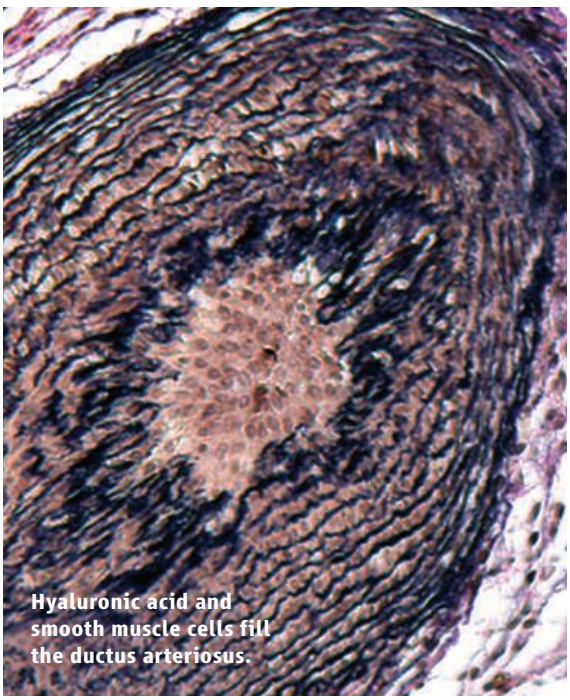


Hyaluronic acid and smooth muscle cells fill the ductus arteriosus.

BIOMEDICINE

Cushioning the Flow

The ductus arteriosus (DA) is a vessel that connects the pulmonary artery and aorta in a developing fetus; blood bypasses the immature fetal lungs and flows to the placenta, where the carbon dioxide is exchanged for oxygen. Shortly after birth, when the neonatal lungs take over responsibility for oxygenation of the blood, there is no longer any need for the DA, and, normally, it closes. However, in about 1 in 2000 infants, and more frequently in those born prematurely, the DA fails to close. This condition, called patent DA (PDA), can strain the lungs and lead to various forms of vascular disease.

The DA remains open in the fetus in part through the vasodilatory effects of circulating prostaglandins such as PGE, and for this reason drugs (such as indomethicin) that inhibit the production of PGE by cyclooxygenase (COX) are commonly used to treat PDA. Working in a rat model system, Yokoyama *et al*. discover that the role of PGE in this setting may be more complex than previously thought. They find that PGE prepares the fetal DA for closure by promoting the formation of the "intimal cushion," a buildup of smooth muscle cells and extracellular matrix that anatomically occludes the vessel. If PGE is found to have the same opposing effects on DA patency in humans, then this discovery could lead to better treatments for PDA. — PAK

J. Clin. Invest. **116**, 3026 (2006).

DEVELOPMENT

Timing Out

In response to adverse conditions, some animals enter into reproductive or developmental arrest (for example, mammalian hibernation, insect diapause, and worm dauer-stage formation). Williams *et al.* examine the molecular contributors to *Drosophila* diapause, an overwintering strategy. By evaluating natural diapause variants representing different climates (one from Canada and one from the southern United States), genetic variation was mapped to the *Dp110* locus, coding for phosphatidylinositol 3-kinase (PI 3-kinase). They found that a reduction in dosage of *Dp110* increased the proportion of flies in diapause, but neuronal expression of *Dp110*, reduced it. Hence, effects on *Drosophila* diapause are seen upon altering signaling from the insulin-regulated PI 3-kinase pathway. The conservation of this pathway in the fly and *Caenorhabditis elegans* as revealed by the involvement of PI 3-kinase in diapause and dauer formation, respectively, provides a link between reproductive and developmental arrest. — BAP

Proc. Natl. Acad. Sci. U.S.A. **103**, 15911 (2006).

GENETICS

Live Fast, Die Early

How an organism repairs damage to its DNA has important implications for disease and, potentially, for aging, as the latter is correlated with increasing DNA damage. Double-stranded breaks (DSBs) in DNA are particularly noxious, and cells have evolved several ways to cope: Homologous recombination (HR) uses the sequences of a homologous chromosome to patch the damaged site, which minimizes the chance of mutation, whereas nonhomologous end joining (NHEJ) is faster but may introduce small additions or deletions.

Preston *et al.* have looked at the way germ cells in male *Drosophila* deal with DSB damage over the lifetime of the individual. They find that the importance of the various pathways changes substantially, with young (1-week-old) males showing a low level (~15%) of repair via HR, which increases to 60% in 6-week-old flies. On the other hand, flies that died or became infertile after only 4 weeks had a tendency to show increasing NHEJ-based repair of the DSB with age. The authors speculate that young flies might benefit from rapid gamete development and production (and thus being first to mate), and therefore evolution favors the rapidity of NHEJ repairs, which outweighs the mutational burden. Older flies, having outlived most of the competition, might find themselves in an environment where the frequency of mating is low and speed is no longer a critical factor. — GR

Screening for DSB repair by fluorescence.

Curr. Biol. **16**, 2009 (2006).

CHEMISTRY

Roaming Around the Saddle

Transition state theory has proven to be a powerful framework for understanding and predicting chemical reaction kinetics. A central tenet of the theory is passage of each productive reaction trajectory through a specific configuration, or transition state, corresponding to a potential energy saddle point. Rate models therefore tend to focus on determination of this configuration. Recently, however, experimental and theoretical analyses of formaldehyde (CH_2O) dissociation implicated a pathway that skirted the transition state and instead relied on the roaming or wandering motion of one H atom about the HCO core.

Houston and Kable have observed evidence of a similar roaming mechanism in the photo-induced dissociation of an acetaldehyde (CH_3CHO) sample to CO and CH_4. By resolving the rotational states of the CO product using laser-induced fluorescence, they found that ~15% of the dissociation events distributed an unexpectedly large proportion of the excitation

Continued on page 897

CREDITS (TOP TO BOTTOM): YOKOYAMA *ET AL.*, *J. CLIN. INVEST.* **116**, 3026 (2006); PRESTON ET AL., GENETICS 172, 1060 (2006).

Continued from page 895

energy to the methane co-product. To explain this outcome, the authors favor a mechanism involving a roaming methyl group, though they note that theoretical simulations will be necessary to rule out an alternative higher-energy H-atom roaming mechanism. — JSY

Proc. Natl. Acad. Sci. USA **103**, 16079 (2006).

APPLIED MATHEMATICS

Unraveling Cellular Motion

The mechanisms whereby living cells propel themselves across various media involve a remarkably complicated set of factors. Experiments 25 years ago sought to track the wrinkle patterns induced by cell motion on an elastic film, and thus to determine the forces underlying cellular motion, but the problem proved highly nonlinear. A later proposal was to monitor the movement of fluorescent marker beads in a soft gel that remained in the linear elastic regime, but these results were highly sensitive to input data. Most recently, cells were observed on a bed of microneedles, with the degree of needle bending used to extract the force exerted by the cells as they traveled. However, in this case spatial resolution was limited and the environment somewhat unrealistic.

Calculations in such a context, which rely on incomplete data to create a model, are called inverse problems and crop up in many fields, including geophysics, medical imaging, and astronomy. Unfortunately, solving this class of ill-posed problems is often difficult on account of their high sensitivity to changes in the data. Ambrosi presents a fresh strategy for solving the inverse problem of cell traction on an elastic substrate, employing marker data to reveal the forces that cells exert on a gel. The method uses minimization followed by numerical solution of coupled partial differential equations and may also be applicable to other similar inverse problems. — DV

SIAM J. Appl. Math. **66**, 2049 (2006).

GEOPHYSICS

Rumbles After Rain

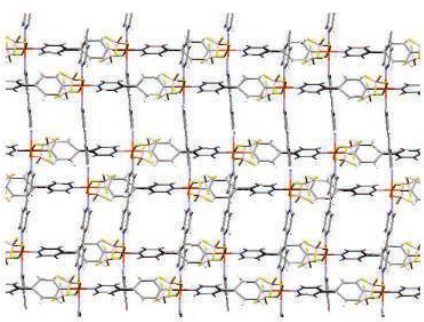
Water buried in the earth has appeared to cause earthquakes beneath certain reservoirs and in other areas with fluctuating groundwater levels. The fluid is thought to lubricate faults and alter pressure, thus making it easier for rocks to slip. Hainzl *et al.* have monitored seismic signals from the landscape surrounding Mount Hochstaufen in southeastern Germany, and they find that minor earthquake swarms tend to follow periods of high precipitation there. Seismic activity has been observed in this range of limestone and dolomite mountains for some 600 years, although such behavior is unusual in the wider region. The earthquakes tend to be small but numerous: approximately 1100 small shallow earthquakes (with moment magnitudes less than 2.4) were detected by a seismic array in 2002. Most earthquakes occurred in the summer months, particularly after wet periods in March and August. The resulting seismic events correlate in space and time with the calculated distribution of pore pressure changes due to diffusing rainwater and the frictional behavior of faults. The seismicity data indicate the sensitivity of the Earth's crust to local disturbances and offer a potential means of predicting earthquakes on the basis of weather patterns in such regions. — JB

Geophys. Res. Lett. **33**, L19303 (2006).

CHEMISTRY

Expansive Accommodations

The interaction of porous metal-organic framework (MOF) materials with adsorbed guest molecules can result in reversible structural transformations. Kondo *et al*. have observed such a transition induced by carbon dioxide adsorption in a $[Cu(BF_4)_2(bpy)_2]$ lattice, where bpy is 4,4′-bipyridine. The authors prepared this MOF, which adopts a two-dimensional (2D) quasi-square grid



MOF structure.

structure, by crystal-to-crystal transformation of a hydrated 3-D interpenetrating network precursor, which they heated under vacuum for several hours to remove the incorporated water.

Exposure of the MOF to CO_2 at 273 K resulted in an abrupt jump in adsorption as the incoming gas pressure approached 35 kPa. To explain this observation, the authors carried out structural modeling of the material, with and without adsorbed CO_2, on the basis of extended x-ray absorption fine structure and powder x-ray diffraction data. The results indicated that CO_2 adsorption and subsequent clathrate formation increased the interlayer distance in the host lattice by ~50% to 0.68 nm. This process, which though reversible exhibited significant hysteresis, led to a macroscopic volume change of 6.6% at a final pressure of 101 kPa. — PDS

Nano Lett. **6**, 10.1021/nl062032b (2006).

CREDIT: KONDO *ET AL.*, *NANO LETT.* **6**, 10.1021/NL062032B (2006)

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