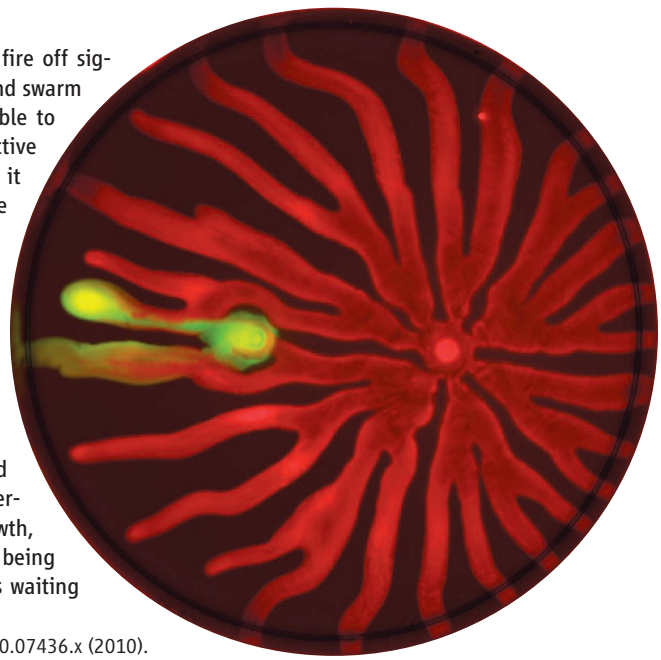
EDITED BY KRISTEN MUELLER AND JAKE YESTON

MICROBIOLOGY

Easy Riders



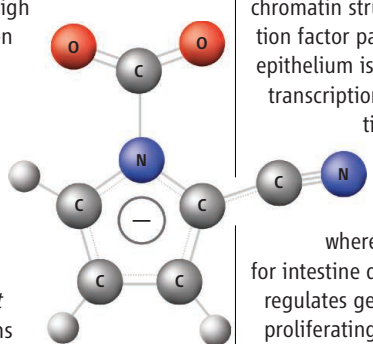
Microorganisms rarely act alone, and bacterial cells continually fire off signaling molecules, behave cooperatively, exchange metabolites, and swarm together. Despite its many advantages, collaboration is vulnerable to cheaters who may exploit the advantages generated by the collective without contributing themselves. Once cheating gains a foothold, it is difficult to eradicate. Xavier *et al.* have explored the occurrence of cheating in the bacterium *Pseudomonas aeruginosa,* which forms motile swarms that move on a self-produced, copious film of rhamnolipid surfactant. A mutant rendered incapable of emitting surfactant (green) could swarm along the film from a wild-type strain (red) without adversely affecting the producer, yet it overwhelmed a different strain engineered to produce surfactant continuously with no regulation. So how do colonies of wild-type producers avoid such takeover? Rhamnolipid production is costly; thus it is only synthesized when carbon is abundantly available and when growth is limited by a lack of nitrogen. In this scenario, perhaps bacteria need to be motile to find better food to resume growth, at which point surfactant production is switched off. Hence, by being frugal with surfactant production, producers can escape cheaters waiting for a free ride. — CA

Mol. Microbiol. 10.1111/j.1365-2958.2010.07436.x (2010).

CHEMISTRY

Agile CO_2 Catchers

There is vigorous ongoing research to develop sorbents that efficiently capture CO_2 generated through coal combustion and thereby keep it out of the atmosphere, where its infrared absorption would contribute to global warming. It's critical to bind the gas rapidly and selectively, but not too tightly, as release for concentrated sequestration should also be facile. Aqueous amines are promising compounds for this purpose, though ionic liquids (ILs), with their low volatility and high stability, might offer even better prospects. Unfortunately, in preliminary studies, introduction of CO_2 has led to an impractical rise in IL viscosity, attributed to the formation of salt bridge networks. To skirt this drawback, Gurkan *et al.* performed simulations on a distinct IL class comprising pyrrolide anions (charge balanced by tetraalkyl phosphonium) that could covalently capture CO_2 without involving network-forming protons. They then went on to synthesize a 2-cyanopyrrolide IL, and as predicted, the medium absorbed superstoichiometric quantities of CO_2 with minimal viscosity increase and even tolerated the presence of water. A variant based on a pyrazolide, rather than pyrrolide, framework confirmed the tunability of the approach. — JSY



J. Phys. Chem. Lett. **1**, 3494 (2010).

DEVELOPMENT

Protein in Context

Proper cell differentiation requires permissive chromatin structure and specific transcription factor participation. The adult intestinal epithelium is an excellent model for studying transcriptional regulation during differentiation. The homeodomain protein CDX2 is expressed in progenitor and differentiated cells of the mammalian intestinal epithelium, where it likely acts as a master regulator for intestine development. Whether this factor regulates genes in the same way in both the proliferating and differentiated cells, however, is unclear. Verzi *et al*. now show that CDX2 is needed for appropriate chromatin modifications in intestinal epithelium; however, rather than showing a conserved mode of regulation, CDX2 associates with different binding sites and participates with variable chromatin and transcription factors among progenitor and differentiated intestinal cells. Hence, temporal function and cellular context dictate the mechanism of action of CDX2. — BAP

Dev. Cell **19**, 713 (2010).

MOLECULAR BIOLOGY

High Fidelity Required

Covalent modifications of histones in nucleosomes can determine characteristic gene expression states for specific cells and tissues. These marks are thought to be maintained through cell division and DNA replication by the close coordination of histone eviction from the parental DNA with the transfer of the "parental" histones onto the nascent daughter DNA strands. The modifications on these recycled histones are then copied to new nucleosomes added to counter the twofold dilution on the daughter DNA. The fidelity of histone transfer depends on its close coordination with DNA replication.

Sarkies *et al*. find that the normally silent [rho]-globin gene, which contains G quadruplex (G4) sequences that disrupt DNA replication, becomes activated in chicken cells lacking the specialized DNA polymerase REV1. REV1 helps the DNA replication machinery bypass G4 DNA. In the absence of REV1, post-replicative

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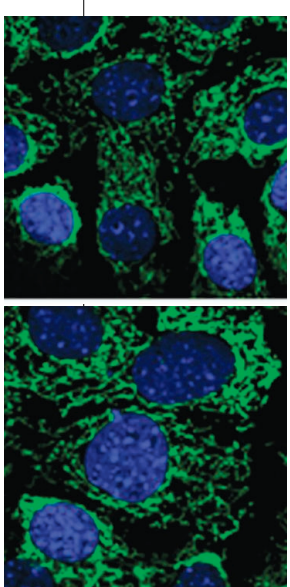
gaps are suggested to form in the vicinity of the G4 DNA, which are filled in later, thereby uncoupling replication and parental histone transfer. In the absence of the coupled transfer, new histones are used to populate the repaired gaps. New histones bear activating marks—not the repressive marks of the [rho]-globin parental nucleosomes—resulting in [rho]-globin gene activation. Many of the genes activated in cells lacking REV1 also have G4 consensus sequences close to their promoters, suggesting that histone recycling is critical for maintaining epigenetic states. — GR

Mol. Cell **40**, 1 (2010).

BIOPHYSICS

Shining Light on Tendonitis

Athletes, whether two- or four-legged, can develop tendonitis, a painful condition that requires a long recovery period. Fundamental imaging studies of damage to collagen in tendon often exploit its birefringence, but polarized light imaging usually requires chemical staining of the fibers. Sivaguru *et al.* exploited collagen's noncentrosymmetric organization to perform direct imaging through second-harmonic generation. In their technique, two near-infrared photons (780 nm wavelength) from an ultrashort pulsed laser combine in the sample to produce a photon at 390 nm. The resulting images, which were taken both with light transmitted through the sample (forward scans) and with reflected light (backward scans), were then Fourier-transformed to determine fiber orientations. They compared normal tendon from horse with tendon that had undergone a model for injury—degradation with collagenase. Degradation led to a decrease in fiber orientation and better spread in the forward and backward scan ratios. Such strain-free methods lend themselves to endoscopic approaches for assessing tendon damage. — PDS



Opt. Express **18**, 24983 (2010).

COMPUTER SCIENCE

Sensing Worms

Arrays of small remote sensors are increasingly being used to gather fundamental data in many fields. Examples range from medical monitoring within and beyond hospitals to assessing energy usage. New sensors communicate wirelessly, are battery-powered, and have their own small processors and memory. For simplicity, they typically lack much security, but it has been considered difficult to infect a network through a few sensors. Giannetsos *et al.* explore how one common type of sensor, using the Van Neumann architecture, can be infected with a worm that will spread through the sensor network. In this architecture, the instructions and data share the same memory, and multiple packets of the virus can be uploaded into the buffer overload; once assembled, they override the instructions. Regular automatic communication with other sensors spreads the worm. The authors also explore how to protect sensor networks from this kind of attack. — BH

Comput. J. **53**, 1576 (2010).

SIGNAL TRANSDUCTION

Getting Apoptosis Started

Activation of the Bak and Bax proteins in response to apoptotic stimuli initiates the cascade of events that commit the cell to death. Bak and Bax activation requires a conformational change followed by multimerization, and now Fox *et al*. provide evidence for an additional layer of regulation. The authors identified a specific tyrosine residue, Y^{108}, on Bak that is phosphorylated in healthy human cells but was dephosphorylated during apoptosis. Dephosphorylation of Bak led to a conformational change and was necessary but not sufficient to cause Bak activation. A siRNA screen identified the protein tyrosine phosphatase PTPN5 as a major contributor to Bak activation in response to apoptotic stimuli. PTPN5 was regulated by the mitogen-activated protein (MAP) kinases ERK1 and ERK2. MAP kinase activation generally promotes cell survival, and MAP kinase activity was transiently decreased in cells treated with an apoptotic stimulus. This corresponded with increased dephosphorylation of Y^{108} by PTPN5. Thus, Bak may act as a point of integration of MAP kinase signaling with other pathways that influence the association of Bak with proapoptotic proteins. These results also suggest that by default, cells are programmed to survive and require multiple positive signals to initiate apoptosis. — LBR

EMBO J. **29**, 3853 (2010).

CREDIT: FOX *ET AL., EMBO J.* **29**, 3853 (2010)

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