

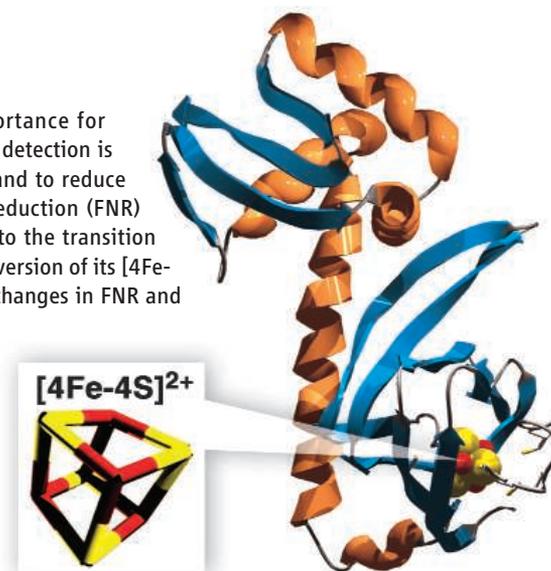
## BIOCHEMISTRY

### Squaring a Cube

The detection of environmental changes is of paramount importance for microbes, and a host of mechanisms have evolved in which signal detection is coupled to an amplification step in order to increase sensitivity and to reduce response time. The bacterial regulator of fumarate and nitrate reduction (FNR) regulates the transcription of more than 100 genes in response to the transition from anaerobic to aerobic growth; molecular oxygen triggers a conversion of its  $[4\text{Fe-4S}]^{2+}$  cluster into a  $[2\text{Fe-2S}]^{2+}$  cluster, leading to conformational changes in FNR and dissociation from DNA.

Crack *et al.* report that this reaction not only detects dioxygen, but actually uses it to amplify the signal, consuming some in doing so. The first step in signal detection is a one-electron oxidation of the  $[4\text{Fe-4S}]^{2+}$  cluster that transforms it into a  $[3\text{Fe-4S}]^{1+}$  cluster, and a kinetic analysis confirmed the oxygen-dependent coincident loss of the  $[4\text{Fe-4S}]$  cluster and the appearance of the ejected  $\text{Fe}^{2+}$  and the superoxide anion ( $\text{O}_2^{\cdot-}$ ). The second step is about 10 times slower, and a second Fe departs (as  $\text{Fe}^{3+}$ ) in the conversion of the  $[3\text{Fe-4S}]^{1+}$  cluster into a  $[2\text{Fe-2S}]^{2+}$  cluster. Superoxide is known to undergo dismutation into oxygen and hydrogen peroxide, which can itself dismutate into oxygen and water. In sum, one  $\text{O}_2$  molecule can trigger the disassembly of four  $[4\text{Fe-4S}]$  clusters. — GJC

*Proc. Natl. Acad. Sci. U.S.A.* **104**, 2092 (2007).



**A model of FNR, with its DNA binding domain at the top and the iron (red)–sulfur (yellow) cluster at the bottom.**

## GENETICS

### Recognizing Oneself

Self-incompatibility, a plant's rejection of pollen from itself or a closely related individual, prevents inbreeding, which can lead to a loss of heterozygosity and deleterious combinations of recessive alleles. *Arabidopsis* has become self-compatible, whereas several closely related species, including *Brassica*, remain self-incompatible. Both the *S*-locus receptor kinase (SRK) and the *S*-locus protein 11 (SP11/SCR) are implicated in the phenomenon.

Shimosato *et al.* have investigated the interaction between SP11 and SRK in *Brassica*. Two proteins of 60 and 100 kD were previously shown to bind to SP11; both are forms of SRK, with the smaller one being a truncated, though still membrane-bound, form of the full-length protein. The latter binds to SP11 with high affinity whereas the former does not, suggesting that they may function differently. Sherman-Broyles *et al.* have investigated the maintenance and degradation of the SRK and SCR genes. They found that in comparison to the fully sequenced *Arabidopsis* Columbia-0 accession, both genes in the C24 accession have undergone extensive rearrangement and significant parts of the SCR gene have been deleted, possibly through the insertion and deletion of

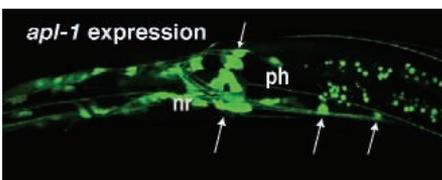
transposable elements. These differences in the *S* locus region suggest that these genes have followed different trajectories after the loss of self-incompatibility. — LMZ

*Plant Cell* **19**, 10.1105/tpc.105.038869; 10.1105/tpc.106.048199 (2007).

## CELL BIOLOGY

### Life Without Amyloid

The amyloid precursor protein (APP) is a transmembrane protein that has been linked to some forms of familial Alzheimer's disease, but the normal function of the protein is a mystery. The nematode worm *Caenorhabditis elegans* possesses a single APP-related gene, termed *apl-1*. Hornsten *et al.* have examined the role of *apl-1*, which is expressed in a variety of tissues, including neurons. Worms with a disrupted *apl-1* gene died as larvae, exhibiting defects in molting, locomotion, and morphogenesis. These mutants could be rescued by the



***apl-1* is expressed in a variety of tissues (green).**

expression of the soluble extracellular domain of APL-1 protein in neurons. In addition, overexpressing the APL-1 protein in a wild-type background was detrimental; this effect could be mitigated by reducing the levels of SEL-12, which is a *C. elegans* homolog of presenilin, an enzyme that cleaves APP in humans. Thus, it appears that APL-1 performs an essential function during development in the nervous system. Interfering with APP expression or modifications in patients may therefore have unintended and unexpected consequences. — SMH

*Proc. Natl. Acad. Sci. U.S.A.* **104**, 1971 (2007).

## ATMOSPHERIC SCIENCE

### Wind, Rain, and Aerosols

Theory suggests that a rising concentration of aerosols should reduce wind speeds below, due mainly to the increase in atmospheric stability that such loading would cause. Consequences range from decreased evaporation and rainfall to a multitude of secondary impacts, such as reduced availability of wind energy for the generation of electricity and decreased hydroelectric potential. Jacobson and Kaufman use a three-dimensional computer model and satellite data to examine the potential effects of aerosol particles on the distribution of wind speeds and the resulting feedbacks to precipitation, water supply, and wind energy

across California. They find that pollution by aerosols may be decreasing local winds by up to ~8% and, together with the second indirect aerosol effect, may be reducing precipitation by 2 to 5%. These effects have obvious and unwelcome practical consequences, but they also raise the hopeful possibility that by limiting or reducing aerosol pollution, California can lessen future strains on its water supply and wind/hydroelectric power-generation systems. — HJS

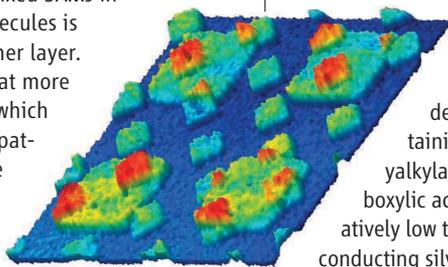
*Geophys. Res. Lett.* **33**, L24814 (2006).

## MATERIALS SCIENCE

## Inserted in Isolation

Microcontact printing ( $\mu$ CP) with elastomeric stamps can be used to pattern self-assembled monolayers (SAMs) on surfaces, but it can also be useful to create mixed SAMs in which one of the molecules is diluted within the other layer. Mullen *et al.* show that more diffusive molecules, which are often difficult to pattern with  $\mu$ CP, can be inserted into more stable SAMs by a method they term microcontact insertion printing ( $\mu$ CIP). An existing SAM (in this case, 1-octanethiolate assembled on gold) is contacted in a subsequent  $\mu$ CP step with a second molecule, either 11-mercaptoundecanoic acid (MUDA) or 1-dodecanethiolate.

The extent of insertion, which occurs preferentially at defect sites, can be controlled by changing the contact time and concentration



Large and small MUDA blocks patterned sequentially on gold.

of molecules on the stamp, and more complex patterns can be created with additional rounds of  $\mu$ CIP. — PDS

*Appl. Phys. Lett.* **90**, 10.1063/1.2457525 (2007).

## CHEMISTRY

## A Silver Solution

Despite widespread efforts toward development of printable semiconductors for large-area, flexible electronics media, far less attention has been given to the printable conducting material required for the wiring and connections within such devices. Both gold and silver possess high conductivity and operational stability, but precise patterning with these metals typically requires vacuum deposition. Wu *et al.* have devised a simple solution-based process for patterning conductive silver features on a substrate.

Using coating, stamping, or printing techniques, they deposit an alcohol solution containing a silver(I) salt, a hydroxylalkylamine, and a long-chain carboxylic acid. Subsequent heating at relatively low temperature (150°C) forms the conducting silver elements. The amine functions as a gentle reducing agent, with sufficient volatility to evaporate easily afterward. Achieving high conductivity requires acid additives with decyl or longer alkyl tails, which foster the growth of films without discernible grain boundaries. The method was applied to fabrication of a layered thin-film transistor device, in which the silver showed conductivity comparable to that of more costly vacuum-processed gold. — MSL

*J. Am. Chem. Soc.* **129**, 10.1021/ja067596w (2007).

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## &lt;&lt; Microregulating Inflammatory Responses



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Inflammatory responses help protect against infection, but these signaling pathways may also contribute to some diseases. O'Connell *et al.* have investigated the fate of microRNAs (miRNAs) during viral infection. They monitored the expression of 200 miRNAs in response to polyriboinosinic polyribocytidylic acid [poly(I:C)], a synthetic double-stranded RNA that is used to mimic viral infection, or to the antiviral cytokine interferon- $\beta$  (IFN- $\beta$ ). One such miRNA, miR-155, showed increased expression in macrophages in response to both stimuli. The response to poly(I:C) required upstream signaling via Toll receptors and the MyD88 or TRIF adaptor proteins. Interferons, on the other hand, stimulated expression of miR-155 through a slower pathway that required autocrine signals mediated by tumor necrosis factor- $\alpha$ . The two pathways were shown to converge onto the JNK mitogen-activated protein kinase as a JNK inhibitor blocked both miR-155 responses. Because the gene encoding miR-155 is a site where avian retroviruses integrate, and miR-155 overexpression can cause B cell lymphoma in mice, the finding of miR-155 as a target of pathways activated by viral infection presents a link between inflammatory responses and cancer. — LBR

*Proc. Natl. Acad. Sci. U.S.A.* **104**, 1604 (2007).

# Science

## A Silver Solution

Marc S. Lavine

*Science* **315** (5814), 915.

DOI: 10.1126/science.315.5814.915b

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