Signal transduction

Calcium lands lead role in cell cycle

J. Cell Biol. doi:10.1083/jcb.200402136 (2004)

Calcium ions have been implicated in many aspects of cell function, but a role in the cell cycle — the sequence of events by which cells replicate — has been speculative. Now, however, Violaine Sée *et al.* have found that Ca^{2+} ions can initiate the cell cycle.

The authors used Ca^{2+}-sensitive dyes to detect changes in Ca^{2+} levels inside connective-tissue cells called fibroblasts. When non-dividing cells were treated with growth-promoting serum, Ca^{2+} levels increased for around 30 seconds. This in turn triggered the activation of a regulatory factor called NF-κB — which is needed for entry into the cell cycle — and the expression of cyclin D1, a protein essential for progression through the cycle.

But Ca^{2+} ions alone were not sufficient to induce these effects: a family of enzymes known as mitogen-activated protein kinases (MAPKs) was also necessary. Sée *et al.* conclude that, in fibroblasts at least, the cell cycle is controlled by serum-dependent Ca^{2+} signalling through the MAPK–NF-κB pathway. **Helen Pilcher**

Developmental biology

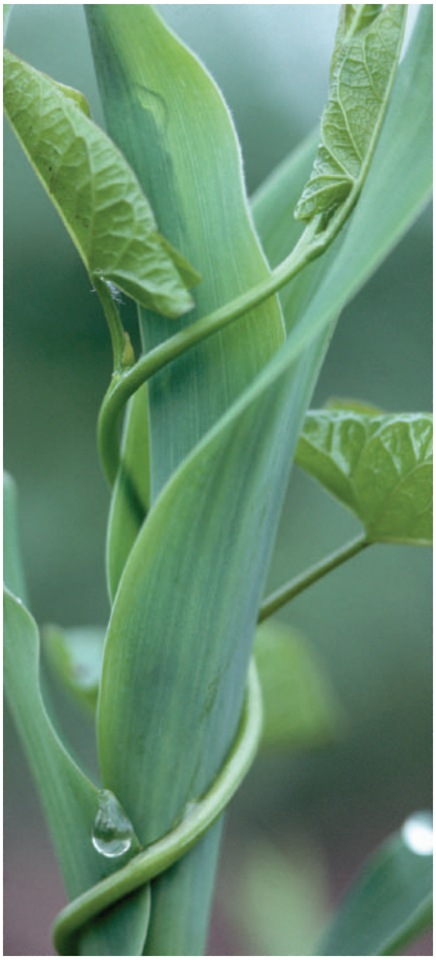
Given a hand

Cell **118,** 517–528 (2004)[1]; *Cell* **118,** 505–516 (2004)[2]

In vertebrate embryos, the protein Sonic hedgehog (Shh) is produced in the zone of polarizing activity (ZPA) in the bud of tissue that will form a limb, and forms a gradient across the limb. It has been generally assumed that cells closer to the ZPA receive a higher dose of Shh than those further away and that this tells cells whether to form digit one, two, three, four or five in a hand or foot.

But matters might not be so simple. Brian D. Harfe *et al.*[1] have looked at cells in the mouse limb that start out making Shh in the ZPA, and found that they ended up in digits three, four and five, closest to the ZPA. They suggest that cells move out of the ZPA at different times and that, in this part of the limb, the time that cells spend in the ZPA and are exposed to Shh helps to determine which digit they will become.

Meanwhile, Sohyun Ahn and Alexandra L. Joyner[2] used the activity of the *Gli1* gene to detect cellular responsiveness to Shh. They found that many cells near the ZPA stop responding to Shh even while they are still exposed to it. So other unknown factors, which regulate the cells' reaction to Shh, might also help determine digit identity. **Helen Pearson**



Evolution

Climb to success

Proc. R. Soc. Lond. B doi:10.1098/rspb.2004.2827 (2004)

'Key innovations' are adaptive traits that confer significant evolutionary success, such that groups that have adopted the adaptation are richer in species diversity than comparable groups that have not. A wide-ranging analysis of plant taxa now suggests that the climbing lifestyle of vines is one such trait.

Ernesto Gianoli scoured the taxonomy catalogues of 45 families of flowering plants, and came up with 48 groups of climbers, each matched to a sister group of non-climbers. In 38 cases, the climbers were more diverse. What's more, the pattern was evident when woody and non-woody pairs of plant groups were compared independently.

A climbing habit is a natural candidate for a key innovation. Provided that suitable support is available (in the form, for instance, of sturdy companion plants such as trees), climbers can reach the top of the canopy and achieve maximum exposure to sunlight. It is perhaps no surprise that climbing has evolved on many separate occasions during plant evolution, and that more than 130 plant families include vine-growing species. **Michael Hopkin**

Optical imaging

Human lasers

Appl. Phys. Lett. **85,** 1289–1291 (2004)

Tumours can be spotted in human tissue by turning them into lasers. Randal C. Polson and Z. Valy Vardeny have found that human tissues infiltrated with organic dyes and illuminated by a standard neodymium:YAG laser may emit narrow-band light by a phenomenon called random lasing.

It has been known for more than a decade that light emitted within a collection of randomly positioned scatterers can give rise to lasing, characterized by sharp spectral lines. Under certain conditions this emission becomes coherent — not only is the light amplified and spectrally sharp, but the photons are in phase.

Polson and Vardeny induced coherent random lasing in a range of biological tissues, including potato and human colon tissue, stained with the dye Rhodamine 6G, which fluoresces with red light. They found more laser lines in the emission spectra from cancerous colon tissue than from healthy tissue, presumably because the diseased tissue was more disordered or more highly scattering (healthy tissue has a more uniform cell size). This allowed the researchers to distinguish healthy from malignant tissue with a spatial resolution of about 2 mm. **Philip Ball**

Physics

Straight to the point

Science **305,** 1267–1269 (2004)

The properties of a light wave, such as its amplitude or wavelength, are easily probed. But the way in which its electric field evolves, or oscillates, has only now been measured.

E. Goulielmakis *et al.* used a laser to generate high-energy pulses of ultraviolet light that blasted electrons away from the atoms in a sample of neon gas. The light pulse lasted just 250 attoseconds (2.5×10^{-16} s) — not much longer than the time it takes the electron to orbit the proton in a Bohr-model hydrogen atom, and a tiny fraction of the oscillation period of visible light. As the electrons were ripped from the neon atoms, they acquired a certain momentum boost, which the authors measured. This momentum depends on what part of the light wave — peak, trough or somewhere in between — hits the electron.

Because an electric field is defined as the force exerted on a single point charge, this is the experimental realization of that theoretical definition. The authors note that their results fit perfectly with theoretical predictions, and suggest that this technique could be used to precisely control the quantum transitions of electrons within atoms and molecules. **Mark Peplow**