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at the IceCube Neutrino Observatory in Antarctica, led by Francis Halzen at the University of Wisconsin–Madison, counted neutrinos of a known type that hit the detector from below. A dearth of these neutrinos at particular energies would have revealed that some of the particles had temporarily mutated into sterile neutrinos during their trip through Earth, but the researchers found no such feature in their data.

The experiment did not rule out the existence of heavier sterile neutrinos. A fourth kind of neutrino would challenge the standard model of particle physics, which allows for only three neutrino types.

Phys. Rev. Lett. 117, **071801 (2016)**

EVOLUTION

Ancient whales heard high notes

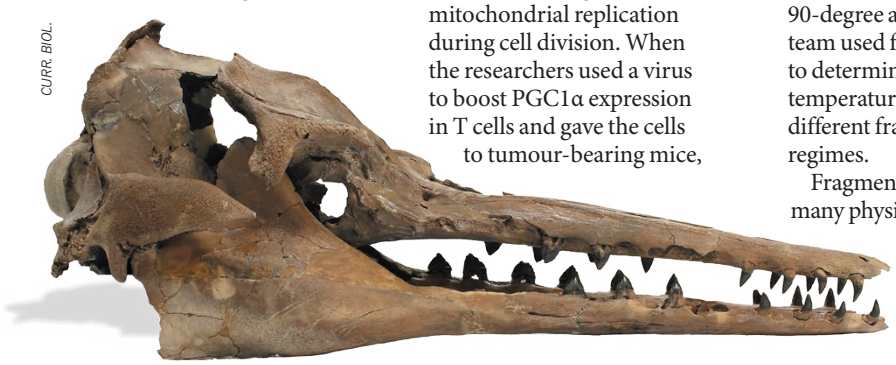
Fossil evidence suggests that the first whales could detect high-frequency sounds.

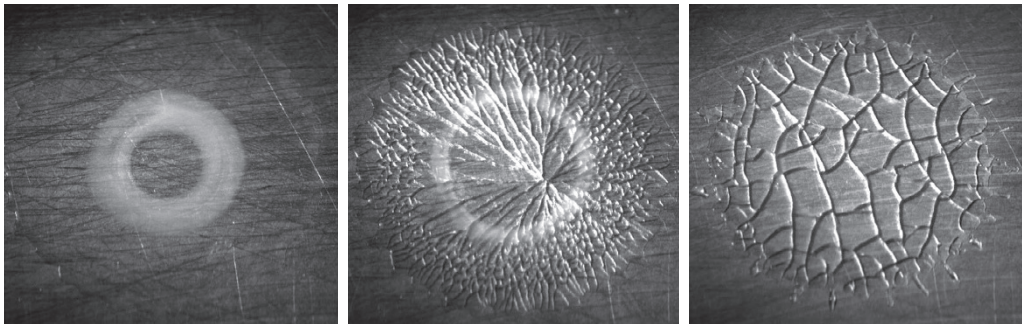
Researchers have debated whether animals called archaeocetes — the common ancestors of all modern whales and dolphins — specialized in hearing high frequencies, like modern killer whales, or low frequencies, like today's humpback whales. Morgan Churchill at the New York Institute of Technology in Old Westbury and his colleagues describe a new species of whale (fossil skull **pictured**) dating from 27 million to 24 million years ago. Features of its remarkably well-preserved inner ear, as well as other structures, suggest that the animal could generate and hear high-frequency sounds. The inner ear also has primitive features similar to those of archaeocetes.

The authors suggest that the first whales could hear higher frequencies than their terrestrial ancestors — an ability co-opted by later toothed whales for echolocation.

Curr. Biol. **http://doi.org/bnh5 (2016)**

CURR. BIOL.





CANCER IMMUNOLOGY

Immune cells tire out in tumours

After they invade tumours, immune cells gradually lose their ability to produce energy.

Greg Delgoffe and his colleagues at the University of Pittsburgh in Pennsylvania studied immune cells called T cells in mice with implanted tumours. They found that T cells inside tumours were less effective at taking up glucose than those in other parts of the body. The tumour-infiltrating cells also showed reduced total mass of mitochondria — cell organelles that produce energy — and contained abnormally shaped mitochondria. The metabolic defects were linked to reduced levels of PGC1α, a protein that regulates mitochondrial replication during cell division. When the researchers used a virus to boost PGC1α expression in T cells and gave the cells to tumour-bearing mice, the tumours shrank more and the animals lived longer than those that received non-reprogrammed cells.

Boosting metabolic processes in immune cells could help to improve cancer therapies, the authors say.

Immunity **http://doi.org/bndn (2016)**

PHYSICS

Crack patterns in freezing water

Water droplets landing on a cold surface fragment into one of two different patterns as they freeze, depending on the temperature of the surface.

Elisabeth Ghabache and her colleagues at the University of Pierre and Marie Curie in Paris used a high-speed camera to monitor the behaviour of pancake-shaped water droplets that froze on a cold steel surface after being dropped from a height of 36 centimetres. They observed no crack formation when the surface was at –20 °C (**pictured** left). At –30 °C and –40 °C, cracks spread from a central point towards the 'pancake' edge (centre). At –50 °C and –60 °C, the cracking occurred in a step-by-step manner, with the initial cracks splitting into newer ones at roughly 90-degree angles (right). The team used fracture modelling to determine the transition temperatures between the different fragmentation regimes.

Fragmentation occurs in many physical processes, such as bubble bursting and glass breaking. This model system could help researchers to learn more about various fracture mechanisms, the authors say.

Phys. Rev. Lett. **http://dx.doi.org/10.1103/physrevlett.117.074501 (2016)**

MICROBIOLOGY

Toxic bacteria adapt fast

Harmful blue-green algae can adapt rapidly to changing environments.

The photosynthetic cyanobacterium *Microcystis* produces toxic blooms in lakes and reservoirs. To test how different strains respond to changing carbon dioxide levels in water, Jef Huisman and his colleagues at the University of Amsterdam kept mixed populations in the laboratory and aerated the water with bubbles containing low or elevated levels of CO_2. In low CO_2 conditions, strains whose carbon-uptake systems are efficient when carbon is limited became dominant. When CO_2 was elevated, however, strains that have systems with high uptake rates outcompeted the others. The team studied *Microcystis* collected from Lake Kennemermeer in the Netherlands and found that the abundance of each strain shifted with seasonal changes in CO_2 availability.

Cyanobacteria may be more adept at dealing with high CO_2 levels than previously thought.

Proc. Natl Acad. Sci. USA **http://doi.org/bnf9 (2016)**

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