

PLANT SCIENCES

Even Parasitic Plants Need Plastids

Plastids, such as the chloroplasts of plants, use photosynthesis as an essential energy source for plant cell function. Plastids probably arose from bacterial endosymbionts, and over time, most flowering plants, even those that no longer photosynthesize, have discarded many genes within their plastids. Delannoy *et al.* sequenced the plastid genome of the orchid, *Rhizanthella gardneri*. *R. gardneri* lives underground and is parasitic, meaning that it obtains its energy and nutrients indirectly by exploiting other plants. Its plastid, the smallest identified land-plant plastid to date, retained genes that are also found in other non-photosynthetic parasitic plants that are not closely related. The genes appear to be transcribed and translated properly. These results suggest that all plant plastids contain key genes and transfer RNAs that function outside of photosynthesis, which explains their convergent retention among distant lineages of parasitic plants and may have implications beyond the plant kingdom. — LMZ

Mol. Biol. Evol. **28**, 10.1093/molbev/msr028 (2011).



PHYSIOLOGY

What's Bred in the Bone

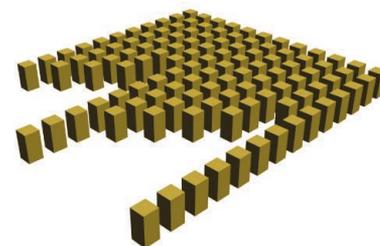
In females, the interaction between the reproductive system and bone physiology is well established: Loss of estrogen during aging is a causative factor in osteoporosis. Oury *et al.* now describe a bone-reproductive system connection in males, where osteocalcin, a hormone produced in bone cells, controls the production of testosterone in the testes. Mice deficient in osteocalcin had smaller testes, decreased concentrations of blood testosterone, and reduced fertility. In the testes, osteocalcin increased expression of genes that participate in testosterone biosynthesis and spermatogenesis and inhibited stem cell death. Osteocalcin probably functions by binding the G protein-coupled receptor Gprc6a, which is specifically expressed in Leydig cells of the testes. Direct binding of osteocalcin to Gprc6a was not directly demonstrated, but mice with reduced expression of Gprc6a in Leydig cells showed impaired testicular function similar to that in osteocalcin-deficient mice. Osteocalcin, which also regulates metabolism through effects on pancreatic beta cells and fat cells, thus appears to have important physiological roles in coordinating energy metabolism, bone remodeling, and reproductive function. — LBR

Cell **144**, 10.1016/j.cell.2011.02.004 (2011).

PHYSICS

A One-Way Wall of Silence

The recent development of metamaterials and photonic crystals has provided a route to control the propagation of electromagnetic waves through the engineered structure of a material. Combined with transformation optics, such control is rewriting the expected rules of behavior governing the propagation of electromagnetic waves, and offers myriad possibilities ranging from imaging to communications and stealth applications. Sound is also a wave, and so the manipulation of acoustic waves may be expected to carry over by analogy to their electromagnetic counterparts. Li *et al.* present a sonic crystal composed of a periodic array of steel rods, the geometry of which was selected to give rise to a band gap, whereby the transmission of sound waves in a specific frequency range is prohibited in one direction but allowed in the opposite direction. The authors also show that by mechanically changing the spacing of the array (by rotating the square steel rods), the diode-like behavior can be switched on and off. A range of applications might be expected to follow, from acoustic isolation and filtering to ultrasound imaging. — ISO



Phys. Rev. Lett. **106**, 84301 (2011).

BIOMATERIALS

Delivered on a Diamond

Doxorubicin (Dox) is a powerful, broad-use anticancer drug, but its effectiveness is limited by toxic damage to healthy tissues and the development of drug resistance by the cancerous cells. One form of resistance arises through an increase in transporter proteins that will pump drugs out of a cell. Chow *et al.* explore the potential for small diamond particles, on the order of 2 to 8 nm in diameter, to increase the effectiveness of doxorubicin. The facets on the truncated octahedral architecture provide a large number of surfaces for drug conjugation, and charges on the surface enable water to bind, aiding dispersability and sustained therapeutic release. In comparison with unbound Dox at equal doses, conjugates of diamond-Dox showed slower *in vivo* clearance, lower toxicity, and a slower but more prolonged uptake of Dox by the cancerous cells, leading to greater apoptosis for mouse models of liver and mammary cancers. Of particular note was that the mammary tumor cells were known to show Dox resistance. The production of the diamond particles can be scaled up. They have furthermore shown wide biocompatibility, and they can be chemically modified for conjugation to a wide range of therapeutics, indicating that they could form a broad-based platform for the treatment of a range of conditions in which drug retention and delivery are limiting factors. — MSL

Sci. Transl. Med. **3**, 73ra21 (2011).

Science

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