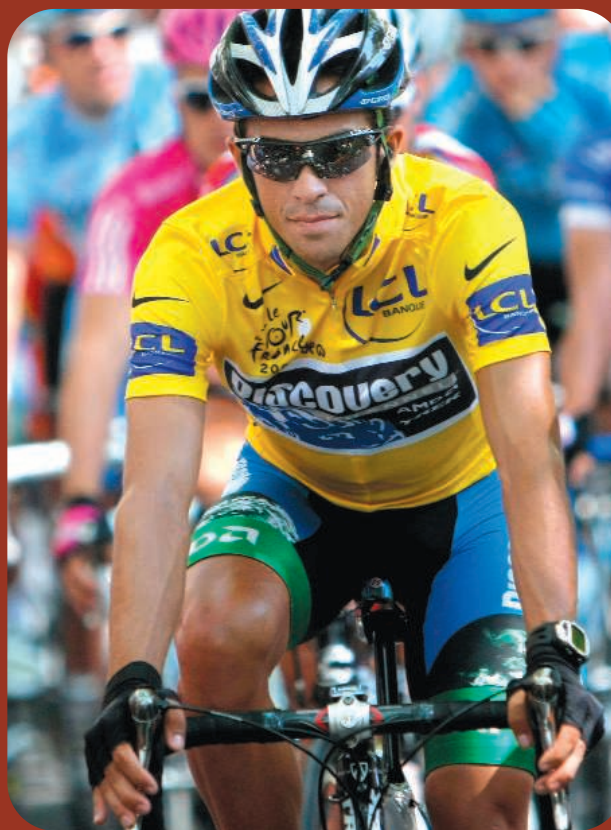


PSYCHOLOGY

Cycling Between Worlds

During the run-up to the first round of the 2007 presidential election in France, boundaries blurred as the usual mix of campaign rhetoric and dirty tricks spilled over into the virtual world of Second Life. Whether these skirmishes influenced the real-world electorate is unclear, and McCabe *et al.* have begun to investigate whether associations learned within the confines of a computer-based contest might affect participants' behavior in real-world situations. They conditioned participants to chase or avoid cyclists who overtook them by linking one type of jersey logo to fruit juice and the other to salty tea, respectively. Several days later and in a different building, approximately two-thirds of the participants, while waiting for their turn in the brain scanner, elected to sit in a chair on which was draped a towel embroidered with the positively associated logo. Furthermore, neural activity of the insula region of the brain (a measure of motivational salience) reflected the previous conditioning of appetitive and aversive stimuli, hinting at a carryover from the virtual reality cycling competition. — GJC

J. Neurosci. **29**, 1046 (2009).



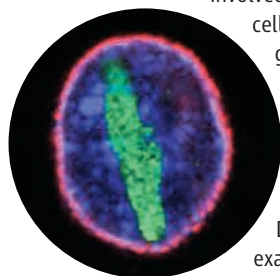
CELL BIOLOGY

Aging Disgracefully

As we age, all too many aspects of our physique deteriorate—not just at the macroscopic scale of our limbs and organs, but also at the single-cell level. Nuclear pores allow for the transport of proteins and nucleic acids across the nuclear envelope, both from the cytoplasm to the nucleus and in the reverse direction, and are essential in normal trafficking processes

involved in gene expression, cellular homeostasis, and growth. Nuclear pores are complexes of many individual protein components, some of which are extraordinarily long-lived.

D'Angelo *et al.* have examined the characteristics of these complexes in aging postmitotic cells from *Caenorhabditis elegans* and from rodents, and find that as cells grow old, the lack of



Normally cytosolic protein tubulin (green) inside an old nucleus.

renewal of some nuclear pore components leads to the gradual deterioration of nuclear pore function. As a consequence, the nuclei of older cells become leaky, and proteins that would normally be excluded from the nucleus can be found within it. — SMH

Cell **136**, 284 (2009).

CHEMISTRY

Product Protection

Chemical transformations often pose the dilemma that a desirable product may prove unstable under the reaction conditions. In certain cases, such intermediate products may be sufficiently volatile to be removed evaporatively from the reaction mixture as they are generated, but many compounds are not amenable to this mode of separation. A particularly insidious challenge arises in the partial alkylation of amines. Adding an alkyl group renders an amine more nucleophilic than before, and so more likely to attract yet another alkyl group; therefore, simply mixing equivalent amounts of amines and alkyl electrophiles tends to afford a mixture of unreacted and polyalkylated products. Yebeutchou and Dalcanale skirt the

problem by adding molecular sequestering agents that selectively capture amines after their preliminary reaction step, thereby protecting them from further interaction with a methylating agent (iodomethane). The optimized protectors were tetra(arylphosphonate)-based cavitands that attracted monomethylated alkyl ammonium cations through ion-dipole forces, hydrogen bonding at the rim, and C-H- π interactions deep in the cavity. In their presence, a range of alkyl and aryl primary amines could be selectively methylated in good yield. The authors verified preferential encapsulation of the secondary ammonium ions in solution using nuclear magnetic resonance spectroscopy. — JSY

J. Am. Chem. Soc. **131**, 10.1021/ja809614y (2009).

NEUROSCIENCE

Opioids and Drink

Substance abusers score higher on measures of cognitive and motor impulsivity. Cognitive impulsivity refers to the inability to delay gratification, whereas motor impulsivity, or disinhibition, describes the inability to withhold a pre-potent response. Animal studies confirm that impulsivity

correlates with drug intake, although nearly all of these studies have examined impulsivity in relationship to psychostimulant drugs.

Olmstead *et al.* have investigated whether deletion of the μ - or δ -opioid receptor genes alters motor impulsivity in mice. They tested the behavior of these mutant animals in an operant-based behavioral task that assesses the ability of mice to withhold a well-learned pre-potent response (a nose poke used to gain a sucrose reward); the reward can be obtained only when nose-poke responses are made during a brief light stimulus. Mice lacking μ -opioid receptors exhibited decreased motor impulsivity, whereas those lacking δ -opioid receptors showed increased motor impulsivity. Additionally, mice lacking μ -opioid receptors were insensitive to the effects of alcohol, which increases impulsivity and decreases conditioned responding in wild-type mice, and the behavior of mice lacking δ -opioid receptors was completely disrupted by alcohol. Taken all together, these results indicate a link between opiate receptors in the brain, impulsive behavior, and behavior directed toward ingesting alcohol. — PRS
PLoS ONE 4, e4410 (2009).

MOLECULAR BIOLOGY

Finely Balanced Registers

Many genes are interrupted by noncoding introns that must be precisely excised from the RNA molecules transcribed from the gene. In the first step of the splicing reaction, a large RNA-protein splicing machine recognizes the 5' end of most introns via the complementarity of this region to one of the spliceosome components, the U1 RNA. Yet other 5' splice sites show little complementarity to the canonical U1 sequence and are nonetheless efficiently and accurately spliced by the very same machine.

In puzzling over this conundrum, Roca and Krainer noticed that a subset of these atypical 5' splice sites did have a sequence that could form a base-paired region with the U1 sequence, but only if shifted one base downstream of the normal 5' splice site (the +1 register). Mutating one of these atypical 5' splice sites to improve its complementarity to the U1 RNA in the canonical register resulted in aberrant, rather than improved, splicing. Furthermore, mutations in the +1, but not canonical, register of the U1 RNA that restored base pairing with the mutated atypical 5' splice sites could rescue the splicing defects. Understanding that the U1 RNA can recognize two subsets of 5' splice sites in two registers accounts for the splicing of atypical 5' splice sites and also explains the deleterious effect of a mutation in the intron of the gene *RARS2*, which is associated with pontocerebellar hypoplasia.

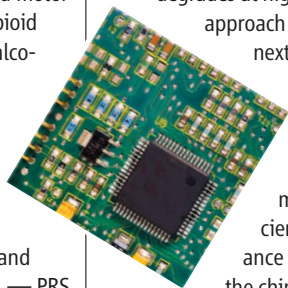
Although the 5' splice site mutation improves complementarity with the canonical U1 register, it weakens base pairing in the +1 register, and it is this imbalance that probably causes the exon skipping seen in the disease. — GR

Nat. Struct. Molec. Biol. 16, 176 (2009).

ENGINEERING

Keeping Chips Cool

The heat that is generated by silicon chips in the integrated circuits at the heart of modern electronic devices must be efficiently removed, because the performance of field-effect transistors degrades at higher temperatures. One



approach for providing active cooling next to a chip is to use thermoelectric materials, which effectively transport heat via current flow. Chowdhury *et al.* fabricated a material with a high coefficient of thermoelectric performance and sandwiched it between the chip and a thermal sink layer.

Specifically, the thermoelectric material comprised superlattices of p-type $\text{Bi}_2\text{Te}_3/\text{Sb}_2\text{Te}_3$ and n-type $\text{Bi}_2\text{Te}_3/\text{Bi}_2\text{Te}_{2.83}\text{Se}_{0.17}$ grown on GaAs substrates by metal-organic chemical vapor deposition. The assembled devices could cool a targeted region on a silicon chip with a high heat flux (1300 W/cm^2) by 15°C . — PDS

Nat. Nanotechnol. 4, 10.1038/NNANO.2008.417 (2009).

APPLIED PHYSICS

Sensing the Vibes Remotely

Vibrations in machinery can lead to excessive wear, and, in the worst case, to catastrophic failure. Monitoring unwanted vibration is therefore an important safety issue. Probing the response of materials to vibrations at ultrasonic frequencies can provide a diagnostic test for defects and cracks in materials that may appear before the device breaks down. It is not always possible, or feasible, to use mechanically attached sensors, and so optical sensors may allow for nonintrusive monitoring. Bouncing laser light off a textured surface (such as a wall, a can, or paper) produces a speckle pattern. Bessette *et al.* introduce a photoconductive sensor that probes the movement of the speckle pattern as the sample, in this case a metal surface cut from a can, is vibrated at high frequency. Using a simple silicon-based photoconductive element, which can be shrunk to micrometer size, they can look at the movement of a single speckle, thereby giving them the ability to monitor vibrations at ultrasonic frequencies remotely. — ISO

Appl. Phys. Lett. 94, 41121 (2009).

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Keeping Chips Cool

Phil Szuromi

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