

# RESEARCH HIGHLIGHTS

Selections from the scientific literature

## HIV

### A race to kill or be killed

HIV's prime cellular victim can itself kill affected cells during the early days of infection. And it seems that the more vigorous this response by CD4 T cells is, the greater an HIV-positive person's chance is of being able to maintain a relatively low viral level and the better their disease outcome is likely to be.

Hendrik Streeck at the Ragon Institute in Charlestown, Massachusetts, and his colleagues studied two groups of people with untreated HIV during the first year of infection. By the end of the period, members of one group had developed a higher viral load than had those of the other. The authors found that patients with a lower HIV load had a greater percentage of HIV-specific CD4 T cells. Moreover, at the beginning of the study, a higher proportion of CD4 T cells in these patients expressed proteins, particularly one called granzyme A, that kill other cells.

The authors say that measuring the responses of these T cells during the early stages of infection could allow medics to predict how HIV infection will progress in individual patients.

*Sci. Transl. Med.* 4, 123ra25 (2012)

SUNCOR ENERGY



KYODO/REUTERS

## OCEANOGRAPHY

### Tsunamis collide and grow taller

Ridges and mountains on the sea floor dangerously amplified the eastward-bound segments of the tsunami that devastated Japan's Tohoku coast (pictured) last year.

Satellite observations made on 11 March at different locations over the Pacific Ocean suggest that tsunami height increased as the wavefront raced towards the west coast of America. Tony Song at NASA's Jet Propulsion Laboratory in Pasadena, California, and his team compared satellite data with a tsunami simulation and maps of ocean-bottom topography. They conclude that

topographic barriers such as the Hawaiian Ridge slowed and curved the eastward-bound tsunami front. As segments of this disrupted front collided and merged, the peak-to-trough height of the tsunami wave more than doubled.

Understanding how tsunamis interact with ocean-floor topography could help researchers to improve tsunami forecasting.

*Geophys. Res. Lett.* <http://dx.doi.org/10.1029/2011GL050767> (2012)

For more on the Japan earthquake, see [www.nature.com/japanquake](http://www.nature.com/japanquake).

## ENVIRONMENTAL SCIENCE

### Oil-sands pollution quantified

Air pollution caused by crude-oil extraction from Canadian oil sands is comparable to that measured over mid-sized cities or in the vicinity of large coal-burning power plants.

Chris McLinden of Environment Canada in Toronto and his colleagues used satellite observations to determine how the mining and processing of oil sands (pictured) affect air quality in Alberta — home to the world's second-largest crude-oil reserve. The authors measured

greatly increased atmospheric levels of two major pollutants, nitrogen dioxide and sulphur dioxide, over a 30-by-50-kilometre area of intense surface mining. They also noted that nitrogen dioxide pollution in the area had risen steadily since 2005.

*Geophys. Res. Lett.* <http://dx.doi.org/10.1029/2011GL050273> (2012)

## IMMUNOLOGY

### Fighting viruses antibody-free

Neutralizing antibodies were thought to be essential to helping the body fight off

viruses, but it turns out that this is not always the case.

Antibodies are made by immune cells called B cells. A team led by Matteo Iannacone and Ulrich von Andrian at Harvard Medical School in Boston, Massachusetts, studied mice engineered to make their B cells incapable of producing antibodies but still able to make a chemical called lymphotoxin  $\alpha 1\beta 2$ . When the animals were infected with vesicular stomatitis virus, this lymphotoxin caused another type of immune cell, the macrophage, to be preferentially infected by the virus. Infected macrophages secreted another molecule,

type I interferon, which prevented fatal viral infection of the nervous system.

The findings suggest that innate immunity — the immune system's first line of defence, which includes macrophages — has an unappreciated role in combating viral infections. *Immunity* <http://dx.doi.org/10.1016/j.immuni.2012.01.013> (2012)

## MATERIALS SCIENCE

## Competition looms for graphene

Graphene — atomically thick sheets of carbon atoms arranged in a honeycomb pattern — has received much attention for its exceptional electrical properties, thought to arise from its hexagonal symmetry. But Daniel Malko and his colleagues at the University of Erlangen-Nuremberg in Germany propose that a similar material, graphyne, might be just as special — or even more so.

Graphynes are similar to graphene, the main difference being that they have triple bonds between some of their carbon atoms. Only small snippets of graphyne have been synthesized so far, but the authors performed a simulation showing that, like graphene, various forms of graphyne should have high electrical conductivity. The researchers note that not all graphynes have graphene's hexagonal honeycomb configuration. This suggests that many more two-dimensional materials — with various symmetries and non-carbon structures — could have graphene-like properties. *Phys. Rev. Lett.* 108, 086804 (2012)

## CELL BIOLOGY

## Sperm steer with calcium

How winding a sperm's path is depends on the degree to which the concentration of calcium ions in the sperm changes.

Eggs attract sperm by

sending out chemical cues that activate calcium-ion release in the sperm's tail, or flagellum. When Luis Alvarez and Benjamin Kaupp at the Center of Advanced European Studies and Research in Bonn, Germany, and their co-workers stimulated calcium surges in the flagella of sea-urchin sperm, the sperm switched from swimming in circles to bouts of near-straight runs interlaced with turns. The curvature of the sperm's movement correlated with how quickly the concentration of calcium changed, regardless of the total concentration.

The researchers propose that two different calcium-ion-binding reactions could allow sperm to sense the rate of change in calcium levels. *J. Cell Biol.* <http://dx.doi.org/10.1083/jcb.201106096> (2012)

## NEUROSCIENCE

## Behind marijuana memory lapse

Marijuana hampers short-term memory by activating a signalling pathway between neurons and non-neuronal cells called astrocytes, work in mice suggests. This is surprising because astrocytes have mostly been considered to be just support cells.

Giovanni Marsicano at the French National Institute of Health and Medical Research in Bordeaux, Xia Zhang of the University of Ottawa in Canada and their colleagues found that marijuana's psychoactive ingredient, tetrahydrocannabinol (THC), weakens the connections, or synapses, between neurons in the hippocampus — a brain region crucial for memory formation. They tested the effects of THC on mice engineered so that either their neurons or their astrocytes lacked the CB<sub>1</sub> receptor that THC acts on. In mice missing the astrocyte receptors, THC had no effect on hippocampal synapses or working memory, as shown in a behavioural test.

The authors propose that the activation of astrocyte

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## MICROBIOLOGY

## Unintended antimicrobial effects

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in January

As antibiotic resistance in microorganisms has risen, some scientists have suggested that short, synthetic amino-acid chains, or peptides, that kill invading pathogens could make a new therapeutic weapon. But

Michelle Habets and Michael Brockhurst at the University of Liverpool, UK, highlight serious potential risks of this strategy.

The researchers exposed the pathogen *Staphylococcus aureus* — which causes a range of dangerous infections and has developed resistance to many antibiotics — to increasing levels of a synthetic peptide called pexiganan, a candidate treatment for diabetic leg-ulcer infection. Over several tens of generations, the bacteria evolved resistance to the peptide. Furthermore, some bacteria also evolved resistance to HNP-1, a natural human peptide that is an important part of innate immunity, which represents the immune system's first line of defence.

The authors say that such cross-resistance could undermine the innate immune system's ability to prevent superficial infections from progressing to life-threatening disease.

*Biol. Lett.* <http://dx.doi.org/10.1098/rsbl.2011.1203> (2012)

CB<sub>1</sub> receptors by THC causes receptors for a compound called AMPA to be removed from the membranes of neurons, which is known to weaken synapses.

*Cell* 148, 1039–1050 (2012)

## VIROLOGY

## Bats can carry flu too

Fruit bats in Guatemala harbour a strain of influenza virus, researchers report — expanding the known mammalian reservoir for the largely bird-borne influenza A.

Suxiang Tong of the US Centers for Disease Control and Prevention in Atlanta, Georgia, and her colleagues screened 316 bats from 21 species for a variety of viruses. Viral genome sequencing revealed that three little yellow-shouldered bats (*Sturnira*

*lilium*; pictured), were positive for influenza A. Analysis of two key proteins that are shared by all influenza strains, as well as other viral genes, showed that this strain — designated H17 — diverged from other known influenza viruses long ago.

The authors say that H17 seems to pose no immediate threat to humans. However,

it is similar enough to other subtypes that genetic exchange with them could produce a virus infectious to other animal species, including humans.

*Proc. Natl Acad.*

*Sci. USA* <http://dx.doi.org/10.1073/pnas.1116200109> (2012)

For a longer story on this research, see [go.nature.com/fnjy2l](http://go.nature.com/fnjy2l)

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