the complexity of the structure imprinted onto the photons.
— ISO
Science, this issue p. 857; see also p. 828

GALAXY EVOLUTION
Finding the necessary negative feedback
The evolution of galaxies seems to be tied to the growth of the supermassive black holes at their centers, but it’s not entirely clear why. Models have suggested a mechanism in which the growth of the black hole results in an outflow of gas that interrupts star formation. However, evidence for enough of this negative feedback has been lacking. Nardini et al. now see a signature in x-ray spectra of a strong persistent outflow in the quasar PDS 456. They estimate a broad solid angle spanned by the wind that enables a far greater impact on the host galaxy than narrower jet outflows.
— MMM
Science, this issue p. 860

PHOTOCHEMISTRY
The dark side of melanin exposed
Sun worshippers may have more to worry about than the DNA damage that occurs while they’re relaxing on the beach. It seems that the DNA photoproducts responsible for cancer-causing mutations in skin cells continue to be generated for hours after sunlight exposure. Premi et al. find that a key mediator of this delayed damage is melanin, a pigment thought to protect against skin cancer (see the Perspective by Taylor). They propose a “chemiexcitation” model in which reactive oxygen and nitrogen species induced by ultraviolet light excite an electron in melanin fragments. This energy is then transferred to DNA, inducing the same damage as ultraviolet light, but in the dark. Conceivably, this energy could be dissipated by adding quenchers to sunscreens.
— PAK
Science, this issue p. 842; see also p. 824

TRANSITION STATES
A transition state holds a pose
The transition state of a chemical transformation is inherently fleeting because the structure is high in energy. Nonetheless, Pearson et al. trapped a classical example of a bond rotation transition state using a modified protein (see the Perspective by Romney and Miller). The biphenyl molecule passes through an energy maximum when its rings rotate through a parallel position. A pocket within the editing domain of threonyl–transfer RNA synthetase was modified to stabilize parallel biphenyl rings, allowing further characterization of this normally transient structure.
— PDS
Science, this issue p. 863; see also p. 829

CANCER
How Pez dispenses with metastasis
Tumor cells have greater numbers of growth-promoting receptors on their surface and release factors that promote metastasis. Belle et al. found that the protein tyrosine phosphatase PTPN14 (also called Pez) prevented receptors from moving to the cell surface and pro-metastatic factors from being released. Mice with breast cancer xenografts that lacked Pez had larger tumors and more metastases.
— LKF

MATERIALS SCIENCE
Microporous mechanics
Metal-organic framework (MOF) materials, in which metal ions or inorganic clusters are linked together by organic ligands to form cages, are highly porous and potentially useful for gas storage. However, repeated cycles of adsorption and desorption mechanically stress these materials and reduce their functionality. With transmission electron microscopy, Su et al. examined the effects of compression on individual micrometer- and submicrometer-scale crystals of a zinc zeolitic-imidazolate framework compound. The presence of methanol in the pores made the crystals much more rigid; they shattered when similar forces would have caused only plastic deformation of the empty framework.
— PDS

T CELL METABOLISM
Flexibility lets activated T cells thrive
For T cells, fighting infections is demanding work. They must proliferate many times over and quickly produce a myriad of antimicrobial factors. T cells do this by switching from mitochondrial to glycolytic metabolism, but what happens when nutrients are scarce, such as in infected tissues or tumors? Blagih et al. examined this question by starving...
Solving the “tyranny of the short”

At an unknown but momentous point in the origin of life on Earth, nucleic acids became the dominant self-replicating molecules. There’s a problem, however, because normally, shorter nucleic acid polymers replicate faster than longer ones and outcompete them, with a subsequent loss of genetic information. Kreysing et al. studied DNA replication in a tiny pore with a thermal gradient across its width and a steady fluid flow along its length. In this confined space, perhaps similar to a pore within a rock, the longer nucleic acid chains outcompete their smaller brethren, which are diluted out of the pore. — GR

Early self-replication may have started deep within rocks, like these white smokers.


Genomics

What are the genomic requirements for life?

To promote identification and understanding of the minimal set of genomic elements required for life, Lluch-Senar et al. studied M. pneumonia. This small bacterium has an 816-kb genome with about 700 open reading frames, of less than 100 residues, made up slightly to be essential. Small open reading frames; about a set of genomic elements under an unknown but momentous point in the origin of life on Earth, nucleic acids became the dominant self-replicating molecules. There’s a problem, however, because normally, shorter nucleic acid polymers replicate faster than longer ones and outcompete them, with a subsequent loss of genetic information. Kreysing et al. studied DNA replication in a tiny pore with a thermal gradient across its width and a steady fluid flow along its length. In this confined space, perhaps similar to a pore within a rock, the longer nucleic acid chains outcompete their smaller brethren, which are diluted out of the pore. — GR


Wisdom of the crowd, waning

Many researchers, agencies, and companies are turning to “the crowd” for help with data collection and analysis, but we lack systematic understanding of who those volunteers are and how they perform. Such insights might help expand and improve crowd sourcing for research. Sauermann and Franzoni draw on over 12 million daily observations of more than 100,000 users across seven projects on the Zooniverse platform. They estimate that the average project received volunteer labor worth roughly $220,000 during the first 180 days. But 79% of the effort, on average, was provided by the most productive 10% of users. Roughly 75% of users failed to participate in a project after their first session, and even those who returned multiple times did so with increasingly long breaks between visits. Significant effort is expended by new users who join over time, but this does not offset the loss of effort from original users. — BW


Crowd Science

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Neurodevelopment

Growth cones carve a path through tissues

A growth cone leading a neuron’s path through tissues is like the invadosomes, fingers that poke out into the surrounding tissue, are packed with cytoskeleton and exude proteases that degrade the extracellular matrix. The invadosomes were key for Xenopus motoneurons trying to find a path out of the spinal cord and into the developing musculature. — PJH


Evolutionary biology

Finch genomes and human face shapes

The beak shapes of 15 Galápagos finch species, each optimized for its island’s most ample food source, helped shape Charles Darwin’s ideas on evolution. Now, scientists have a genetic link: Lamichhaney et al. sequenced the genomes of 120 individual birds and found a gene, ALX1, which varies between species with large or small, pointy or dull beaks. In humans, mutations in this gene are linked to frontonasal dysplasia, a birth defect ranging in severity from a cleft palate to skull malformations. Smaller variations in ALX1 could be behind the diversity of our face shapes. — SW


Planetary science

Why the “Y” in the Venetian sky?

Venus has its own version of Jupiter’s Great Red Spot, an enormous Y-shaped feature which comes and goes on a monthly cycle. The origin and stability of the atmospheric feature, visible only in ultraviolet photographs, have perplexed observers for decades. Peralta et al. take a fresh look at this persistent structure with an updated analytic atmospheric model. A wind-distorted equatorial wave reproduces the morphology, darkness, and time evolution of the “Y.” The model should be applicable to the atmospheres of other slowly rotating bodies, in our solar system and beyond. — BG

What are the genomic requirements for life?
L. Bryan Ray

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