

found that 67% of 101 patients diagnosed with chronic fatigue syndrome carried the retrovirus XMRV in their blood, whereas fewer than 4% of 218 healthy individuals did.

The virus was able to spread from infected immune cells to cultured prostate cancer cells. The genomes of the XMRV strains associated with prostate cancer are more than 99% identical to those correlated with chronic fatigue syndrome, which is marked by increased cancer susceptibility. The authors say further study is needed to determine whether the virus causes the syndrome and if it is responsible for the elevated cancer risk.

For a longer story on this research,
see go.nature.com/X72Lco

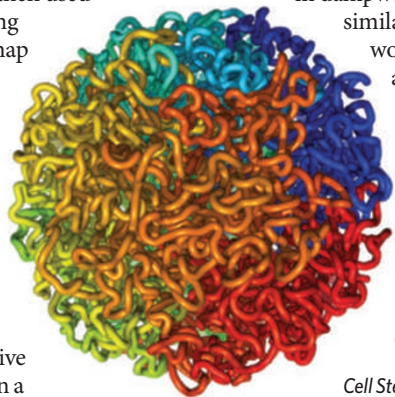
GENOMICS

Human genome in 3D

Science **326**, 289–293 (2009)

The three-dimensional structure of the human genome has been mapped. Job Dekker of the University of Massachusetts Medical School in Worcester, Eric Lander of the Broad Institute in Cambridge, Massachusetts, and their co-workers identified segments of the genome that tend to sit close together. They then used next-generation sequencing technology to build up a map showing the proximity of the segments to each other — a novel method they call 'Hi-C'.

The team found that each chromosome weaves between two compartments: one contains active genes; the other, more compact compartment houses inactive stretches of the genome. On a larger scale, the chromosomes are tightly packed into a 'fractal globule' (pictured right) that remains unknotted to allow easy access to genes.



ASTROPHYSICS

Merge, no surge

Astrophys. J. **704**, 324–340 (2009)

When galaxies merge, the gravitational jostling of gases can lead to a bump in the galaxies' star formation rate. But this effect is short-lived and does not significantly add to overall star numbers, say Aday Robaina of the Max Planck Institute for Astronomy in Heidelberg, Germany, and his colleagues.

In analysing images of 2,551 galaxies from the Spitzer and Hubble space telescopes, the researchers found that merging and closely

interacting galaxies gave birth to stars at rates only 1.8 times higher than non-interacting galaxies — a smaller effect than previously thought. For the portion of the Universe between about 1 billion and 2 billion parsecs away, the researchers estimate that only about 8% of star births are triggered by galaxy mergers.

BIOLOGY

When colonies collide

Proc. Natl Acad. Sci. USA **106**, 17452–17456 (2009)

Many insect species organize themselves into social classes with distinct roles, such as reproductive queens and sterile workers. How this 'eusociality' evolved is an open question.

Barbara Thorne at the University of Maryland, College Park, and her colleagues staged encounters between 25 pairs of colonies of dampwood termites (*Zootermopsis nevadensis*). During encounters, at least one colony in each pair lost its king or queen and the pairs merged.

The team found that worker termites developed into reproductive ones in 17 of the 25 merged colonies and that interbreeding occurred in 14 colonies. This shows that,

in dampwood termites, which are similar to ancestral termites, workers can become breeders and inherit a colony and its resources, providing them with an incentive to stay with their colony and cooperate with non-relatives — a key aspect of eusociality.

STEM-CELL BIOLOGY

Chemical reset

Cell Stem Cell doi:10.1016/j.

stem.2009.09.012 (2009)

Adult cells can be turned into 'pluripotent' or embryonic-like stem cells with the insertion of four genes — *Sox2*, *Oct4*, *Klf4* and *c-Myc*. However, this method is not clinically useful because *c-Myc* and *Sox2* have been linked to cancer and the viral vectors used to transfer those genes are also cancer-promoting.

Using chemical screening, Lee Rubin and Kevin Eggan at Harvard University in Cambridge, Massachusetts, and their colleagues discovered a small molecule, which they call RepSox, that essentially does the jobs of *c-Myc* and *Sox2*. Mouse cells expressing only *Klf4* and *Oct4* became pluripotent after treatment with RepSox.

This may be a step towards chemical cell reprogramming that avoids gene transfer altogether.

JOURNAL CLUB

Sam Wang

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A neuroscientist explores the energy efficiency of the brain.

Considering its substantial processing capacity, the human brain consumes remarkably little power — about as much as an idling laptop computer. So I was interested to learn that action potentials — the electrical 'spikes' that are the fundamental units of neuronal activity — are likewise remarkably energy efficient (H. Alle *et al.* *Science* **325**, 1405–1408; 2009).

During a spike, the voltage across a neuron's membrane is reversed when sodium ions flow into the cell and potassium ions move out. This reversal spreads as a wave down the neuron's axon towards its terminals, where it triggers synaptic transmission to other neurons.

Henrik Alle of the Max Planck Institute for Brain Research in Frankfurt, Germany, and his colleagues recorded charge movements at axon terminals in mammalian hippocampal neurons. They found that sodium and potassium ions flow at largely non-overlapping times, with more than 75% of all charge contributing unopposed to the rise or fall of a spike.

Such efficiency comes as a surprise. These axons outperform the much-studied squid giant axon by a factor of three. If the findings apply to other mammalian neurons, brain tissue may support more firing than suspected. The authors suggest that synaptic transmission may dominate the energy budget of brain tissue.

These results have implications for functional magnetic resonance imaging, which measures increases in blood oxygenation in the brain as an indicator of neural activity. What causes the blood-oxygen boost is unknown: suggested triggers include synaptic transmission and action potentials. This paper is evidence for the former, because energy-intensive events such as synaptic signalling are more likely to be oxygen-hungry and to stimulate blood flow. The idea is supported by other recent evidence — a wonderful convergence.

Discuss this paper at <http://blogs.nature.com/nature/journalclub>