

genes are more readily exchanged among populations located near each other. *Science* 344, 1289–1293 (2014)

PHYSICS

Global quantum clock proposed

A set of atomic clocks linked together using the principles of quantum physics could be the authoritative world clock — more accurate and stable than any atomic clock today.

Mikhail Lukin of Harvard University in Cambridge, Massachusetts, and his team propose combining ultra-precise atomic clocks using quantum entanglement, which links the quantum states of particles separated over large distances. Entangling the clocks would allow scientists to combine measurements in a way that reduces the overall noise, rendering the combined signal more accurate. The resulting space-based network could be used to synchronize timekeeping standards globally, the authors say.

Building the clock will require technological advances, such as improving the stability of clock signals sent through Earth's turbulent atmosphere. *Nature Phys.* <http://doi.org/s7k> (2014)

MOLECULAR BIOLOGY

Genome editing of stem cells

A genome-editing system allows researchers to introduce multiple gene alterations into human stem cell lines.

A team led by Danwei Huangfu at Memorial Sloan-Kettering Cancer Center in New York used the recently developed genome-editing systems TALEN and CRISPR-Cas9 to efficiently create human embryonic stem (ES) cells and induced pluripotent stem (iPS) cells containing up to three different gene alterations. The researchers used their approach to introduce various mutations linked to Alzheimer's disease

into iPS cells, as well as to delete certain genes in pancreatic cells derived from ES cells.

The method should make it faster and easier to determine the effects of disease-related gene changes on cell and tissue development, the authors say. *Cell Stem Cell* <http://doi.org/s6w> (2014)

PARTICLE PHYSICS

Exotic four-quark particle confirmed

A team have confirmed the existence of a four-quark particle, named Z(4430). The finding, together with other exotic particles, challenges the idea that quarks only combine in pairs (mesons) or triplets.

Z(4430) was first spotted in 2008 at the Belle detector in Japan, but another detector in California failed to see it, casting doubt on the initial observations. A team working on the LHCb experiment at CERN, Europe's particle physics laboratory near Geneva in Switzerland, analysed about a billion high-energy proton-proton collisions. The scientists noticed that in about 4,000 cases there was a highly significant Z(4430) signal — about 14 standard deviations above background levels.

The authors determined that the particle is composed of four quarks because of its observed decay patterns, and is not an artefact of interactions between ordinary two-quark mesons. *Phys. Rev. Lett.* 112, 222002 (2014)

REGENERATIVE BIOLOGY

Love hormone revitalizes muscles

The hormone involved in social bonding also enables old muscles to rejuvenate.

Wendy Cousin, Irina Conboy and their colleagues at the University of California, Berkeley, injected the hormone oxytocin into old mice, and found that after an injury the muscles in these animals had similar regeneration levels to muscles in young mice. The hormone improves repair by

SOCIAL SELECTION

Popular articles
on social media

Lab animals spark debate

Social media is hosting the latest round of the debate over medical studies involving animals. Writing in the *British Medical Journal*, Yale University epidemiologist Michael Bracken and UK medical sociologist Pandora Pound argued that too many animal trials investigating medical treatments are poorly designed, and called for better use of systematic reviews to maximize their benefit. Lenny Verkooijen, a clinical epidemiologist at University Medical Center Utrecht in the Netherlands, tweeted that there is “insufficient systematic evidence for the clinical benefits of animal research”. But in a letter to the journal, pharmacologist Fernando Martins do Vale at the University of Lisbon noted that animal research has benefited medicine and has led to “seminal discoveries in the field of physiology, biochemistry, pharmacology and genetics”. Pound, P. & Bracken, M. B. *Br. Med. J.* 348, g3387 (2014)



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activating a signalling pathway in muscle stem cells — thereby boosting the cells' proliferation. Moreover, mice engineered to lack oxytocin showed decreased muscle repair and greater loss of muscle tissue compared with normal mice of the same age.

Oxytocin could be used as a drug to prevent or slow down muscle ageing, the authors say. *Nature Commun.* 5, 4082 (2014)

ANIMAL BEHAVIOUR

Apes cooperate on their own

Without any prior training, captive chimpanzees team up on a task, suggesting that the primates are more cooperative than previously thought.

Malini Suchak, now at Canisius College in Buffalo, New York, and her colleagues designed a device that required one or two chimps (*Pan troglodytes*) to remove a barrier in order for another individual to simultaneously obtain a tray of food. The researchers placed the device in a large enclosure in which 11 chimps lived, and found that the animals



spontaneously worked together in groups of two or three to complete the task (pictured) more than 3,000 times — an average of 38 per one-hour session. Unlike most previous studies, the apes were free to choose their own partners, which could have allowed them to avoid competitors that might impede cooperation. Complex cooperative behaviour is not a uniquely human trait, the authors suggest.

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