Chemical biology

Synthetic stimulus to transcription

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A goal of the field known as chemical genetics is to control cell function using small synthetic molecules that interact with genes and proteins. As part of this endeavour, Aaron R. Minter *et al.* have identified a small molecule that can activate gene transcription.

Natural transcriptional activators are proteins that bind to specific DNA sequences and stimulate transcription of nearby genes. They typically possess a DNA-binding domain and an activation domain that mediates interactions between proteins (for example, by influencing the RNA polymerase that transcribes a gene).

Minter *et al.* looked for small molecular mimics of a 'minimal' peptide module, ATF14, found in a viral transcriptional activator called VP16. They synthesized several candidates containing the key functional groups of ATF14, attached them to a DNA-binding protein, and screened them for their ability to induce transcription of a 'test' gene. One of these molecules was nearly as active as ATF14 itself, despite being less than a fifth of its molecular weight. Such synthetic molecules are more resistant to proteolytic degradation than natural transcription factors — something that might partly account for the high activity of the best candidate here. **Philip Ball**

Atmospheric physics

Raindrops on charge

Geophys. Res. Lett. **31,** doi:10.1029/2004GL020465 (2004)

Raindrops form when tiny cloud droplets coalesce after colliding with each other. Although the electrical charge on the droplets could regulate how quickly they come together, reliable information about charge size has been hard to come by.

Kenneth V. Beard *et al.* now report aircraft measurements of a droplet's charge from inside a cloud, data that have been difficult to collect given that an aircraft may itself charge up the droplets. To solve this problem, Beard *et al.* used a steady flow of nitrogen gas out of the sampling probe to keep any droplets that came into direct contact with the aircraft out of the sampling device.

For drops between about 10 and 26 micrometres across, they find that in different parts of a cloud the droplets can carry 80–90 positive or negative charges each. They point out that the electrical environment inside a cloud floating high above the Earth's surface is very different from one drifting across a mountain top, where previous measurements revealed just a few charges per drop.

The measurements were carried out in low-lying stratocumulus clouds over Michigan in winter. The authors plan to extend their analyses to other seasons and cloud types, especially stratus and cumulus, in which ice and precipitation form more readily. **Mark Peplow**

Quantum mechanics

Links and loops

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Topology enters quantum mechanics through the Aharonov–Bohm (AB) effect, in which an electromagnetic field affects a charged particle even if the particle moves along a trajectory for which the field is zero. For example, an electron executing a loop around a magnetic field can experience a phase shift of its quantum wavefunction, known as the Berry phase. John Kimball and Harry Frisch point out that such a situation can be realized within a topologically complex molecule or molecular assembly, and that the AB effect

could then lead to a measurable shift in the electronic energy levels of the molecules.

Consider, for example, a catenane, in which two ring-like molecules are interlinked. If one of the rings is electrically conducting and the other is magnetic (with its magnetization oriented along the chain), this is a molecular version of the AB experiment: an electron traversing the first link circumnavigates the magnetic flux of the second link. The energy shift then depends on the 'linking number' of the assembly, a purely topological quantity which specifies the number of times that the magnetic loop threads the conducting loop. A similar situation is seen in a single molecule if it is both conducting and magnetic and woven into a trefoil knot (pictured); the energy shift then depends on the 'writhe', a measure of the number of self-crossing points. **Philip Ball**

Neurobiology

Sex and the brain

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It is not surprising that male and female brains are different, but the processes controlling certain neuroanatomical disparities between them are unclear. Early in development, the brains of both sexes are similar; by adulthood, however, differences in neuronal number can be seen in key brain regions. Nancy G. Forger and colleagues now implicate one of the main players in programmed cell death in controlling events in specific regions.

The team studied mice lacking the *Bax* gene, which is known to regulate the cell death of some developing neurons. Normally, female mice have more neurons than do males in an area of the brain called the anteroventral periventricular nucleus; males have more neurons in another area, the principal nucleus of the bed nucleus of the stria terminalis. There were no such sex differences in *Bax*-free mice.

It is thought that hormones, such as testosterone, help to control the survival of sex-specific neurons during development. But from the study by Forger *et al.* it seems that *Bax* can override hormonal signals, and may be the target gene regulated by testosterone. **Helen Pilcher**

Biomaterials

Stamp it out

Adv. Mater. **16,** 1345–1348 (2004)

The ability to control the distribution of cells within three-dimensional scaffolds could facilitate the development of engineered tissues, and provide a tool for studying biological interactions *in vitro*. One way to achieve such spatial control would be to create compartments of different physical structure or chemical composition within a biological gel — as Min D. Tang and colleagues now describe.

These authors have modified the process of soft lithography to stamp a micrometre-scale pattern onto a substrate. The pattern is defined by one biopolymer hydrogel (an insoluble network of protein molecules that swells in water) deposited on another, type I collagen. This is a protein found in many tissue types and is the most abundant form of collagen in the human body.

The stamp is then removed under a solution of phosphate-buffered saline, to which a collagen precursor is added that triggers gelation when the temperature is subsequently raised. When the enzyme dispase is introduced, it eats away the patterned hydrogel, leaving an array of cavities. Tang *et al.* have shown that endothelial cells can be encapsulated within these cavities. **Rosamund Daw**