Cell biology

Nuclear squeeze and stretch

J. Cell Sci. **117,** 4779–4786 (2004)

Stretching or compressing cells can change which of their genes are switched on or off. But researchers have been unclear as to whether this occurs because signals are sent from the squashed cell membrane — or whether the nuclear envelope, which surrounds nuclear DNA, transmits the mechanical force.

To investigate this, Kris Noel Dahl *et al.* placed the nuclei of frog (*Xenopus*) egg cells in a solution and added polymer to control by osmosis how much the nucleus swelled. They found that the nuclear membrane can expand to almost twice its regular size.

The researchers also sucked up the membrane into a tiny pipette to test its strength, and concluded that it is stiffer and more resilient than the cell membrane, somewhat like a rubber glove. But the nucleus could not be made to compress down below its normal volume.

The authors conclude that the nuclear envelope offers a degree of protection for the DNA inside, while being flexible enough to transmit some forces when the cell's shape changes. They plan to examine whether stretching the nucleus and its envelope causes changes in gene activity, and how this is affected by mutations in certain nuclear-envelope proteins — for example lamins, which have been linked to human disorders such as premature ageing diseases. **Helen Pearson**

Physiology

Stiffness and striation

J. Cell Biol. **166,** 877–887 (2004)

Adam J. Engler *et al.* have found that muscle fibres might be sensitive to the stiffness of their environment — a discovery that could affect future treatments of skeletal-muscle defects.

Immature muscle cells can be grown on surfaces of varying flexibility, fusing together to form muscle fibres. But in order to function properly, thick and thin filamentous proteins inside the fibres have to line up in a particular way, in a process called striation. Engler *et al.* show that this can only occur when the growth substrate is of medium stiffness, similar to that of normal muscle. On a stiff substrate such as glass, or a soft substrate such as a weak gel, striation is limited.

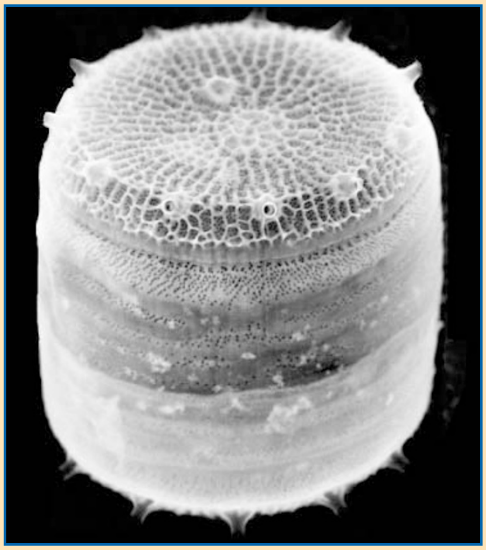
The authors also find that muscle samples from mice with a form of muscular dystrophy are stiffer than those from normal animals. The less flexible environment may limit striation, perhaps explaining why injured muscles in such mice are not repaired.

This may be bad news for those wishing to use stem-cell transplants to treat patients with muscular dystrophy. The stiff environment might prevent the cells from turning into contractile muscle, the authors warn. **Helen Pilcher**

Genomics

Lifestyle secrets of a diatom

Science **306,** 79–86 (2004)



N. KRÖGER, UNIV. REGENSBURG

Researchers have sequenced the genome of the marine diatom *Thalassiosira pseudonana*. Lurking within its 24 chromosomes and various assorted other DNA segments are genes that are involved in fashioning its ornate silica cell walls (pictured), utilizing iron and nitrogenous compounds, making fatty acids, and processing a complete urea cycle.

Diatoms are single-celled organisms found in both fresh water and the oceans. They are collectively responsible for 20% of the carbon fixed by photosynthesis throughout the globe — a contribution comparable to that of the world's rainforests. As E. Virginia Armbrust and colleagues now show, their diverse watery lifestyles are helped by their wide genetic repertoire.

The authors used the 'shotgun' whole-genome sequencing method to draw up a draft of *T. pseudonana*'s 34 million base pairs of nuclear DNA, as well as its 129,000-base-pair plastid genome and the 44,000 letters of its mitochondrial code. The fact that it possesses genes for processing silica is no surprise — it has to build its intricate cell wall somehow. But the presence of so many different metabolic pathways, and the fact that half of the genes discovered have unknown functions, is testament to how little we understand about diatoms' eclectic metabolism. **Michael Hopkin**

Particle physics

Rare prize

Phys. Rev. Lett. **93,** 131802 (2004)

Within the intricate filigree of the standard model, a *B* meson can decay into other particles in a variety of ways. The details of its decay patterns reveal 'CP violation' — an effect that shatters the delicate balance between matter and antimatter.

J. Dragic *et al.* report the first evidence of the decay of a neutral *B* meson (B^0) into two neutral particles, ρ^0 and π^0. Using the Belle detector at the KEKB accelerator in Japan, the authors have collected more than 10^8 pairs of *B* mesons, produced in collisions between electrons and their antimatter counterparts, positrons. From this huge data set, Dragic *et al.* have pinpointed a $B^0 \rightarrow \rho^0\pi^0$ signal representing just 15.1 ± 4.8 events.

This is a rare decay indeed; other experiments had succeeded only in setting limits on the probability of its occurrence. But its value comes in helping to pin down a vital parameter of the CP-violation process. A larger signal is needed to achieve that, but there are more data to come from this and competing experiments. **Alison Wright**

Photoelectrochemistry

Molecular trees split water

J. Am. Chem. Soc. **126,** 12084–12089 (2004)

Polymers that sprout bushy branches all along their molecular chains prove to be efficient at channelling light energy into the production of hydrogen from water. Such photocatalytic water-splitting could one day fuel a hydrogen economy, if it can be done cheaply enough. Dong-Lin Jiang *et al.* (of the ERATO nanospace project) have used these 'dendrimeric' polymers in a photochemical process that relays electrons onto colloidal particles of platinum, where they are used to reduce water and liberate hydrogen gas.

The electrons are ferried to the platinum particles by a dye molecule called methyl viologen, in the form of a positively charged free radical. The polymer is the initial electron donor: capture of a photon of sunlight kicks an electron loose. Conjugated polymers could play this role in principle, but they have poor solubility and suffer from self-quenching — the liberated electrons tend to fall back into the 'holes' they leave behind. Wrapping the polymer chains in negatively charged, dendrimeric side-branches not only renders them soluble but also suppresses self-quenching. The efficiency of this system (measured by the fraction of H_2 molecules produced for each photon absorbed) is, at 13%, an order of magnitude better than obtained with previous dye-based photoreduction systems. **Philip Ball**