

edited by Gilbert Chin

## ECOLOGY/EVOLUTION

## Phenotypic Plasticity

There is a growing literature on the likely biological consequences of anthropogenic effects on the atmosphere, such as distribution shifts in response to changing temperature, plant growth effects in response to increased atmospheric carbon dioxide, and extinction of large swathes of biodiversity. Other effects may be subtle in their mechanism but nevertheless ecologically significant in outcome.

Mondor *et al.* show that the aphid *Uroleucon nigrotuberculatum*, which feeds on goldenrod, exhibits phenotypic variation in the production of



Aphids on goldenrod (bottom) and a predatory ladybug (top).

winged and nonwinged offspring as carbon dioxide and ozone concentrations increase, and that these responses interact with responses to beetle predators and hymenopteran parasitoids. Under higher carbon dioxide, the aphids produce more winged offspring in the presence of predators. Under higher ozone, more such offspring are produced in response to parasitoids. Thus, atmospheric change has the potential to affect an organism's response to higher trophic levels, suggesting that food web dynamics can be altered too. — AMS

*Ecol. Lett.* 7, 941 (2004).

the former, and the impersonal aspects of quotidian labor in the other. — GJC

*Psychol. Sci.*, in press.

## IMMUNOLOGY

## Getting at the Guts

Celiac disease develops from the reaction of T cells of the small intestine to gluten present in dietary wheat, which leads ultimately to changes in villous architecture and severe impairment of mucosal function.

Studies from Hue *et al.* and Mersesse *et al.* suggest that the interaction of the immune receptor NKG2D with its ligand MICA,

which is normally associated with natural killer cell and T cell activation by tumors and infectious agents, also contributes to the aberrant activity of T cells in celiac disease. Both groups observed that MICA is up-regulated on the villous epithelium of celiac patients, which Hue *et al.* show to depend on interleukin-15 (IL-15), a cytokine that was overexpressed in the intestinal mucosa of the patients. Both groups found that recognition of MICA by NKG2D on activated intestinal T cells from celiac patients induced killing of epithelial cells in vitro, and Mersesse *et al.* show that adding IL-15 also led to NKG2D-dependent acquisition of cytotoxicity by intestinal T cells from healthy individuals. Because additional IL-15 was not needed for T cell cytotoxicity in celiac patients, these results suggest that the cytokine directly primes T cell killing of villous epithelium in vivo. — SJS

*Immunity* 21, 367; 357 (2004).

## PLANETARY SCIENCE

## To Bounce or Not to Bounce

The terrestrial planets formed by the accumulation of rocky fragments. First, kilometer-sized planetesimals accumulated over a period of about 100 to 10,000 years, then megameter-sized embryos accumulated over 100,000 to one million years. Finally, the embryos either collided in giant impacts or became isolated on stable orbits to produce the inner solar system.

Agnor and Asphaug modeled the accretional efficiency of megameter embryos by simulating collisions between two one-10th-Earth-mass bodies at different velocities and collision angles. Low-velocity head-on collisions produced one larger aggregate, whereas low-velocity glancing collisions forced the bodies to become bound gravitationally and eventually to merge. Higher-velocity glancing collisions allowed the two bodies to bounce and escape the local system. If these collisional scenarios for same-sized bodies are put into the collision dynamics assumed for solar

system formation, then only about 50% of collisions will lead to merging, which is a relatively inefficient accretion rate that leaves a lot of bouncers exiting the solar system at high speed on random paths. — LR

*Astrophys. J.* 613, L157 (2004).

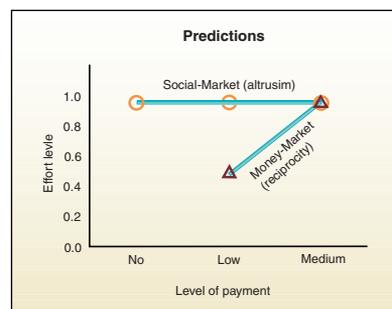
## PSYCHOLOGY

## Fair Trade or Fair Play

A distressing trend of the past few decades has been the increasing regard for quantification of behavior with the attendant corollary that developing a metric and quantitatively analyzing it are sufficient for understanding how humans behave. Within the realm of social exchanges, monetization, whether of time or productivity or reward, is readily achieved, and open markets soon establish prices for everything and anything. But is this the whole story?

Heyman and Ariely describe a trio of experiments, loosely based on Tom Sawyer and his whitewashing escapade, that reveal behavior in a social versus a monetary market. Small- or

medium-sized payments of money or candy, or no payment at all, were used as incentives for students to perform a set of tasks designed to gauge the extent of effort expended. As expected, effort increased with the amount of money paid. In contrast, effort was relatively insensitive to the amount of candy offered, but explicitly mentioning the prices of the small and medium amounts of candy resulted in expended effort that did then vary with price. The authors suggest that social and monetary markets evoke different behaviors and may rely on dissimilar motivations, with the tacit considerations of altruism and reputation in



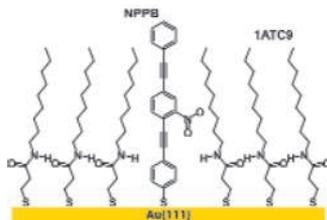
Working harder for nothing than for low wages.

## CHEMISTRY

## Biased Switching

The conductivity of highly conjugated oligo(phenylene-ethynylene) (OPE) molecules has been explored in a number of settings. When these molecules are thiol-derivatized and surrounded with alkanethiol molecules on gold films, random switching in their conductance from a high "on" state to a low "off" state has been observed by scanning tunneling microscopy (STM), and the switching has been attributed to hybridization changes in the OPE-surface bond.

Lewis *et al.* report that the rate of stochastic switching can be slowed by chemically adding hydrogen-bonding interactions and that it can be controlled to a large extent by the bias of the STM tip. They introduce an amide functionality into the alkanethiol and add a nitro substituent to the center ring of the OPE. A negative tip bias of 1 V increases the on/off ratio, and a positive tip bias repopulates the off state. The authors note that the ability to cycle the OPE molecules be-



Schematic of OPE and alkanethiol molecules on gold.

tween these on and off states argues against mechanisms that attribute the changes to desorption and adsorption of the OPE molecules. — PDS

*J. Am. Chem. Soc.* 126, 12214 (2004).

## GEOCHEMISTRY

## Looking Beneath the Surface

Perhaps the most important and familiar environmental redox couple is that between ferrous and ferric iron. We see this reaction daily in common rust, but its influence goes well beyond: The reduction or oxidation of iron are often coupled to that of other environmental contaminants, affecting their speciation and thus their chemistry and mobility. It is now recognized that the reduction and oxidation of iron are influenced by the actions of bacteria as well as the local chemistry and nature of mineral surfaces in rocks and soils, and by the presence of water, so detailed investigations are needed at this scale to probe reaction pathways.

Williams and Scherer use Mossbauer spectrometry to identify absorbed ferrous iron species on the surfaces of several representative iron oxides. Their data show that a separate ferric iron layer, with the same structure as that of the underlying mineral, is generated by electron transfer through an aqueous layer. Reactions driven by this film require the presence of aqueous ferrous iron, which implies that these mineral surfaces are not merely passive supports. — BH

*Environ. Sci. Tech.* 10.1021/es049373g (2004).

## HIGHLIGHTED IN SCIENCE'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT



## Two Wnt Pathways

Frizzled proteins act as receptors for Wnts, secreted proteins that play a critical role in animal development. In *Caenorhabditis elegans* vulval development, the anterior-posterior orientation of cells of the P7.p lineage is disrupted by mutation of *lin-17* (which encodes a Frizzled protein) leading to a defect in morphology, the bivulva phenotype. Inoue *et al.* discovered that *lin-18*, mutations of which produce a similar bivulva phenotype, encodes the *C. elegans* member of the Ryk (related to tyrosine kinase)/Derailed protein family, which is not related to the Frizzled family. The authors tested protein constructs containing portions of LIN-18 and found that, whereas the extracellular Wnt binding domain was required for rescue of the *lin-18* mutant phenotype, the intracellular kinase domain was not. Mutational analysis and RNAi disruption indicated that the products of three *wnt* genes, LIN-44, MOM-2, and CWN-2, acted redundantly in this process. Genetic analysis of receptor-ligand and receptor-receptor double mutants led the authors to propose a model in which the two receptors mediated parallel signaling pathways, with LIN-44 preferentially acting through LIN-17 and MOM-2 preferentially acting through LIN-18 to determine cell fate. — EMA

*Cell* 118, 795 (2004).