EDITED BY JESSE SMITH AND KRISTEN MUELLER

ECOLOGY

It's All in the Timing

Phenology is the timing of biological events, such as the time of year when flowers bloom. Because phenology is dependent on environmental cues, including temperature, how it is affected by climate change is unclear. Understanding this connection is challenging, however, due to natural variation in events such as flowering time. CaraDonna *et al*. report on the results of a 39-year effort to record a suite of ecological data, such as first, peak, and last flowering dates, within an alpine meadow community in the Colorado Rocky Mountains. Over the time span of the experiment, data were collected on 60 plant species, largely every other day during the growing season. Although there was a general trend toward earlier flowering dates and a longer growing season, individual species' responses were distinct, and changes within a species in first, peak, and last flowering dates shifted independently of one other. These results suggest that first flowering date, the most commonly collected phenological metric in plants, is not necessarily an accurate estimator of total responses to a changing climate. Furthermore, changes in coflowering patterns were observed, which indicates that even small changes in timing could alter alpine plant communities. — SNV

Proc. Natl. Acad. Sci. U.S.A. **111**, 10.1073/pnas.1323073111 (2014).

IMMUNOLOGY

Dead But Not Dangerous

How the innate immune system senses and responds to dead cells and how non-infectious inflammatory responses are controlled remain unclear. Neumann *et al.* identified an inhibitory C-type lectin receptor, Clec12a, as a specific immune receptor for dead cells. Both human and mouse Clec12a acted as direct sensors for uric acid crystals, which are key "danger" signals that alert the immune system to cell death. Dead cells or uric acid crystals triggered Clec12a signaling. Clec12a-deficient mice exhibited hyperinflammatory responses to uric acid crystals or sterile dead cell challenges in vivo. Thus, Clec12a represents a regulatory immune receptor that dampens the inflammatory immune response to dead cells. By doing so, it may help to minimize potential damage during non-infectious inflammation. — SMH

Immunity **40,** 389 (2014).

CELL BIOLOGY

Seeing Signaling

A classic model for the study of cell signaling is the bacterial chemotaxis system. Fukuoka *et al*. describe the latest step in "seeing" just how this simple yet elegant mechanism really works. The basics of the system are known. Receptors on the cell surface bind attractant or repellent molecules, and this leads to alterations in the phosphorylation of a regulatory protein known as CheY. CheY in turn interacts with the molecular motor of the flagellum, altering its direction of rotation. Bacteria were engineered to express CheY protein that was fluorescently tagged. This enabled the use of total internal reflection fluorescence microscopy to monitor the interaction of CheY with the flagellar motor in single bacterial cells, while at the same time observing the direction of rotation of the flagellar motor. The rotor turned clockwise when phosphorylated CheY (CheY-P) was bound and counterclockwise when CheY-P dissociated. Although the motor has been estimated to contain approximately 34 subunits that can bind CheY-P, calculations showed that clockwise-turning motors bound 13 ± 7 CheY-P molecules, so not all the subunits needed to be bound to alter the rotor's direction. In addition, the affinity for binding of CheY-P to the motor in its clockwise-moving state was about fivefold greater than that of a counterclockwise-moving motor. Dissociation of CheY-P from the motor occurred with a ~70-ms time frame—much too fast to be controlled by dephosphorylation of CheY-P. — LBR

Sci. Signal. **7**, ra32 (2014) .

NEUROSCIENCE

Disrupted Development

Socioemotional difficulties and abnormal overgrowth of the brain are apparent early in childhood for those with autism. Although the brain overgrowth has resolved by adulthood, the difficulties remain. Stoner *et al*. analyzed the expression of a variety of genes that relate to the identification of neuron and glial subtypes, as well as a handful of genes linked to autism in postmortem samples of brains from unaffected children and children with autism. Multiple readouts were assembled computationally to reconstruct the three-dimensional pattern of gene expression. Samples from children with autism showed small patches, 5 to 7 mm in length, in which the expression of several genes was abnormally reduced. The expression of genes related to excitatory neurons was most affected in these patches, genes related to interneurons less so, and genes related to glia even less affected. No one subset of genes or specific locations characterized all the samples. Neurons were present, however, in patches of reduced gene expression. The diversity in locations of the disrupted patches may reflect the diversity in how autism affects children, so that, depending on where a disruption happened to land, different brain functions could be affected. — PJH

N. Engl. J. Med. **370**, 1209 (2014).

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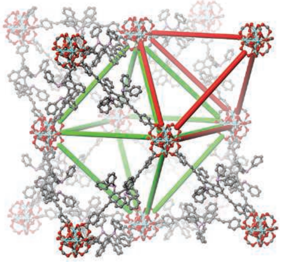
CHEMISTRY

Doing Better Caged

Asymmetric synthesis, which builds organic molecules with a preferred chirality, is often performed with homogeneous metal complexes bearing large chiral ligands that position reactants to produce the desired isomer. However, for catalyst recovery, heterogeneous catalysts are often more convenient, and the caged environment of metal-organic frameworks (MOFs) can also perform asymmetric catalysis if linkers based on chiral ligands are used.



Falkowski *et al.* now report on MOF-based syntheses with one of most successful ligands for late-transition metals, Noyori's BINAP ligand, 2,2′-bis(diphenylphosphine)-1,1′-binaphthyl. They first synthesized a MOF where the structure-directing unit is a zirconium-based cluster $[Zr_6O_4(OH)_4]$ and the linkers are BINAP-derived dicarboxylic acids. They then introduced Ru or Rh by adding metal complexes and then HBr. Rotational disorder prevented assignment of the metal coordination by x-ray diffraction, but x-ray absorption fine-structure spectroscopy confirmed metal coordination to the two P atoms of BINAP. They obtained very high enantiomeric excesses for a variety of organic reactions, including the asymmetric addition of arylboronic acids to 2-cyclohexanone (where yields with a Rh catalyst were moderate to high) and asymmetric hydrogenation of β-ketoesters (where the yields with a Ru catalyst were quantitative). — PDS

J. Am. Chem. Soc. 10.1021/ja500090y (2014).

ATMOSPHERIC CHEMISTRY

On the Wall

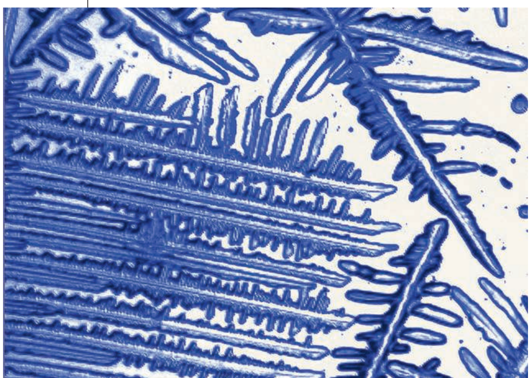
Aerosols exert a major influence on air quality and the radiative properties of the atmosphere, so deciphering how they form is central to understanding pollution control and climate change. Secondary organic aerosols (SOAs) make up a major fraction of these particles, but their formation is particularly underconstrained. Most of what we know about their mechanism of formation comes from laboratory studies done in enclosed chambers, but these studies generally detect SOA formation at rates much too low to explain their atmospheric abundances. Zhang *et al*. report experimental results that show that the deposition of oxidized vapors on the chamber walls can substantially reduce estimates of the rate of formation of SOAs measured in such environments, by a factor of as much as 4. Correcting for such effects would help reconcile chamber experimental results and observations made in the atmosphere, without the need to invoke other factors such as missing precursors, as some other work has done. — HJS

Proc. Natl. Acad. Sci. 10.1073/pnas.1404727111 (2014).

CHEMISTRY

Lead-Free Film

Ferroelectric materials have a permanent electric dipole moment that can be switched by the application of an external electric field, a property that makes them widely used in sensing, memory, and actuators. Most commonly used ferroelectrics are perovskites, such as lead zirconium titanate (PZT). Molecular ferroelectrics present an interesting, more environment-friendly alternative, but in the technologically



relevant thin-film form they have been found to perform considerably more poorly than in bulk. Zhang *et al.* find that imidazolium perchlorate is a molecular ferroelectric with relatively high spontaneous polarization and transition temperatures. The authors grow films of this material by depositing it on a substrate by the spin-coating method, and induce dendritic crystal growth on the surface by placing it in a saturated solution. The resulting films show properties comparable to those of the bulk material and, in addition, their piezoelectric response, relevant to applications and measured by piezoresponse force microscopy, compares well to those of films of the more established ferroelectrics such as PZT. — JS

Angew. Chem. Int. Ed. 10.1002/anie.201400348 (2014).

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Science

Seeing Signaling

L. Bryan Ray

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