Teixeira *et al.* identified the peptides within apoA-1 where antibodies bound. These findings may point toward new therapeutic opportunities and improved biomarkers for predicting the risk of cardiovascular disease. — MDC

*J. Biol. Chem.* 10.1074/jbc.M114.589002 (2014).

## EDUCATION

### One scoring rubric to rule them all

Evaluating the effectiveness of undergraduate STEM (science, technology, engineering, and mathematics) courses requires assessing teaching practices.

This is largely done through student course evaluations, which often have not been administered or collected in a consistent manner. To standardize this process, Wieman and Gilbert developed a rubric that assigns points to each teaching practice for which there

## ALSO IN SCIENCE JOURNALS

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## NANOMATERIALS

**Casting gold and silver with DNA origami**

Controlling the size and shape of nanoparticles synthesized in solution can be challenging, especially if the goal is to create less symmetric shapes for use in electronic and plasmonic applications. Sun *et al.* show that DNA “origami”—nanostructures in which the contacts between DNA strands are designed to assemble a particular shape—are sufficiently stiff to act as a mold for the growth of gold and silver nanostructures. The authors created shapes, including a gold particle with a rectangular cross section and a silver triangle with designed plasmonic properties. — PDS

*Science*, this issue p. 717

## LOCAL TRANSLATION

**The wheres and whys of protein translation**

Localized protein synthesis is important for a broad range of biological activities, from specifying the animal body plan to coordinating entry into the secretory pathway.

Few tools are available that can investigate translation at specific subcellular sites. Jan *et al.* present a flexible ribosome profiling–based methodology to enable precise characterization of localized protein synthesis (see the Perspective by Shao and Hegde). Proximity-specific ribosome profiling provides a high-precision tool for looking at the mechanism of localized protein targeting and synthesis in living cells. The approach yielded a high-resolution systems-level view of cotranslational translocation at the endoplasmic reticulum. Williams *et al.* applied the technique to look at localized mRNA translation at the mitochondrial outer membrane. — SMH

*Science*, this issue p. 716, p. 701; see also p. 748

## QUANTUM SPIN LIQUIDS

**Nailing down a quantum spin liquid**

Quantum spin liquids (QSLs) possess magnetic interactions that, even at absolute zero temperature, remain in a disordered liquid-like spin state. It is very

difficult to prove unambiguously that a material is a QSL, because there is always a possibility that it can become ordered below the lowest measured temperature. Barkeshli *et al.* used quantum field theory to propose a direct way to identify a QSL by placing it in contact with other exotic materials, such as superconductors or magnets. The theory predicted that, at such a boundary, electrons entering the QSL would turn into excitations lacking charge or lacking spin. Future experiments may be able to detect this transmutation. — JS

*Science*, this issue p. 722

## PHASE TRANSFORMATION

**Melting can follow many pathways**

Melting involves the loss of order as additional kinetic energy is added to a system. Although simple models of this sort of phase transition exist, it can be very difficult to observe the initial stages either experimentally or using simulations. Samanta *et al.* developed a robust rare-event sampling technique that makes it possible to examine melting events without needing

excessive computing time (see the Perspective by van de Walle). For both copper and aluminum, they observed the formation of defects that act as starting points for the melting process rather than the homogeneous loss of order assumed in classic nucleation theory. — MSL

*Science*, this issue p. 729

## HIV ENTRY

**HIV’s shape-shifting envelope protein**

HIV’s envelope protein (Env) coats virus particles and allows HIV to enter host cells. HIV entry is highly dynamic. Env proteins work in groups of three (called trimers), which bind to the viral receptor and co-receptor, both expressed by host cells. Viral receptor binding causes a structural rearrangement in the trimer that allows for co-receptor binding and finally, viral entry. To visualize dynamic changes in Env conformation during viral entry, Munro *et al.* added differently colored fluorescent tags to two different regions of individual HIV trimers. Single-molecule

fluorescence resonance energy transfer revealed three distinct Env conformations before cell entry. Occupation of particular conformations depended on host receptor binding. — KLM

*Science*, this issue p. 759

## INSECT PHYLOGENOMICS

### Toward an insect evolution resolution

Insects are the most diverse group of animals, with the largest number of species. However, many of the evolutionary relationships between insect species have been controversial and difficult to resolve. Misof *et al.* performed a phylogenomic analysis of protein-coding genes from all major insect orders and close relatives, resolving the placement of taxa. The authors used this resolved phylogenetic tree together with fossil analysis to date the origin of insects to ~479 million years ago and to resolve long-controversial subjects in insect phylogeny. — LMZ

*Science*, this issue p. 763

## EVOLUTION

### On the hunt for a fourth domain of life

All known living organisms belong to one of three broad domains: archaea, bacteria, and eukaryotes.

But could there be life on Earth so different that it defines a novel fourth domain? In a Perspective, Woyke and Rubin explain that scientists may have missed signs of such unusual organisms. Powerful genomic technologies overcome the limitations of earlier searches and allow scientists to characterize microbes that cannot be grown in the laboratory. With these advanced tools, we may now be poised to discover fourth-domain organisms—if they exist. — JFU

*Science*, this issue p. 698

## HEPATITIS C VIRUS

### Toward an ounce of HCV prevention

Chronic hepatitis C virus (HCV) infection causes liver inflammation that can reduce liver function or even cause liver failure. Recent approval of antiviral drugs for HCV provides treatment options; however, these new therapies are expensive, with limited availability, leaving the door open for preventative approaches such as vaccines. Now, Swadling *et al.* report a preliminary trial of a prime-boost vaccine strategy for HCV in human patients. The strategy induced an immune T cell response similar to one that can control HCV in natural infection. — ACC

*Sci. Transl. Med.* **6**, 261ra153 (2014).