

lubricant because the friction between sheets is minuscule under certain circumstances. Kawai *et al.* show that the same ultra-low frictional properties extend to other surfaces. They find ultralow friction when dragging graphene nanoribbons across a gold surface using an atomic force microscope. This discovery sets up the potential for developing nanographene frictionless coatings. — BG

Science, this issue p. 957

FOREST ECOLOGY

Leaf seasonality in Amazon forests

Models assume that lower precipitation in tropical forests means less plant-available water and less photosynthesis. Direct measurements in the Amazon, however, show that production remains constant or increases in the dry season. To investigate this mismatch, Wu *et al.* use tower-based cameras to detect the phenology (i.e., the seasonal patterns) of leaf dynamics in tropical tree crowns in Amazonia, Brazil, and relate this to patterns of CO₂ flux. Accounting for age-dependent variation among individual leaves and crowns is necessary for understanding the seasonal dynamics of photosynthesis in the entire ecosystem. Leaf phenology regulates seasonality of the carbon flux in tropical forests across a gradient of climate zones. — AMS

Science, this issue p. 972

CANCER

Managing metastasis

Because of the poor prognosis of metastatic cancer, it is critical to determine exactly how various factors contribute to cancer spread. Mlecnik *et al.* examined the impact of tumor-intrinsic, microenvironmental, and immunological factors on tumor metastasis in colorectal cancer patients. A decrease in the presence of lymphatic vessels and a reduction in immune cytotoxicity was associated more

strongly with the metastatic process than were tumor-intrinsic factors such as chromosomal instability or cancer-associated mutations. Testing this so-called Immunoscore could be used as a biomarker to predict metastasis and guide therapy. — ACC

Sci. Transl. Med. **8**, 327ra26 (2016).

CELL MIGRATION

Control cAMP to control migration

Activation of the G protein-coupled receptors that stimulate cellular migration generates active G protein α and $\beta\gamma$ subunits. These subunits then interact with distinct effector molecules. Using a small molecule that activates $\beta\gamma$ subunits without activating α subunits in neutrophils, Surve *et al.* determined that active $\beta\gamma$ subunits alone increased the intracellular concentration of the second messenger cAMP so much that the cells stuck to coated surfaces. Active G protein α_i subunits balanced this $\beta\gamma$ signal, reducing cAMP sufficiently to enable the cells to move. — JFF

Sci. Signal. **9**, ra22 (2016).

CIRCADIAN RHYTHMS

Layered versatility atop circadian clocks

The circadian clock evolved to allow cells or organisms to anticipate changes in physiological requirements associated with Earth's 24-hour light/dark cycle. Some activities, however, need to occur out of phase with the core clock. Liang *et al.* imaged changes in intracellular concentration of Ca²⁺ in populations of neurons in the fruit fly brain. Although the underlying clock was synchronous, the rhythms of Ca²⁺ changes corresponded with distinct timing of activities associated with activity of the particular neuronal populations. Proper coordination of these distinct phases required expression of the neuropeptide pigment-dispersing factor and its receptor. — LBR

Science, this issue p. 976

IN OTHER JOURNALS

Edited by **Kristen Mueller** and **Jesse Smith**



Amazonian *Heliconious* butterflies show incredible diversity in wing patterning

STELLAR EVOLUTION

Red giants can get dusty with age

When a low-to-intermediate-mass star exhausts the hydrogen in its core, its temperature and luminosity evolve in a well-known sequence. During the post-asymptotic giant branch (post-AGB) stage, the star throws off its outer layers, forming copious amounts of dust. Kamath *et al.* have found a previously unrecognized group of stars whose evolution seems to have been interrupted at the earlier red giant branch (RGB) stage, appearing as dusty "post-RGB" stars. They speculate that these stars may form in a binary system, either by a companion stripping off the outer layers of the star before it reaches the AGB, or by the two stars merging. — KTS

Astron. Astrophys. **586**, L5 (2016).

OPTICS

Polarimetry takes to a new plane

Polarimetry involves the measurement of polarization of light. Polarization can be used in characterization of a material, in remote sensing applications, or

even as a degree of freedom for the encoding of information in an optic fiber. Determining the polarization of an optical signal typically involves bulk optical components such as lenses, beam splitters, and birefringent crystals; which can quickly become unwieldy for complex optical applications. Mueller *et al.* take a nanophotonics approach, which uses patterned planar arrays of subwavelength metal antennas, or metasurfaces, designed to scatter light, depending on the specific polarization properties of the light. The demonstration should pave the way for ultracompact on-chip polarimetry applications in sensing, characterization, and optical communication. — ISO

Optica **3**, 42 (2016).

ECOLOGY

It's tough for life on a plastic planet

We dump an estimated 4 to 12 million tons of plastic waste into the oceans every year. This plastic breaks down into tiny pieces called microplastic particles, which can be ingested by marine life, causing unknown effects. To assess the impact of



EVOLUTIONARY GENETICS

How new wing patterns evolve

Butterflies show enormous diversity in wing patterning, so much so that many species can be identified by their wing patterns alone. Differences in gene expression underlie pattern variation between closely related species. To better understand this, Wallbank *et al.* examined the genetic elements that control the expression of *optix*, which encodes a transcription factor that determines red patterning in Amazonian *Heliconius* butterflies. The authors identified two distinct genetic regions that affect *optix* expression and hence the pattern of colors on the wing. These elements appear to have evolved in separate species but were brought together when these species hybridized, demonstrating that regulatory elements introduced by new species can cause phenotypes to evolve. — LMZ

PLOS Biol. **14**, e1002353 (2016).

microplastic particles, Sussarellu *et al.* exposed Pacific oysters to polystyrene microspheres. The oysters efficiently ingested the microspheres but to ill effect. The microspheres interfered with their digestion and affected fecundity, lowering egg and sperms counts. Some negative effects also carried over to the next generation. Overall, their findings suggest that microplastic particles affected the oysters' ability to acquire and allocate energetic resources. — GR

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1519019113 (2016).

MEMORY CONSOLIDATION

Storing emotional memories

When we remember events, we often also remember what we were feeling at the time. Cambiaghi *et al.* asked where in the brain we store such connections. To answer this, they conditioned rats to associate a tone with an unpleasant experience. They then simultaneously recorded from two brain regions, the higher-order auditory cortex and the amygdala, 1 day and 1

month after the conditioning. Animals displayed fearful behavior at both time points, and both areas showed learning-evoked changes. However, the two brain regions only interacted significantly after 1 month had passed. The degree of interaction predicted the animals' ability to recognize the tone as unpleasant. — PRS

J. Neurosci. **36**, 1647 (2016).

MATERIALS SCIENCE

Two ways to surface recovery

Superhydrophobic surfaces often rely on specific surface chemistry or texturing to provide their extreme water repellency. Surface damage results in a loss of this property, although progress has been made in making self-healing materials that can restore either the surface architecture or chemistry. Lv *et al.* developed an epoxy shape-memory polymer with a lotus leaf-like surface texture that gives it superhydrophobicity. When damaged with an O₂ plasma or physically crushed, the surface properties can be restored simply by heating the material to 85°C, with full

restoration occurring even after several cycles of damage and recovery. — MSL

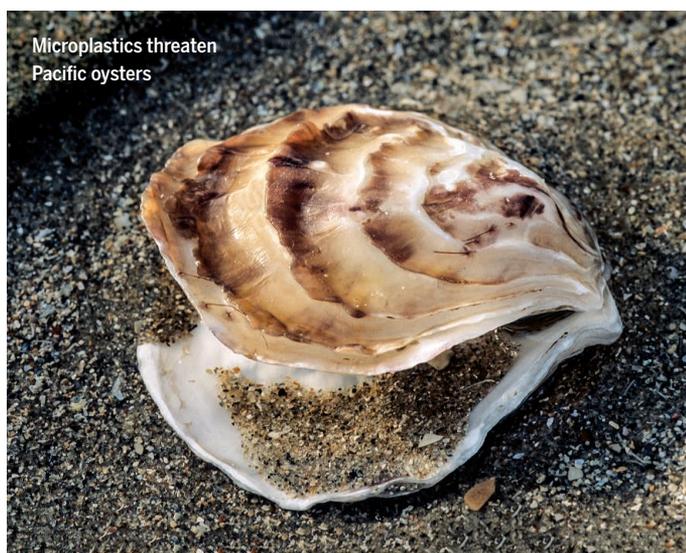
Small 10.1002/sml.201503402 (2016).

INFLUENZA

Influenza HA needs stability to spread

Influenza pandemics occur every few decades, but scientists still do not understand why only some strains cause pandemics. To enter host cells, the virus' hemagglutinin (HA) protein must undergo a pH-driven conformational change. During the 2009 pandemic, a swine H1N1 virus jumped to humans. Russier *et al.* now report that for swine H1N1, the HA conformational switch occurs at pH 5.5 to 6.0. In viruses isolated from humans, the pH of the switch changed from 5.5 to 5.6 early in the pandemic to 5.0 to 5.4 later in the pandemic. A swine H1N1 with HA mutated to switch at pH 6 was less pathogenic in mice and ferrets. The lower-pH switching probably increases HA stability in the upper respiratory tract. — VV

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1524384113 (2016).



Microplastics threaten Pacific oysters

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Science

Storing emotional memories

Peter Stern

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