

## STRUCTURAL BIOLOGY

### Blueprint for a macromolecular machine

Nuclear pore complexes (NPCs) consist of around 1000 protein subunits, are embedded in the membrane that surrounds the nucleus, and regulate transport between the nucleus and the cytoplasm. Although the overall shape of NPCs is known, the details of this macromolecular complex have been obscure. Now, Lin *et al.* have reconstituted the pore components, determined the interactions between them, and fitted them into a tomographic reconstruction. Kosinski *et al.* have provided an architectural map of the inner ring of the pore. — VV

*Science*, this issue pp. 308 and 363

## THERMODYNAMICS

### Making a teeny tiny engine

Steam locomotives, cars, and the drinking bird toy all convert heat into useful work as it cycles between two reservoirs at different temperatures. Usually, the working substance where the heat-work conversion occurs is a liquid or a gas, consisting of many molecules. Roßnagel *et al.* have made a working substance of a single calcium ion in a tapered ion trap. A laser-cooling beam plays the part of a cold reservoir for the calcium ion, and in turn, electric field noise acts as a hot reservoir. — JS

*Science*, this issue p. 325

## CANCER

### Adding fuel to the fire

Antioxidant drugs used to treat cancer can cause undesirable side effects. Diabetic patients are at increased risk of developing cancer, and Wang *et al.* show that drugs with antioxidant properties used to treat diabetes all accelerated metastasis in mouse models of cancer. Although not yet tested in human patients, it might be prudent to exercise caution when prescribing these types of drugs to patients with an increased risk of developing cancer. — YN

*Sci. Transl. Med.* **8**, 334ra51 (2016).

## ORGANOMETALLICS

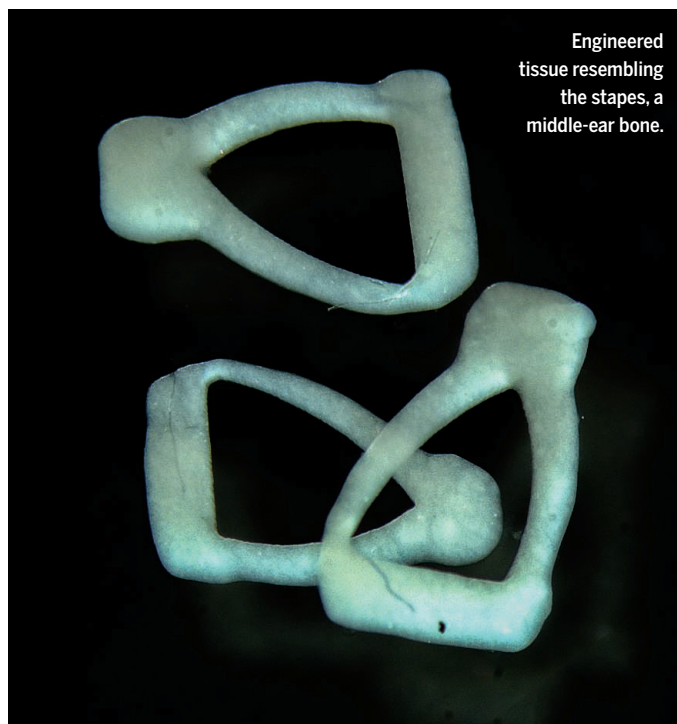
### Where Pd and B meet in Suzuki coupling

The Suzuki-Miyaura reaction is widely used to form carbon-carbon bonds. It operates by transferring a carbon center from boron to palladium, although the handoff itself happens too quickly to see. Thomas and Denmark have caught sight of the previously elusive intermediate complexes linking palladium to boron through an intervening oxygen. Using low-temperature nuclear magnetic resonance spectroscopy, they characterized the intermediate structures just before the carbon transfer event. — JSY

*Science*, this issue p. 329

## IN OTHER JOURNALS

Edited by Sacha Vignieri and Jesse Smith



Engineered tissue resembling the stapes, a middle-ear bone.

## BIOMATERIALS

### Shaping cells to mature together

**T**issue engineering requires the use of degradable scaffolds that provide temporary support and an architectural guide that controls the initial growth and proliferation of seeded cells to form a desired tissue. Vrij *et al.* develop a more general approach in which cellular aggregates progressively fuse and assemble to form tissues. By controlling the general shape of the well into which the cells or clusters are seeded, they introduce anisotropy into both the shape of the growing objects and in deformation upon compaction. This encourages the formation of a primitive vasculature and self-scaffolding as the final tissue is assembled from the smaller building blocks. — MSL

*Adv. Mater.* 10.1002/adma.201505723 (2016).

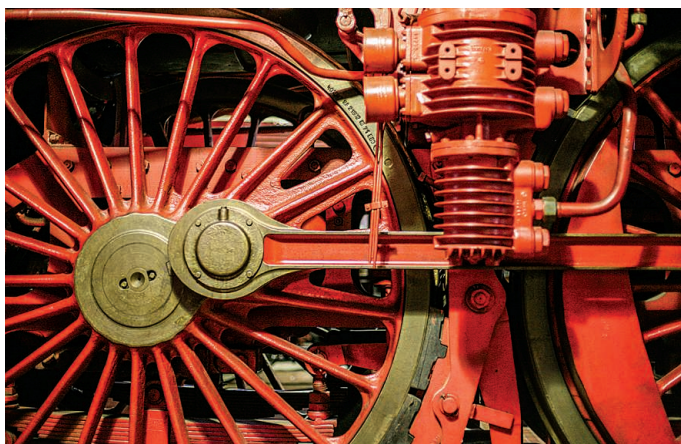
## MEMORY RESEARCH

### A pathway for forgetting

Memories tend to fade over time. We still only partially understand the processes that underlie this erosion of long-term memory. Miguez *et al.* infused two synthetic peptides that slow down the activity-induced synaptic removal of a specific type of glutamate receptor into the rat dorsal hippocampus. This procedure

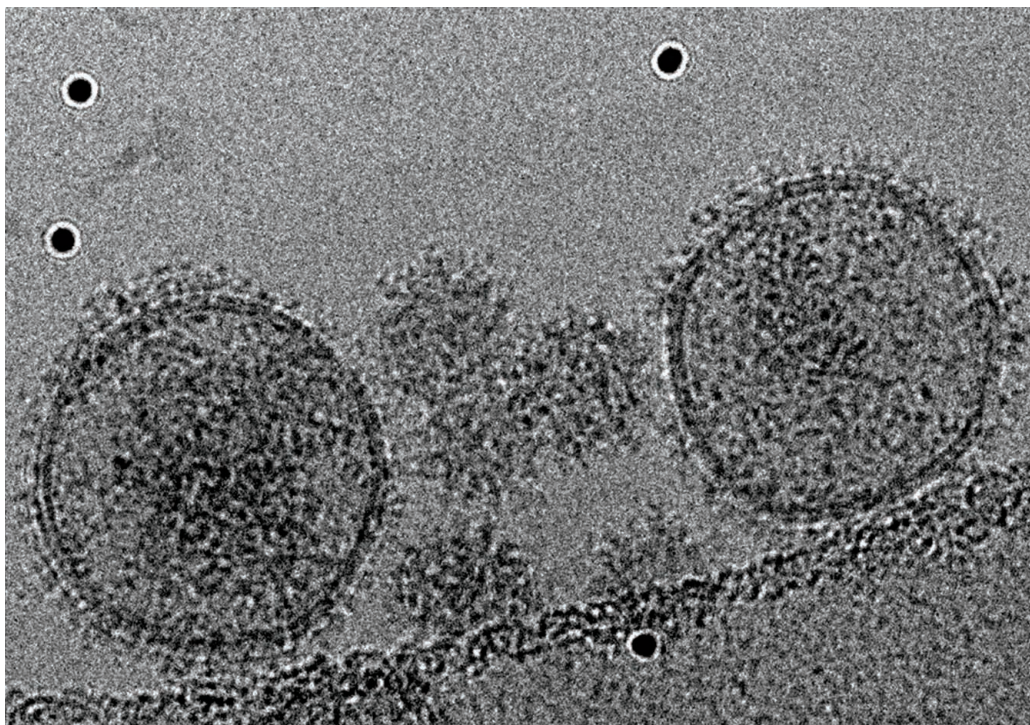
prevented the forgetting of specific forms of spatial memory but did not block the acquisition of new object location memories. It also prevented the generalization of contextual fear. Infusion of one these peptides into a different brain area preserved extinction memory because it inhibited time-dependent spontaneous recovery of extinguished auditory fear. — PRS

*J. Neuroscience* **36**, 3481 (2016).



Heat engines can also be made from single atoms.

PHOTOS: (LEFT TO RIGHT) © VFC PHOTO/ALAMY STOCK PHOTO; ERIK VRLJ



Two forms of glycoprotein B facilitate interface of herpes simplex virus 1 with host cells.

## STRUCTURAL BIOLOGY

### Herpes virus opens up

**H**erpes simplex virus 1 (HSV-1), the cause of cold sores, is an enveloped virus that uses glycoprotein B (gB) to fuse with host cells. Zeev-Ben-Mordehai *et al.* used electron cryotomography to determine the structure of gB in a native membrane. They found two conformations: One, the known trimeric postfusion conformation, has fusion loops close together and proximal to the membrane. The other is a more compact trimer with fusion loops distal to the membrane and played apart. The new conformation explains antibody and mutagenesis data that could not be rationalized on the basis of postfusion structure. It is likely a prefusion or intermediate conformation that may be a target for antivirals. — VV

*Proc. Natl. Acad. Sci. U.S.A.* 10.1073/PNAS.1523234113 (2016).

## α-SYNUCLEIN TOXICITY

### Viewing a killer in action

The pathological deposition of aberrant protein aggregates and fibrils is associated with a variety of neurodegenerative disorders. The protein  $\alpha$ -synuclein is implicated in Parkinson's disease. Pinotsi *et al.* used super-resolution imaging to visualize  $\alpha$ -synuclein as it formed aggregates in neuronal cells in culture. First they introduced pre-formed fibrils of  $\alpha$ -synuclein and saw the endogenous soluble protein adding onto the fibrils. This process did not seem to harm the cells; however, when they added exogenous monomeric  $\alpha$ -synuclein,

it formed aggregates within the cells, which killed them. Thus,  $\alpha$ -synuclein fibrils seem to be protective rather than harmful to neurons—at least in culture. — SMH

*Proc. Natl. Acad. Sci. U.S.A.* 10.1073/pnas.1516546113 (2016).

## EDUCATION

### The evolution of teaching evolution

Current research in evolution encompasses more than natural selection. However, evolutionary mechanisms other than natural selection are not always presented in classrooms. Price and Perez analyzed evolution

education literature and high-school and college education standards to highlight the lack of concepts such as genetic drift, dominance in allelic pairs, and evolutionary developmental biology. They analyzed students' answers on concept inventories and found that students favor natural selection as the explanation for all evolution, which may ultimately impede their understanding of additional evolutionary mechanisms. The proposed solution, interleaving the teaching of natural selection with other evolutionary processes through iterative cycles of natural selection, genetic drift, dominance, etc., could result in students having a stronger

understanding of all evolutionary processes. — MM

*Am. Biol. Teach.* 10.1525/abt.2016.78.2.101 (2016).

## BIOFUELS

### Liquid fuel flows from gas streams

Renewable resources can directly replace fossil fuels for generating electricity, but finding a cleaner replacement for liquid fuels is less clear. Biofuels have shown potential, but the cost of feedstocks, competition with land for food crops, and the overall carbon balance have hindered their progress. Hu *et al.* integrated two bioreactors to turn syngas—a mixture of  $\text{CO}_2$ ,  $\text{CO}$ , and  $\text{H}_2$ —into lipids that can be used as biodiesel. Although carbon from syngas accounts for just over half of the carbon in the lipids produced, further optimization and recycling of  $\text{CO}_2$  between bioreactors should improve the net carbon balance of the system. — NW

*Proc. Natl. Acad. Sci. U.S.A.* 10.1073/pnas.1516867113 (2016).

## PLANT SCIENCE

### Know when to hold 'em...

During cell division, cohesins keep replicated sister chromatids attached until they segregate into separate daughter cells. This cohesion is stabilized by chromosome transmission fidelity 7 (Ctf7) protein and destabilized by the Wings apart-like (Wapl) protein. Inactivation of Ctf7 results in poorly condensed chromosomes, whereas inactivation of Wapl results in chromosomes that won't let go. De *et al.* investigated the interaction of cohesion, Wapl, and Ctf7 in *Arabidopsis* plants. Inactivation of Wapl is lethal to animal cells but has divergent effects on plant cells, so that meiosis and germ cell development are more affected than is vegetative plant growth. The results hint at an as-yet-unidentified system to regulate sister-chromatid cohesion during mitosis. — PJH

*Plant Cell* 28, 521–536 (2016).

# Science

## Shaping cells to mature together

Marc S. Lavine

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