EDITORS' CHOICE

EDITED BY KRISTEN MUELLER AND JESSE SMITH

ECOLOGY

Productive Trees

Forests in tropical Asia may capture carbon and produce wood half as fast again as South American forests. Banin *et al*. compared the growth rates of trees (as above-ground woody production) in permanent forest plots in northwest Amazonia and northern Borneo and found that Bornean forests produced wood at a 49% faster rate than their Amazonian counterparts. The differences remained even when soil conditions and rainfall were controlled for. The greater production in Borneo may partly reflect higher solar radiation, but another important factor appears to be the different tree species composition: Species of the dominant Southeast Asian tree family Dipterocarpaceae exhibit significantly higher production than other tree species in the sampled plots. These results suggest a potential for a key role for dipterocarp forest conservation and restoration to maintain and enhance carbon sequestration. — AMS

J. Ecol. 1111/1365-2745.12263 (2014).

EVOLUTION

Rock Soup

The fossil record of ancient microorganisms is difficult to disentangle, but the consensus is that complex life on Earth emerged during the Archean Eon, between 2.5 and 4 billion years ago. However, several biochemical processes, including the prebiotic synthesis of proteins and nucleic acids, must already have been established to form the structural and genetic basis of even the simplest life forms. The evolution of metabolic pathways is equally perplexing, yet was essential to allow life to develop autotrophy and adapt to different environments. Keller *et al.* exposed phosphorylated sugar intermediates—metabolites that form abiotically—to the harsh temperatures and chemical environment that were probably present in Earth's earliest oceans. With metals such as iron acting as catalysts instead of enzymes, they observed 29 interconversion reactions, including the formation of ribose 5-phosphate: the molecule that forms the backbone of RNA. Additionally, the formation of triose-, tetrose-, pentose-, hexose-, and sedoheptulose phosphates, which are components of modern central carbon metabolism, is consistent with the idea that metabolic reaction networks are of primordial origin and developed as a result of the specific geochemical environments present on early Earth. — NW

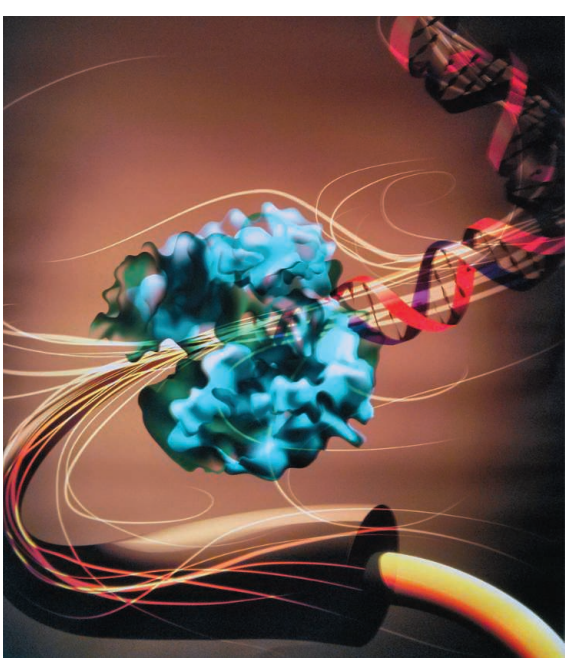
Mol. Syst. Biol. **10**, *725* (2014).

CHEMISTRY

Guiding Polymers with DNA

Insights into how a DNA template can guide the formation of conducting polymer nanowires have been obtained from atomic force microscopy (AFM), and molecular dynamics (MD), and coarse-grained simulations. Watson *et al.* prepared polypyrrole [poly(Py)] and poly-2,5-bis(2-thienyl)pyrrole [poly(TPT)] nanowires by mixing the oxidized monomers with $FeCl_3$ and bacteriophage lambda DNA templates in solution. The formation process was followed by removing solution at various times and depositing it on trimethylsilane-modified silica for AFM analysis. For poly(TPT), after 10 min, a low density of spherical polymer particles nucleated on the DNA; at 1 hour, the density and size of the particles increased and developed a beads-on-a-string morphology. By 4 hours, polymer particles began to merge and cover all of the DNA, and by 24 hours, a uniform wire with no distinct particles was seen. The process is similar for poly(Py) but is more rapid, and displays eariler elongation. The MD modeling studies show that DNA rotation promotes polymer binding in the initial stage, and the coarse-grained simulation shows that the smooth-wire formation is driven by a balance between adhesion to the DNA template and lowering the surface tension of the polymer. — PDS

J. Am. Chem. Soc. 10.1021/ja500439v (2014).



STEM CELLS

The Mechanics of Change

As embryonic stem cells differentiate toward specific cell fates, shifts in the gene regulatory network accompany progression through the different states: from pluripotency, where cells are competent to differentiate into any somatic cell; to a transition state; and finally to a differentiated state where cells are irreversibly committed to a particular cell fate. Pagliara *et al.* used atomic force microscopy to compare the elastic stiffness of mouse cells in each of these different fates. When compressing the cytoplasm of cells in all of these states, a 5 to 10% increase in the cytoplasmic area was observed. However, only nuclei of cells in the transition state became smaller upon compression. When materials become denser with such mechanical stress, they are termed auxetic. Differences in chromatin condensation were observed by electron microscopy of the three cell states with considerably less-condensed nuclei during transition relative to the pluripotent or differentiated state. This work shows that the nucleus undergoes dynamic changes in mechanical properties and chromatin structure as cells transition toward a differentiated state. It is proposed that this auxeticity may be important for cell mechanotransduction. — BAP

Nat. Mater. 10.1038/NMAT3943 (2014).

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CELL SIGNALING

Sensing Cellular Chloride

Control of the concentration of chloride ions is critical for the proper function of neurons, control of blood pressure, regulation of cell volume, and other physiological functions. Piala *et al*. reveal the molecular basis of a cellular calcium sensor that enables such regulation. Chloride ions are moved across cell membranes by transporters, and the activities of several of such transporters are regulated by phosphorylation though a cascade of protein kinases, the first of which is known as WnK1 [with no lysine (K) 1]. This protein kinase, the authors show, is itself a sensor for chloride concentration. In crystal structures of WnK1 bound by chloride ions, the ion was bound to the catalytic site of the enzyme. This inhibited autophosporylation of the enzyme and thus would lead to activation of appropriate transporters when the concentration of chloride ions dipped below normal. This regulation mechanism is distinct from well-known examples in which calcium ions, for example, regulate kinase activity by binding to a separate regulatory subunit. Furthermore, it helps explain the unusual displacement of the catalytic lysine residue in WnK1, as the chloride binding site occupies the usual position of this essential lysine residue. — LBR

Sci. Signal. **7**, ra41 (2014).

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PHYSICS

A Sign-Changing Gap

Superconductors owe some of their fascinating properties to the formation of so-called Cooper pairs of electrons that (loosely) bind to each other thanks to a mediating interaction. The finite energy needed to break them apart is set by a function called "gap," which, for unconventional superconductors, may have a complicated dependence on the momenta of the participating electrons. Much effort has been expended to elucidate the gap function in iron-based superconductors, many of which have multiband electronic structures that favor antiferromagnetism. A compatible gap function that changes sign going from an electron to a hole band was proposed and observed in some of those compounds, but the question remains whether this so-called symmetry is universal among the iron-based superconductors, and in particular whether it holds for the material LiFeAs, which lacks a static magnetic phase. Chi *et al.* use scanning tunneling and photoemission spectroscopy measurements coupled with calculations to analyze the scattering from impurities in LiFeAs. This scattering is sensitive to the change in sign of the gap function, leading to simple selection rules, and the authors find that their data support the gap scenario, and by implication, a magnetism-mediated superconductivity. — JS

Phys. Rev. B **89**, 104522 (2014).

PSYCHOLOGY

Our Moral Vocabulary

Situational factors can exert ephemeral influence on cognitive processes. These effects are not short-lived in the sense of being refuted by the next paper; rather, they can be observed only when stronger or mainline factors fail to dominate the neural pathways underpinning our thoughts. Gantman and Van Bavel nicely illustrate how this works by measuring the extent to which a briefly visible morality-related word is more likely to be detected than an unrelated word. They presented people with words and nonwords for durations ranging from 20 to 100 ms. At the longest durations, words and nonwords were accurately categorized, and there were no differences in accuracy between moral and nonmoral words. At the shortest durations, all words and nonwords were equally difficult to identify. In the middle, where the perceptual awareness for words was near threshold, those words semantically related to morality were slightly—and significantly—more readily identified correctly, so that a 40-ms peek was sufficient, whereas nonmoral words needed an extra 10 ms of exposure. — GJC

Cognition **132**, 22 (2014).

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Productive Trees

Andrew M. Sugden (May 8, 2014)

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