IMMUNOLOGY
Timely defence

Many activities of the immune system follow rhythmic daily cycles. Now researchers have found that some immune cells have their own circadian clocks.

Achim Kramer of the Charité Medical University in Berlin and his colleagues took immune cells and tissues from mice at regular intervals throughout the day. They found that macrophages — cells that form part of the immune system's first line of defence against bacterial infections — from the spleen, lymph nodes and abdominal area express circadian clock genes. In addition, they showed that about 8% of macrophage genes are expressed rhythmically.

The authors also report that the secretion of immune modulators by spleen macrophages in response to bacterial toxins follows circadian rhythms.

BIOLOGY
Beetle-juice antifreeze

Many animals survive extreme cold by producing 'antifreeze' compounds that inhibit ice growth. The compounds described so far have all been proteins.

Kent Walters at the University of Notre Dame in Indiana and his colleagues have now characterized the first animal antifreeze that contains little or no protein.

They isolated the compound from the darkling beetle Upis ceramboides (pictured below), which can withstand temperatures as low as −60°C, allowing it to live in harsh climates like that of Alaska. Analysis showed it to comprise a xylomannan saccharide with a fatty acid component.

Chess obeys the law

In a large sample of texts, ‘the’ is the most frequently used word. Coming in second is ‘of’, which is used about half as often. ‘And’ — in third place — is used about one-third as often, and so on. This curious relationship is known as Zipf’s law after the linguist George Kingsley Zipf.

Various phenomena follow formulations of Zipf’s law, and chess can now be added to the list. Bernd Blasius of the University of Oldenburg in Germany and Ralf Tönjes of Ochanomizu University in Tokyo analysed the first 40 moves of more than a million chess games recorded in an online database. They found that the frequency of the most common moves followed the law. They add that board games could help physicists to develop new statistical tools.

ENVIRONMENTAL CHEMISTRY
Plucking pollutants

DNA fragments offer an effective way to extract arsenic from contaminated groundwater, a team in South Korea reports. Jinho Min at Chonbuk National University, Yang-Hoon Kim at Chungbuk University and their colleagues designed an aptamer — a short, single strand of DNA that can bind to a specific molecule — for the purpose.

The aptamer was able to efficiently remove arsenic from samples of groundwater collected in different areas of Vietnam, where arsenic levels are often higher than the US Environmental Protection Agency’s recommended maximum.

Aptamer devices could be made with cheap materials such as silicon, the authors say.

NEUROSCIENCE
Brain’s immune connection
Neuron 64, 463-470 (2009)

Connections between neurons strengthen or break during brain development. Unexpectedly, key cell-surface proteins involved in immunity seem to regulate some of this plasticity.

Carla Shatz of Stanford University in Palo Alto, California, and her colleagues found that two members of the family of major histocompatibility complex class I (MHC I) proteins limit the ‘tuning up’ of circuitry involved in visual processing. Mice in which the genes for these two proteins

GENETICS
One on one
Science 326, 1231-1235 (2009)

Human cells, with their two sets of chromosomes, do not lend themselves to large-scale genetic screens as simple model organisms such as yeast have so profitably done.

Thijn Brummelkamp at the Whitehead Institute for Biomedical Research in Cambridge, Massachusetts, and his colleagues have devised a way around the problem. Using a cell line with only one copy of most human chromosomes, they inactivated various genes using a method called insertional mutagenesis. The researchers then screened cells that were resistant to particular pathogens to see which genes invaders might rely on to attack.

Using the technique, the team identified two host genes used by the influenza H1N1 virus to infect cells, as well as genes exploited by other bacterial toxins to kill host cells. The authors say the method could help in developing new antiviral therapies.
had been deleted performed better in a visual task involving the blocking of one eye than did normal mice. The MHC I proteins curb the retuning of circuitry that enables the functioning eye to compensate for the blocked one, the authors say.

ECOLOGY
Diverse recovery
Protecting biodiversity improves the chances that an ecosystem will contain a species that allows it to recover after an extreme environmental event, scientists have concluded.

Jasper van Ruijven and Frank Berendse at Wageningen University and Research Centre in the Netherlands followed the progress of more than 100 small experimental plots planted with either individual species or varying mixtures of eight common species, including several grasses, before and after a natural drought. The drought occurred six years after planting.

They found that plots with greater biodiversity did not show improved resistance to the drought — but they were able to recover more efficiently. They attribute most of this effect to one species, Anthoxanthum odoratum. Recovery was independent of predrought biomass.

GENETICS
Immune impediment
Nature Genet. 41, 1341-1344 (2009)
Transplanted bone marrow cells commonly attack the recipient’s cells, even though key proteins on the surface of the donor’s and recipient’s cells match. To find out what might be the cause of this ‘graft-versus-host disease’, Steven McCarroll of Harvard Medical School in Boston, Massachusetts, and his colleagues analysed gene deletions in the genomes of 1,345 pairs of patients and immune-matched siblings from whom bone-marrow transplants were made.

They found that the immune attack was more likely to occur when the donor — but not the recipient — had deletions in both copies of the gene UGT2B17. The donor’s immune cells seem to respond to the gene’s protein as ‘foreign’ in the recipient.

ASTRONOMY
A black hole draws near
Astronomical distances are best measured by trigonometric parallax — using the annual shift in star position caused by Earth’s motion around the Sun to derive distance. Now James Miller-Jones of the National Radio Astronomy Observatory in Charlottesville, Virginia, and his colleagues have used parallax to measure the first accurate distance to a nearby binary star system containing a black hole.

The authors took radio measurements at three-month intervals for a year and combined them with archival data. They reveal that the star–hole system, known as V404 Cygni, is just 2,390 parsecs from Earth — nearly half the distance previously thought.

The group believes that the previous work underestimated the interstellar dust along the line of sight to the star system. The authors suggest that future parallax measurements will improve the understanding of how black holes form and behave.

NEUROSCIENCE
Rude awakening
Neuron 64, 522-536 (2009)
Fruitflies recruit distinct neural circuits when undergoing different forms of arousal — either waking from sleep, or being disturbed by puffs of air.

David Anderson at the California Institute of Technology in Pasadena and his colleagues found that flies with loss-of-function mutations in the dopamine receptor were more easily startled by air puffs than were flies without the mutation, but seemed less easily roused from sleep, as they slept longer.

When the researchers restored normal functionality to the dopamine receptor in a brain area called the central complex (pictured left, dopamine receptors labelled green), the puff-induced arousal dropped to normal levels but sleep arousal remained unchanged.

JOURNAL CLUB
Peter Baumann
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A molecular biologist explores ways to revolutionize agriculture.

The complete absence of sex in a few species has long fascinated biologists, but their research is driven by more than just curiosity. Hybrid plants are the mainstay of agriculture, but require ongoing breeding and selection to maintain their desirable traits. Apomixis, or asexual reproduction by seeds, is rare among commercially important crops, but engineering plants capable of this could produce stable crops with valuable traits.

Three Herculean tasks are involved: alteration of meiosis (the cell division that normally reduces the number of chromosomes in the sex cells, or gametes) to maintain the full maternal genome; fertilization-independent development of the embryo; and formation of the endosperm tissue that nourishes the embryo.

Raphaël Mercier of the French National Institute for Agricultural Research in Versailles and his team have taken a step towards achieving this goal. Using a combination of three mutants, they engineered a mustard weed that produces gametes carrying the complete maternal genome (I. d’Erfurth et al. PLoS Biol. 7, e1000124; 2009). Their breakthrough came while characterizing a mutation in the aptly named omission of second division (osd1) gene, which causes the reproductive cells to skip the second meiotic division.

By combining an osd1 mutant with mutations that modify two other steps in meiosis, the team made meiosis similar to mitosis — cell division that occurs in non-reproductive cells.

Conservation of the genes involved across crop species fosters hopes that the strategy can be applied to many of them. The problem of endosperm formation will have to be overcome, and unfertilized seeds will need to be coaxed into development. The available tool kit of mutants affecting these processes makes me optimistic that these challenges will be overcome. However, convincing consumers that heavily engineered plants can secure future food supplies may require more than scientific ingenuity.

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