

CLIMATE SCIENCE

Modern Warming by Proxy

Records constructed by compiling direct measurement of surface air temperatures made at thousands of locations worldwide over the past century or so show clearly and repeatedly that climate is warming globally. Surface air temperatures for periods before direct measurements were made systematically and broadly enough to be useful on global scales are inferred from sources such as tree rings, corals, ice cores, speleothems, and marine sediments, which provide proxies for temperature. What do proxy records say about modern global warming, though? Anderson *et al.* present an independent record of climate warming over the past 130 years, assembled from a collection of 170 temperature-sensitive paleo proxies, which show the same warming trend as the instrumental record over the same time, including the more detailed picture of warming from around 1910 to the 1940s, the pause in temperature rise until the 1960s, and a continuation of warming from the 1960s to the present. This work validates both the modern instrumental record of temperature rise and the use of these proxies to reconstruct the temperatures of the past. — HJS

Geophys. Res. Lett. **40**, 189 (2013).



ECONOMICS

Risky Fishing

Fishing is a risky way to make a living, not only in terms of physical injury and death but also financially. Although farmers often have access to crop insurance, price supports, and futures markets to mitigate risk, such tools are unavailable to commercial fishers. One approach common to both farmers and fishers, however, is to diversify their harvests. But fishers face constraints on their portfolio due to limited licenses and catch quotas imposed by fisheries managers. To better understand this phenomenon, Kasperski and Holland analyzed harvest and revenue data for over 30,000 commercial fishing vessels operated off the U.S. West Coast and Alaska from 1981 to

2010. Maximum income variability was observed when harvests were only modestly diverse, roughly a 90-10% split between the two fisheries. Although income was slightly more stable when harvests were not at all diverse (100-0%), income stability was more pronounced as harvests were spread 50-50% across two fisheries, or even more stable when spread 50-25-25% across three fisheries. Fishery restrictions may be necessary to ensure sustainability and efficiency; however, they do have important economic effects on fishers. — BW

Proc. Natl. Acad. Sci. U.S.A. **110**, 2076 (2013).

NEUROSCIENCE

Tuning Brain Blood Flow

Although the brain is insulated from many systemic effects on blood flow, delicately regulated changes in blood flow bring resources to sites of high neuronal activity. Astrocytes are in contact with neurons, and astrocyte endfeet also touch the small blood vessels that penetrate the brain. Cerebral arteries dilate in response to glutamate and D-serine signaling through NMDA receptors. LeMaistre Stobart *et al.* have studied the signaling pathways by which astrocytes regulate the blood flow in arterioles in mouse brain slices and found that astrocytes can be a source of endogenous D-serine. D-serine found in the endfeet of astrocytes was released in response to the stimulation of glu-

tamatergic neurotransmission. The subsequent vascular dilation required nitric oxide synthase and nitric oxide signaling from intact vascular endothelium. These results suggest that astrocytes activated by neighboring neural activity call in additional blood flow by signaling for the local dilation of blood vessels. — PJH

Proc. Natl. Acad. Sci. U.S.A. **110**, 10.1073/pnas.1215929110 (2013).

DEVELOPMENT

Old Stem Cells Rejuvenated

Hematopoietic stem cells (HSCs) in the bone marrow give rise to all cells of the blood, but with age, this capacity decreases. Sirtuin 3 (SIRT3) is a deacetylase expressed in mitochondria that can control the production of damaging reactive oxygen species (ROS) by, for example, improving the antioxidative activity of other enzymes. Brown *et al.* observed that SIRT3 is highly expressed in the HSCs of young mice but not in older mice. In mice genetically engineered to lack SIRT3, the number of HSCs declined in older animals and, consequently, reduced the number of differentiated blood cells. In contrast, young mice lacking SIRT3 showed no such effects. In bone marrow transplant assays, only HSCs from young wild-type mice or young SIRT3-deficient mice could reconstitute blood in recipient mice. SIRT3-deficient HSCs from old mice also were susceptible to oxidative stress in vitro and showed reduced survival in vivo. The overexpression of SIRT3 in older SIRT3-deficient HSCs reduced ROS production and boosted the production of blood cells in bone marrow transplantation assays. Thus, the reduced expression of SIRT3 with age probably disrupts mitochondrial



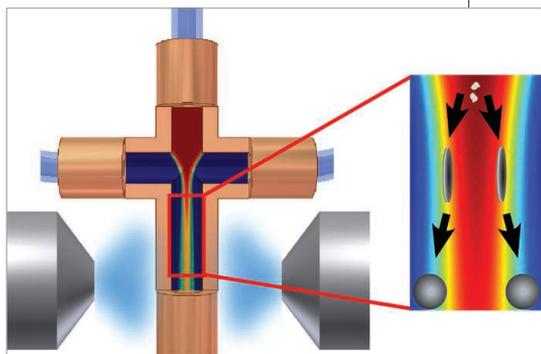
homeostasis and increases oxidative stress, thereby compromising stem cell renewal and function. Age-related stem cell degeneration may be reversed by manipulating mitochondrial homeostasis. — LC

Cell Rep. 10.1016/j.celrep.2013.01.005 (2013).

APPLIED PHYSICS

A Quick Freeze

Microfluidics, in which small volumes of liquids are manipulated inside narrow channels, has proven to be a useful tool for the controlled fabrication of a range of materials. For example, through the delicate mixing of two fluid streams,



it is possible to produce uniform oil-in-water emulsion droplets. Because the flow is laminar, it is also possible to create a long mixing layer at the interface between two miscible fluids. Cryogenic freezing has been used to capture or preserve fragile biological structures while minimizing ice crystal formation for subsequent analysis with an electron microscope. Jahn *et al.* extended this thinking to devise a technique for rapidly freezing a capillary stream as it exits the microfluidic device using jets of liquid propane. They studied the formation of nanometer-sized lipid membrane structures such as unilamellar vesicles, which are of interest because of the use of liposomes in cosmetics, pharmaceuticals, and food production. Through this process, they were able to capture both fully formed structures and their intermediaries. For the assembly of phosphocholines at the water and isopropyl alcohol interfaces, they observed disklike intermediate assemblies, consistent with current theories on the assembly process. — MSL

Langmuir 29, 1717 (2013).

PHYSICS

Voltage-Controlled Magnetism

Many components of modern devices are based on magnetic effects; magnetic read heads, for example, use the phenomenon known as

exchange bias, in which two materials that order magnetically are interfaced, causing the magnetic properties of the ferromagnetic layer (in which spins align parallel to each other) to be affected by the antiferromagnetic layer (in which neighboring spins prefer to be antiparallel). In devices, the control of magnetic effects with electric fields is desirable. Building on earlier work that showed a change in the size of the exchange bias effect, Wu *et al.* demonstrate a reversible switching of the sign of the exchange bias after the application of a voltage pulse. Key to this result is the use of a multiferroic material for the antiferromagnetic layer, in which switching the sign of the voltage pulse causes spins to reverse their direction and changes the distance between the magnetic ions in the antiferromagnetic and ferromagnetic layers; this, in turn, causes the exchange bias to switch. The switching is achieved at constant temperature (without cooling or heating cycles) and without applying additional magnetic fields; the mechanism the authors offer as an explanation may aid in the understanding of the exchange bias effect. — JS

Phys. Rev. Lett. 110, 067202 (2013).

IMMUNOLOGY

Regulating TLR Traffic Flow

Sensing pathogen-derived nucleic acids is important for mounting antipathogen immunity. Such nucleic acid-sensing receptors are expressed intracellularly so that they do not inappropriately respond to self nucleic acids and cause autoimmunity. The specific mechanisms that regulate how these receptors, which include Toll-like receptors (TLRs) 3, 7, 8, and 9, reach their specific locations within cells, however, are not well understood. Lee *et al.* use cell biology techniques and mutational analysis to demonstrate that the transmembrane endoplasmic reticulum (ER) protein UNC93B1 is important for this process. UNC93B1 assists in the packaging of at least six TLRs in the ER and then remains associated with these receptors as they are processed through the Golgi apparatus. How TLRs go from the Golgi to their final destination, however, appears to be regulated by distinct mechanisms depending on the receptor. UNC93B1-dependent recruitment of AP-2 was required for TLR9 trafficking to endosomes; however, AP-2 was not required by other receptors. Thus, a variety of mechanisms may be employed to get TLRs from the Golgi to the right locations within the cell. — KLM

eLife 10.7554/eLife.00291 (2013).

Science

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