Bright Source of Photon Pairs
Pairs of correlated photons can be generated via parametric down-conversion in nonlinear crystals, but this method has not provided enough pairs to realize application in areas such as quantum cryptography. Thompson et al. (p. 74) optically pumped a laser-cooled cloud of cesium atoms inside an optical cavity, and show that they can prepare 50,000 correlated pairs every second. The photons have linewidths sufficiently narrow that they should interact strongly with atoms and molecules.

The Topology of Music
In Western music, harmony—the selection of notes to create a chord—and counterpoint—how individual notes are connected in time to establish melodic voices—together form the basis for composition. The rules of harmony and counterpoint embody aesthetic norms but also represent constraints on the composer that can sometimes be difficult to reconcile. Tymoczko (p. 72; see the Perspective by Hook) discusses a mathematical system for organizing the 12 tones of the western scale that makes use of a topological structure called an orbifold, in which chords are points in the topological space and the segments connecting them indicate how chords progress. Examination of the geometry of these spaces provides an understanding of some long-standing puzzles in music theory.

Standing Long and Tall
Water alters the main anhydrous feldspar minerals of many rocks to clays. Because the hydrogen isotope composition of precipitation varies with altitude, the clay minerals that form from surface weathering preserved in ancient stream cobbles could be used to infer ancient elevations. Mulch et al. (p. 87) have applied this principle to infer the topography of the Sierra Nevada mountains 50 million years ago. The Sierra Nevada now stand about 2 kilometers above sea level, but when they arose has been widely debated. The hydrogen isotope data from ancient cobbles in a preserved river channel mimic those in present-day drainages, implying that the mountains have been high since the Eocene.

Snagging Photogenerated Charges
Biological photosystems use elaborate protein-chromophore structures to separate photo-induced charges so that, rather than recombine, they perform useful chemical reactions. Bhosale et al. (p. 84; see the Perspective by Kinbara and Aida) synthesized a photosystem that partitions electron and hole acceptors on the inside and outside of vesicles that react with the photoinduced charges before they recombine. Molecules containing face-to-face stacks of fluorophores self-assembled as tetramers in lipid vesicles. In the presence of visible light, these assemblies create long-lived electron-hole pairs that reduced quinones inside the vesicles and oxidized EDTA in the surrounding solution. The resulting pH gradient between the interior and exterior of the vesicle could be released by the addition of an intercalator that caused the photosystem to reassemble as a channel structure.

The Well-Dressed Fly
Drosophila melanogaster sports a set of forewings and a small pair of serially homologous structures, termed halteres, that help provide balance during flight. Crickmore and Mann (p. 63, published online 1 June; see the Perspective by Stern) used genetic analyses to examine the variation in size control between the wing and haltere during development. Ultrathorax (Ubx), a homeotic selector gene, controls the size of the haltere primordium and, subsequently, the haltere itself, by restricting the expression and mobility of the morphogen, Decapentaplegic (Dpp), via the Dpp receptor, thickveins. Thus, selector genes can regulate organ size by regulating both growth factors and their receptors.

Dicing with Viral Defense
In RNA silencing, Dicer endonuclease cleaves double-stranded RNAs to generate small interfering (si)RNAs that target complementary RNA sequences. The plant Arabidopsis has four Dicer-like (DCL) enzymes (DCL1 to DCL4) that are involved in genesis of micro (mi)RNAs, natural antisense siRNAs, repeat-associated siRNAs, and trans-acting siRNAs, respectively. The role that

Setting Global Priorities for Conservation
At least nine major templates of global biodiversity conservation priority have been published during the past decade, but this literature has been largely disconnected from parallel advances in systematic conservation planning. Brooks et al. (p. 58) review how the different approaches relate to one another in the context of the broader conservation planning theory. Areas of agreement are identified between the approaches that lead to a clearer message on the need to protect particular regions.

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the DCLs play in viral infection is less clearly understood. Deleris et al. (p. 68, published online 1 June; see the cover and the Perspective by Waterhouse and Fusaro) show that the Arabidopsis dicers have equally distinct roles in defending the plants from infection, with DCL4 and DCL2 having major and partially redundant roles in incorporating viral siRNAs into antiviral effector RISCs. DCL4 also prevents viral movement outside the plant vasculature.

Resisting Antibiotic Stress
An unwanted effect of antibiotic treatment is promotion of antibiotic resistance through the dissemination of resistance genes and the selection of resistant subpopulations of bacteria. Prudhomme et al. (p. 89) discovered that the stress of exposure to antibiotics triggers competence (“parasexuality”) in Streptococcus pneumoniae, not only enabling the acquisition of new antibiotic resistance genes but also permitting the acquisition of virulence determinants. Natural transformation is widespread—it has been observed in about 50 different species of bacteria. The discovery that it can be stimulated by antibiotics has significant implications for strategic antibiotic development.

Of Mice and Mammoths
What are the molecular genetic changes that underlie an organism’s adaptation to a new environment? Beach mice (Peromyscus polionotus) living on coastal dunes of Florida’s Gulf Coast barrier islands are prey for owls and hawks and subject to selection based on their ability to hide: Beach mice are lighter and have different coloration patterns compared to their mainland cousins. Hoekstra et al. (p. 101) show that a major determinant of this coat color variation is the melanocortin-1 receptor that is involved in the switch between production of dark and light pigments. The beach mice have a change in a single amino acid compared to the darker mainland mice, which correlates with changes in coat color. Curiously, Florida’s Atlantic Coast beach mice do not have this allele, which suggests that their light color evolved independently. Römpler et al. (p. 62) looked at the gene for the melanocortin-1 receptor from woolly mammoths, and find that in this case as well, it may have been responsible for the existence of both dark- and light-haired individuals.

Blood-Borne Prion Protein
Prion proteins (PrP) are thought to represent the infectious agent responsible for a variety of progressive, fatal neurodegenerative disorders. Recently, three cases of variant Creutzfeldt-Jakob disease (the human form of “mad cow” disease, bovine spongiform encephalopathy) have been reported to have been transmitted by blood transfusion, so a presymptomatic test to allow the screening of blood donors is crucial. Saá et al. (p. 92) describe how an in vitro amplification procedure allowed the biochemical detection of PrP in the blood of experimentally infected animals long before the onset of clinical disease. Trifilo et al. (p. 94) examined scrapie infection in a transgenic mouse system in which the endogenous mouse PrP lacked its membrane anchor. The mice did not exhibit neurological problems, but instead developed heart disease. Furthermore, PrPres, the disease-associated folded PrP protein, could be detected in undiluted plasma without any amplification.

Fine-Tuning of the Unfolded Protein Response
The unfolded protein response (UPR) plays a central role in governing a cell’s survival after exposure to stress. The UPR encompasses a diverse range of transcriptional and translational responses stimulated by the increase in levels of unfolded or misfolded proteins within the endoplasmic reticulum (ER). The UPR uses different strategies to provide a coherent response, which allows cells both to survive acute folding stresses and to fine-tune the ER folding capacity to meet the needs of a cell. Hollien and Weissman (p. 104; see the Perspective by Ron) systematically explored the outputs of various players in the UPR. They found that IRE1 (the transmembrane protein that monitors the folding status of the ER) mediates a rapid and robust down-regulation of a subset of ER-targeted messages by direct destabilization of ER-bound messenger RNAs.