



The role of duplicate genes in evolution remains contentious—whereas some have argued that they provide the raw material for evolutionary novelties on which selection acts, others have suggested that only less essential genes are maintained after they are duplicated. In flowering plants, the *FLOWERING LOCUS T* (*FT*) gene is an important determinant of fitness through its control of the time of flowering. Blackman *et al.* identified four *FT* genes in the sunflower that appear to have arisen via genus-specific duplications. Although the coding regions of all of these genes were conserved, their expression patterns differed; one of these replicates is not expressed and thus is probably nonfunctional. Transgenic *Arabidopsis ft* mutants expressing the wild sunflower genes showed accelerated flowering. However, an allele found in all domesticated sunflowers extended the time to flowering, suggesting that it may be a negative regulator. This allele shows signatures of selection consistent with domestication and provides an example of how the duplication of genes controlling development can bring about phenotypic change during domestication, and maybe during evolution generally. — LMZ

*Curr. Biol.* **20**, 10.1016/j.cub.2010.01.059 (2010).

## APPLIED PHYSICS

### Ghost Hunting

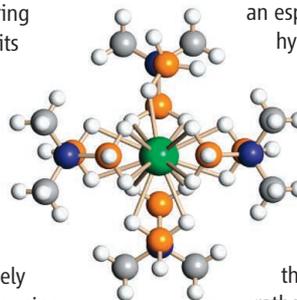
The usual method of viewing an object involves photons bouncing directly off the object and then making their way to your eye (or perhaps a photodetector), where an image is formed and stored. Ghost imaging, in contrast, builds an image with photons that have never interacted with the object. Two correlated beams of light are used, one of which interrogates the object while the other heads straight to the detector. If the beams are entangled, a perfect image can be obtained. For stealth imaging, however, thermal (that is, incoherent) light would be preferred—the object would then experience no sign of being under surveillance. With thermal light, an image is assembled by correlating the intensities of signal and reference photons at a pixelated detector and by then subtracting a background. Thus far, however, images so obtained have been rather blurry. Chan *et al.* present a theoretical treatment directed toward understanding which factors are most critical in improving the clarity of

such images. They find that analysis of normalized high-order correlations offers comparable improvements to coupling low-order correlation analysis with background subtraction. — ISO  
*Opt. Express* **18**, 5562 (2010).

## CHEMISTRY

### Tight Squeeze

One of the first things students learn in a chemistry course is the octet rule: Atoms of the light elements are capable of sharing at most eight electrons, which limits them to four bonding partners (at two electrons to a bond). Of course, rules are made to be broken, as students soon realize when they are confronted with the stability of  $\text{PF}_5$  and  $\text{SF}_6$ . And then there are the metals, such as iron and chromium, that routinely form six-coordinate compounds by using their partially vacant *d* orbitals. Notable exceptions in this realm involve coordination by



seven guests, but it all depends on how big the guests are; smaller ones such as hydrogen can crowd together more effectively.

This brings us to tetrakis(*N,N*-dimethylamino)borate thorium. Among the heaviest metals, thorium boasts a comparatively large radius, and Daly *et al.* have managed to squeeze 15 different hydrogen atoms around it, tethering the central metal to eight boron centers in the periphery. The authors characterized the compound by neutron as well as x-ray diffraction (the former being an especially sensitive technique for hydrogen detection), and their theoretical simulations suggest that, were it not for crystal packing effects, yet another hydrogen would coordinate. Heating this crowded compound induces some chemical rearrangements, the net effect of which is to bring the coordination number down to the rather less shocking value of 14. — JSY  
*Angew. Chem. Int. Ed.* **49**, 10.1002/anie.200905797 (2010).

## NEUROSCIENCE

## Insurance Against Deprivation

Individuals suffering a stroke show various degrees of neurological dysfunction due to brain tissue that has been deprived of oxygen. Strategies to minimize damage from this common problem are needed, and this has focused the attention of investigators on a process whereby the resistance of neurons to ischemia (or loss of blood flow) is increased if cells have been exposed previously to a mild bout of ischemia insufficient to cause permanent damage. Stapels *et al.* conducted a systematic search for proteins that showed increased abundance in such resistant neurons and identified SCMH1, a mouse homolog of a *Drosophila* polycomb group protein. SCMH1 can modify histones and is thought to function by repressing transcription. In a mouse neuroblastoma cell line, depletion of SCMH1 diminished the induction of tolerance to ischemia, and overexpression of SCMH1 promoted tolerance even in the absence of a conditioning ischemic event. SCMH1 associates with the promoters of two potassium ion-channel genes, and inhibiting the transcription of these genes was sufficient to produce tolerance to subsequent ischemia. — LBR

*Sci. Sig.* **3**, ra15 (2010).



annealed films could be considered as practical alternatives to a range of metals and metal oxides, especially if cost is a concern. — MSL

*Proc. Nat. Acad. Sci. U.S.A.* **107**, 10.1073/pnas.0913879107 (2010).

## BIOCHEMISTRY

## Pain Relief

The endogenous alkaloids of the opium poppy, such as morphine and codeine, have been used as analgesics for several millennia. These compounds and their precursors, especially thebaine, have also been used as the starting material for making semisynthetic opioids, with the aim of creating a less dangerous yet still potent drug. The focal differences are situated at positions C3 and C6: thebaine contains two O-methyl groups, codeine has undergone 6-O-demethylation, and morphine has been denuded of both O-methyl groups. Hagel and Facchini have identified the enzymes responsible for these reactions, the-

baine 6-O-demethylase (T6ODM) and codeine O-demethylase (CODM), by differential transcript screening against a poppy varietal that is deficient in both morphine and

codeine. Both enzymes are members of the  $\alpha$ -ketoglutarate/Fe(II)-dependent dioxygenase family, and the mechanism probably involves the insertion of an oxygen into a C-H bond of the methyl group and then elimination of a molecule of formaldehyde. — GJC

*Nat. Chem. Biol.* **6**, 273 (2010).

## MATERIALS SCIENCE

## The Power of Annealing

Combine a conducting polymer with a small molecular acid and you get high conductivity but poor processability. A polymeric acid improves processability, but the conductivity plummets. Yoo *et al.* show that you can have the best of both worlds by using a polymeric acid as the dopant and then performing a post-processing solvent annealing step that substantially improves the conductivity. Polyaniline becomes conductive through proton doping with poly(2-acrylamido-2-methyl-1-propanesulfonic) acid. Exposure to dichloroacetic acid (DCA) decreases film roughness by allowing the colloidal particles that form during polymerization to blend, leading to chain conformations with improved charge transport. A somewhat different effect occurs in poly(ethylene dioxythiophene) films doped with poly(styrene sulfonic) acid (PSS). Treatment with DCA increases conductivity as well as surface roughness. The authors attribute this result to disruption by DCA of the insulating surface layer of PSS that forms during spin casting. The DCA-treated films were tested in organic thin-film transistors, solar cells, and light-emitting diodes. In all cases, the treated films showed much better characteristics than the untreated ones. Although the properties did not match those of devices made with indium tin oxide (the current benchmark material), the

## EVOLUTION

## Structured Differently

Selection may amplify or promote sex-specific differences within a species, and many morphological and behavioral changes have been correlated with differences between the sexes within a species. Li and Merila investigated genome-based sex bias in wild Siberian jays and identified a significant amount of genomic differentiation between males and females. They found that on average, females were more heterozygous than males; that the Z sex chromosome showed greater selection than the autosomes; and that linkage disequilibrium differed between the sexes, with males showing lower levels than females. These data suggest that females and males experience different selective forces, which may either be due to or drive life history traits, such as sex-specific dispersal. — LMZ

*BMC Evol. Biol.* **10**, 10.1186/1471-2148-10-66 (2010).

# Science

## Selected Domestically

Laura M. Zahn

*Science* **328** (5974), 18.

DOI: 10.1126/science.328.5974.18-a

### ARTICLE TOOLS

<http://science.sciencemag.org/content/328/5974/18.1>

### RELATED CONTENT

<file:/content/sci/328/5974/twil.full>

### PERMISSIONS

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

---

*Science* (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. 2017 © The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. The title *Science* is a registered trademark of AAAS.