A Matter of Faith?
The intersection, if any, between science and religion is a hot-button issue guaranteed to inflame scientists and nonscientists alike. Norenzayan and Shariff (p. 58) review recent empirical approaches in social psychology, experimental economics, and evolutionary anthropology primarily aimed at studying pro-social behavior among humans past and present. A synthesis of these findings highlights issues that are being tackled in the current wave of experimental studies and the interdisciplinary interest in religion as a force for cooperative and altruistic human interactions.

Ups and Downs
Most of the geological history of the Paleozoic Era (542 to 251 million years ago) remains opaque, largely due to the difficulty of constructing records from such old and sparse remains. In particular, the history of sea level during the Paleozoic has remained piecemeal. Haq and Schutter (p. 64, cover) integrated published accounts of sea-level changes to reconstruct the history of sea-level fluctuations for the entire Paleozoic. One hundred seventy-two individual events were recorded, each lasting typically between half a million and three million years and varying in magnitude from a few tens to ~125 meters. Most events were not caused by glaciations, however, leaving unanswered the question of what caused more than half of these changes in Paleozoic sea level.

Temperature-Sensitive Water Layers
Water layers that interact with hydrophobic properties play a key role in processes such as protein folding and membrane transport, but their properties can be difficult to determine because they are themselves in contact with bulk water. The interior of single-walled carbon nanotubes (SWNTs) would be expected to be hydrophobic, and water will absorb in their interior. Wang et al. (p. 80) used a gentle method to open SWNTs with diameters of 1.4 nanometers and studied their absorption and nuclear magnetic resonance (NMR) properties over a range of different temperatures. The water actually underwent a transition from appearing to be in a hydrophobic environment at 22°C to appearing to be in a hydrophilic environment at 8°C.

Back to the Future for Negative Refraction
Waves refract, changing their angle of propagation when going from one medium to another. The extent of refraction depends on the relative refractive indices of the media. In nature, all materials are run-of-the-mill positively refractive. However, recent work has demonstrated materials with a negative refractive index. The ability to manipulate electromagnetic radiation with such materials can lead to perfect lensing and cloaking. However, limitations on the fabrication of these metamaterials inevitably lead to losses, which can severely limit their implementation. Linking time-reversal processes with negative refraction, Pendry (p. 71, published online 28 August) discusses an alternate route that may overcome these limiting losses. Optically active materials, with the correct nonlinear optical properties, may be able to be made to mimic negative refraction without the losses associated with true negative refractive materials.

Lending an Electron
Catalysts for the preparation of chirally pure organic compounds tend to operate through paired electron mechanisms involving charged or highly polarized intermediates. Generation of an intermediate with an unpaired electron (a radical) can open other reaction pathways, favoring different products while avoiding undesirable competing reactions. In this vein, Nicewicz and MacMillan (p. 77, published online 4 September; see the Perspective by Renaud and Leong) demonstrate the utility of a photo-excitable ruthenium complex for shuttling single electrons to induce otherwise intractable reactions. The complex was combined with a chiral amine established for catalyzing a range of aldehyde transformations. Upon visible light irradiation, electron transfer to and from the Ru co-catalyst facilitates a radical mechanism for efficient asymmetric alkylation of the aldehydes, avoiding an aldehyde self-coupling reaction.

Gas from the Past
Carbon dioxide is the atmospheric trace gas with the largest influence on climate. Because the carbon cycle and climate are coupled so intimately, with CO₂ variations both causing and being caused by climate change, knowing how climate and atmospheric CO₂ have varied in the past is central to a better understanding of climate dynamics. Ahn and Brook (p. 83, published online 11 September) compare records of atmospheric CO₂ concentrations, Antarctic surface air temperatures, and Greenland climate during a relatively under-studied period: the last ice age, from 90,000 to 20,000 years ago.
Life History Matters

In plants, changes in life history traits have been suggested to be correlated with their rate of evolution, but previous analyses have yielded conflicting results. In order to investigate whether the rate of molecular evolution correlates with life history traits, Smith and Donoghue (p. 86) tested the evolutionary rates across five groups of flowering plants. The rates of molecular evolution were generally low in trees and shrubs with long generation times in comparison to the relatively high rates of molecular evolution in related herbaceous plants, which have shorter generation times. Thus, evolutionary rates can indeed differ among closely related species, depending on their life history traits.

Getting to Grips with Gastrulation

Gastrulation involves the coordinated movements of germ layers to form the body axis. Nair and Schilling (p. 89, published online 21 August) studied chemokine regulation of endodermal morphogenesis and the positioning of the liver and pancreas in developing zebrafish. During development the endoderm normally migrates together with mesoderm, but the two germ layers could be physically separated by disrupting chemokine signaling, due to a loss of integrin-dependent adhesion to fibronectin. A chemokine-mediated adhesive interaction may thus normally tether endodermal cells to their mesodermal neighbors, providing a mechanism by which chemokines regulate embryonic cell movements distinct from their roles as classical chemoattractants.

Homing In on the Hub

Microorganisms respond to a variety of environmental stresses by up-regulating stress-response genes. In many cases the response is coordinated by a multiprotein signaling hub, the stressosome, which integrates multiple inputs to affect a single outcome. Marles-Wright et al. (p. 92) have fitted high-resolution structures of the stressosome components into an electron microscopy structure to determine a pseudo-atomic resolution structure of the stressosome from Bacillus subtilis. The complex has an icosohedral virus-capsid-like core with 20 protruding turrets. Sequences comprising the turrets are variable, perhaps allowing them to sense different signals. The conserved domains of the core may integrate these signals to give a single signaling outcome.

Homer-ing In on Memories

The neural correlates of remembering can only be studied with complete confidence in humans, because the subjects can verbally report their internal experience. Brain surgery in which therapeutic electrodes are implanted in the brain of patients with intractable epilepsy provides an opportunity for doing such studies. Gelbard-Sagiv et al. (p. 93, published online 4 September; see 5 September news story by Miller) report that neurons in and near the hippocampus of these patients showed specific patterns of activation for each episode of the television show The Simpsons. Later, when these same episodes were brought to mind by free recollection, the same pattern of neural activity was seen, demonstrating that, at least in the hippocampus, recall of a stimulus is accompanied by activation of the same neurons that were activated during the initial experience.

Controlling Conspiracy Theories

Believing oneself to be in control is a well-established and remarkably effective route to reduced anxiety and stress; conversely, being placed in an out-of-control situation activates behaviors aimed at regaining secure ground. Whitson and Galinsky (p. 115) show that the need for control is sufficiently strong as to influence perception to the extent of seeing patterns where they do not exist. In a series of studies, subjects were provided with feedback unrelated to their performance. Doing so increased their reported need for personal structure, increased the likelihood that they would see patterns in random visual static, and led them to see conspiracies where there were none. Allowing subjects to combat their anxiety through self-affirmation exercises brought their illusory perceptions under control.