SIGNAL TRANSDUCTION
A function for multisite phosphorylation
Many transcription factors are regulated by phosphorylation on multiple residues. Mylona et al. analyzed multisite phosphorylation in the transcription factor Elk-1 and showed that it may protect against excessive activation (see the Perspective by Whitmarsh and Davis). Phosphorylation by the kinase ERK2 occurred at eight sites, but the sites were phosphorylated at different rates. Those that were phosphorylated more quickly promoted transcriptional activation. Those that were phosphorylated more slowly dampened excessive activation by ERK2s without needing a phosphatase or any other negative regulatory component. —LBR
Science, this issue p. 233; see also p. 179

PROTEIN EVOLUTION
Phosphorylation and fungal evolution
Phosphorylation after transcription modifies the activity of proteins. To understand how phosphorylation sites have evolved, Studer et al. studied a range of fungal species (see the Perspective by Matalon et al.). Only a few sites were apparently present in the common ancestor of all 18 species investigated. Evolutionary age appeared to predict the potential functional importance of specific conserved phosphotyrosines. —LMZ
Science, this issue p. 229; see also p. 176

HIV-1 THERAPY
Antibodies sustain viral control
For many infected individuals, antiretroviral therapy (ART) means that an HIV-1 diagnosis is no longer a death sentence. But the virus persists in treated individuals, and complying with the intense drug regimen to keep virus loads down can be challenging for patients. Seeking an alternative, Byrareddy et al. treated ART-suppressed monkeys with antibodies targeting α4β7 integrin. When ART was halted in the antibody-treated animals, viral loads stayed undetectable, and normal CD4 T cell counts were maintained for over 9 months—and persisted—even after stopping the antibody therapy. —KLM
Science, this issue p. 197

IN OTHER JOURNALS
Edited by Kristen Mueller and Jesse Smith

BIOPHYSICS
Two roads diverged in a yellow photolyase
Photolyase enzymes repair DNA that has been damaged by ultraviolet sunlight. The repair process begins when blue light absorption by a cofactor drives an electron transfer step. Zhang et al. applied ultrafast absorption spectroscopy to study the dynamics of this step. A bifurcation in the electron transfer pathway favors a direct tunneling mechanism in the prokaryotic enzymes and a two-step hopping mechanism in the eukaryotic variety. This difference explains the higher repair quantum yield seen in prokaryotes. —JSY
Science, this issue p. 209

SICKLE CELL DISEASE
Hammering out the sickle cell mutation
Sickle cell disease is a genetic disorder caused by a mutation in one of the hemoglobin genes. This causes deformation of red blood cells and results in occlusion of blood vessels, severe pain, and progressive organ injury. To correct the mutation that causes this disease, De Witt et al. modified hematopoietic stem cells from sickle cell disease patients by using a CRISPR-Cas9 gene editing approach. The corrected cells successfully engrafted in a mouse and produced enough normal hemoglobin to indicate a potential clinical benefit in ameliorating sickle cell disease. —YN

CELL DIVISION
Crossing over to let go
Eukaryotic cells package their genomes into chromosomes, and when they divide, they deliver a complete set of chromosomes to each daughter cell. During meiosis (the cell division that creates germ cells), “DNA crossovers” hold homologous chromosomes together, which helps to ensure that they segregate correctly. Studying worms, Machovina et al. show that cells carefully monitor how these crossovers form. The presence of a crossover strengthens the protein complex that holds the two homologous chromosomes together. Failure to form a crossover weakens the protein complex until a crossover can occur. —GR

BRAIN RESEARCH
Encoding false memories
A unique human ability is the use of concepts that confer meaning in an abstract way. Despite the importance of conceptual knowledge for human cognition, scientists know little about the underlying neural mechanisms and structures. To better understand this process, Chadwick et al. scanned people’s brains while they performed tasks known to cause false memories in a statistically predictable manner.

Crossovers help ensure that chromosomes segregate properly during meiosis.
They found that activity in the temporal pole, a region known as the “semantic hub” of the brain, could predict false memories. Moreover, individuals had distinct patterns of activity in this region, allowing the authors to predict specific memory errors in different subjects. —PRS

**AUTISM GENOMICS**

Mosaic mutations in autism

Spontaneously arising de novo mutations are likely important contributors to the development of autism spectrum disorder (ASD) in affected individuals. Genetic mutation is an ongoing process. Although people inherit deleterious mutations from their parents, some can also arise postzygotically. Freed and Pevsner examined the degree to which postzygotic mutations contribute to ASD and found mosaic mutations, which occur postzygotically and only in a subset of a person’s cells, in multiple genes implicated in ASD. On the basis of these observations, the authors estimated that mosaic mutations contribute to ~5% of ASD diagnoses. —LMZ
PLOS Genet. 12, e1006245 (2016).

**MATERIALS SCIENCE**

Push both ways to avoid a jam

When subject to shear flow, dense solutions of particles can jam together, dramatically increasing their viscosity. This can be helpful, such as in traction control systems, or it can be harmful, such as when a pipe becomes blocked during industrial processing. During flow, when the stress exceeds a critical value, particle interactions transform from lubricated to frictional, leading to transient force chains. Lin et al. show that this particle jamming transition is not fixed by the suspension formulation, but rather can be dynamically tuned: The trick is to introduce perturbations in an orthogonal direction to break up the force chains before they fully form. This enables control of the thickening viscosity over two orders of magnitude. —MSL

**STRUCTURAL BIOLOGY**

Dynamics of a protein knot

A small fraction of proteins have an unusual conformation in which the backbone forms a knot. An example is a bacterial enzyme, TrmD, that transfers a methyl group from S'-adenosyl methionine (AdoMet) to a guanine nucleotide that is conserved in many transfer RNAs (tRNAs). This methyl transfer ensures accurate protein synthesis. Christian et al. combine structural, mutagenesis, and computational studies to examine the role of the protein knot in catalysis. They show that the knot binds the AdoMet in a bent conformation oriented for methyl transfer. Despite its constrained topology, the knot undergoes complex dynamics that couple AdoMet binding to tRNA binding and facilitate catalysis. —VV
Nat. Struct. Mol. Biol. 10.1038/ncomms3282 (2016).

**CARBON FOOTPRINT**

Mapping the impact of nations

The consumption and production of goods have a much wider impact than simply on the country or region where they are used or made. For example, the carbon footprint of global supply chains varies within and between countries, mostly according to economics and trade. Using spatial modeling, Kanemoto et al. linked carbon emissions maps to industrial activity across 187 countries from 1970 to 2008. The carbon footprints of developed countries such as the United States have become more globally diffuse over that time span, whereas hotspots of carbon footprints in rapidly developing economies such as India and China are located in their expanding urban areas. —NW

**MACHINE LEARNING**

A quantum leap for machine learning

Machine learning is a field of artificial intelligence in which a set of algorithms and training sets can teach a computer to learn and then to independently perform a particular set of tasks. These thinking machines are now at the stage of pitting their wits against human opponents, and can, in recent instances, outperform and beat the very best opponents in complex gaming scenarios. So far, the implementations have been classical algorithms running on classical computers. Dunjko et al. show that certain aspects of quantum information processing, when applied to machine learning, could provide a quantum advantage. They identify certain traits in machine learning for which quantum processing algorithms can improve learning efficiency, and they show that quantum processing could provide faster solutions when applied to particular categories of machine learning problems. —ISO

<table>
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<tr>
<td>1e+04</td>
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<td>Gray indicates no data.</td>
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**Figure:** Carbon footprint change from 1970 to 2008. The carbon footprints of developed countries such as the United States have become more globally diffuse over that time span, whereas hotspots of carbon footprints in rapidly developing economies such as India and China are located in their expanding urban areas. —NW

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