

<< Battle of the Sperm

In insects, sperm from multiple matings are stored and retained, and are thought to compete for ova within a female's reproductive tract. **Manier *et al.*** (p. 354, published online 18 March) visualized sperm from fruit flies transgenically tagged with green or red fluorescent protein within the reproductive tracts of female flies. Sperm showed more mobility within the female storage organs than expected, with those from the most recent copulation

displacing sperm from previous males; however, sperm viability remained consistent over long-term storage and each male's sperm was equally competitive in fertilizing the female's eggs.

Eat Less, Live Long

Studies in several model organisms have shown that dietary restriction without malnutrition, or manipulation of nutrient-sensing pathways through mutations or drugs, can increase life span and reduce age-related disease. **Fontana *et al.*** (p. 321) review the ways in which nutrient-sensing pathways are central to aging. Studies of yeast, worms, rodents, and primates show that these pathways are conserved during evolution. Although data on the effects of dietary restriction in primates are very limited, in humans, the protective effects of dietary restriction against cancer, cardiovascular disease, and diabetes must be judged against potentially negative long-term effects. More work is needed to determine whether dietary restriction and the modulation of anti-aging pathways through drugs can extend life span and reduce pathologies in humans.

Deadly Diced DNA

Mammalian cells undergoing programmed cell death, or apoptosis, destroy DNA with the deoxyribonuclease known as DFF40. Cells of the worm *Caenorhabditis elegans* also undergo cell death but they do so without a DFF40 enzyme. **Nakagawa *et al.*** (p. 327; see the Perspective by **Liu and Paroo**; see the cover) searched for other nucleases that might be involved in worm apoptosis by systematically depleting nucleases with interfering RNA. They found the ribonuclease Dicer, known for its role in sequence-specific silencing of gene expression,

was cleaved by a protease that changed Dicer's catalytic activity. The remaining C-terminal fragment switched from being a ribonuclease to a deoxyribonuclease. Thus, caspase activation leads to DNA degradation in the worm as well.

Bulking Up Water Oxidation

Storing solar energy by water oxidation, in a process akin to photosynthesis, is a promising approach for building a renewable energy infrastructure. Unfortunately, many of the most active synthetic catalysts for this process fall prey to degradation by the generated oxygen. **Yin *et al.*** (p. 342, published online 11 March; see the Perspective by **Hurst**) used bulky polyoxometalate ligands to protect a catalytic cobalt center from this fate. The full complex was easily prepared by mixing proper ratios of inexpensive tungsten, cobalt, and phosphate salts in boiling water. After isolating and redissolving the catalyst in slightly basic aqueous solution, rapid oxygen generation was observed with a ruthenium-based oxidant.

Cluster Within Virgo

Globular clusters are gravitationally bound systems within galaxies containing hundreds of thousands of stars. Using data from the Sloan Digital Sky Survey of the thousands of galax-

ies that constitute the Virgo cluster, **Lee *et al.*** (p. 334, published online 11 March) fulfilled a prediction made almost 60 years ago and found globular clusters outside galaxies. In Virgo the clusters are found far from the center and are concentrated in several substructures much larger than galaxies. Possibly they were stripped off from low-mass dwarf galaxies, and potentially trace the dark matter distribution within the Virgo cluster.

Aromatic Lead

The bond stabilization, or aromaticity, observed in cyclic carbon molecules, such as benzene, relies on delocalization of electrons around the ring. Although electron distributions in heavier elements can complicate this arrangement, **Saito *et al.*** (p. 339) show that even lead, one of the heaviest metals, is able to participate in an otherwise carbon-based aromatic network. In an analog of the well-studied cyclopentadienyl anion, one carbon atom was replaced with lead, and the framework stabilized by appending phenyl groups to the other four carbons. Crystallography revealed a planar structure, which together with spectroscopic data and theoretical calculations confirmed the aromatic character of the product.

One B, One O

Boron has a tendency to share electrons with multiple different atoms, hence exhibiting a rich cluster chemistry, in contrast to the more traditional two-center, two-electron bonds prevailing in the compounds of most other light elements. **Braunschweig *et al.*** (p. 345) have coaxed boron into a more confined setting and made a boron analog of carbon monoxide as a triply bonded BO anion that was stabilized by coordination to a platinum center. The product formed easily in room temperature solution from a precursor substituted with a silyl group on the oxygen and a bromide on the boron and exhibited surprising stability toward heating and photolysis. The BO anion is a fundamental binary material, isoelectronic with CO, CN⁻, and NO⁺, which have been the key binary ligands in organometallic and coordination chemistry for more than 50 years.

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This Week in *Science*

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Less Old Martian Meteorite

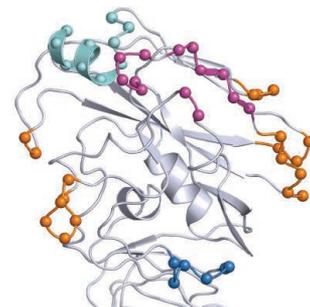
The oldest Martian meteorite known, ALH84001, was thought to be a remnant of primordial martian crust formed during solidification of an early magma ocean. Using isotope data, **Lapen *et al.*** (p. 347) revised the crystallization age of this meteorite from 4.51 billion years to 4.09 billion years ago, meaning that this rock cannot be a fragment of primordial crust that escaped the period of intense bombardment that occurred between 4.25 and 4.10 billion years ago. The revised age also suggests that magmatism was ongoing in Mars for a large part of its history and that ALH84001 was actually formed during the heavy bombardment period, just before the martian core dynamo stopped and the planetary magnetic field was lost.

Revealing *Volvox*

Female and male gametes of the green alga, *Volvox*, significantly differ in size. Those of *Chlamydomonas*, another green algae from a lineage that separated from *Volvox* some 200 million years ago, are the same size. We know sex in *Chlamydomonas* is governed by a sex-determining locus called *MT*. In a detailed comparison of the *MT* loci of *Volvox* and *Chlamydomonas*, **Ferris *et al.*** (p. 351) found that although *MT* has retained some similarity in gene order, its composition has greatly changed between the two species. In *Volvox*, new genes have been coopted into this locus and show sex-specific expression.

Swine Flu Neutralized

The 2009 H1N1 flu virus had an unusually low infection rate in elderly people. An antibody isolated from survivors of the 1918 flu pandemic was recently shown to cross-neutralize 2009 H1N1 viruses. **Xu *et al.*** (p. 357, published online 25 March) report crystal structures of the virus envelope protein, hemagglutinin (HA) from 2009 H1N1 and of 1918 H1 HA in complex with a neutralizing antibody that cross-reacts with both pandemic viruses. These studies reveal an epitope that is conserved in the pandemic viruses, but divergent in other known H1 HAs, from the 1930s to the present. This antigenic similarity explains the age-related immunity to the 2009 H1N1 influenza.



Domain Swaps to Phenotype Shifts

For natural selection there must be mechanisms that create phenotypic diversity, presumably from relatively simple molecular changes in an organism. **Peisajovich *et al.*** (p. 368) tested the extent to which changes in phenotype can occur by systematic swapping of protein domains in the components of the biochemical signaling pathway that controls mating in yeast. Such changes decreased or increased responsiveness to yeast mating pheromone, and some translated into changes in mating efficiency. The authors propose that shuffling of modular protein domains may be an important source of phenotypic diversity in evolution and may also be a useful strategy for the engineering of biological systems.

Yin-Yang T Cell Signaling

Immune responses are kept in check by CD4⁺ regulatory T cells (T_{reg}) that suppress other immune cells, including CD4⁺ effector T cells (T_{eff}). T_{reg} and T_{eff} cells have many signaling components in common, yet triggering through their T cell receptors (TCRs) leads to very different outcomes. **Zanin-Zhorov *et al.*** (p. 372, published online 25 March) compared the recruitment of signaling molecules to the immunological synapse after TCR triggering in T_{reg} and T_{eff} cells. Although T_{reg} cells do form synapses, signaling molecules that promote T_{eff} activation, such as protein kinase C- θ (PKC- θ), were not recruited. Inhibition or depletion of PKC- θ in T_{reg} cells led to suppressive activity against T_{eff} cells, whereas costimulation enhanced PKC- θ recruitment and less suppression. Together, this suggests that PKC- θ is inflammatory in both T_{reg} and T_{eff} cells; however, by excluding it from the synapse, T_{reg} cells are able to maintain suppression in the face of TCR signaling.

CREDIT: XU ET AL.