

EDITORS' CHOICE

edited by Stella Hurtley

IMMUNOLOGY

Soft Landing

Successful embryo implantation can be threatened by inflammation at the site where the blastocyst invades the endometrium. This risk is most significant when paternal proteins differ from those of the mother, because this can provoke a response against the embryo from the maternal immune system. Several mechanisms may explain how this is normally suppressed, including expression of ligands or suppressive factors by trophoblast cells that hinder lymphocyte activity.

Makrigiannakis *et al.* describe how corticotrophin-releasing hormone (CRH) produced by various cell types after implantation might act to dampen T cell responses within the pregnant womb. In culture, CRH increased expression of Fas ligand (Fas-L) on trophoblast-derived cell lines, which in turn induced apoptosis in activated T cells. A CRH receptor antagonist that impeded Fas-L expression was

able to prevent T cell death and, when administered to rats, cut the rate of successful implantation and pregnancy by half. This depended on the presence of T cells capable of reacting against paternal proteins, suggesting that hormone induction of Fas-L may offer the developing embryo protection against the unwanted attention of T cells. — SJS

Nature Immunol., 10.1038/ni719.

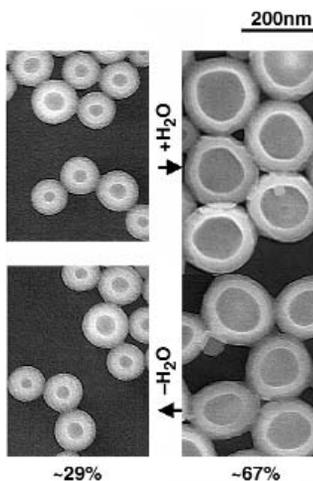
POLYMER SCIENCE

Sizing Vesicles Up and Down

When block copolymers (in which "blocks" of dissimilar polymers are connected in a single chain) are placed in solution, they can behave like surfactants if the two blocks of the polymer have differing affinities for the solvent and thus form micelles, spheres, cylinders, and vesicles.

Luo and Eisenberg studied a system of polystyrene-*b*-poly(acrylic acid) (PS-*b*-PAA) in a mixed solvent, where vesicles form with a hydrophobic PS

corona sandwiched between hydrophilic PAA inner and outer shells. The size of the vesicles is thermodynamically (and reversibly) controlled by solvent composition. Increasing the water content raises the interfacial



Changes in water content of solvent (from ~29 to ~67%) change vesicle size from ~100 to 200 nanometers, respectively.

energy and increases the vesicle size. For small vesicles, segregation is observed between the long PAA segments that migrate to the outside of the vesicle and the short blocks that remain inside. Small changes in solvent composition lead to rapid and dramatic changes in the equilibrium vesicle size, which indicates that there is a constant flux in the vesicle sizes, possibly through fusion and fission mechanisms. — MSL

Langmuir, 10.1021/la0104370.

PHYSICS

Atom Lasers—It's a Matter of Time

The cooling of a cloud of bosonic atoms to such low temperatures that they form a quantum-degenerate gas, or Bose-Einstein condensate, promises to provide the matter analog of the laser, in which a beam of coherent atoms would replace photons.

Any temporal fluctuations in the phase of the condensate would be passed on to an extracted beam of atoms forming the atom laser, and thus these fluctuations will limit the coherent properties of such an atom beam. It is thus necessary to know just what those limitations are. So far, however, only the spatial coherence of condensates has been probed, by optically splitting the matter wave and bringing it back together, allowing it to interfere with itself. Information about the temporal properties is lacking.

A technique has now been developed by Köhl *et al.* that can yield information on the temporal coherence of the condensate. A matter wave is reflected back on itself, and the self-interference between the front of the atom wavepacket and its back end produces a standing wave. The shape and structure of the standing wave can be used to determine the temporal coherence of the condensate. — ISO

Phys. Rev. Lett. **87**, 160404 (2001).

CLIMATOLOGY

A Hot Record of a Cooling Climate

Earth's climate has generally cooled during the past 50 million years or so. Large ice sheets first formed in Antarctica, though the exact timing of their growth has been debated. Their development is important because the presence of large ice sheets affects Earth's climate and oceans greatly.

When magma intrudes into the upper crust, its heat drives vigorous hydrothermal systems, as is currently happening, for example, in Yellowstone Park and in New Zealand. The heated ground water alters the rocks of the shallow crust. The hydrogen isotope composition of the altered rocks can then provide information about the air temperatures when the wa-

ECOLOGY/EVOLUTION

Hidden Benefits of Spawning Salmon

Salmon return from the sea to the freshwater breeding grounds of their birth to spawn and die. In doing so, they import ocean-derived mineral nutrients that fertilize the riparian ecosystem. The effect of this mineral import has been quantified by Helfield and Naiman for a site in southeast Alaska. Using isotopic analysis, which can identify marine-derived elements, they find that at least one-fifth of the nitrogen (N) in the needles of Sitka spruce trees and other plants near spawning sites comes from the ocean via Pacific salmon carcasses. Growth rates of trees near spawning sites were significantly higher than in reference sites. These marine subsidies to inland ecosystems are likely to decline as Pacific salmon become increasingly rare. — AMS



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Ecology **82**, 2403 (2001).

ter evaporated and formed as rain or snow. By analyzing fossil hydrothermal systems of different ages, Dallai *et al.* show that the temperatures over Antarctica cooled dramatically about 40 million years ago, consistent with an onset of glaciation shortly thereafter. — BH

Geology 29, 931 (2001).

EARTH SCIENCE

Understanding Environmental Change

Carbon dioxide (CO₂) is an important component in Earth's radiative energy budget and acts as a bridge between organic and inorganic biogeochemical domains. Knowing how the concentration of CO₂ in the atmosphere has varied is thus essential for understanding environmental change. Atmospheric CO₂ concentrations can be measured directly, from bubbles of air trapped in polar ice, for as far back as 400,000 years ago, the age of the oldest Antarctic ice cores. For periods older than this, geochemical models and proxies must be used to provide indirect estimates.

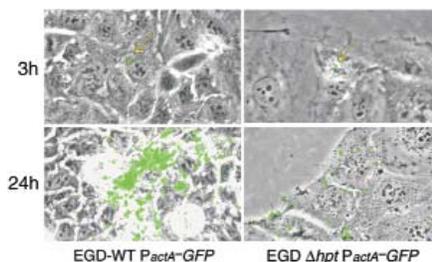
Royer *et al.* discuss the theory and use of geochemical modeling of the long-term carbon cycle, and four paleo-pCO₂ proxies (the δ¹³C of pedogenic carbonates, the δ¹³C of marine sedimentary organic carbon, the stomatal density of land plants, and the δ¹¹B of marine calcium carbonate) commonly employed in atmospheric reconstructions. Models, which can be applied across the entire Phanerozoic, have low temporal resolution and increasingly large uncertainties with increasing age. Proxies can provide better resolution and precision but are subject to a variety of limitations and systematic errors that are not always easy to estimate. — HJS

Earth Sci. Rev. 54, 349 (2001).

MICROBIOLOGY

Lethal Injection

Although a few intracellular bacterial pathogens, such as *Listeria monocytogenes*, can replicate within the cytosol of the host cell, most do so within a modified vacuolar compartment. To work out why and how some bacteria replicate in the cytosol when others do not, Goetz *et al.* used microinjection to circumvent normal phagocytotic uptake of bacteria. Contrary to dogma, they discovered that normally vacuole-dwelling bacteria such as *Salmonella enterica* and *Legionella pneumophila* could not replicate when injected directly into the cytosol, unless the host cell was already unhealthy and undergoing apoptosis or necrosis. They also discovered that the only mutants of *L. monocytogenes* in which cytosolic replica-



Cells microinjected with bacteria (green) capable (left), or incapable (right) of replicating within the cytosol.

tion was hindered were those with disruptions in the *hpt* gene. *Hpt* encodes an uptake system for phosphorylated sugars and is regulated by the key transcriptional activator for virulence genes, PrfA. Thus, a major constraint to survival in the cytosol appears to be nutrient limitation although, in healthy cells, a role for antibacterial components cannot be ruled out. — CA

Proc. Natl. Acad. Sci., 10.1073/pnas.211106398.

HIGHLIGHTED IN SCIENCE'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT



Dendritic Spine Formation

Changes in the morphology of neuronal dendritic spines are correlated with changes in synaptic plasticity. The cell surface proteoglycan syndecan-2 is clustered at the surface of mature hippocampal neurons and is thought to regulate structural changes of the spines. Now Ethell *et al.* have demonstrated that syndecan-2 is phosphorylated on at least two tyrosine residues by the receptor-type tyrosine kinase EphB2 *in vitro* and *in vivo*. The two transmembrane proteins colocalized in dendrites of hippocampal neurons and were isolated in a complex from mouse brain neurons. Phosphorylation was required for their interaction, for syndecan-2 to cluster, and for normal dendritic spine formation in transfected neurons. Phosphorylation could trigger clustering of syndecan-2, and the EphB2–syndecan-2 complex may subsequently initiate the recruitment of downstream signaling molecules that control dendritic spine formation. — LC

Neuron 31, 1001 (2001).